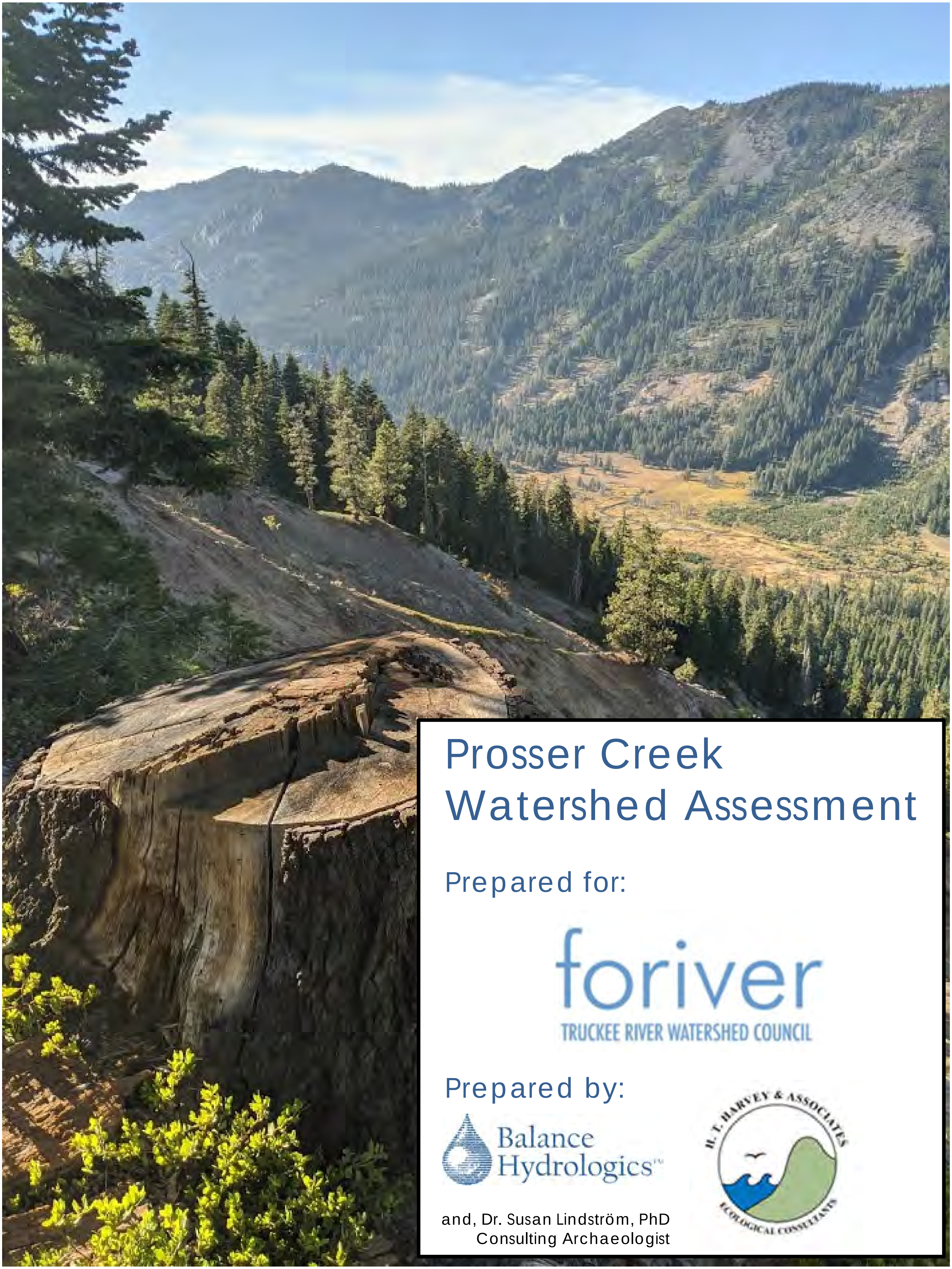

Prosser Creek Watershed Assessment

Prepared for:

foriver
TRUCKEE RIVER WATERSHED COUNCIL

Prepared by:

Balance Hydrologics

H. T. Harvey & Associates
Ecological Consultants

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Cover Photo: Red Mountain looking into Upper Carpenter Valley, July 2020

Prosser Creek Watershed Assessment
Nevada County, California

A report prepared for:

foriver
TRUCKEE RIVER WATERSHED COUNCIL

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May 25, 2022

This assessment was conducted and completed under three separate reports. Those reports are included here under a single cover and referred to herein as the following ‘chapters’:

Chapter 1: Watershed Attributes

Chapter 2: Watershed Existing Conditions and Disturbance Inventory

Chapter 3: Watershed Restoration and Protection Opportunities

Appendices from each chapter are included at the end of this document and identified in alphabetical order in which they appear in each chapter.

The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the opinions or policies of the U.S. Government or the National Fish and Wildlife Foundation and its funding sources. Mention of trade names or commercial products does not constitute their endorsement by the U.S. Government, or the National Fish and Wildlife Foundation or its funding sources.

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APPENDICES

1 INTRODUCTION

This Watershed Attributes Report is the first of three reports that will be assembled as part of an overall technical watershed assessment for the Prosser Creek watershed. The primary objective of this report is to describe the watershed's physical and biological attributes and history of land-uses and occupation in the Prosser Creek Watershed, as based on readily available information. Contents of this report are used to characterize the watershed and support additional future field observations and desktop analyses that will, in turn, be used to identify restoration opportunities and management actions. Opportunities will include both big and small projects that collectively will provide restoration of watershed processes and functions that were previously identified as impaired or disturbed. Once completed, this information will be compiled into a single Prosser Creek Watershed Assessment document consisting of the three parts: (1) Watershed Attributes; (2) Existing Conditions and Disturbance Inventory; and (3) Restoration Opportunities.

1.1 Previous Assessments or Studies of Prosser Creek and its Watershed

Pertinent previous documents, studies, and assessments were reviewed and summarized as part of this report:

- Reconnaissance of Channel Sedimentation and Stability, Lower Carpenter Valley (Hecht, 1983), includes an assessment of channel conditions, measurements of channel geometry and geomorphic change following the significant floods of 1982-83. The letter report documents Carpenter Valley's geomorphology and summarizes discussions with the Euer Family regarding land management practices, including logging episodes as recently as the 1970s. Mr. Hecht concluded that the North Fork (NF) Prosser Creek through the Lower Carpenter Valley was impaired based on his observations of an entrenched channel and abundant point bar sediment deposits. Sources of degradation were assumed to derive from upstream disturbances, possibly in the Upper Carpenter Valley. Overall, NF Prosser Creek was deemed a likely candidate for restoration in 1983.

- Carpenter Valley Easement Documentation Report (Podolak, 2017) includes a thorough assessment of the Lower Carpenter Valley including mapping of springs, fens, habitat, etc. This reach and associated habitats are described as 'functioning well' and may be used as reference reaches or analog features for other areas in the watershed that may show impairment and be targeted for restoration activities.

- The Lower Carpenter Valley Baseline Monitoring, Habitat Typing, and Condition Assessment, prepared by Trout Unlimited (TU, 2018), provides a set of biological data for existing reaches of North Fork Prosser Creek that can be used to further assess the potential to enhance and/or reintroduce Lahontan Cutthroat Trout (LCT) and Sierra Nevada Yellow Legged Frog (SNYLF). This assessment also uses the incised stream evolution model adapted by Cluer and Thorne (2013) which is consistent with the approaches being employed for development of the Existing Conditions and Watershed Disturbance portion of this assessment.

- Characterization and Delineation of Fens in Carpenter Valley, included as an appendix to Easement Documentation Report (Dittes & Guardino Consulting, 2017), highlights multiple fens and their habitats in Lower Carpenter Valley. These are rare natural communities that are unique to eastern Sierra watersheds.

- Tahoe Donner 5-year Trails Implementation Plan (TDA, 2015). Balance Hydrologics was part of the interdisciplinary team that developed this report, and provided drainage analysis, erosion risk, and trail design recommendations based on LiDAR-derived topography and flow accumulation analysis, in addition to the cultural resources and biological assessment work compared by others.

- The Tahoe Donner Association Land Management Plan (Dudek, 2016) prepared by Dudek and Balance Hydrologics for the Tahoe Donner Association has identified many of the watershed attributes for portions of the watershed owned and managed by Tahoe Donner Association.

2 WATERSHED PHYSICAL SETTING AND ATTRIBUTES

The Prosser Creek watershed is located in eastern Nevada County near Truckee, California and is a tributary of the Truckee River (**Figure 2-1**). The ‘project watershed’ is 34.8 square miles as delineated from a point in the Prosser Creek Reservoir above the confluence of Alder Creek. This watershed is a majority of the larger, 52.9-square mile physiographic watershed as delineated from its mouth at the confluence with the Truckee River.

The project watershed rises in elevation from 5,741 feet at the spillway elevation or full pool of Prosser Creek Reservoir to 9,103 feet at the summit of Castle Peak along the Sierra Crest. Three main tributaries to Prosser Creek lie within the project watershed: (1) North Fork (NF) Prosser Creek and (2) South Fork (SF) Prosser Creek and (3) an un-named tributary which we refer to as Hobart Mills tributary in this report (see **Figure 2-1**).

The project watershed includes multiple landowners and land managers (**Figure 2-2**). The Tahoe National Forest (TNF) manages approximately 63.4 percent (14,130 acres) of the project watershed. Multiple private landowners manage the second largest cumulative area with 3,262 acres or 14.7 percent. Truckee Donner Land Trust (TDLT) currently manages approximately 13 percent (2,972 acres) of the watershed, having acquired Frog Lake, Carpenter Ridge and Lower Carpenter Valley over the past several years. Tahoe Donner Association (TDA) manages about 8.6 percent (1,908 acres) of the watershed, including lands recently acquired in the Lower Euer Valley (**Table 2-1**).

A privately-owned and managed reservoir is located within the watershed, located just upstream of Euer Valley within the ‘Horse Range’ tributary watershed, built in 1966 with a earthen dam height of 21 feet, 80 acre-foot capacity, and “Low” hazard rating (California DWR, 2019). This assessment focuses on publicly accessible lands owned or managed by the TNF, TDLT, and TDA. Private lands are included as part of this general watershed-wide attributes report but are not targeted as part of detailed field assessments, disturbance inventory, or in identifying restoration opportunities.

Table 2-1 Land Ownership, Prosser Creek Watershed, Nevada County, California

Landowner	Area (acres)	Percent of Project Watershed
Tahoe National Forest	14,130	63.4
Private (multiple)	3,262	14.7
Truckee Donner Land Trust	2,972	13.3
Tahoe Donner Association	1,908	8.6
Total	*22,272*	*100*

2.1 Climate

The Prosser Creek project watershed experiences cold, snowy, and wet winters and warm dry summers. Precipitation varies considerably across the watershed depending primarily on elevations and proximity to the Sierra Crest. Annual Precipitation is reported to range between 15 and 85 inches depending on elevation in the watershed with an average of 43.1 inches annually (USGS, 2020a). Precipitation falls mostly as snow between the months of October and April, with occasional rain-on-snow events during these same months and afternoon thunderstorms during the summer months. Typically, snow begins to melt in March and supports snowmelt runoff and annual spring snowmelt peak flow that occurs typically between May and July, though timing varies depending on the snowpack and springtime temperatures. The largest annual floods that have occurred over the last several decades have been associated with rain-on-snow events.

2.1.1 Climate Variability: Wet and Dry Periods

Watershed processes are dependent on a number of factors including climate variability, as marked by periods of greater than average precipitation ('wet periods') and periods of below average precipitation or drought. Identification of historical wet and dry periods provides context during evaluation and comparison of current and historical conditions. For example, wetland desiccation or meadow conversion to drier conditions may be a relatively temporary phenomenon resulting from successive dry years or it may be a combination of factors including a conversion due to land-use practices. A series of wet years can recharge local groundwater and support a robust meadow and riparian community in some locations where in others the level of degradation may prevent support to riverine and former wetland ecosystems, requiring restoration or specific management strategies. Similarly, a single large flood event or succession of floods can generate significant changes to channel patterns or sediment supply—in effect, resetting the riparian community.

Year-to-year precipitation variability is shown in **Figure 2-3**, as measured at 6,020 feet elevation in Truckee, California (Truckee, CDEC ID: TKE) between water year[1] 1904 (WY1904) and WY2019. It shows the annual percent deviation and cumulative percent deviation from mean annual precipitation in the vicinity of the project area and, provides context for interpretation of historical conditions, aerial photography and field investigations carried out as part of this assessment. A number of multi-year dry periods are apparent in **Figure 2-3**, with notable droughts indicated during the period from WY1928 to WY1935 (noted from other nearby stations), WY1976 to WY1977, WY1987 to WY1994, and WY2000 to WY2015 with a few notable wetter years within that 15-year period.

Wetter-than-average periods occurred from WY1875 to WY1915 (generally), WY1950 to WY1952, WY1963 to WY1969, WY1982 to WY1983, the wettest year on record, and WY1995 to WY1999. WY2017 was notable for several major rain-on-snow events and the second wettest year on record. Overall, it is notable that the very wettest years deviate further from the average annual precipitation than the dry year. In other words, the wettest years are much wetter (over 180%) than the average, while the driest years are only moderately (50%) drier than the average. This can be attributed to years with multiple Atmospheric River (AR) types of storms, which tend to produce warm rain on snow events, extreme flooding, and episodic change along watercourses.

This assessment was conducted during a below average year (WY2020), which was preceded by near-average and above-average years, following the historical drought from 2012 to 2015.

2.2 Watershed Geology

Geology of the watershed has been mapped by Birkeland (1963), Sylvester and Raines (2017), and Sylvester and others (2012) and is shown in **Figure 2-4**. The project watershed

1 Unless otherwise stated, all years discussed in this report are referred to on a water year (WY) basis. The term 'water year' refers to a 12-month period beginning October 1 and ending September 30th of the named water year; for example, water year 2020 began October 1, 2019 and ended September 30, 2020.

includes a geological transition between two major geomorphic provinces: (1) the Sierra Nevada Geomorphic Province in the western upper portion of the watershed, and (2) the Basin and Range Geomorphic Province to the east.

The upper watershed is dominated by older, Cretaceous-age crystalline rocks, uplifted as part of the Sierra Nevada province. These rocks are easily recognized in the headwaters with their peppered texture typical of granodiorites and tonalites and are relatively resistant to erosion. The very highest points in the watershed (i.e., Basin Peak, Castle Peak) are younger, Tertiary-age volcanic flows and volcanoclasitics that overlie the older crystalline basement rocks. These younger rocks are easily erodible and form rugged exposed cliffs and jagged ridgelines, whereas the older basement rocks tend to be more resistant and polished by glacial action. Further east and downstream, Tertiary-age andesitic lava flows and volcanoclastics also form the west-east oriented ridgelines (i.e., Carpenter Ridge, Red Mountain, Prosser Hill). Overlying much of the above described geology is a blanket of Quaternary glacial drift deposits which left U-shaped valleys, glacial till and outwash, and defined most of the existing topography across the watershed.

2.2.1 Structure

Due to its location at the transition between two geomorphic provinces, structural geology plays an important role in the physiography and hydrology of the watershed. Faults that bisect the Prosser Creek project watershed and region have been mapped in detail by Melody (2009), Hunter and others (2011), and Sylvester and others (2012, 2017).

In general, the watershed is located within the larger Walker Lane geologic trough that extends along the eastern Sierra and more locally identified as the Truckee Fault Zone. This zone is characterized by active transverse and extensional faulting oriented in the north and northwest directions, which allows for a portion of the movement between the North American and Pacific Tectonic Plates. As a result of this stress, a number of north and northwest-trending faults bisect the watershed and offset its geology. Locally two different types of faulting are present within the watershed as depicted in the literature and maps: (1) right-lateral, strike-slip faults with recent (Holocene) movement; and (2) multiple normal faults with vertical displacement associated with the larger Truckee Fault Zone. The Polaris Fault zone, mapped in detail through the project watershed by Hunter and others (2011), offsets moraines and drainage channels including Prosser Creek and the Hobart Mills tributary near the Prosser Creek Reservoir, suggesting movement during the Holocene, after glaciers retreated. Normal faulting is well depicted across the upper watershed of Prosser Creek by Sylvester and others (2017). Displacement of Tertiary bedrock also suggests active movement during the Pleistocene. Faulting through both surficial deposits and bedrock affect the location and formation of steep drainages and tributaries within the watershed.

Faulting is not mapped continuously but extends both north and south of the Prosser Creek watershed, bisecting features such as Independence Lake and mountain aquifers and resulting in dynamic surface-groundwater interactions in the region. Wolf and Cooper (2015) mapped 79 fens in the Sierra Nevada that revealed that underlying geology and structure exert strong controls over their location, distribution and vegetation. In fact, water quality of each fen differed depending on geology; fens discharging from volcanics were richer in cation concentrations and thus species richness than those discharging from granitic or granodiorite rocks (Wolf and Cooper, 2015). Fens are described in greater detail in Chapter 3.

2.2.2 GLACIATION

Birkeland (1964) provides a detailed mapping of glacial extents (**Figure 2-5**) in the Truckee River Basin, including Prosser Creek watershed. The Donner Lake glaciation (400 to 600 thousand years ago [ka]), the oldest recognized glacial advance in the Pleistocene, included ice that advanced as far as Hobart Mills in the Prosser Creek Watershed. Subsequently, the Tahoe glaciation (64 to 75 ka) advanced in both forks of Prosser Creek and joined to form a larger glacier which terminated at 6,200 feet elevation (Birkeland, 1964), near the confluence of both forks. Finally, the Tioga glaciation (13 to 32 ka) was the most recent, with ice that only extended into Carpenter and Euer Valleys. A younger small glacial period known as Frog Lake (<12 ka) was limited to the area for which its named and formed the distinctive glacial cirque that supports the lake. Unstratified glacial drift (till) from these glaciations overlie much of the geology in the areas where ice was present and is mapped in detail by Sylvester and Raines (2017). These unstratified deposits are easily eroded and can be subject to gullying, landslides, and debris flows.

Prosser Creek and its tributaries are filled with a succession of glacial moraines in the western half of the watershed. Many moraines in the North and South Forks are numerous, sharp-crested, and well preserved. Several recessional moraines cross the Euer and Carpenter Valleys with limited erosion. The streams have been able to cut down through the moraines to a degree but also serve as landscape-scale grade controls, with aggradation of fluvial, alluvial, and/or lake deposits behind most moraines.

Prosser Creek and its tributaries are filled with glacial outwash terraces in the eastern half of the watershed. During the various glacial stages, sediment-laden braided streams aggraded thick sequences of alluvium or fill terraces that blanketed the lower elevations of Prosser Creek, leaving a relatively smooth glacial outwash plain. During deglaciations, these streams incised their channels, leaving prominent terrace risers. Because each successive glaciation was significantly smaller, both climatically and spatially, than the previous one, a nested fill-terrace sequence is preserved in downstream areas of Prosser Creek. Hence, the highest outwash terrace on the watershed margins corresponds with the oldest Donner Lake glaciation, and the subsequent Tahoe and Tioga glacial deposits, where present, are inset at progressively lower elevations (Birkeland, 1964), with the youngest alluvium at the lowest elevations closest to the active stream channel. The active floodplain of Prosser Creek is confined by these terraces in many locations. Current-day erosion of these terraces by stream processes provide coarse sediment for active in-channel bar development and channel braiding. Older, pre-glacial deposits, regionally known as the Prosser Creek Alluvium (Qpa), may be exposed in areas where erosion has removed Donner outwash deposits. These deposits are known to be easily erodible and a source of fine sediment.

2.3 Geomorphology

Climate, geology, glaciation, and soils all play important roles in the landforms and processes of Prosser Creek and its watershed. In the uppermost elevations, erosion and sediment transport are the dominant fluvial processes. Downstream and at lower elevations sediment transport and deposition are dominant, with glacial outwash and alluvium mapped in many areas.

Unstratified and unconsolidated volcanoclastic rocks (Tvc) and glacial till (Qtam, Qtao, Qc+d) deposited on the steeper slopes are prone to gullying, landslides and debris flows. Erosional slopes on these deposits are readily visible on aerial photographs and align with mapped fault traces. Geologic maps (Sylvester and Raines, 2017) identify Quaternary landslide deposits (Qls) in some locations. In 1997, a large landslide occurred along the south slope of Carpenter Ridge and effectively dammed the North Fork of Prosser Creek. From its crown to its toe, the landslide measures just over 0.5 miles (**Figure 2-6**). It is uncertain from examination of aerial photographs if this landslide was triggered naturally or from disturbance (e.g., logging, roads), however there is evidence of numerous older landslides along the same southern valley wall. Colluvium and alluvial fans coalesce where these steeper slopes intersect valley floors. Over time, hillslope runoff and stream processes rework these deposits and provide an abundant sediment supply to Prosser Creek.

Glaciation has also developed a distinct watershed profile with glacially carved u-shaped and hanging valleys and rugged canyon terrain. Longitudinal profiles for Prosser Creek and its tributaries are shown in **Figure 2-7**. From **Figure 2-7**, the large glacial valleys are apparent.

The glacial history of Prosser Creek watershed dictates current-day channel form and slope. At the highest elevations, the transition from Sierra Crest to glacial valleys coincides with a transition between erosion-resistant crystalline bedrock and more erosion-prone volcaniclastics and glacial drift. Above this transition, streams are largely bedrock-controlled and confined by steep canyon slopes. Channel slopes exceed 5 percent and express step-pool or cascade morphology. Erosion and transport are dominant processes. In a transition, the stream channels within Carpenter and Euer Valleys exhibit slopes less than 1 percent and promote depositional environments that support meadow habitats. Under these shallow gradients the channels typically exhibit meandering planforms with pool-riffle morphology. Below the glaciated and alluvium-filled valleys the channel slope again increases and is mostly controlled by more competent volcanic bedrock (Tpla) and bouldery glacial till (Qtao). Step-pool morphology again is prominent.

Prosser Creek transitions again once it enters and crosses the Polaris Fault zone. Here, Prosser Creek is confined by glacial outwash terraces (Tao, Qdo) and the channel slope is less than 2 percent. While these channels are still dominantly transport channels for sediment and wood, deposition occurs to form mid-channel islands, point bars, and near channel floodplains, all inset within the glacial outwash terraces. As a result, the channel exhibits meandering and braided planforms with pool-riffle morphology. Wide floodplain-supported meadows are limited by terrace slopes, but can occur as small pockets, especially where shallow groundwater is sufficient to support meadow and riparian vegetation.

Tree fall and instream wood transport are dominant geomorphic processes in a number of reaches. In the upper watershed aerial imagery depicts instream wood structures that span the active channels and function to detain or store sediment. Farther downstream, closer to Prosser Creek Reservoir, channel widths and capacity increase and instream wood becomes more mobile. In these reaches, instream wood typically becomes a part of the transport load, but can be temporarily deposited to promote in-channel bars, channel braiding, and localized scour pools.

McGraw and others (2001) modeled suspended-sediment loads in 1997 from 10 tributaries to the Middle Truckee River based on historical data collected. Results of that study suggested that Prosser Creek exhibits one of the highest average annual suspended sediment loads in the Basin. McGraw and others (2001) surmised that higher loads are attributed to the dirt road density. Roads are discussed in greater detail in subsequent sections but highlighted here as a potential sediment source, and in the effect of roads on flow concentration. In fact, McGraw and others (2001) further deduced from their model that reducing road density by 25 to 40 percent and reducing hydrologic connectivity associated with poorly constructed and maintained dirt roads could result in a 30 to 40 percent reduction in suspended sediment in the creek.

Field observations carried out as part of the Existing Conditions and Disturbance Inventory Assessments will: a) help document existing road, channel, and hillslope conditions; b) identify disturbances to geomorphic processes in the watershed; and c) identify restoration and management actions to restore geomorphic processes that support habitat and improve water quality.

2.4 Soils

The soils mantling the watershed generally reflect the underlying geologic units from which they have developed. Much of the uplands and steeper slopes include soils derived from granitics or granodiorites and volcanoclastics. Significant portions of the upper and middle watershed include soils weathered from glacial deposits, primarily glacial till. Slopes in glacial till along the prominent valleys are also subject to rilling, gullying and landslides. The valley floors include soils derived from glacial outwash and alluvium and are typically able to support wetland soils where the water table is high. Downstream, in the lower portion of the watershed, soils are primarily derived from volcanic terrains and glacial till and outwash. Older glacial outwash terraces support more mature soils (Birkeland, 1964).

Figure 2-8 is a map showing distribution of soil types within the Prosser Creek Watershed, as mapped by Hanes (2002). In this section, we discuss a few of the more prominent soil types associated with wetlands and meadows.

Aquolls and Borolls (AQB) are wetland soils and are mapped in almost 5 percent of the watershed (**Figure 2-8**). These soils are typically found in the valley bottoms where slopes are less than 5 percent. These areas include Carpenter Valley, Euer Valley, lower Crabtree Canyon, Hobart Meadows, along the Hobart Mills tributary, and to a lesser extent, isolated areas supported by glacial features in the headwaters of SF Prosser Creek, Devils Oven Lake, and a tributary to Coon Canyon and NF Prosser Creek (see **Figure 2-8**).

Cryumbrepts (wet) are poorly drained soils formed on steeper slopes of alluvium and colluvium, and typically support wetland species including alder, willow, carex, and juncus. These soils are identified in **Figure 2-8** and are mapped in roughly 21 percent of the watershed along the NF and SF Prosser Creeks above roughly 6,200 feet elevation and typically in areas underlain by glacial till. These soils are typically mapped above the valley-floor Aquolls and Borolls and occupy areas of known springs and seeps. These include both the northern and southern aspects of Red Mountain and portions of the south aspect of Carpenter Ridge. These include the Jorge-Waca Cryumbrepts (JXF), Meiss-Waca Cryumbrepts (MLE, MLG), Tinker Cryumbrepts (RSG, RSE), Tallac Cryumpbrepts (TBF, TBE, THF, TIG), and Waca-Cryumbrepts (WBF).

2.5 Hydrology

Peak flow in Prosser Creek is driven by snowmelt runoff while baseflow is sustained into the drier months by perennial springs and seeps. In this section, we describe estimated peak flows, flood recurrence probabilities, and describe high flow and low flow regimes. Prosser Creek Reservoir and operations are also discussed in terms of reservoir baseflow effects on channel mouth inundation and morphology.

2.5.1 Peak Flows

The Prosser Creek project watershed is currently an ungaged watershed. The USGS has, however, operated a streamflow gage on Prosser Creek below the Prosser Creek Reservoir Dam since 1943 (USGS 10340500, Prosser Creek below Prosser Creek Dam). This record includes a 20-year record of pre-dam unregulated flow. The USGS also operates and maintains a streamflow gage on Sagehen Creek (USGS 10343500, Sagehen Creek near Truckee, California), an adjacent watershed. Annual peak flows for the project watershed were computed using: (1) unit-discharge from measured peak flows from USGS 10340500, Prosser Creek below Prosser Creek Dam, for the pre-dam period (WY1943-WY1962); and (2) unit-discharge from measured peak flows from USGS 10343500, Sagehen Creek near Truckee (WY1963-WY2019) (**Figure 2-9**). We note that

Sagehen Creek watershed elevations are lower than Prosser Creek watershed; therefore, some of the peak flows computed from this record may over-estimate actual flood peaks in Prosser Creek, especially floods generated from rain-on-snow events (e.g., 1997). From **Figure 2-10**, notable floods include: 2,850 cfs (November 20, 1950), 3,000 cfs (December 23, 1955), 2,500 cfs (February 1, 1963), 1,750 cfs (December 23, 1964), 1,500 cfs (March 8, 1986), 4,000 cfs (January 1, 1997), and 1,800 cfs (December 31, 2005). Floods of these magnitudes or larger were also recorded regionally in 1938 and 1940. Aerial photography bracketing these flood events will be used to evaluate possible impacts of floods on channel geomorphology and meadow condition (see **Figure 2-9**).

Table 2-2 Summary of estimated streamflow statistics Prosser Creek and major tributaries, Nevada County, California

	Prosser Creek at Reservoir Spillway Elevation	North Fork Prosser Creek	South Fork Prosser Creek
Watershed Area (sq. mi)	*29.3*	*13.3*	*8.4*
	(cfs)	*(cfs)*	*(cfs)*
1-year flood	75-140	34-65	21-40
2-year flood	345-416	155-266	98-179
5-year flood	728-834	327-534	206-360
10-year flood	1,125-1,240	505-794	319-535
25-year flood	1,800-1,853	833-1,160	526-778
50-year flood	2,440-2,600	1,172-1,560	741-1,050
100-year flood	3,000-3,598	1,617-1,930	1,021-1,300

Notes:
1. Values or range of values for recurrence floods are estimated using: (1) unit-discharge and watershed scaling from 20-year period of pre-dam gaging data at USGS 10340500 and a Log-Pearson Type III distribution; and (2) regional regression equations developed by Gotvald and others (2012); (3) HEC-HMS model using Nevada County engineering standards (10-year and 100-year floods only); and (4) manual streamflow measurements with comparison to same day streamflow and flood recurrence at nearby gages.

For greater context, common recurrence intervals for floods presented in **Figure 2-9** were estimated using: (1) a Log-Pearson Type III distribution using unit-discharge from the Prosser Creek pre-dam record and, (2) USGS regional regression equations developed by Gotvald and others (2012; **Table 2-2**). Based on these estimates, the 1950 and 1955 floods were between 50-year and 100-year floods. The 1950 flood is also the flood of record for the Truckee River with a 120-year period of record (USGS 10346000, Truckee River at Farad). While the 1997 flood was a significant flood, regionally, it was not ranked higher than the 1950 flood. The higher magnitude (4,100 cfs) computed using the Sagehen Creek record is likely in error and associated with differences in watershed elevation and rain-snow levels during that event. Since 1997, the largest floods observed over the last 30 years occurred in 2006 (25-year flood, 1,800 cfs) and January 2017 (10-year flood, 1,150 cfs).

2.5.2 Low Flows

Prosser Creek is a perennial channel. Based on a 20-year record of pre-dam daily streamflow values, low flows generally ranged between 3 cfs and 15 cfs (USGS 10340500; WY1943-WY1962). Sources of perennial flow include seeps and springs that are located throughout the watershed and late season snowpack, when in some years can persist well into July in wetter than average years. Dittes and Guardino (2017) ground-verified at least 20 perennial springs in the Lower Carpenter Valley alone. USGS (1940) and USFS (2016) topographic maps also identify springs in the watershed below the confluence of North and South Forks and near Hobart Mills. Condition and flow rate (if measured) of springs are documented as part of the Existing Conditions and Disturbance Inventory (Chapter 2). Springs in the Prosser Creek watershed are important for supporting aquatic habitat and sustaining cool, clean water through the drier months of the year.

2.5.3 Regulated Streamflow and Storage

In general, Prosser Creek above Prosser Creek Reservoir is an unregulated watershed[2] under current landownership and land and water-uses. Prosser Creek Reservoir was constructed in 1963 by the U.S. Bureau of Reclamation (USBOR) and is located approximately 1.5 miles upstream above the confluence of Prosser Creek and the Truckee River. The reservoir provides up to 20,000 acre-feet of storage for flood control but is capable of storing as much as 29,800 acre-feet for flood control, recreation, and improvement of fishery flows in the Truckee River (USBOR, 2020).

Because the reservoir is primarily operated for flood control purposes, water levels in the reservoir can fluctuate over 40 feet to accommodate and operate as a storage facility each spring during snowmelt runoff. Drawdown of reservoir levels begins as early as September 1 of each year until the reservoir's water surface elevation is reduced to 5,703.7 feet and held at or below this level from November 1 to April 9. The spring reservoir-filling season lasts from April 10 to May 20 of each year, based on runoff

[2] A private reservoir stores water from a watershed area less than 3 square miles on the SF Prosser Creek. Storage volume and operations of releases are unknown.

conditions (Berris, Hess, and Bohman, 1998) and can fill to or near the spillway elevation at 5,741 feet. For the purposes of this assessment, channel and watershed conditions are evaluated from the spillway elevation (5,741 feet) upstream. Below this elevation, we assume reservoir operations generate seasonal and annual changes to channel, riparian, and habitat conditions.

2.5.4 Water Quality

Prosser Creek is not currently included on the Clean Water Act 303(d) list of impaired waters but is a tributary to the Middle Truckee River, which is listed as impaired by suspended-sediment concentration (SSC). Characterization of water quality conditions in Prosser Creek is limited to: (a) modeling data for 1996 and 1997 (McGraw and others, 2001), (b) 18-years of once-annual data collection by trained volunteers under the guidance of the Truckee River Watershed Council (TRWC, unpublished data), and (c) a limnological study of Prosser Reservoir (Caldwell and Chandra, 2012). The USGS collected limited nutrient and biological data in Prosser Creek in 1980 (USGS, 2020); however, because these data were collected below the Prosser Creek Reservoir, outside the project watershed, they were not examined as part of this assessment.

McGraw and others (2001) modeled suspended sediment loads to the Middle Truckee River from 10 different tributaries and found that Prosser Creek exhibited the fourth highest predicted load (1,228 tons) in 1996 and third highest load (~1,600 tons) in 1997. These predicted values are almost 3 times higher than 'target conditions' of roughly 500 tons modeled as a watershed absent of roads and increased canopy, two factors that were largely responsible for higher sediment loads in the study. In consultation with the Lahonton Regional Water Quality Control Board, they identified Prosser Creek above Prosser Creek Reservoir as an area of concern, as it relates to downstream water quality.

The TRWC has conducted volunteer water-quality measurements in Prosser Creek at State Route (SR) 89 since 2002 (TRWC, unpublished data) (**Figure 2-10**). Data is limited to once-annual values of standard physical and chemical parameters including: (a) water temperature, (b) dissolved oxygen, (c) pH, and (d) specific conductance. Based on these limited data and parameters, Prosser Creek at SR89 exhibits generally fair to good water quality relative to established water quality objectives in the Basin (LRWQCB, 1995). From **Figure 2-10**, some water samples collected earlier than 2014 show pH values outside (low) of the acceptable range, while dissolved oxygen has been measured below the lower limit for Cold Freshwater Habitat, and on one occasion, below the lower limit for Spawning, Reproduction, and Development, both designated beneficial uses for waters in the Truckee River Basin. While we note that an 18-year record of measurements provides a basis to detect potential changing conditions, most if not all of measurements were collected during low-flow, non-storm conditions (May through September) and only represent a ‘snap-shot’ in time. Daily, seasonal, or annual variability in these parameters are not well-documented.

Caldwell and Chandra (2012) observed no invasive adult invertebrates (e.g., mussels and clams) or invasive plants in Prosser Reservoir in 2010, 2011, and 2012. These results are a positive sign given that the reservoir is a recreational destination where invasives can be introduced from boaters. Based on measured low calcium concentrations, Prosser Creek Reservoir is identified as ‘low-risk’ for mussel invasions.

2.6 Inferred Hydrogeology and Surface-Groundwater Interactions

The varying geologic rock types, geologic structure, and glacial history in Prosser Creek watershed support unique surface-groundwater interactions. The watershed supports groundwater discharge zones along contacts between differing geologies and along faults. These springs and seeps provide hydrologic support to existing mapped wetlands, fens, and meadow habitats (**Figure 2-11**). Euer and Carpenter Valleys collectively support approximately 650 acres of montane meadows with an additional 60 acres of mapped montane meadow in the Hobart Mills tributary; while an additional 200+ acres of dispersed montane meadows are mapped throughout the project watershed (Viers and others, 2013). We examined false-color infrared aerial photography of the project watershed to identify other potential unmapped springs or seeps (**Figure 2-12**). **Figure 2-12** shows areas of vibrant, healthy vegetation depicted by bright red hues. These areas are likely supported by shallow groundwater or areas of groundwater discharge. Future field investigations will verify the existence of these meadow and fen habitats and evaluate their condition.

3 CULTURE, LAND USES, AND HISTORICAL LAND USES

A detailed summary of pre-historic and historic culture and land uses was completed by Dr. Susan Lindstrom and is provided in **Appendix A**. We summarize key elements of her findings and other available literature below.

3.1 Pre-Historic Occupation

The project watershed is located within the center of the Washoe territory, which was occupied primarily by the northern Washoe or "Wa She Shu". The precise time Native Americans occupied this portion of the eastern Sierra Nevada Range is unknown. Archeological sites have been found in the project watershed that have large stemmed, edge-ground projectile points of the Great Basin Stemmed series, which are dated between 7,000 to 10,000 years before present (Lindström 2015). Artifacts found in the watershed include numerous lithic scatters indicating temporary small hunting camps. Some scatters are very dense and also contain ground stone assemblages such as hopper mortars, pestles, manos and matates indicating more permanent base camp sites (Lindström 2015). Historic declines in Washoe populations and traditional resource use were caused by disruptions imposed by incoming Euro-American groups (Dudek, 2016).

3.2 Historic Occupation and Land-Uses

3.2.1 Logging

In general, logging in the Sierra Nevada began as early as the mid-1800s. Beesley (1996) describes the intensity of logging that occurred in sections of the Sierra as early as 1850. Nearly all virgin timber in the Truckee River Basin was cut between the 1855 and 1936, most of it between 1856 and 1880. A California State Forestry Board report published in 1886 estimated that twenty years of cutting and fire had consumed and destroyed one-third of the Sierra's timber. It further estimated that if the same rate of consumption was continued, all of the range's forests would soon be cut over (Clar 1959, cited in Beesley, 1996). In the early 20th century, USGS reports detailed the impact of unregulated cutting in the northern and central Sierra, on both of its flanks. The reproduction of certain species such as sugar pine was reported to be imperiled by the wasteful practices that took only the best parts of the large trees leaving the rest as waste. Yellow pines (a.k.a., Ponderosa) were reported to have been taken in great numbers. Brush and other noncommercial plant species were reported to be replacing them (Sudworth 1900; Leiberg 1902, cited in Beesley, 1996). These documented accounts, in part, help us understand the current structure and diversity of forests today in the Sierra, including Prosser Creek watershed.

The project watershed has a long history of logging. While logging in the watershed pre-1900 is poorly documented, Lindstrom (2020) found evidence for logging as early as 1860. J.S. Carpenter reportedly logged much of the North Fork Prosser Creek (Carpenter Valley) in 1860s. The Nevada & California Lumber Company (NCLC) established a mill along Prosser Creek a few miles downstream of Carpenter Valley in 1873. By 1896, a company-owned mill and town was established in the lower watershed by the Sierra Nevada Wood and Lumber Company (SNWLC), first named Overton and later became known as Hobart Mills (**Figure 3-1**). A third mill was established in Euer Valley sometime before 1917. It is reported that the Euer family leased the right to harvest timber and construct a mill on their property in the Euer Valley, identified on most maps as 'Euer Mill' (Huisman, personal communication 5/27/15, cited from Lindstorm, 2015). A combination flume and ditch once diverted water from Red Mountain (Crabtree Tributary) to the steam engine circular saw at Euer Valley Mill which was reported to have cut out about four or five million feet of lumber (chiefly fir) during 1917 and 1918 (Beesley, 1996).

Logging expanded to higher elevations into the Prosser Creek watershed using narrow-gauge railroads as a means of transporting timber to the mills and then the Transcontinental Railway in Truckee. Local and regional logging railroads and mills are well documented and shown in **Figure 3-2**. A narrow-gauge logging railroad is reported above the south side of Euer Valley (Huisman, personal communication 1/21/15, cited in Lindstrom, 2015) and another section of railroad grade is documented along the north side of Euer Valley. A standard-gauge railroad is mapped passing along Alder Creek from Hobart Mills up into the vicinity of Euer Valley and is identified by some maps as the Floriston Paper Mill Logging Railroad, Standard Gauge 1924-1928. This railroad network included an upper branch line extending along the north-facing slopes above South Fork Prosser Creek and another upper branch reaching northward into Crabtree Canyon (see **Figure 3-2**).

Lindstrom (2020) also found historical evidence for a logging railroad that originated in Hobart Mills and extended up along Prosser Creek's north bank and into Carpenter Valley (see **Figure 3-2**). Within Carpenter Valley the railroad follows the alignment of the existing Carpenter Valley Road up to an elevation of roughly 6,600 feet. Another line originated at Hobart Mills and extended into the northern areas of the project watershed just west of existing State Road 89. All of these branching railroad lines connected with the main line that connected Hobart Mills south to the Transcontinental Railway in Truckee (**Figure 3-3**). Today remnants of this main line and its Prosser Creek crossing is submerged under Prosser Creek Reservoir. Many of the logging railroad grades throughout the watershed were maintained and converted for use as roads.

In 1936, the Hobart Mill and many of its railroad lines closed since most of the profitable timber was reportedly cutover. The most significant effect of logging before 1940 was the removal of the largest yellow and sugar pines. Replacing these were smaller but more densely packed pines in some areas, more fir and cedar in other areas formerly dominated by pine species, and more shrubs than had existed in the earlier forests (Laudenslayer and others, 1989; Laudenslayer and Darr 1990, cited in Beesley, 1996). 1939 aerial photographs of the project watershed depict disturbed watershed conditions, characterized by denuded slopes, streambank erosion, in-channel sediment bars, and road building.

The Hobart Mill was reopened by the Fiberboard Corporation in the 1940s to harvest fir from the Prosser Creek watershed and surrounding areas for pulp. More advanced logging techniques and technologies replaced the narrow-gauge railroads and steeper terrain above the valleys were logged between the late 1940s and early 1960s (see **Figure 3-2**). After the 1960 Donner Ridge Fire, which burned a considerable area of the watershed, it was common practice to harvest any trees that were partially burned or unburned. Historical aerial photographs from 1969 depicts extensive logging and yarding features across the burn area of Prosser Creek watershed.

While there is limited documentation of logging in the 1970s and 1980s, historical aerial photographs from these decades show considerable road building, clear cutting, and tree farms on Prosser Hill, Billy Hill and the Sagehen Hills. Active logging roads are also visible on aerial photos into the 1990s up to elevations near 8,000 feet.

3.2.2 Forest Management Including Wildfire

As early as the 1880s, the California State Board of Forestry wanted to exclude all fires to improve timber production and watershed potential of Sierra Nevada forests for agricultural uses (Wagoner 1886, cited in Beesley, 1996). At the turn of the 20th century, these reserves were re-designated as national forests. Tahoe National Forest (TNF) was established in 1905 and included Prosser Creek watershed. Most activities of TNF personnel before 1940 could be described as custodial; their principal duties were establishing accurate boundaries, preventing timber theft and trespass, suppressing fires, managing special use activities such as mining and grazing, building ranger facilities, preparing and supervising timber sales, and building campgrounds (Beesley, 1996).

Across most newly established national forests, fire was generally seen as a degrading force to be excluded, if possible. By the mid-1920s all national forests in the Sierra Nevada had fully developed policies, procedures, and organization to suppress fire in their jurisdictions; these took into consideration season, topography, and past fire histories. A California Forestry Commission was created and supported a policy of complete suppression. While mature trees and open canopies were good for logging and grazing interests, fire discouraged effective regeneration of mixed forests. If forests were to be sources of a sustainable timber supply, fire had to be suppressed (Pyne, 1982; Show and Kotok, 1923; cited in Beesley, 1996). The Clarke-McNary Act was passed by Congress about the same time and it clearly established fire exclusion as national policy. Federal money was offered to state agencies that would comply with the fire suppression doctrine (Pyne, 1982). Absolute fire suppression would form the basis of Forest Service policy into the 21st century.

A map of historical wildfires from 1908 through 2019 in the Prosser Creek Watershed is provided in **Figure 3-4**. While it is now established that fire is a natural process in Sierran forests, few fires are documented during this period and likely reflects the fire suppression policy. However, a fire in 1960, known as the Donner Ridge Fire, originated from construction of Interstate 80 and spread northeasterly across the lower half of the project watershed, primarily downstream of both Carpenter and Euer Valleys, but included a significant portion of the uplands above Euer Valley to the south. In total, the Donner Ridge Fire burned almost 45,000 acres, including 8,000 acres of the project watershed.

Forest structure has changed significantly from pre-European times under the century-long policy of fire suppression and the threat of catastrophic wildfire has increased. Among other sources, this risk is documented in the Middle Truckee River Watershed Forest Health Assessment technical report (Vibrant Planet, 2022). The assessment analyzes current ecosystem health conditions, current risk from wildfire and drought, and impact of treatments on improving ecological function and reducing risk. In several of the assessment scenarios, parts of the Prosser Basin are among the high priority areas of Middle Truckee River Watershed recommended for forest health, fuels reduction, and vegetation management (treatments). See **Figure 3-5** for one of the scenarios.

Forest treatments over the last decade or more have been focused on fuel reduction and prescribed burns. For example, Tahoe Donner Association (TDA) is implementing fuels reduction on portions of their property within the project watershed and the Truckee Donner Land Trust (TDLT) recently executed a timber harvest plan with the emphasis on fuel reduction in the Lower Carpenter Valley parcel (Svahn, J., pers. comm., 2020). The Tahoe National Forest has initiated planning for vegetation management in conjunction with TDA, TDLT, and others.

3.2.3 ROADS AND TRAILS

The watershed is rural with limited improved roads. Existing roads and trails are shown in **Figure 3-6**. These include SR89 which runs north-south and bisects the eastern side of the project watershed. All other roads in the watershed are unpaved and used for recreation, forest access, access to private lands. A number of abandoned roads and grades are associated with historical logging and ranching—many of these are unmapped.

Many of the watershed's active roads occupy former logging railroad grades that reached up into Carpenter and Euer Valleys. SF Prosser Creek subwatershed appears to have a higher density of roads when compared to the NF Prosser Creek subwatershed. In fact, the headwaters of the Upper Carpenter Valley in areas such as Warren Lake and Coon Canyon are absent of roads based on historical maps, LiDAR hillshade imagery, and historical aerial imagery. The rugged terrain, high elevation, and limited timber likely were disincentives to road building.

Lower elevations in the eastern third of the watershed also include a relatively high density of roads. These roads were likely associated with the long logging history around Hobart Mills and now provide access to Prosser Creek Reservoir for recreation. Similarly, the TNF manages a network of Off-Highway Vehicle (OHV) trails in the lower watershed (TNF, 2020c). TNF continues to manage and maintain these trails and a new motorcycle trail is proposed for the Billy Hill area by the Tahoe National Forest (TNF, 2020b).

Existing roads shown in **Figure 3-6** do not include many of the historical roads and trails constructed for logging practices over the last 50 years or more. However, many of these road features, including yarding and skid roads are visible in the LiDAR-based topography or hillshade imagery (**Figure 3-7**). After the 1960 Donner Ridge Fire, ditches were cut on-contour to minimize post-fire hillslope erosion, as visible in **Figure 3-7**. Many of these features are observed from LiDAR in the lower or eastern half of the watershed in areas such as Prosser Hill, Billy Hill and Sagehen Hills. Future field reconnaissance are recommended to evaluate whether they can be classified as on-going disturbances that impair watershed processes or functions.

TNF, TDA, and TDLT also currently manage a network of multi-use recreational trails in the project watershed. Many of these trails are also unmapped. These trails are primarily used by hikers, bikers, and equestrians (see **Figure 3-6**). These land managers continue to maintain and build new multi-use trails on their respective properties. Trail locations and construction have been guided by multi-year planning efforts (TDA, 2016) and use modern methods and best management practices to minimize hillside erosion and stream capture. Accurate mapping data for recently constructed trails were unavailable at the time of this report. Additional informal, private or illegal trails exist in the watershed in addition to those shown in **Figure 3-6**.

3.2.4 Grazing and Ranching

Sierran meadows, including those in Carpenter and Euer Valleys, were heavily grazed by both cattle and sheep before 1900. There was no limit to the size or the number of sheep bands that entered the Sierra before 1900, nor was there a limit on the length of time they could utilize a specific area. The First Biennial Report of the California State Board of Forestry for the Years 1885–1886 recommended that all sheep be excluded from the Sierra because of the damage they caused to soils and vegetation (Wagoner 1886; Muir 1894; Sudworth 1900; Leiberg 1902; Johnston n.d., *as cited in* Beesley, 1996). Some observers attribute the reduction of some native perennials and their replacement by more aggressive annual species in upper-elevation grassy hillsides and higher-elevation meadow systems to this unregulated sheep grazing (Muir 1894; Douglass and Bilbao 1975; Rowley 1985; Beesley 1985, as c*ited in* Beesley, 1996). Regulation and reduction in sheep herds didn't transpire until well after the federal government acquired much of the land in 1905. USFS document permits for over 100,000 sheep across the Tahoe National Forest in 1926 but were reduced to 75,000 in 1930, and less than 12,000 by 1937. Lindstrom (2020) gathered historical maps and accounts that document the grazing and ranching history within the project watershed.

Lindstrom (2015) identifies the Euers as a multi-generational ranching-dairying family that existed in Euer Valley for 140 years. Since 1868 the Euers were one of the pioneering dairy farmers in the Sierra. They drove cattle from Folsom, California up and over Donner Summit into Euer Valley each year. The Euers purchased all water rights in the valley in 1915 and used them to irrigate the meadows for pasture. This was accomplished through a network of ditches, cisterns and creek diversions along the South Fork Prosser Creek (Huisman, personal communication 5/27/15, cited in Lindstrom, 2015). A water-powered mill churned to make butter. At the turn of the 20th century, the Euer family expanded the business and converted much of the dairy to a beef ranch. The 7-C Ranch at the valley's west end was the focus of the beef cattle, while just downstream they established a guest or dude ranch. The Euer Family still maintains a 40-acre property in the center of Euer Valley known as Circle E Ranch.

Maps as early as 1865 show a road extending up into Carpenter Valley. Reports of grazing the Carpenter Valley are documented as early as 1868, possibly by the Euer Family. By 1880, historical maps indicate that W. Carpenter owned much of the Upper Carpenter Valley, and apparently used the valley for summer grazing. Photographic evidence (**Figure 3-8**) suggests sheep were in abundance in the upper Carpenter Valley around the turn of the 20th century.

3.2.5 Current Land-Uses and Management

Nevada County zoning map (2010) suggests that the project watershed is zoned for timberland production with no zoning for urban or residential development. Current land-uses and management in the watershed are consistent across some landowners but differs among others. In this section we describe current land-uses based on landowner.

Tahoe National Forest

TNF is the majority landowner in the project watershed and like other USFS forests management is multiple-use oriented. Recreation is the primary land-use and includes both motorized and non-motorized users. Under the USFS, the East Zone Connectivity and Restoration Project was created to reduce impacts to natural and cultural resources, to maintain or enhance the quantity, quality, and diversity of recreation opportunities on motorized trails, to better manage and reduce road and trail maintenance needs, and to improve overall access to, connectivity on, and public enjoyment of the National Forest Recreational Trails System (TNF, 2020a). A series of trails, both single and double track, are used by hikers, mountain bikers, motorbikes, and equestrians. Some trails occupy old railroad and road grades, logging roads and link up to other trail networks managed by other large landowners. TNF also maintains and manages multiple off-highway vehicle (OHV) trails within the project watershed, mostly concentrated around Prosser Hill, Sagehen Hills, and areas around Prosser Creek Reservoir.

The TNF is part of the greater USFS Ecological Restoration Implementation Plan. Part of this plan includes improving forest health and reducing overall wildfire hazards. Other aspects are focused on habitat improvements and protection of ecological functions and values (USFS, 2020). Currently, there are on-going efforts within the project watershed and adjacent lands to reduce fuels or enhance habitat.

Tahoe Donner Association

TDA is a recreational-oriented mountain community with large open space forested parcels that extend into the southern portions of the project watershed, many adjacent to TNF lands. TDA land management objectives include forest management, recreation, and wildlife or habitat. In 2012, TDA acquired 482 acres that expands the existing TDA property into Euer Valley (formerly the Euer Property). The new parcel honors previous owners by managing it as open space. Grazing was phased out by 2015 and planning began for a focus on recreation and habitat restoration and protection. In 2016, Nevada County and Town of Truckee approved TDA's Trails Five-Year Implementation Plan (Ball, 2016). The plan expands on TDAs existing trail network with their goal of providing a connected and sustainable network of trails available for a wide range of non-motorized users. Many of the new trails are located in Euer Valley and adjacent hillsides of TDA property. Euer Valley acquisition also expanded use for winter recreation with multiple kilometers of grooming for Nordic skiing. Existing roads through Euer Valley remain a deeded right-of-way for other private property owners in the valley.

Over the last decade, TDA has actively pursued and maintained forest thinning and fuel reduction projects creating fire breaks but also restoring a healthy forest. They continue to reforest areas burned over by historical wildfires and regenerate a diverse forest with representative species of pre-European logging (TDA, 2020). As part of their Land Management Plan (Dudek, 2016), they identify priorities in management geared towards protecting and enhancing water quality, habitat, and cultural resources.

Truckee Donner Land Trust

TDLT's recent acquisition of previously private parcels in the watershed form a contiguous area with TNF lands that provide opportunities for joint management to achieve larger landscape goals and objectives. TDLT's mission statement is "To preserve and protect scenic, historic and recreational lands with high natural resource values in the greater Truckee Donner region and manage recreational activities on these lands in a sustainable manner. (TDLT, 2020)". Through the Northern Sierra Partnership, the TDLT is a partner seeking 'protection of the Truckee River headwaters and a foundation for its restoration and public enjoyment' (Northern Sierra Partnership, 2020). TDLT acquisition of Lower Carpenter Valley, Frog Lake, and Carpenter Ridge and Red Mountain are a significant step in achieving this goal. These parcels are now open to the public for non-motorized recreation.

Private Property

Private property within the project watershed includes some historic or long-standing ranches in Upper Euer Valley (7-C Ranch), a 40-acre parcel that remains with the Euer Family in Lower Euer Valley (Circle E Ranch), and the Upper Carpenter Valley parcels. Current specific land uses for these parcels are not well documented but generally are limited to recreation since grazing operations have been slowly phased out.

Private property in the lower watershed is limited to the former Hobart Mills parcel and a near adjacent parcel, west of SR89. The former Hobart Mills now maintains a quarry operation and staging and storage grounds for quarry rock and timber. A near adjacent parcel, east of SR89 is a small rural development of roughly a dozen homes. Separately, a small portion of a private RV park (Tahoe Timber Trails Association) encroaches on the northeastern edge of the project watershed.

Documented or Proposed Restoration Activities

A brief search of landowner records and on-line resources did not identify any recent documented restoration projects within the project watershed.

Dudek (2016) identified attempts at in-stream restoration or stability in North Fork Prosser Creek based on their observations of placed rock weirs in the channel. However, information about the goals or objective of these efforts are unavailable.

The TRWC recently released a request for proposals for an assessment, design and restoration of a creek crossing (Coyote Crossing) on South Fork Prosser Creek on TDA property (TRWC, 2020). The opportunities identified by the proposed project include: restoration of geomorphic function and channel stability, increased connectivity with floodplain, water quality improvements, and recreational access improvements. The project is projected to be completed by 2023.

4 BIOLOGICAL RESOURCES

4.1 Vegetation and Wildlife

This chapter describes the vegetation communities and other land cover types in the project watershed, as well as associated plant and wildlife species, including special-status species and invasive species that potentially occur in the watershed. The following data sources were reviewed for relevant information in preparing this chapter:

- U.S. Forest Service (USFS) vegetation and land cover data (USFS 2017)
- University of California, Davis Sierra Nevada meadow mapping (UC Davis 2017)
- eBird queries of submitted species lists in, and immediately bordering, the Prosser Creek Watershed (Cornell Lab of Ornithology, 2020)
- Inventories of vertebrate species occurring on the Sagehen Creek Field Station (Morrison and others, 1985, iNaturalist 2020)
- California lakes, reservoirs, and ponds (CDFW 2012)
- Recent and historical aerial imagery (Google Earth 2020)
- California Natural Diversity Database (CNDDB 2020)
- USFS Fire Effects Information System (USFS 2019)
- California Native Plant Society's Inventory of Rare and Endangered Plants of California (CNPS 2020)
- USFS occurrence records maintained in the Natural Resources Information System (NRIS) (TNF 2020)
- Tahoe Donner Association Land Management Plan (Dudek 2016)
- Lower Carpenter Valley Property Easement Documentation Report Nevada County, California (Dittes and Guardino 2017)
- Characterization and Delineation of Fens in Carpenter Valley, Nevada County, California (Buck-Diaz and others, 2016)
- Report on Benthic Macroinvertebrate Species Occurring in Carpenter Valley (Serpa 2016)

- Resource Assessment at Devil's Oven Lake, Nevada County (Lockhart 2019a) and Resource Assessment at Warren Lake, Nevada County (Lockhart 2019b)
- Calflora Database (Calflora 2020)
- California Invasive Plant Council's (Cal-IPC's) inventory and Weed Mapper web application (Cal-IPC 2020a, 2020b) (**Appendix E**)
- California Department of Food and Agriculture's Encycloweedia (CDFA 2020)
- Nevada-Placer Weed Management Area Priority Invasive Plant List (Nevada-Placer WMA 2018)
- Invasive Weeds of the Tahoe National Forest guidebook (USFS 2013)
- Lake Tahoe Region Aquatic Invasive Species Management Plan (TRPA 2014)

No additional field data collection occurred to support development of these existing attributes; however, existing watershed conditions were noted, at a reconnaissance level, by H. T. Harvey & Associates senior associate ecologist Matt Wacker concurrently with other fieldwork conducted on July 14, 2020 in Euer Valley and August 20 in lower Carpenter Valley. Observations and photographs during other fieldwork throughout the watershed, combined with existing knowledge and prior experience working in and around the Truckee region, were used to supplement the information contained in the background documents described above.

4.2 Vegetation Communities and Land Cover Types

Vegetation communities and other land cover types in the project watershed were mapped using a combination of sources. Most land cover types were mapped using the Classification and Assessment with LANDSAT of Visible Ecological Groupings (CALVEG) mapping for the North Sierra zone of USFS Region 5, which uses a combination of satellite imagery (ranging from 2000–2014) and field verification (USFS 2017). This data is a coarse-scale map product, created at a scale of 1:24,000 to 1:100,000 with horizontal geospatial positioning accuracy of approximately 166 feet.

Additional vegetation types that occur at smaller scales (i.e., meadows, fens, and quaking aspen [*Populus tremuloides*] stands) were mapped from higher-resolution data sources (i.e., UC Davis 2017, Buck-Diaz and others, 2016, and TNF 2020, respectively). With the exception of aspen, in instances where this more detailed vegetation community mapping overlapped with CALVEG, the more specific mapping was used. In the case of aspen, because this species typically occurs intermixed with other vegetation communities, the underlying CALVEG classification was retained, and mapped aspen stands were displayed as an overlay on top of the mapped CALVEG type. CALVEG map units were cross-walked with California Wildlife Habitat Relationship (CWHR) types (CDFW 2014) to map 14 vegetation communities and other land cover types in the project watershed (**Table 4-1**, **Figure 4-1**).

Drainages, which are linear features and not mapped in the CALVEG data, were plotted from stream network data derived by Balance for this watershed assessment. Only the North Fork and South Fork of Prosser Creek, their major tributaries, and the Hobart Mills drainage were included as these are the most significant streams in the watershed; numerous other, generally ephemeral drainages and smaller springs and spring-fed drainage networks exist throughout the watershed, but these habitats were not mapped on **Figure 4-1**or summarized in **Table 4-1**. Lakes and ponds were plotted on **Figure 4-1**, and acreages tabulated for **Table 4-1**, using mapping prepared by CDFW (2012).

Table 4-1 Land Cover Types and Acres in the Prosser Creek Project Watershed

Land Cover Type	Acres	Miles
Vegetation communities		
Evergreen Forest		
Eastside Pine	3146.4	–
Sierran Mixed Conifer	5722.6	–
White Fire	1934.1	–
Red Fir	2231.4	–
Lodgepole Pine	365.0	_
Subalpine Conifer	529.0	_
Shrubland		
Montane Chaparral	3853.5	–
Mixed Chaparral	91.7	–
Sagebrush	566.5	–
Meadows and Grassland		
Dry meadow	639.6	–
Wet meadow	1035.7	–
Fen	28.6	–
Deciduous Woodland and Riparian		
Aspen[1]	61.1	–

Land Cover Type	Acres	Miles
Montane Riparian	214.0	–
Other land cover types		
Barren	1267.8	–
Streams	–	31.1
Lacustrine	351.0	–

Source: USFS 2017, Buck-Diaz and others, 2016, UC Davis 2017, USFS 2020, CDFW 2012

Notes: [1]Acres of Aspen are also included (i.e., duplicated) with other mapped CALVEG community acreages.

4.2.1 Evergreen Forest

Throughout the Sierra Nevada's evergreen forests, the plant species assemblage at any one location is a function of several factors that include local soil conditions, climate, slope, topography, and aspect, all of which affect available water supply and evaporative demand. These factors, along with disturbance history (e.g., logging and wildfire), are the primary drivers of forest species composition (Fites-Kauffman and others, 2007). Wildfire and logging may be especially important in determining patterns of evergreen forest species composition in the eastern half of the project watershed owing to the Donner Ridge Fire that burned a large portion of the lower watershed in 1960 and the extensive salvage logging that occurred thereafter into the early 1970s. The project watershed, which spans a large area ranging from the crest of the Sierra Nevada on the west to the initial transition zone into the Great Basin on the east, encompasses a broad diversity of abiotic factors, biotic factors, and disturbance histories and, therefore, supports a variety of evergreen forest types. Specific evergreen forest communities mapped in the watershed consist of the following: Eastside Pine, Sierran Mixed Conifer, White Fire, Red Fir, Lodgepole Pine, and Subalpine Conifer. The characteristics of these communities are described briefly below.

4.2.2 Eastside Pine

Eastside Pine occurs at elevations of approximately 4000–6500 feet, usually in areas with coarse, well-drained soil. The canopy of this vegetation community is characterized by ponderosa pine (*Pinus ponderosa*), with smaller amounts of Jeffrey pine (*Pinus jeffreyi*), lodgepole pine (*Pinus contorta* ssp. *murrayana*), white fir (*Abies concolor*), and other conifers. The understory typically consists of an herbaceous layer dominated by grasses, such as California needlegrass (*Stipa occidentalis* var. *occidentalis*) and squirreltail (*Elymus elymoides*), soft mule's-ear (*Wyethia mollis*), and scattered, low shrubs such as big sagebrush (*Artimesia tridentata*), rubber rabbitbrush *(Ericameria nauseosa)*, antelope bitterbrush (*Purshia tridentata*), manzanita (*Arctostaphylos patula*), Mahala mat (*Ceanothus prostratus*), Sierra chinquapin (*Chrysolepis sempervirens*), Sierra gooseberry (*Ribes roezlii*), mountain whitethorn (*Ceanothus cordulatas*), and other shrubs. Approximately 3146.4 acres of Eastside Pine occurs in the project watershed, mostly in eastern half.

4.2.3 Sierran Mixed Conifer

Sierran Mixed Conifer occurs on a variety of soil types throughout the Sierra Nevada, generally at mid elevations (e.g., approximately between 5000–7000 feet). Within the project watershed, this vegetation community is typically characterized by a mix of white fir (*Abies concolor*), Ponderosa pine, sugar pine (*Pinus lambertiana*), and incense-cedar (*Calocedrus decurrens*). The understory of Sierran Mixed Conifer is general similar to that described above for Eastside Pine and below for White Fir. Relative to Eastside Pine, Sierran Mixed Conifer generally occurs at slightly higher elevations within the project watershed in areas that receive greater precipitation or that have relatively more fertile, productive soils. This community occupies 5722.6 acres of land distributed throughout all but the highest portions of the watershed approaching the Sierra Nevada crest.

4.2.4 White Fir

White Fir, as a distinct plant community (as opposed to a component of Sierran Mixed Conifer or other evergreen forest communities) typically occurs at higher elevations, above 7000 feet, in areas that are relatively more mesic (e.g., north-facing slopes). Other conifers, especially red fir (*Abies magnifica*) and lodgepole pine, may occur in minor amounts intermixed with white fir as well as quaking aspen. The shrub canopy is represented by a variety of shrubs described above under Eastside Pine or below under Montane Chaparral. A variety of upland grasses such as California needlegrass, blue wildrye (*Elymus glaucus*), Bolander's bluegrass (*Poa bolanderi*), California brome (*Bromus carinatus*), and squirreltail, along with broadleaf plants, such as soft mule's-ear, snowberry (*Symphoricarpos mollis*), California goldenrod (*Solidago californica*), naked-stemmed buckwheat (*Eriogonum nudum*), scarlett gilia (*Ipomopsis aggregata*), pallid mountain monardella (*Monardella ordoratissima* ssp. *pallida*), slender beardtongue (*Penstemon gracilentus*), and silvery lupine (*Lupinus argenteus* var. *argenteus*) may intermix with shrubs in the White Fir understory. This community occupies 1934.1 acres of land in the project watershed, mostly in Crabtree Canyon, in the upper watershed south of Frog Lake, and along north-facing slopes above Carpenter Valley.

4.2.5 Red Fir

Red Fir generally occurs at higher elevations above White Fir and below Lodgepole Pine and Subalpine Conifer; although, in some locations Red Fir may intermix with the dominant tree species from these other evergreen forest communities at relatively lower elevations. Owing to typically dense, even-aged stands of red fir, the understory in this community is usually limited. Where an understory is present, it consists of various species of shrubs, grasses, and broadleaf plants, several of which are described above under White Fir. Red Fir occupies 2231.4 acres of land in the project watershed, mostly along the south-facing slope above Carpenter Valley and the middle portion of the upper watershed extending up to Frog Lake, Crabtree Canyon, and Coon Canyon.

4.2.6 Lodgepole Pine

In the Sierra Nevada, Lodgepole Pine communities are often found at higher elevations, below the Subalpine Conifer zone, but in the watershed, Lodgepole Pine has been observed scattered in a variety of locations, including some areas in lower portions of the watershed. Lodgepole pine is typically the dominant tree species in this community; although, quaking aspen may be scattered and interspersed with lodgepole pines in more mesic locations along streams, hillslope seeps, and where lodgepole pine has invaded meadows. The understory of this community ranges from sparse to fairly well-developed in less dense tree stands. In these more open stands or where lodgepole pine occurs in meadows, a variety of grasses and broadleaf plants may occur, most of which are described above under White Fir and Eastside Pine or below under Dry Meadow or Wet Meadow. Shrubs include such species as mountain whitethorn, pinemat manzanita (*Arctostaphylos nevadensis*), bitterbrush, and western blueberry (*Vaccinium uliginosum* ssp. *occidentale*). Lodgepole Pine occupies 365.0 acres of land in the watershed and has been mapped in Carpenter Valley, in upper Coon Canyon, along the mainstem of Prosser Creek west of SR 89, and in Hobart Mills and near the outlet of Prosser Creek Reservoir east of SR 89.

4.2.7 Subalpine Conifer

Subalpine Conifer occurs in the highest, rockiest portions of the watershed, generally above 8000 feet in elevation. Lodgepole pine and red fir may be scattered occasionally in this community, but the dominant trees are more commonly Western white pine (*Pinus monticola*), mountain hemlock (*Tsuga mertensiana*), Sierra juniper (*Juniperus grandis*), and whitebark pine (*Pinus albicaulis*). The understory is generally sparse, owing to the abundance of rock, but areas of low-stature shrubs such as red elderberry (*Sambucus* *racemosa*), huckleberry (*Vaccinium* spp.), willow (*Salix* spp.), honeysuckle (*Lonicera* spp.), currant (*Ribes* spp.), snowberry, and serviceberry (*Amelanchier* spp.) may occur as well as scattered broadleaf plants such as spreading phlox (*Phlox diffusa*), sulfur buckwheat (*Eriogonum umbellatum*), and pussy toes (*Calyptridium umbellatum*) as common components in more open, rocky locations. Subalpine Conifer occupies 529.0 acres of land in the watershed, limited to the upper reaches of the watershed along the crest of the Sierra Nevada.

4.3 Shrubland

In general, the Shrubland community in the Sierra Nevada are early-successional and typically follow a disturbance such as logging or wildfire. However, in some locations, such as sites with steep, shallow, rocky soils and high evapotranspiration potential (e.g., sites with southern exposures), Shrubland may represent an edaphic climax condition. In other locations, shrubs tend to persist for years, or even decades, following disturbance and may represent an alternative stable vegetation state that persists indefinitely without active management intervention to encourage forest regeneration and succession. These factors, combined with the transition from the Sierra Nevada to Great Basin at the watershed's eastern edge, all contribute to creating a diversity of Shrubland communities in the watershed, each of which is described briefly below.

4.3.1 Montane Chaparral

Montane Chaparral habitat occurs at elevations of approximately 3,000–9,000 feet in the Sierra Nevada coniferous forest zone, on a wide variety of soil depths, exposures, and slopes. Vegetation structure ranges from prostrate to treelike (up to 10 feet), characterized by evergreen species such as tobacco brush (*Ceanothus velutinus*), manzanitas (*Arctostaphylos* spp.), curl leaf mountain mahogany (*Cercocarpus ledifolius*), mountain whitethorn, Sierra chinquapin, and huckleberry oak (*Quercus vaccinifolia*). Deciduous shrubs such as bitter cherry (*Prunus emarginata*) also may occur in Montane Chaparral. Mature Montane Chaparral habitat is often impenetrable to large mammals, and there is generally a lack of understory vegetation. Montane Chaparral occupies 3853.5 acres of land in the watershed with extensive stands occurring in areas burned in the Donner Fire and subsequently logged as well as the south-facing, upper extent of Carpenter Valley and the North Fork of Prosser Creek toward Warren Lake.

4.3.2 Mixed Chaparral

Mixed Chaparral is more commonly mapped in the Coastal Mountains and Transverse Range in California. In the Sierra Nevada, the difference between Montane Chaparral and Mixed Chaparral is likely represented by stands intermediate between Montane Chaparral and Sagebrush (or other shrubland types, such as Bitterbrush) in terms of dominant species composition, likely with greater component of antelope bitterbrush, or potentially tobacco brush, and lesser amounts of shrubs occurring in the other shrubland types. Mixed Chaparral only occurs on 91.7 acres of the watershed, in four mapped stands in the eastern part of the watershed mostly located within the areas burned in the Donner Ridge Fire.

4.3.3 Sagebrush

Sagebrush communities occur on dry slopes and flats along the east and northeast borders of California, primarily at elevations of 1,600–10,500 feet within the Great Basin ecological province. Sagebrush also can occur along the margins of montane meadows throughout the east slope of the Sierra Nevada, in between wetter meadows and drier evergreen forests. Vegetation is characterized by large, open, discontinuous stands of big sagebrush of fairly uniform height, often mixed with other shrub species of similar form and growth habit such as antelope bitterbrush and rubber rabbitbrush. Depending on the topography, soil composition, and soil moisture the understory may be barren or support low to moderate herbaceous cover composed of perennial grasses and forbs such as squirreltail, one-sided blue grass (*Poa secunda* ssp. *secunda*), yampah (*Yampah* spp.), soft mule's-ear, California fuschia (*Epilobium canum*), lupines (*Lupinus* spp.), lotus (*Acmispon* spp.), navarretia (*Navarretia* spp.), whiskerbrush (*Leptosiphon ciliatus*), and other species. The invasive grasses cheatgrass (*Bromus tectorum*) and medusa head (*Elymus caput-medusae*) also commonly occur in Sagebrush communities (Dittes and Guardino [2017] noted the presence of cheatgrass in Lower Carpenter Valley) where these species can alter fire cycles and fire intensity, and, ultimately threaten the sustainability of Sagebrush communities. Sagebrush occupies 566.5 acres of the watershed, primarily along the margins of Prosser Creek Reservoir; although, smaller areas of sagebrush habitat (not mapped) were observed around Euer Valley and Carpenter Valley during reconnaissance fieldwork by H. T. Harvey & Associates and by Dittes and Guardino (2017).

4.4 Meadows and Grassland

Meadows and Grassland develop along a continuum of elevation and moisture gradients and, in addition to these factors, can be differentiated by landscape position and by geomorphic factors (Weixelman and others, 2011). Owing to the interactions of these factors, individual meadow systems can be complex and encompass a wide variety of plant associations that vary at small spatial scales (i.e., on the order of square feet as opposed to acres) However, for simplicity, Meadows and Grassland communities in the watershed have been segmented into three general classifications: Dry Meadow, Wet Meadow, and Fen, each of which is summarized below.

4.4.1 Dry Meadow

Dry Meadow occurs throughout the project watershed along the upper edges of wet meadows and drainages, in disturbed areas, and within forest openings along hillslopes where shallow groundwater and surface water are absent for the majority of, if not all of, the growing season. This is an open plant community characterized by bare ground interspersed with annual forbs and perennial grasses along with scattered shrubs. Characteristic plant species include: mat muhly (*Muhlenbergia richardsonis*), squirreltail, slender hairgrass (*Deschampsia elongata*), slender wheatgrass (*Elymus trachycalus*), annual hairgrass (*Deschampsia danthoniodes*), California needle grass, California brome, one-sided blue grass, various annual forbs (e.g., navarretia, lupine, whiskerbrush, knotweed [*Polygonum sawatchense*], and pussy toes), and upland perennial forbs such as Parish's yampah (*Perideridia parishii*), yarrow (*Achillea millefolium*), and potentilla (*Potentilla* spp.). Some areas mapped as Dry Meadows along upland hillslopes likely also consist of nearly pure stands of soft mule's-ear. Low-statured willows (*Salix* spp.) and shrubs such as silver sagebrush (*Artemisia cana*) may occur in some locations, but trees are typically absent. Dry Meadow occupies 639.6 acres of the project watershed along the margins of Euer Valley, Carpenter Valley, Crabtree Canyon, hillslopes in the upper watershed, and in flats around Prosser Creek Reservoir and in Hobart Mills.

4.4.2 Wet Meadow

Wet Meadow occurs on poorly drained soils where groundwater or surface water maintains soil inundation or saturation at or near the ground surface for most of the growing season. Wet Meadow communities form along active and abandoned stream channels, around lake margins, below springs and similar groundwater seeps, and other wet–mesic areas. Dominant vegetation is characterized by dense growth of perennial graminoids and forbs; low-statured willows such as Lemmon's willow (*Salix lemmonii*) and shrubs such as silver sagebrush may occur in some locations, but trees are typically absent. Dominant species vary widely and include rhizomatous graminoids such as sedges (*Carex* spp.), rushes (*Juncus* spp.), bulrushes (*Scirpus* spp.), spikerushes (*Eleocharis* spp.), cottongrass (*Eriophorum gracile*), wood-rush (*Luzula comosa*), and bentgrasses (*Agrostis* spp.) as well as bunch grasses such as tufted hairgrass (*Deschampsia cespitosa*), meadow barley (*Hordeum brachyantherum* ssp. *brachyantherum*), and pull-up muhly (*Muhlenbergia filiformis*). Forbs found in the Wet Meadow community can include columbine (*Aquilegia formosa*), bog orchid (*Platanthera dilatata*), Oregon checker mallow (*Sidalcea oregana*), lupines, corn lily (*Veratrum californicum*), alpine aster (*Oreostemma alpigenum* var. *andersonii*), Western mountain aster (*Symphyotrichum spathulatum var. spathulatum*), mountain dandelion (*Agoseris glauca*), yarrow, meadow beardtongue (*Penstemon rydbergii* var. *oreocharis*), long-stalked clover (*Trifolium longipes*), and violets (*Viola* spp.). Wet Meadow occupies 1035.7 of land in the watershed, including the majority of Carpenter Valley and Euer Valley, the margins of spring-fed channels in Hobart Mills, and in scattered locations in the headwaters of the North Fork and South Fork of Prosser Creek.

4.4.3 Fen

Fens are unique wetland ecosystems that are primarily created by the presence of perennial, shallow groundwater, often spring-fed, combined with unique geologic conditions that result in the formation peat soils (i.e., soils high in organic matter created when the rate of plant growth exceeds the rate of organic matter decomposition). In many ways, Fens are similar to Wet Meadows, with the primary differentiating factors being the source of hydrology and water chemistry (i.e., groundwater for fens versus streams for wet meadows) and landscape position (fens often occur at toe slopes below springs whereas meadows most often occur on floodplains). Owing to their rarity on the landscape and unique hydrologic, soil, and geologic conditions, Fens are biologically rich and support many species of rare and unique plants. Dominant plant species in Fen communities are similar to Wet Meadows with greater composition of rhizomatous gramanoids (such as sedges) as well as increased cover of mosses, liverworts, and moonworts represented by species such as *Meesia triquerta* and *Meesia uliginosa*, *Sphagnum* spp., *Drepanocladus* spp., *Aulacomnium palustre*, *Philonotis fontana pusilla*, *Ptychostomum pacificum*, *Riccardia multifidi*, and various *Botrychium* species. Sundews (*Drosera rotundifolia* and *D. anglica*), seep monkeyflower (*Mimulus primuloides*), and tinker's penny (*Hypericum anagalloides*) also are common components of Fen communities. Fen communities occupy 28.6 acres in lower Carpenter Valley (see **Figure 2-12**); however, it is likely that other areas of Fens occur throughout the watershed as aerial photograph signatures imply that (minimally) significant extents of Fen communities likely occur on private property in upper Carpenter Valley.

4.5 Deciduous Woodland and Riparian

4.5.1 Aspen

Aspen communities are characterized by the presence of a single species, quaking aspen. In the Sierra Nevada, Aspen typically occurs at higher elevations, generally on the east slope of the Sierra, intermixed with various species of conifers (described above under Evergreen Forest) in areas with some amount of groundwater availability such as meadows, along streams, or on hillslopes where groundwater is available (e.g., near springs on unconsolidated moraine deposits where some amount of groundwater seepage occurs). Where quaking aspens do occur in nearly pure stands, these stands tend to be fairly small. Large, extensive stands of pure quaking aspens, as seen in other Western mountain ranges (e.g., the Rocky Mountains), are relatively uncommon in the Sierra Nevada with some exceptions. Similar to Fens, Aspen communities are rare on the landscape and ecologically important as they provide functions and wildlife habitat values not provided by evergreen forests. Among Sierra Nevada tree species, quaking aspens are somewhat distinct in that they reproduce vegetatively; thus, contiguous stands of individual “trees” (in reality, each tree is an individual ramet, or stem, arising from a shared root system) are composed of only a small number of genotypes (i.e., individual ramets are clones of each other and may represent only a single genotype). Quaking aspens also resprout vigorously, allowing them to rapidly regenerate and expand following disturbances such as wildfire or when competing conifers are removed from Aspen stands.

Where the presence of conifers is lower, and quaking aspens occur in relatively pure stands, Aspen communities may support a rich herbaceous understory composed of many of the species described above under Dry Meadow, Wet Meadow, or White Fir that are adapted to more mesic conditions—typically many of these species are bunchgrasses (as opposed to rhizomatous species) such as meadow barley, tufted hairgrass, slender wheatgrass, slender hairgrass, and various species of perennial, broadleaf plants. Aspen occurs on 61.1 acres of land in the watershed, primarily in a stand of quaking aspens intermixed with lodgepole pines and other conifers along hillslopes near the junction of the North Fork and South Fork of Prosser Creek (an area likely burned in the Donner Ridge Fire); a second, smaller stand also is mapped along the Hobart Mills drainage. The watershed has not been exhaustively surveyed for Aspen communities, so additional stands potentially occur in other locations.

4.5.2 Montane Riparian

Montane Riparian communities are dominated by willows and creek alder (*Alnus incana* ssp. *tenuifolia*) and typically are found along creeks and streams. Low-gradient Montane Riparian communities are most typically associated with Wet Meadows and dominated by willows; high-gradient Montane Riparian communities are associated with various Evergreen Forests or Shrublands and are generally dominated by thickets of creek alder along hillslope seeps and drainages. If present, trees may include scattered conifers (described above under Evergreen Forest), quaking aspen, or black cottonwood (*Populus trichocarpa*). A well-developed herbaceous layer may be lacking in Montane Riparian communities, but in more open stands, where an herbaceous layer is able to develop, common species are similar to those described above under Wet Meadow. Montane Riparian occupies 214.0 acres of the watershed along creeks, streams and drainages within Carpenter Valley and Euer Valley, upper watershed tributaries, and along the lower reaches of Hobart Mills and Prosser Creek, near Prosser Creek Reservoir.

4.6 Barren

Barren land is characterized by rock, gravel, sand, silt, clay, or other earthen material with less than 15% vegetation cover. Vegetation, if present, is widely spaced, scrubby, and similar to that described above for Dry Meadow, Montane Chaparral, or Sagebrush. Within the watershed, Barren areas include bedrock, talus, slides, volcanic material, glacial debris, and other accumulations of earthen material. They can also include small areas of pavement and buildings with minimal vegetative landscaping. Barren areas occupy 1267.8 acres of the watershed, mostly in the upper areas of the watershed associated with bare granitic and volcanic rock, talus slopes, and similar areas.

4.7 Streams

Streams are flowing, open water habitats. Although typically characterized by a lack of vegetation, Stream communities in the watershed support large areas of filamentous algae as well as scattered plants such as sedges, rushes(e.g., *Juncus nevadensis*), pondweed (*Potamogeton* spp.), Indian rhubarb (*Darmera peltata*), and similar wetland plants. Gravel bars, which are likely seasonally inundated during snowmelt and higher flows, can support sparse willows and weedy, annual species such as white sweetclover (*Melilotus albus*), woolly mullein (*Verbascum thapsus*), or annual fireweed (*Epilobium brachycarpum*). Over 31 miles of major streams occur in the watershed, including the Hobart Mills drainage, the mainstem of Prosser Creek, and the North and South Forks of

Prosser Creek. Numerous other ephemeral streams and drainages occur throughout the watershed.

4.8 Lacustrine

Lacustrine land cover includes wide areas of open-water habitat. Floating aquatic plants such as duckweeds (*Lemna* spp.) and pondweeds may be present in some areas, and shallow areas (i.e., areas less than 3 feet deep) at lake margins can support growth of various species of moderate-stature, such as sedges, rushes, and bulrushes that are tolerant of prolonged, shallow inundation. Lacustrine areas occupy 351.0 acres of the watershed including Prosser Creek Reservoir, Frog Lake, Devil's Oven Lake, Warren Lake, and numerous, small, glacial ponds in the upper watershed.

4.9 Wildlife

This section provides an overview of general wildlife use of the watershed. The species discussed below were included based prior reports completed for the watershed (summarized in Section 1.1), standard reference sources (e.g., California Herps 2020), and professional knowledge and prior experience regarding the wildlife that may be expected to be found in the Truckee-North Tahoe area. As indicated above, field surveys of the watershed for the purpose of documenting general wildlife use were not conducted as part of this assessment.

4.10 Mammals

The watershed consists of a mosaic of connected habitat types that provide breeding and foraging opportunities as well as sources of water for many mammal species. The following common species of mammals are either known to occur or are expected to occur in the watershed: American black bear (*Ursus americanus*), North American beaver (*Castor canadensis*), bobcat (*Lynx rufus*), coyote (*Canis latrans*), long-tailed weasel (*Mustela frenata*), mountain lion (*Puma concolor*), Columbia mule deer (*Odocoileus hemionus hemionus*), common porcupine (*Erethizon dorsatum*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), western spotted skunk (*Spilogale gracilis*), golden-mantled ground squirrel (*Callospermophilus lateralis*), northern flying squirrel (*Glaucomys sabrinus*), Douglas' squirrel (*Tamiasciurus douglasii*), Belding's ground squirrel (*Urocitellus beldingi*), yellow-bellied marmot (*Marmota flaviventris*), chipmunks (*Tamias* spp.), deer mouse (*Peromyscus maniculatus*), mountain pocket gophers (*Thomomys monticola*), shrews (*Sorex* spp.), and voles (*Microtus* spp.).

Columbia mule deer are a particularly important wildlife species that use the watershed. The mule deer found regionally belong to the Loyalton-Truckee Deer Herd unit (LTH), whose range covers approximately 1,240 square miles in Lassen, Plumas, Sierra, Nevada, and Placer Counties in California, and Washoe County in Nevada (CDFW 2020a). The watershed lies in the southern portion of the LTH range and serves as summer range for the herd. The mule deer migrate to winter ranges in Nevada in mid-October to November and return to the Truckee area in May or June; the timing of these movements is dependent on weather conditions (CDFW 2020a). Important habitat areas including summer ranges and migratory corridors are negatively affected by fire, development, and barriers such as roads and highways. The LTH is stable to declining with an average estimated size of approximately 3,200 individuals (CDFW 2020a).

North American beaver is known to be present in the watershed, particularly along the South Fork of Prosser Creek in Euer Valley and North Fork of Prosser Creek in Carpenter Valley. There is debate regarding the status of the North American beaver in the Sierra Nevada and whether the species is native to the region or intentionally introduced. Lindström (2012) conducted extensive archival and oral history research and could not determine whether historical beaver accounts by the Washoe Tribe and early non-Washoe settlers referred to the native Sierra Nevada mountain beaver (Aplodontia rufa californica), which is a relatively small fossorial animal that does not construct large dams, or to the North American beaver. Based on her research, Lindström (2012) concludes that beavers were not an important Native American game species and that there was not a historical fur trade in the area, despite extensive exploration of the Sierra Nevada by fur traders in the 1800s. She therefore postulates that North American beavers were likely not native to the Truckee area. Other studies have offered conflicting evidence, some supporting the long-held notion that North American beavers in the Middle Truckee River watershed were nonnative and intentionally introduced by the California Department of Fish and Wildlife in the 1940s (Beier and Barrett 1989) and others maintaining that the North American beaver was native to the Sierra Nevada (Lanman and others, 2012, James and Lanman 2012) and locally extirpated in the 1800s.

4.11 Amphibians and Reptiles

Amphibians are most likely to occur near the various lakes, streams, meadows, and ponds in the watershed. Common species expected to use these habitats for foraging and reproduction include Sierran chorus frog (*Pseudacris sierra*), western toad (*Bufo boreas*), and southern long-toed salamander (*Ambystoma macrodactylum sigillatum*). The Sierra

Nevada yellow-legged frog (*Rana sierrae*) occurs in the upper watershed, as described in more detail in **Section 4.14**.

Reptiles likely to occur on the open space lands include: Great Basin rattlesnake (*Crotalus oreganus lutosus*), mountain garter snake (*Thamnophis elegans elegans*), Sierra garter snake (*Thamnophis couchii*), western yellow-bellied racer (*Coluber constrictor mormon*), northern rubber boa (*Charina bottae*), western fence lizard (*Sceloporus occidentalis*), Sierra alligator lizard (*Elgaria coerulea palmeri*), western sagebrush lizard (*Sceloporus graciosus gracilis*), and western skink (*Plestiodon skiltonianus skiltonianus*).

4.12 Birds

Despite their relatively sparse distribution, montane meadows and associated riparian areas in the Sierra Nevada, such as Carpenter Valley and Euer Valley, play a crucial role in the life history and ecology of many Sierra Nevada bird species (Grinnell and Miller 1944, Orr and Moffitt 1971, Stewart 1977, Gregory and others, 1991, Gaines 1992, Cicero 1997, Lynn and others, 1998, Bombay and others, 2003a, Cain and Morrison 2003, Heath and Ballard 2003, Borgmann 2010). The juxtaposition of water, herbaceous vegetation, and riparian shrubs create habitats for both the aquatic and terrestrial life stages of many insect species on which meadow birds prey (Erman 1984, Gray 1993, Erman 1996, Hatfield and LeBuhn 2007). In addition, Sierra Nevada meadows provide dense herbaceous cover for avian nesting, predator avoidance, and thermal cover as well as bountiful seed crops for granivorous birds in late summer and fall. The presence of meadows, in addition to a diversity of other habitat types (e.g., evergreen forest, sagebrush, aspen) along with streams and lakes, support a wide diversity of bird species in the watershed.

A query of eBird records indicated that 164 species of birds have been reported within or adjacent to the watershed (**Appendix B**). Although this is not a conclusive list (eBird, as a crowd-sourced, citizen science portal, is not necessarily curated to the same degree as CNDDB, NRIS or similar species occurrence databases), and it likely includes species occasionally observed as migrants (versus breeding birds), it nonetheless provides a good indicator of bird species diversity in the watershed and an interesting comparison to other regional bird species lists that have been compiled for Sagehen Creek (148 species reported, Morrison and others, 1985 and iNautralist 2020) and Martis Valley (176 species reported, Richardson 2014), both of which are recognized regionally for their biodiversity. Bird species expected to be commonly-observed in the watershed include: white-faced ibis (*Plegadis chihi*), osprey (*Pandion haliaetus*), red-tailed hawk (*Buteo jamaicensis*), American coot (*Fulica americana*), mallard (*Anas platyrhynchos*), Amercian wigeon

(*Mareca Americana*), cinnamon teal (*Anas cyanoptera*), green-winged teal (*Anas carolinensis*), gadwall (*Mareca strepera*), northern pintail (*Anas acuta*), common merganser (*Mergus merganser*), ring-necked duck (*Aythya collaris*), ruddy duck (*Oxyura jamaicensis*), bufflehead (*Bucephala albeola*), killdeer (*Charadrius vociferus*), red-breasted sapsucker (*Sphrapicus ruber*), hairy woodpecker (*Picoides villosus*), white-headed woodpecker (*Picoides albolarvatus*), Williamson's sapsucker (*Sphyrapicus thyroideus*), northern flicker (*Colaptes auratus*), American kestrel (*Falco sparverius*), western wood-pewee (*Contopus sordidulus*), warbling vireo (*Vireo gilvus*), gray flycatcher (*Empidonax wrightii*), Steller's jay (*Cyanocitta stelleri*), Clark's nutcracker (*Nucifraga columbiana*), common raven (*Corvus corax*), horned lark (*Eremophila alperstris*), cliff swallow (*Petrochelidon pyrrhonota*), barn swallow (*Hirundo rustica*), mountain chickadee (*Poecile gambeli*), red-breasted nuthatch (*Sitta canadensis*), pygmy nuthatch (*Sitta pygmaea*), brown creeper (*Certhia americana*), mountain bluebird (*Sialia currucoides*), American robin (*Turdus migratorius*), orange-crowned warbler (*Oreothlypis celata*), MacGillivray's warbler (*Geothlypis tolmiei*), yellow-rumped warbler (*Setophaga coronata*), Wilson's warbler (*Cardellina pusilla*), green-tailed towhee (*Pipilo chlorurus*), chipping sparrow (*Spizella passerina*), Brewer's sparrow (*Spizella breweri*), vesper sparrow (*Pooecetes gramineus*), fox sparrow (*Paserella iliaca*), song sparrow (*Melospiza melodia*), white-crowned sparrow (*Zonotrichia leucophrys*), dark-eyed junco (*Junco hyemalis*), western tanager (*Piranga ludoviciana*), black-headed grosbeak (*Pheucticus melanocephalus*), red-winged blackbird (*Agelauis phoeniceus*), western meadowlark (*Strunella neglecta*), Brewer's blackbird (*Euphagus cyanocephalus*), Cassin's finch (*Haemorhous cassinii*), and pine siskin (*Spinus pinus*) (E. Beedy, pers. comm. 2020).

4.13 Fish and Aquatic Macroinvertebrates

Moyle and others, (1996) identified four zoogeographic regions (drainages) in the Sierra Nevada, each defined by distinctive native fish communities that share few species in common. The Lahontan drainage, consisting of the Susan, Truckee, Carson, and Walker River drainages, is characterized by 10 native fish species: mountain whitefish (*Prosopium williamsoni*), Lahontan cutthroat (*Oncorhynchus clarki henshawi*), Paiute cutthroat (*Oncorhynchus clarki seleniris*), Lahontan lake tui chub (*Gila bicolor pectinifer*), Lahontan creek tui chub (*Gila bicolor obesa*), Lahontan redside (*Richardsonius egregious*), Lahontan speckled dace (*Rhinichthys osculus robustus*), Tahoe sucker (*Catastomus tahoensis*), mountain sucker (*Catostomus platyrhynchus*), and Paiute sculpin (*Cottus beldingi*). These fishes historically were distributed widely throughout the drainage from the lowlands to elevations above 6,600 feet. Fish absence is typical in high-elevation eastern Sierra Nevada watersheds (La Rivers 1994, Moyle and others, 1996), and, before Euro-American settlement, nearly all Sierra Nevada lakes and streams were fishless above roughly 6,000 feet (Knapp 1996) due to the presence (generally) of natural migration barriers above this elevation.

Lahontan cutthroat trout are known to occur in the watershed Lahontan speckled dace were observed in the North Fork of Prosser Creek during surveys conducted by H. T. Harvey & Associates in 2020 to support this Watershed Assessment; and mountain whitefish have been documented in the South Fork in Upper Euer Valley (CNDDB, 2020). It is possible that Lahontan redside, Paiute sculpin, and mountain sucker also occur in the Prosser Creek watershed, and all of these species, except Lahontan redside, have been observed in Prosser Creek downstream of Prosser Creek Reservoir, immediately outside the watershed boundary (CDFW, 2014).

Nonnative fishes, namely rainbow trout (*Oncorhynchus mykiss*), eastern brook trout (*Salvelinus fontinalis*), and brown trout (*Salmo trutta*), were introduced to historically fishless high-elevation lakes and to many streams in the Sierra Nevada through private and government-sponsored programs beginning in the mid-1800s and continuing far into the 1900s (Knapp and others, 2001). These nonnative species now represent the primary target species for anglers in the Middle Truckee River watershed. Both brook trout and rainbow trout were observed in the South Fork and North Fork of Prosser Creek during surveys conducted by H. T. Harvey & Associates in 2020 to support this watershed Assessment. During summer 2020, upwards of 1500 nonnative trout per mile were estimated in the South Fork of Prosser Creek in Euer Valley. Far fewer nonnative trout were observed in the North Fork of Prosser Creek in lower Carpenter Valley, perhaps numbering less 100 fish per mile, if not significantly less than this number (e.g., only 10s or fewer per mile). Brook trout have also been documented in numerous lakes and ponds in the upper watershed (Dudek 2016, Lockhart 2019a, Lockhart 2019b). Brown trout occur in Prosser Creek Reservoir and in Prosser Creek downstream of the reservoir (CDFW, 2014), and are therefore expected to occur at least in the lower reaches of the mainstem of Prosser Creek, if not also into the North Fork and South Fork of Prosser Creek. Other nonnative game fish, such as smallmouth bass (*Micropterus dolomieu*), also are known to occur in Prosser Creek Reservoir.

Limited surveys of aquatic macroinvertebrates have also been conducted in the North Fork of Prosser Creek, in lower Carpenter Valley (Serpa, 2016). Although survey results are preliminary and do not represent a comprehensive inventory of aquatic macroinvertebrates, 103 different species were identified over 4 survey days, with roughly

25% of the observed species occurring only in springs and spring channels. The results of this limited survey documented approximately 40% of the species diversity observed during long-term aquatic macroinvertebrate surveys conducted in the Sagehen Creek watershed. These results, over a relatively limited period of time and in only a small subset of aquatic habitats in Carpenter Valley (and including no surveys of the upper Watershed, upper Carpenter Valley, Euer Valley, or the lower watershed), imply that high levels of aquatic macroinvertebrate biodiversity likely are present in the watershed.

4.14 Special-Status Species

For the purpose of this watershed assessment, special-status species include species listed as threatened or endangered (or candidate/proposed species for such listing) under the California or federal Endangered Species Acts, vascular plants and lichens included in the *CNPS Inventory of Rare and Endangered Plants of California* (CNPS, 2020a), California Fully Protected species of Species of Special Concern (CDFW, 2020) or Tahoe National Forest (TNF) Sensitive species. The following sources were consulted to develop an initial listing of special-status species that could potentially occur in the watershed.

- A query of all California Natural Diversity Database (CNDDB 2020) records reported within 2 miles of the Prosser Creek Watershed.
- A query of the California Native Plant Society's Inventory of Rare and Endangered Plants of California (CNPS 2020) for all species potentially occurring the Truckee, Norden, Hobart Mills, and Independence Lake 7.5-minute USGS topographic quadrangles.
- A query of all USFS species occurrence records maintained in NRIS for the Prosser Creek Watershed (TNF 2020).
- Lists of special-status species provided in the Tahoe Donner Association Land Management Plan (Dudek 2016) or in the Lower Carpenter Valley Property Easement Documentation Report Nevada County, California (Dittes and Guardino 2017).
- Species that, in the professional opinion of H. T. Harvey & Associates ecologists, could occur in the watershed, even if the species was not recorded as potentially present in any of the sources listed above.

The species identified through these sources were combined, organized, and preliminarily assessed for their potential for occurrence in the watershed as follows:

Known to Occur: Species documented by CNDDB or NRIS as occurring in the watershed; this also includes species personally observed by H. T. Harvey & Associates ecologists, or species noted as being observed by qualified biologists in Dudek (2016) or in Dittes and Guardino (2017).

Could Occur: Species documented as occurring outside of, but in close proximity to (i.e., within 2 miles) the watershed, and the watershed provides suitable habitat for the species.

Less Likely to Occur: Species documented as occurring outside of, but in close proximity to (i.e., within 2 miles), the watershed, but suitable habitat is limited in the watershed. "Less likely to occur" was also used to describe species that are believed to have been extirpated from the watershed or regionally, even if background research indicated the species historically occurred in the watershed (e.g., on the basis of historic observations from museum specimens recorded in CNDDB), as well as species for which the watershed provides suitable habitat, but the species is not known regionally and/or the species is known to have a restricted distribution that does not include the watershed (typically, this applies to species of rare plants only).

Unlikely to Occur: Any species not meeting one of the criteria above.

For species not known to occur in the watershed, the potential for occurrence was determined based on the experience and knowledge of H. T. Harvey & Associates ecologists, information provided in Dittes and Guardino (2017), and occurrence record notes and observations recorded in CNDDB or Calflora (2020). **Appendix C** (plants) and **Appendix D** (fish and wildlife) summarize all species identified through initial background information research and database queries. A total of 46 species of rare plants were documented as possibly occurring in the watershed; 27 of these species are either known to occur in the watershed or could occur (see **Appendix C**). A total of 32 species of special-status fish and wildlife were documented as possibly occurring in the watershed; 23 of these species are either known to occur in the watershed or could occur (see **Appendix D**).

Results of CNDDB and NRIS records searches are depicted visually on **Figure 4-2** and **Figure 4-3**, and **Table 4-2** and **Table 4-3** summarize the ecology and local distribution of those species of plants, fish, and wildlife that are known to occur or that could occur in the watershed.

Table 4-2 Special-status Plants Known to Occur or that Could Occur in the Prosser Creek Watershed

Species	Status[1]	Communities, Soils, Elevational Range, and Blooming Period	Potential for Occurrence in Plan Area
Species that are Known to Occur in the Watershed			
Threetip sagebrush *Artemisia tripartita* ssp. *tripartite*	2B.3	Upper montane coniferous forest (openings). Rocky, volcanic. Elevations from 7,215–8,530 feet. Blooms in August.	**Known to Occur.** This species has been recorded in Euer Valley (Dudek 2016).
Austin's astragalus *Astragalus austiniae*	1B.3	Alpine boulder and rock field, subalpine coniferous forest. Rocky. Elevations from 8,005–9,745 feet. Blooms from (May)July–September.	**Known to Occur.** This species has been recorded at the upper edge of Coon Canyon on the ridge of Castle Peak (CNDDB 2020).
Upswept moonwort *Botrychium ascendens*	2B.3, TNF-S	Lower montane coniferous forest, meadows and seeps. Mesic. Elevations from 3,655–9,990 feet. Blooms from (June)July–August.	**Known to Occur.** This species has been recorded in Lower Prosser Creek (TNF 2020).
Scalloped moonwort *Botrychium crenulatum*	2B.2, TNF-S	Bogs and fens, lower montane coniferous forest, meadows and seeps, marshes and swamps (freshwater), upper montane coniferous forest. Elevations from 4,160–10,760 feet. Blooms from June–September.	**Known to Occur.** This species has been recorded in Lower Prosser Creek (TNF 2020).
Common moonwort *Botrychium lunaria*	2B.3, TNF-S	Meadows and seeps, subalpine coniferous forest, upper montane coniferous forest. Elevations from 6,495–11,155 feet. Blooms in August.	**Known to Occur.** This species has been recorded in Lower Prosser Creek (CNDDB 2020).
Davy's sedge *Carex davyi*	1B.3	Subalpine coniferous forest, upper montane coniferous forest. Elevations from 4,920–10,500 feet. Blooms from May–August.	**Known to Occur.** This species has been recorded in Euer Valley (Dudek 2016).
Mud sedge *Carex limosa*	2B.2	Bogs and fens, lower montane coniferous forest, meadows and seeps, marshes and swamps, upper montane coniferous forest. Elevations from 3,935–8,860 feet. Blooms from June–August.	**Known to Occur.** This species has been recorded in Lower Carpenter Valley (Buck-Diaz and others, 2016).
English sundew *Drosera anglica*	2B.3	Bogs and fens, meadows and seeps (mesic). Elevations from 4,265–7,400 feet. Blooms from June–September.	**Known to Occur.** This species has been recorded in Lower Carpenter Valley (Buck-Diaz and others, 2016).

Species	Status[1]	Communities, Soils, Elevational Range, and Blooming Period	Potential for Occurrence in Plan Area
Starved daisy *Erigeron miser*	1B.3, TNF-S	Upper montane coniferous forest (rocky). Elevations from 6,035–8,595 feet. Blooms from June–October.	**Known to Occur.** This species has been recorded in the North Fork upper watershed (USFS) and at the upper edge of Coon Canyon (summit of Castle Peak) (CNDDB 2020).
Donner Pass buckwheat *Eriogonum umbellatum var. torreyanum*	1B.2, TNF-S	Meadows and seeps, upper montane coniferous forest. Volcanic, rocky. Elevations from 6,085–8,595 feet. Blooms from July–September.	**Known to Occur.** This species has been recorded in the South Fork upper watershed (TNF 2020).
Slender cottongrass *Eriophorum gracile*	4.3	Bogs and fens, meadows and seeps, upper montane coniferous forest. Acidic. Elevations from 4,195–9,515 feet. Blooms from May–September.	**Known to Occur.** This species has been recorded in Lower Carpenter Valley (Buck-Diaz and others, 2016, Dittes & Guardino 2017).
Plumas ivesia *Ivesia sericoleuca*	1B.2, TNF-S	Great Basin scrub, lower montane coniferous forest, meadows and seeps, vernal pools. Vernally mesic, usually volcanic. Elevations from 4,295–7,220 feet. Blooms from May–October.	**Known to Occur.** This species has been recorded in Hobart Mills (TNF 2020, CNDDB 2020).
Long-petaled lewisia *Lewisia longipetala*	1B.3, TNF-S	Alpine boulder and rock field, subalpine coniferous forest (mesic, rocky). Granitic. Elevations from 8,200–9,595 feet. Blooms from July–August(September).	**Known to Occur.** This species has been recorded in the North Fork upper watershed (USFS) and at the upper edge of Coon Canyon (Castle Peak summit) (CNDDB 2020).
Three-ranked hump moss (moss) *Meesia triquetra*	4.2	Bogs and fens, meadows and seeps, subalpine coniferous forest, upper montane coniferous forest (mesic). Soil. Elevations from 4,265–9,690 feet. Blooms in July.	**Known to Occur.** This species has been recorded in Lower Carpenter Valley (Buck-Diaz and others, 2016).
Broad-nerved hump moss (moss) *Meesia uliginosa*	2B.2, TNf-S	Bogs and fens, meadows and seeps, subalpine coniferous forest, upper montane coniferous forest. Damp soil. Elevations from 3,965–9,200 feet. Blooms in July and October.	**Known to Occur.** This species has been recorded in Lower Prosser Creek (TNF 2020).
Alder buckthorn *Rhamnus alnifolia*	2B.2	Lower montane coniferous forest, meadows and seeps, riparian scrub, upper montane coniferous forest. Elevations from 4,490–6,990 feet. Blooms from May–July.	**Known to Occur.** This species has been recorded in Lower Carpenter Valley (Dittes & Guardino 2017).

Species	Status[1]	Communities, Soils, Elevational Range, and Blooming Period	Potential for Occurrence in Plan Area
Lesser bladderwort *Utricularia minor*	4.2	Bogs and fens, marshes and swamps (assorted shallow freshwater). Calcium rich water. Elevations from 2,625–9,515 feet. Blooms from (May–June)July–August.	**Known to Occur.** This species has been recorded in Lower Carpenter Valley (Buck-Diaz and others, 2016, Dittes & Guardino 2017).
Species that Could Occur in the Watershed			
Fell-fields claytonia *Claytonia megarhiza*	2B.3	Alpine boulder and rock field, subalpine coniferous forest (rocky or gravelly). In crevices between rocks. Elevations from 8,530–11,590 feet. Blooms from July–September.	**Could Occur**. The nearest CNDDB record is located approximately 2 miles outside the watershed on Mount Lola, north of the North Fork upper watershed (CNDDB 2020). Suitable habitat occurs in upper watershed.
Clustered-flower cryptantha *Cryptantha glomeriflora*	4.3	Great Basin scrub, meadows and seeps, subalpine coniferous forest, upper montane coniferous forest. Granitic or volcanic, sandy. Elevations from 5,905–12,305 feet. Blooms from June–September.	**Could Occur.** Several records exist near the watershed along the Middle Truckee River upstream of Prosser Creek and near Boca Reservoir. Suitable habitat occurs in lower watershed near Prosser Reservoir.
Subalpine fireweed *Epilobium howellii*	4.3	Meadows and seeps, subalpine coniferous forest. Mesic. Elevations from 6,560–10,235 feet. Blooms from July–August.	**Could Occur**. The closest CNDDB record is located approximately 2 miles northwest of the North Fork upper watershed (CNDDB 2020) and suitable habitat occurs in the upper watershed (e.g., upper Coon Canyon).
Hiroshi's flapwort (liverwort) *Nardia hiroshii*	2B.3	Meadows and seeps. Damp soil with granitic bedrock. Elevations around 7,200 feet.	**Could Occur**. The closest CNDDB record is located less than 1 mile outside the watershed, just south of I-80 southwest from Euer Valley (CNDDB 2020), and suitable habitat occurs in numerous locations throughout the watershed.
Rayless mountain ragwort *Packera indecora*	2B.2	Meadows and seeps (mesic). Elevations from 5,250–6,560 feet. Blooms from July–August.	**Could Occur.** Species occurs in Sagehen Creek Watershed, and suitable habitat occurs in the Watershed.
Water awlwort	4.3	Upper montane coniferous forest. Lake margins. Elevations	**Could Occur.** Numerous historic observations surrounding Donner Lake

Species	Status[1]	Communities, Soils, Elevational Range, and Blooming Period	Potential for Occurrence in Plan Area
Subularia aquatica ssp. *americana*		from 6,230–10,170 feet. Blooms from July–September.	(Calflora 2020), and suitable habitat occurs in the watershed.
Lemmon's clover *Trifolium lemmonii*	4.2	Great Basin scrub and lower montane coniferous forest. Elevations from 4,920–6,005 feet. Blooms from May–July.	**Could Occur.** Numerous records around Boca Reservoir, Dog Valley, Sattley, Loyalton, Antelope-Smithneck Wildlife Area. Suitable habitat exists in eastern watershed.

[1] Status Codes

California Department of Fish and Wildlife

SE: State Endangered

California Rare Plant Rank (CRPR)

1B = Plants rare, threatened, or endangered in California and elsewhere.

2B = Plants rare, threatened, or endangered in California, but more common elsewhere

3 = More information needed

4 = Plants of limited distribution — a watch list

Threat code extension

.1 = seriously threatened in California

.2 = fairly endangered in California

.3 = not very endangered in California

Region 5 United States Forest Service Tahoe National Forest (USFS 2013)

TNF-S = Designated Sensitive Species

Table 4-3 Special-status Fish and Wildlife Known to Occur or that Could Occur in the Prosser Creek Watershed

Species	Status[1]	Habitat	Potential for Occurrence
Species that are Known to Occur in the Watershed			
Northern goshawk *Accipiter gentilis*	CSSC, TNF-S	Mature coniferous forest with large diameter trees and high canopy closure. Frequently forages along meadow edges or in aspen/willow shrub communities.	**Known to Occur.** This species has been recorded in multiple locations within the watershed (CNDDB 2020, TNF 2020).
Golden eagle *Aquila chrysaetos*	CFP	Cliffs or trees on hillslopes, often overlooking grasslands. Frequently forages in open rangelands, grasslands, oak savannas, open woodlands, and chaparral.	**Known to Occur.** This species has been recorded in the North Fork upper watershed (CNDDB 2020, TNF 2020).
Willow flycatcher *Empidonax traillii*	SE, TNF-S	Medium to large meadows with extensive areas of montane wet meadow, emergent vegetation and large stands of willow or other riparian deciduous shrubs.	**Known to Occur.** This species has been recorded in Lower Carpenter Valley (TNF 2020).
Greater sandhill crane *Grus canadensis* ssp. *tabida*	ST, CFP, TNF-S	Shallow freshwater wetlands and open grasslands. Nests in montane meadows, open forest, and sagebrush.	**Known to Occur.** This species has been recorded in Lower Carpenter Valley (TNF 2020).
Bald eagle *Haliaeetus leucocephalus*	SE, CFP, TNF-S	Mountainous habitat near reservoirs, lakes, and rivers. Usually nests in mature and old-growth forest within 1 mile of water.	**Known to Occur.** TNF (2020) records near Prosser Creek Reservoir and in Euer Valley.
Yellow warbler	CSSC	Riparian vegetation along streams and in wet meadows,	**Known to Occur.** This species has been observed in North Fork's

Species	Status[1]	Habitat	Potential for Occurrence
Setophaga petechia		especially willow and alder thickets.	upper watershed (Dittes & Guardino 2017) and commonly breeds at the Sagehen Field Station (Morrison and others, 1985).
California spotted owl *Strix cccidentalis occidentalis*	CSSC, TNF-S	Coniferous forests that have a complex multi-layered structure, dense canopies, and large diameter trees.	**Known to Occur**. TNF (2020) records reported in Carpenter Valley.
Mountain whitefish *Prosopium williamsoni*	CSSC	Clear, cold streams with deeper pools and runs.	**Known to Occur.** This species has been recorded in Lower Prosser Creek below the reservoir, outside the watershed, and in the upper reaches of the South Fork in Euer Valley (CNDDB 2020). Likely to occur in other reaches of Prosser Creek throughout the watershed.
Southern long-toed salamander *Ambystoma macrodactylum*	CSSC	Flooded alpine meadows, permanent and temporary high mountain ponds and lakes up to 10,000 feet.	**Known to Occur.** This species has been recorded in the North Fork upper watershed (CNDDB 2020).
Sierra Nevada yellow-legged frog *Rana sierrae*	FE, ST, TNF-S	Streams, lakes, and ponds in montane riparian, lodgepole pine forest, subalpine conifer, and wet meadow habitats. Elevation range is 2,040–12,070 feet.	**Known to Occur.** This species is known to occur in the upper watershed in the Coon Canyon drainage (CNDDB 2020). Other CNDDB records, located at lower elevations in the watershed, are questionable.
Ring-tailed cat *Bassariscus astutu*	CFP	Occurs in various riparian habitats, and in brush stands of most forest and shrub habitats. Nests in rock crevices, tree	**Known to Occur.** Documented around Prosser Creek Reservoir (TNF 2020) and suitable habitat exists elsewhere in lower-

Species	Status[1]	Habitat	Potential for Occurrence
		hollows, woodrat nests, or under cliffs.	elevation, mixed forest-shrub-riparian areas of the watershed.
Species that Could Occur in the Watershed			
Vaux's swift *Chaetura vauxi*	CSSC	Nests and roosts in hollow trees found in mature conifer forest. Forages above streams and throughout a variety of other habitat types.	**Could Occur.** Suitable habitat present in the watershed. Noted as a possible breeder in the Sagehen Field Station (Morrison and others, 1985) and reported locally (Cornell Lab of Ornithology, 2020).
Norther harrier *Circus hudsonius*	CSSC	Forages in marshes, grasslands, meadows, and treeless habitats. Nests on ground in patches of dense, tall, vegetation.	**Could Occur.** Suitable breeding habitat widespread in watershed and noted as present in Cornell Lab of Ornithology, (2020).
Olive-sided flycatcher *Contopus cooperi*	CSSC	Conifer forests, burns, and clearings. Breeds in coniferous forest of higher mountains, around edges of open areas such as bogs, ponds, and clearings.	**Could Occur.** Suitable breeding habitat occurs throughout the watershed and noted as present in Cornell Lab of Ornithology (2020) and as an uncommon breeder at the Sagehen Field Station (Morrison and others, 1985).
Mountain sucker *Catostomus platyrhynchus*	CSSC	Cool, clear mountain streams with hiding cover and a mix of riffles, pools, and runs. Also large rivers, turbid streams, and lakes.	**Could Occur.** This species has been recorded in Lower Prosser Creek, below Prosser Creek Reservoir, and could occur in other reaches of Prosser Creek above the reservoir (CNDDB 2020).

Species	Status[1]	Habitat	Potential for Occurrence
Lahontan cutthroat trout *Oncorhynchus clarkii henshawi*	FT	Cool-water streams with riffle-runs, rocky substrates, and pools with vegetated and stable stream banks.	**Could Occur.** This species is stocked, as a sport fish, in Prosser Creek Reservoir and in Warren Lake. On the basis of these planted fish, the species may occasionally occur in Lower Prosser Creek or in the upper reaches of the North Fork below Warren Lake. Stream-resident Lahontan cutthroat historically occurred in the watershed, but are not thought to be present currently.
Pallid bat *Antrozous pallidus*	CSSC TNF-S	Grasslands, shrublands, woodlands, and forests from sea level up through mixed conifer forests. Roosts in tree cavities.	**Could Occur**. Species occurs regionally (D. Johnson pers. obs.) and suitable roosting habitat likely present in the watershed.
Sierra Nevada mountain beaver *Aplodontia rufa californica*	CSSC	Montane riparian habitat with deep, friable soils.	**Could Occur.** Extensive habitat available in riparian scrub in Euer and Carpenter Valley as well as other meadow habitats in the Watershed. A rare resident at the Saghen Field Station (Morrison and others, 1985), and reported from Hobart Mills and UGSG quad in CNDDB (2020).
Spotted bat *Euderma maculatum*	CSSC	Arid deserts, grasslands, and mixed conifer forests. Roosts in cliffs and rocky outcrops.	**Could Occur**. Suitable foraging and roosting habitat present in the watershed.
Western mastiff bat *Eumops perotis*	CSSC	Arid to semi-arid habitats including forests, woodlands, grasslands, urban areas. Typically roosts in rock crevices, cliffs or structures.	**Could Occur.** Suitable foraging and roosting habitat present in the watershed.

Species	Status[1]	Habitat	Potential for Occurrence
Sierra Nevada snowshoe hare *Lepus americanus tahoensis*	CSSC	Montane riparian scrub, mixed conifer, lodgepole pine forest, aspen, chaparral, montane meadow. Elevation range is 4,850–8,600 feet.	**Could Occur.** Extensive habitat available in aspen stands in mid-watershed and in riparian scrub in Euer and Carpenter Valley as well as other meadow habitats throughout the watershed.
Sierra marten *Martes caurina sierra*	TNF-S	Forest/meadow ecotones, rockslides and talus slopes, and riparian zones with thick cover.	**Could Occur**. Reported from Sagehen Field Station (CNDDB 2020), and other observations recorded regionally in CNDDB. Suitable habitat occurs in forested areas surrounding Carpenter and Euer Valley.
Fringed myotis *Myotis thysanodes*	TNF-S	Grasslands, sagebrush steppe, mixed deciduous and mixed conifer forest, and pinyon/juniper. Roosts in rock crevices, cliff edges, caves, mines, and sometimes tree cavities and built structures.	**Could occur.** Suitable foraging and roosting habitat occurs in the watershed.

[1] Status Codes

U.S. Fish and Wildlife Service

FE: Federal Endangered

FT: Federal Threatened

FC: Federal Candidate for Listing

California Department of Fish and Wildlife

SE: State Endangered

ST: State Threatened

CFP: California Fully Protected Species

CSSC: California Species of Special Concern

Region 5 United States Forest Service Tahoe National Forest (USFS 2013)

TNF-S = Designated Sensitive Species

4.15 Invasive Species

The Invasive Species category include species of plants, vertebrates, and invertebrates that may adversely affect aquatic ecosystems as well as species of terrestrial plants (i.e., weeds) considered to be capable of producing adverse economic or ecological effects. For the purposes of this watershed assessment, invasive plants are defined by inclusion on the California Invasive Plant Council's Inventory (Cal-IPC 2020a), and invasive animals are defined as species of concern listed by the Lake Tahoe Aquatic Invasive Species Management Plan (TRPA 2014). Based on a review of available data and literature (Dittes and Guardino 2017; Calflora 2020; Cal-IPC 2020a, 2020b; CDFA 2020; Nevada-Placer WMA 2018; USFS 2013), there are 26 species of invasive plants that are known or likely to occur in the watershed (**Table 4-4**), and dozens of additional species that are less likely to occur under current conditions but that could become established and more common within the watershed in the future (e.g., in response to climate change) (see **Appendix C**). In general, areas where disturbance occurs are at the highest risk for introduction or expansion of invasive plants (e.g., in developed areas, along roadways and recreational trails), and in other areas of previous or ongoing ground disturbance (e.g., areas disturbed by logging, areas burned in wildfires). Several species listed in **Table 4-4** are potential candidates for control, if not eradication, in the watershed because these species are highly invasive, have the potential to cause significant ecological impacts (e.g., alter wildfire frequency or severity, degrade wildlife habitat values, outcompete native plants), and are likely to be relatively limited in distribution within the watershed, making control or eradication a feasible management objective using tools such as hand pulling, mowing, or targeted herbicide application.

There are 20 invasive vertebrates and invertebrates of concern that are most likely to occur in the watershed: Asian clam (*Corbicula fluminea*), bluegill (*Lepomis macrochirus*), northern pike (*Esox lucius*), black crappie (*Pomoxis nigromaculatus*), brown bullhead (*Ameiurus nebulosus*), fathead minnow (*Pimephales promelas*), golden shiner (*Notemigonus crysoleucus*), green sunfish (*Lepomis cyanellus*), white crappie (*Pomoxis annulari*), bullfrog (*Rana catesbeiana*), goldfish (*Carassius auratus*), mysid shrimp (*Mysis relicta*), common carp (*Cyprinus carpio*), largemouth bass (*Micropterus salmoides*) and smallmouth bass, New Zealand mudsnail (*Potamopyrgus antipodarum*), quagga mussel (*Dreissena rostriformis*), signal crayfish (*Pacifastacus leniusculus*), spiny water flea (*Bythotrephes longimanus*), and zebra mussel (*Dreissena polymorpha*) (TRPA 2014). Smallmouth bass and signal crayfish (Caldwell and Chandra 2012) are known to occur in Prosser Creek Reservoir; smallmouth bass also potentially occur in the lower reaches of Prosser Creek above the reservoir, at least on occasion, and signal crayfish likely are distributed throughout lower elevation reaches of Prosser Creek, extending into Euer Valley and Carpenter Valley (crayfish were observed in the South Fork of Prosser Creek in Euer Valley by H. T. Harvey & Associates ecologists in 2020). Additionally, New Zealand mud snails are known to occur in the main stem Middle Truckee River, just outside the watershed boundary and could potentially occur in Prosser Creek below or above Prosser Creek Reservoir. Other invasive animals are not known to occur in the watershed; however, only Asian clam, quagga mussel, and zebra mussel have been the focus of prior survey efforts (Caldwell and Chandra, 2012), so it is possible that other species could potentially occur in the watershed, or be introduced into the watershed (particularly to Prosser Creek Reservoir, which provides potentially suitable habitat for almost all species listed above) in the future.

Table 4-4 Invasive Plants Present or Likely to Occur in the Prosser Creek Watershed

Species	Invasive Status[1]	Potential for Occurrence in Watershed	Management Opportunity[2]	Management Notes
Species Present in the Watershed				
Russian knapweed *Acroptilon repens*	Cal-IPC: Moderate CDFA: B NPWMA: 1b	**Present**. This species has been recorded in Euer Valley (Dudek 2016) and Hobart Mills (Calflora 2020).	Containment	High priority for eradication in the watershed.
Creeping bentgrass *Agrostis stolonifera*	Cal-IPC: Limited CDFA: None NPWMA: None	**Present**. This species has been recorded in Lower Carpenter Valley (Dittes & Guardino 2017).	Containment	Widely naturalized nonnative, eradication potentially infeasible; spot control only where negative impacts are documented and control is possible.
Cheatgrass *Bromus tectorum*	Cal-IPC: High CDFA: C NPWMA: None	**Present**. This species has been recorded in Lower Carpenter Valley (Dittes & Guardino 2017). Likely present elsewhere, particularly in lower elevation portions of the eastern watershed	Containment	Widely naturalized nonnative, eradication potentially infeasible; spot control only where negative impacts are documented and control is possible.
Musk thistle *Carduus nutans*	Cal-IPC: Moderate CDFA: A NPWMA: 2	**Present**. This species has been recorded in Hobart Mills and Lower Prosser Creek (USFS), and Euer Valley (Dudek 2016).	Containment	High priority for eradication in the watershed.

Species	Invasive Status[1]	Potential for Occurrence in Watershed	Management Opportunity[2]	Management Notes
Diffuse knapweed *Centaurea diffusa*	Cal-IPC: Moderate CDFA: A NPWMA: 1b	**Present**. This species has been recorded in Euer Valley (Dudek 2016). There are also multiple records from the Boca vicinity just east of the watershed (Calflora 2020).	Containment	High priority for eradication in the watershed.
Yellow starthistle *Centaurea solstitialis*	Cal-IPC: High CDFA: C NPWMA: 1b	**Present**. Recorded in Hobart Mills. There are also several records immediately south of the watershed in Tahoe Donner (Calflora 2020).	Containment	Although extremely widespread elsewhere, this species' distribution is likely limited in the watershed, making it a possible candidate for eradication.
Spotted knapweed *Centaurea stoebe* ssp. *micranthos*	Cal-IPC: High CDFA: A NPWMA: 1b	**Present**. This species has been recorded in Euer Valley (Dudek 2016). There are also several records in the Tahoe Donner and Truckee area (Calflora 2020).	Containment	High priority for eradication in the watershed.
Canada thistle *Cirsium arvense*	Cal-IPC: Moderate CDFA: B NPWMA: 1b	**Present**. This species has been recorded in Euer Valley (Dudek 2016). There are also records just outside the watershed near Hobart Mills (Calflora 2020).	Containment	High priority for eradication in the watershed.
Bull thistle *Cirsium vulgare*	Cal-IPC: Moderate CDFA: C NPWMA: 2	**Present**. This species has been recorded in Euer Valley (Dudek 2016). There are multiple records within 5 miles to the north and south of the watershed (Calflora 2020).	Containment	High priority for eradication in the watershed.
Field bindweed *Convolvulus arvensis*	Cal-IPC: None CDFA: C NPWMA: None	**Present**. This species has been recorded in Euer Valley (Dudek 2016) and Lower Carpenter Valley (Dittes & Guardino 2017).	NA	Unlikely to cause significant impacts in the watershed and distribution likely limited. Potentially a lower priority for management.

Species	Invasive Status[1]	Potential for Occurrence in Watershed	Management Opportunity[2]	Management Notes
Scotch broom *Cytisus scoparius*	Cal-IPC: High CDFA: C NPWMA: 1b	**Present**. This species has been recorded in Hobart Mills. There are also several records along the I-80 corridor within the watershed vicinity (Calflora 2020).	Containment	Unlikely to be widespread in the watershed. Spot control recommended where feasible.
Klamathweed *Hypericum perforatum*	Cal-IPC: Moderate CDFA: C NPWMA: 2	**Present**. This species has been recorded in Euer Valley (Dudek 2016) and Lower Carpenter Valley (Dittes & Guardino 2017).	Containment	Species likely limited to scattered, relatively small infestations. Lower priority for management. Spot control only where negative impacts are documented and control is possible.
Hairy whitetop *Lepidium appelianum*	Cal-IPC: Limited CDFA: B NPWMA: 1b	**Present**. This species has been recorded in Euer Valley (Dudek 2016). There are also multiple records within 5 miles of the watershed to the south and east (Calflora 2020).	Containment	High priority for eradication in the watershed. Difficult to manage once established.
Lens-podded hoary cress and whitetop *Lepidium chalepense* and *Lepidium draba*	Cal-IPC: Mod-Alert CDFA: B NPWMA: 1b	**Present**. *Lepidium draba* has been recorded in Euer Valley (Dudek 2016). Both species have also been recorded along the I-80 corridor south of the watershed (Calflora 2020).	Containment	High priority for eradication in the watershed. Difficult to manage once established.
Perennial pepperweed *Lepidium latifolium*	Cal-IPC: High CDFA: B NPWMA: 2	**Present**. This species has been recorded in Euer Valley (Dudek 2016). There are also several records in Tahoe Donner and along the I-80 corridor (Calflora 2020).	Containment	High priority for eradication in the watershed. Could potentially colonize meadows and streamside habitats and difficult to control once established.
Scotch thistle *Onopordum acanthium*	Cal-IPC: High CDFA: A NPWMA: 1b	**Present**. This species has been recorded in Euer Valley (Dudek 2016). There are also two records immediately south of	Containment	High priority for eradication in the watershed.

Species	Invasive Status[1]	Potential for Occurrence in Watershed	Management Opportunity[2]	Management Notes
		the Watershed at Tahoe Donner, and several additional records within 5 miles to the south and east of the watershed (Calflora 2020).		
Timothy grass *Phleum pratense*	Cal-IPC: None CDFA: None NPWMA: None	**Present**. This species has been recorded in Lower Carpenter Valley (Dittes & Guardino 2017). There are also two records approximately 2 miles north of the watershed (Calflora 2020).	NA	Widely naturalized nonnative species. Control likely infeasible and not a high priority for management in the watershed.
Kentucky bluegrass *Poa pratensis*	Cal-IPC: Limited CDFA: None NPWMA: None	**Present**. This species has been recorded in Lower Carpenter Valley (Dittes & Guardino 2017). There is also one record approximately 2 miles south of the watershed in the Norden vicinity (Calflora 2020).	Containment	Widely naturalized nonnative species. Control likely infeasible and not a high priority for management in the watershed.
Sheep sorrel *Rumex acetosella*	Cal-IPC: Moderate CDFA: None NPWMA: None	**Present**. This species has been recorded in Lower Carpenter Valley (Dittes & Guardino 2017). There are also records from within approximately 2 miles north and south of the watershed (Calflora 2020).	Containment	Widely naturalized nonnative species. Control likely infeasible and not a high priority for management in the watershed.
Russian thistle *Salsola tragus*	Cal-IPC: Limited CDFA: C NPWMA: 2	**Present**. This species has been recorded in Euer Valley (Dudek 2016). There are also multiple records within 4 miles south of the watershed in the Truckee vicinity (Calflora 2020).	Containment	Widely naturalized nonnative species. Populations tend to be cyclical, generally doing better in drought years when competition from other plants is reduced, and becoming less common once other vegetation is established. Spot control only where negative impacts are

Species	Invasive Status[1]	Potential for Occurrence in Watershed	Management Opportunity[2]	Management Notes
				documented and control is necessary.
Species Likely to Occur in the Watershed				
Houndstongue *Cynoglossum officinale*	Cal-IPC: Moderate CDFA: None NPWMA: None	**Likely.** Recorded approximately 1 mile north of the Watershed in Tahoe National Forest, and approximately 2 miles south of the watershed near Donner Lake (Calflora 2020). Suitable habitat occurs in the watershed.	Containment	Generally limited to open, disturbed areas. Spot control as necessary to prevent spread.
Orchard grass *Dactylis glomerata*	Cal-IPC: Limited CDFA: None NPWMA: None	**Likely.** Recorded approximately 2 miles south of the Watershed in the Norden vicinity (Calflora 2020). Suitable habitat occurs in the watershed.	Containment	Widely naturalized nonnative species. Control likely infeasible and not a high priority for management in the watershed.
Redstem filaree *Erodium cicutarium*	Cal-IPC: Limited CDFA: None NPWMA: None	**Likely.** Two records within 5 miles of the watershed's east side (Calflora 2020). Suitable habitat occurs in the watershed, and this species is extremely widespread and common.	Containment	Widely naturalized nonnative species. Control likely infeasible and not a high priority for management in the watershed.
Curly dock *Rumex crispus*	Cal-IPC: Limited CDFA: None NPWMA: None	**Likely.** One record approximately 2 miles south of the watershed in the Norden vicinity (Calflora 2020). This species has also been recorded in the Hobart Mills and Independence Lake 7.5-minute USGS quadrangles (Cal-IPC	Containment	Widely naturalized nonnative species. Control likely infeasible and not a high priority for management in the watershed.

Species	Invasive Status[1]	Potential for Occurrence in Watershed	Management Opportunity[2]	Management Notes
		2020). Suitable habitat exists in disturbed areas in the watershed. This species is extremely common and widespread.		
Common mullein *Verbascum thapsus*	Cal-IPC: Limited CDFA: None NPWMA: None	**Likely.** Multiple records approximately 1 mile north and south of the watershed, in Sagehen Creek and Tahoe Donner, respectively. There are additional records along the I-80 corridor south of the watershed (Calflora 2020). Suitable habitat exists along roadsides and streambanks, and in disturbed areas in the watershed. This species is extremely common and widely distributed.	Containment	Widely naturalized nonnative species. Spot control of denser or larger populations recommended (e.g., along creeks or roadsides) to discourage spread.

Source: Calflora 2020; Cal-IPC 2020a, 2020b; CDFA 2020; Nevada-Placer WMA 2018; USFS 2009.

Notes: Cal-IPC = California Invasive Plant Council; CDFA = California Department of Food and Agriculture; NPWMA = Nevada-Placer Weed Management Area; USGS = U.S. Geological Survey.

[1] Cal-IPC ratings:

High – These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.

Moderate – These species have substantial and apparent—but generally not severe—ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.

Limited – These species may be invasive, but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.

None – Not included on the Cal-IPC Inventory of invasive plants.

CDFA ratings:

A – A pest of known economic or environmental detriment and is either not known to be established in California or it is present in a limited distribution that allows for the possibility of eradication or successful containment. A-rated pests are prohibited from entering the state because, by virtue of their rating, they have been placed on the of Plant Health and Pest Prevention Services Director’s list of organisms “detrimental to agriculture” in accordance with the FAC Sections 5261 and 6461. The only exception is for organisms accompanied by an approved CDFA or USDA live organism permit for contained exhibit or research purposes. If found entering or established in the state, A-rated pests are subject to state (or commissioner when acting as a state agent) enforced action involving eradication, quarantine regulation, containment, rejection, or other holding action.

B – A pest of known economic or environmental detriment and, if present in California, it is of limited distribution. B-rated pests are eligible to enter the state if the receiving county has agreed to accept them. If found in the state, they are subject to state endorsed holding action and eradication only to provide for containment, as when found in a nursery. At the discretion of the individual county agricultural commissioner they are subject to eradication, containment, suppression, control, or other holding action.

C – A pest of known economic or environmental detriment and, if present in California, it is usually widespread. C-rated organisms are eligible to enter the state as long as the commodities with which they are associated conform to pest cleanliness standards when found in nursery stock shipments. If found in the state, they are subject to regulations designed to retard spread or to suppress at the discretion of the individual county agricultural commissioner. There is no state enforced action other than providing for pest cleanliness.

None – Not included on the CDFA list of noxious weeds.

NPWMA categories:

1b – Watch for, report, and eradicate immediately. Present in small populations.

2 – Encourage the management/control of populations to prevent further spread. Isolated populations will be targeted for eradication.

None – Not included in the NPWMA priority invasive plant list.

[2] CalWeedMapper Management Opportunity ratings:

Surveillance – Species not known to exist in the region, but is found within 50 miles of the region.

Eradication – Species exists only in single, isolated quads in the region.

Containment – Species exists in the region at levels higher than surveillance and eradication.

NA – Species was not returned in the Management Opportunities report, indicating it is either not included on the Cal-IPC inventory of invasive plants, or is not known to occur within 50 miles of the region.

5 LIMITATIONS

As stated in the introduction of this report, the primary objective of this report is to describe the watershed physical and biological attributes and histories of land-uses and occupation in the Prosser Creek project watershed based on readily available information at the time of this writing. Compilation of information for this report excludes any observations within the watershed; those findings are included in subsequent chapters under this assessment.

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APPENDICES

1 INTRODUCTION

This report is the second of three chapters of the Prosser Creek Watershed Assessment:

1. Attributes Report (Hastings and others, 2020)
2. Existing Conditions, Disturbance Inventory and Preservation Recommendations
3. Restoration Opportunities and Management Actions (expected summer 2021)

In this report, we describe existing conditions in the watershed, as based on field reconnaissance carried out during 2020, analysis of high-resolution topographic data, and hydrologic modeling. These analyses are presented against the understanding of historical and current land-uses, past episodic events, and watershed processes, as presented in Part 1- the Watershed Attributes Report (Hastings and others, 2020). We also identify specific disturbances and inventory both functioning and impaired areas. When compared side-by-side, watershed impairments and healthy watershed functioning will provide a clear vision of restoration goals that are appropriate to varying landscapes in the watershed. This provides landowners and land managers with an overview of watershed functions, both in terms of where those functions are impaired, and where they are not. Taken together with the Watershed Attributes (Part 1), this report provides the necessary background and context for development of a comprehensive and watershed-based approach to restoring impaired areas and protecting watershed functions, as will be described in Part 3 of the Watershed Assessment: Restoration Opportunities and Management Recommendations.

This report includes:

- Section 2.0: A description of methods and analyses used to complete this assessment
- Section 3.0: Findings from a field-based watershed reconnaissance
- Section 4.0: A summary of identified problems based on land use history and themes described in the Watershed Attributes Report (Part 1)
- Section 5.0: Identification of functional areas that should be protected and that also can be used as reference conditions for future restoration or management monitoring.

Four appendices are included:

F) Representative photographs of each reach designation for Prosser Creek and tributaries described in Section 3.0;

G) Flow accumulation analysis map booklet showing both disturbance and functional areas described in Sections 4.0 and 5.0;

H) Evaluation of the potential for LCT and SNYF reintroduction and analysis of habitat availability; and

I) Documentation of our investigations and analyses.

From this information, we will work with landowners and land managers to identify actions that are sensible under existing conditions or describe where additional more detailed assessment or study is warranted.

2 METHODS FOR EVALUATING EXISTING CONDITIONS, DISTURBANCES, AND PRESERVATION RECOMMENDATIONS

2.1 Review of Historical Aerial Imagery to Detect Change

Balance compiled historical aerial imagery of the project watershed from U.S. Forest Service (USFS) and on-line sources from 1939 to present. Key images were geo-rectified and used to compare conditions and identify changes over time. We examined changes such as channel locations, widths, and sinuosity; landslides; roads; ditches; and forest cover. We also evaluated aerials that bracketed major flood events to understand if and how flood events "reset" riparian and channel conditions. Historical aerial photographs used for our analysis are listed in **Table 2-1**. Throughout this report, we provide examples of change using aerial imagery.

2.2 Hydrology and Hydrologic Analysis

In the absence of streamflow records within Prosser Creek Project Watershed, Balance: (a) conducted manual flow measurements during near-peak snowmelt runoff in 2020, (b) estimated common recurrence flood flows using unit-discharge from a 20-year period of pre-dam gaging data from USGS 10340500 (Prosser Creek below Prosser Creek Dam), and regional regression equations developed by Gotvald and others (2012); and (c) used the U.S. Army Corps of Engineers (USACE) Hydrologic Modeling System (HEC-HMS) software (version 4.7) to estimate the 10-year (Q10) and 100-year (Q100) peak design flows per the hydrologic design criteria for storm drainage within the Nevada County Road Standards (Nevada County, 2020).

Manual flow measurements were compared to same-day flow values recorded at regional gages with long periods of record to estimate the recurrent probability of the 2020 snowmelt runoff peak flow. Balance evaluated these recurrence floods from nearby gages: Sagehen Creek (USGS 10343500) and Ward Creek (USGS 10336676).

2.3 Flow Accumulation Analysis

Balance developed a digital elevation model (DEM) of the watershed using Light Detection and Ranging (LiDAR) bare-earth imagery (USFS, 2014)[1]. The DEM was processed in GIS using the flow accumulation tool to generate flow lines draining areas

[1] During this assessment, 2018 LiDAR imagery was made available to the public (USGS, 2020); however, we had already started our analysis using the 2014 LiDAR.

accumulating runoff from 1 acre and greater.[2] The analysis provides an indication of where flow paths in the watershed may have been manipulated by either anthropogenic or natural features and disturbances. For instance, flow captured and/or concentrated by cross-slope roads, abandoned railroad grades, drainage ditches, and/or logging skid trails.

2.4 Road and Trail Assessment

Balance used the flow accumulation analysis (described above) to identify areas where road capture of streams may be occurring. We then conducted limited field assessments of selected road areas to verify the analysis and observe degree of natural flow path alterations. Examples were photographed and identified with known coordinates. The lengths and density of roads and trails in the watershed may require a more focused assessment or effort, beyond the scope of this assessment.

2.5 Stream Reconnaissance

In 2020, Balance and HT Harvey experts conducted reconnaissance of major streams, meadows, and wetlands within the watershed that may support sensitive habitats or may be impacted by historical land-uses. Due to the size of the project area, duration of snow cover at higher elevations, and remoteness of some areas, reconnaissance was completed in selected areas. Reconnaissance of private property was excluded.

The field reconnaissance was carried out iteratively with the desktop analyses described above and allowed us to classify Prosser Creek and its tributaries at a reach scale. Reach classifications were initially made using methods outlined by Fryirs and Brierley (2013), and according to:

- geomorphic structure and function,
- channel planform and geometry,
- flow regime,
- sediment transport regime,
- floodplain character, and
- vegetation and groundwater-surface water exchange, as consistent with methods described

[2] Analysis completed for TDA by Shaw and Kulchawik (2015) indicates that accumulated watershed areas of approximately 1 to 1.5 acres are sufficient to generate channel-forming runoff in sloping portions of the watershed with soils derived from volcanic formations.

Where channel reconnaissance was conducted, Balance observed and documented the following physical conditions:

- channel planform,
- channel geometry,
- bed morphology,
- hydrologic functionality,
- bed and bank substrate (existing and relic channels in meadows), and
- presence or absence of beaver activity.

Stream reaches were also described based on their channel condition and post-disturbance channel evolution as described by Thorne and Cluer (2014) to better identify reaches into categories of functional, in recovery, or degraded.

Finally, Balance captured high-resolution low-altitude aerial imagery of Lower Carpenter Valley and Lower Euer Valley during near-peak snowmelt runoff to evaluate existing channel-meadow conditions under higher flow conditions.

2.6 Channel-Floodplain Function

In selected reaches, Balance evaluated the degree of impaired channel-floodplain functions using field metrics, estimates of flood magnitude for selected flood recurrences, and a normal-depth model (NOAA, 2020). The results provide an estimate of whether channel-floodplain connectivity exists and an estimate of the overbank flow recurrence.

2.7 Habitat Assessments and Feasibility of Sensitive Species Reintroduction

HT Harvey biologists conducted habitat assessments for Lahontan Cutthroat Trout (LCT) and Sierra Nevada Yellow Legged Frog (SNYLF) in selected areas of the watershed.

LCT reintroduction feasibility evaluations relied on field identification of highly suitable habitat for critical life stages, specifically adult spawning habitat and rearing habitat for juvenile LCT. Reaches were limited to NF Prosser Creek in Lower Carpenter Valley and SF Prosser Creek in Lower Euer Valley based on metrics of channel slope, stream velocities, and land ownership.

Separately, HT Harvey biologists identified waterbodies that might have hydrologic regimes suitable for SNYLF life histories and examined their permanence across the watershed employing a review of historical aerial imagery. Aquatic habitat types potentially containing still or slow-moving water were considered, including lakes, reservoirs, ponds, tarns, meadow pools, oxbows, beaver-constructed canals, side channels and backwaters of streams and creeks. Site permanence was assessed using review of historical aerial imagery for two focal, late-summer time points, 28 August 2012, a representative dry year, and 11 August 2017, a representative wet year.

3 FINDINGS

In this section, we provide a description of watershed hydrology based on direct measurements, observations, regional regression, gaging, and hydrologic modeling results. We then provide a reach-by-reach narrative of our observations in the watershed. A watershed map showing reach designations and land ownership is provided in **Figure 3-1**.

3.1 Hydrology

We observed Prosser Creek and its tributaries during a below average precipitation year. Water Year 2020 (WY2020) snowpack was roughly 67 percent of long-term median in the Truckee River Basin (NRCS, 2020). Peak snowmelt runoff was very low, approximately a 1-year flow according to long-term streamflow gages operated in the region. Summer precipitation was also well below monthly long-term averages. The most recent significant flood event occurred in January 2017 and was estimated from regional stream gages to have a 10- to 50-year recurrence. One of the most significant flow events on record occurred in 1997.

Common recurrence floods for three different locations of the project watershed are listed in **Table 3-1**. These values were derived from pre-dam gaging data, regional regressions, and direct measurements. The range in flows are those that are actually more likely to occur and should be considered in restoration design (e.g., bankfull flows, floodplain protection).

Table 3-1. Summary of estimated and modeled common flood recurrences Prosser Creek and major tributaries, Nevada County, California

	Prosser Creek at Reservoir Spillway Elevation	North Fork Prosser Creek	South Fork Prosser Creek
Watershed Area (sq. mi)	*29.3*	*13.3*	*8.4*
	(cfs)	*(cfs)*	*(cfs)*
1-year flood	75-140	34-65	21-40
2-year flood	345-416	155-266	98-179
5-year flood	728-834	327-534	206-360
10-year flood	1,125-1,240	505-794	319-535
25-year flood	1,800-1,853	833-1,160	526-778
50-year flood	2,440-2,600	1,172-1,560	741-1,050
100-year flood	3,000-3,598	1,617-1,930	1,021-1,300

Notes:
1. Values or range of values for recurrence floods are estimated using: (1) unit-discharge and watershed scaling from 20-year period of pre-dam gaging data at USGS 10340500 and a Log-Pearson Type III distribution; and (2) regional regression equations developed by Gotvald and others (2012); (3) HEC-HMS model using Nevada County engineering standards (10-year and 100-year floods only); and (4) manual streamflow measurements with comparison to same day streamflow and flood recurrence at nearby gages.

Hydrologic modeling results supplement **Table 3-1** and provide a tangible set of data to support future phases of work, including regulatory review. Our model results outline the estimated 10-year and 100-year flood event at 17 locations across 3 sub-basins in the Prosser Creek Watershed for future planning and design purposes (**Table 3-2**). All subbasin drainage areas and flood magnitudes for 17 different locations are shown in **Figure 3-2.** These values may differ from those in **Table 3-1**, because these are conservative values based on County Standards and used for sizing of engineering structures or regulatory conditions (e.g., FEMA floodplain).

The modeled 10-year peak flow is approximately 6,360 cfs, and the 100-year modeled flood event is approximately 10,840 cfs for Prosser Creek at the most downstream location. This flood magnitude occurs approximately 11 hours after the start of the 24-hour, 100-year precipitation event.

Table 3-2 Hydrologic Model Results, Prosser Creek, Nevada County, California

			10-year Modeled Flood	100-year Modeled Flood
Junction[1]	Drainage Area	Total Area[2]	Peak Discharge	Peak Discharge
	sq. mi.	percent	cfs	cfs
J-NF-1	1.82	6.2	1,176	1,752
J-NF-2	4.84	16.5	2,991	4,443
J-NF-3	6.09	20.8	3,433	5,177
J-NF-4	7.52	25.7	3,676	5,612
J-NF-5	9.07	31.0	3,994	6,177
J-NF-6	10.20	34.8	4,181	6,523
J-NF-7	12.35	42.2	3,969	6,445
J-SF-1	2.28	7.8	540	929
J-SF-2	3.70	12.7	1,035	1,741
J-SF-3	4.77	16.3	1,172	2,024
J-SF-4	5.49	18.8	1,257	2,190
J-SF-5	6.32	21.6	1,338	2,355
J-SF-6	7.74	26.5	1,543	2,755
J-M-1	21.56	73.7	5,657	9,429
J-M-2	25.60	87.5	5,975	10,128
J-M-3	28.29	96.7	6,272	10,683
Sink	29.3	100.0	6,360	10,842

Notes:

1. See map - Figure 3-1 for junction locations
2. Areas in percent of project watershed as measured at Prosser Creek Reservoir (29.3 sq. mi.) - excludes Hobart Mills Tributary

3.2 Existing Conditions Based on Reconnaissance

Reach designations are mapped in **Figure 3-1**. **Table 3-3** provides information about each reach and subwatershed including: (a) reach-length, (b) elevation, (c) slope (d) land ownership, (e) geomorphic/geologic setting, (f) channel planform, (g) channel morphology, and (h) channel evolution based on Cluer and Thorne (2013).

In this section, we briefly describe and illustrate existing conditions for 37 designated reaches in alphabetical order (A thru Z), including 14 sub-reaches (e.g., D1, D2, D3), classified according to similarity of landforms or geomorphic conditions, but differentiated alluvial reaches primarily by channel evolution per Cluer and Thorne (2013). Reaches are described from downstream to upstream and grouped by subwatershed. Representative photos of each reach are provided in **Appendix F**. Reaches located on private property and in remote portions of the watershed were not accessed or photographed; instead, the most recent aerial photographs (2018) available from Google Earth are included to provide a general overview and context for the upstream and downstream reach descriptions. The Existing Conditions map (**Figure 3-1**), **Table 3-3**, **Appendix F**, and the narrative below provide a basis for the disturbance inventory and preservations recommendations outlined in Sections 3.0 and 4.0 of this report.

3.2.1 Prosser Creek Reservoir and Shorelines

Prosser Creek Reservoir is a year-round recreational area, as designated by the Tahoe National Forest, Truckee Ranger District. The shoreline elevation changes seasonally based on reservoir operations, and from year to year depending on annual runoff from Prosser Creek and other tributaries. At higher water levels during the spring and summer, recreation is limited to two developed campgrounds (Prosser Lakeside and Prosser Family Campground) in the forest fringe while providing abundant opportunities for boating, swimming, and fishing. At lower water levels during late summer and fall, the public can access the shoreline using both established and non-established OHV trails. While dispersed camping is prohibited, frequent camping within the inundation zone of the reservoir was observed. Winter recreation includes snowmobiling, snowshoeing and ice-skating. Representative conditions of the reservoir shoreline in a dry year are provided in **Appendix F1**.

This assessment did not evaluate the disturbances associated with recreational or historical uses along the reservoir shoreline since the project watershed does not include the entire reservoir. The Tahoe National Forest manages lands surrounding the reservoir for recreation and the U.S. Bureau of Reclamation operates the reservoir and Dam.

3.2.2 Lower Prosser Creek Confluence with Prosser Creek Reservoir

Reach A

Reach A designates the downstream-most 1.2 miles of Prosser Creek above Prosser Reservoir. This reach drains a 29.6 square mile watershed and is formed in glacial outwash and alluvium. The channel planform is braided with multiple active channels during higher flows. Channel slopes are slightly less than 1 percent with pool-riffle morphology. This reach is an active sediment and wood transport reach with depositional floodplain environments. Northeastern aspects of the Prosser Hill OHV area and the former Nevada & California Lumber Company Mill drain to Reach A (Hastings and others, 2020). The reach is bisected by State Route 89 (SR89).

Reach A is subdivided into reaches A1 and A2. Reach A1 is a sinuous, braided channel with an alignment that crosses, and appears to be influenced by the Polaris Fault. Reach A2 was straightened in the 1960s to facilitate the SR89 bridge construction and crossing. Observations of over steepened riffles and rock-slope bank protection suggest that Reach A2 is actively incising and widening—a common natural response to channel straightening. Reach A representative existing conditions are illustrated in **Appendix F2**.

3.2.3 Prosser Creek Canyon including Sagehen Hills and Prosser Hill

Reach B

Reach B is a canyon-confined 3.95-mile reach defined by a 1.3 percent channel slope and draining a 27.6 square mile watershed. Reach B expresses pool-riffle morphology with boulder-dominated steps, riffles and bars and abundant loading of instream wood. This reach is an active sediment and wood transport reach, draining the adjacent Sagehen Hills and northern aspects of Prosser Hill--uplands underlain by volcanic terrains and glacial drift. Several mapped springs augment baseflow in this reach. There is one existing road crossing with evidence of historical grade crossings and multiple grade crossings over incoming tributaries. The entire reach and uplands were severely burned in the 1960 Donner Ridge Fire. Reach B representative existing conditions are illustrated in **Appendix F3**.

3.2.4 North Fork Prosser Creek

The North Fork of Prosser Creek drains a 13.3 square mile subwatershed and includes Upper and Lower Carpenter Valley, Devils Oven Lake, Warren Lake, and Coon Canyon. We have classified the tributary into 15 reaches, Reaches C-K, including reaches D1-D7.

Reach C

Reach C is a canyon-confined 1.1-mile reach with a nearly 2.0 percent slope. Boulders and instream wood force relatively deep pools and riffles with some sections exhibiting step-pool morphology. This reach was burned over by the 1960 Donner Ridge Fire which appears to have provided high wood loading in the years since the fire. We also observed abundant fine sediment retention behind instream woody debris jams, evidence of upstream sediment sources and retention of post-fire sediment. Reach C representative existing conditions are illustrated in **Appendix F4**.

Reach D: Lower Carpenter Valley

Reach D is a 5.13-mile long reach in Lower Carpenter Valley, a glacially carved valley with distinct recessional and/or terminal moraines and 264 acres of montane meadows. A well-defined moraine divides the valley into Upper and Lower Carpenter Valleys. The meadows are hydrologically supported by snowmelt runoff and multiple mapped and unmapped perennial springs.

Reach D is further classified into 7 subreaches according to channel evolution stage (Cluer and Thorne, 2013) as assessed in the field or from recent aerial photographs. Reaches D1, D2 and D3 are in Lower Carpenter Valley on TDLT property. Reaches D4, D5, D6 and D7 are in Upper Carpenter Valley on private property. While our reconnaissance did not include private property, we provide aerial photographs of these reaches with general descriptions of their form and condition as based on available data and to provide context for our interpretation of conditions in other reaches.

Representative conditions of Reaches D1, D2, and D3 in Lower Carpenter Valley are shown in **Appendix F5**. A high-resolution aerial image of reaches D1 and D2 and the associated meadow in Lower Carpenter Valley is provided in **Figure 3-3**. The aerial images depict conditions observed along the channel and meadow on May 8 and 9, 2020, near peak snowmelt runoff conditions (shown to be on April 30 at nearby USGS gages). Flow was measured to be 63 cfs on May 8, 2020 at the downstream end of Reach D1, approximately a 1-year flow as based on same day flow at nearby gaged streams with long periods of record. Since the images were captured just after the peak snowmelt runoff occurred, we use this image to document the presence or absence of overbank flow or high-water marks along the channel margin. The imagery suggests that the 1-year flow was completely contained within the incised single-thread channel. Observed high-water marks indicated that earlier peak flows were slightly higher than shown in the aerial imagery, but still contained entirely within the main channel. Ponded relic channels or oxbows shown in the imagery are likely associated with spring runoff and higher groundwater in areas fed by springs and runoff from tributaries along the northern meadow edge.

Reach D1 and D2 have slopes less than 0.5 percent and exhibit single-channel sinuous planforms with pool-riffle morphology. Both reaches exhibit degradation indicating historical episodes of channel incision and widening. The degree of degradation is more measurable in reach D1, with a deeper active channel and more frequent unstable banks. In most cases, the active channel depth exceeds 6 feet below the meadow surface. High-water marks from the 2020 peak snowmelt runoff are well below the meadow surface and ranged from 2 to 4 feet below the top of bank. Exposed banks are fine-grained, mostly silts and clays; however, bed substrate includes sand and small to medium gravels.

Evidence of beaver activity such as willow cuttings, trails, and bank burrows are present, but we only identified one active beaver dam in reach D1 during the channel reconnaissance. The dam measured roughly 2.5 feet high and backwatered several hundred feet of channel under baseflow conditions (September 2020). Additional beaver dam remnants are present which may suggest that relatively frequent floods actively remove the features. This is notable since this may further suggest that restoration approaches involving beaver dam analogues alone may not be a reliable approach to promoting recovery of the incised channel.

The meadow between the active channel and north slopes of the valley exhibited wet, verdant conditions even in late summer. Perennial springs along the northern slopes are likely responsible for maintaining hydrologic support for this portion of the meadow in the absence of overbank flooding (see **Figure 3-3**). Spring-fed tributaries are perched above the active channel but exhibit knickpoint erosion or headcutting into the meadow. Historical ditches appear to divert and focus flows in some limited areas of this northern meadow.

The meadow along the south side of the valley exhibits a mixture of wetland and xeric (upland) plants and conifer encroachment, suggesting active conversion from a wet meadow to a drier upland environment. The conifers are similar in size and estimated to be between 30 and 40 years old.

Similar to Reach D1, D2 is an incised channel with channel depths between 3 and 6 feet below the meadow surface. Reach D2 exhibits channel widening but also shows more advanced development of inset floodplains and greater bank stability. Exposed banks show the valley floor alluvium is dominantly fine-grained with thin lenses of gravel-sized sediment deposits. Relative to Reach D1 and the valley floor alluvium at this location, bed substrate is coarser with large gravels and small cobbles present and active bar formation.

In the 1990s, eight vortex rock weirs were constructed along roughly 6,000 feet of channel in NF Prosser Creek Reaches D1 and D2 (Dittes and Guarado, 2019). Goals and objectives of these rock weirs are not documented. Historically, vortex rock weirs were used to create vortices and secondary flow patterns that dissipate energy and steer hydraulic forces away from the banks, protecting them from erosion (Rosgen, 1992). Balance observed these weirs to be partially or mostly buried by fine sediment or displaced from their original presumed alignment. In several instances, boulders were deflecting flow towards eroding banks, potentially exacerbating bank failures, but also providing some deep scour holes that may provide fish cover/habitat.

The meadow along the north side of the Reach D2 channel was also observed to be verdant, wet, and with surface flow emanating from springs located above the valley floor. These springs support a collection of fens along the toe of the slope at the base of Lower Carpenter Ridge (**Figure 3-4**)

Throughout Lower Carpenter Valley, we observed remnant secondary channels throughout the meadow (see **Figure 3-3**). These features exhibited narrower and shallower channel geometries with higher sinuosity than the existing active channel. These features may be evidence of a pre-disturbance regime and analogues for what could be a restored condition.

Reach D3 defines the short reach through the moraine separating Lower and Upper Carpenter Valleys. This reach is characterized by forested banks, instream boulder and wood structures and forced pool-riffle morphology.

The uplands of adjacent to Lower Carpenter Valley are steep slopes of volcanoclastic deposits and glacial drift—both subject to rapid rilling, gullying and landsliding. In the field, we observed multiple large, unvegetated gullies and landslides on both the north and south facing slopes of the valley. Based on the earliest historical aerial images (1939), these features may be natural, but influenced by earlier logging history.

Reach D: Upper Carpenter Valley

Reaches D4 through D7 are within Upper Carpenter Valley. The North Fork (NF) of Prosser Creek through the Upper Carpenter Valley is bisected by several recessional or terminal moraines, several mapped and inferred normal fault lines (Sylvester and Raines, 2017), and deposits from a large landslide that occurred in 1997. The landslides, moraines, and geologic structure disrupt channel processes and create varying channel planforms and morphologies in the reach downstream of the landslide.

Reach D4 exhibits similar channel slope and planform to reaches in the Lower Carpenter Valley (D1, D2). The degree of incision and/or active channel widening is uncertain; however, aerial photographs depict a narrow corridor of active near-channel bar deposition suggesting that the channel reach is also incised to similar depths observed downstream. Sediment characteristics of bank and bar deposits cannot be definitely established from aerial photography; however, close inspection of the bar deposits in the imagery suggest sand and gravel. Remnant meander bends and secondary channels with higher sinuosity than the existing channel are visible in the meadow north of the channel. The south-facing slopes also support springs and fens.

The 1997 landslide that effectively dammed the North Fork of Prosser Creek influenced the channel slope and character in reaches D5 and D6. Reach D5 is a steeper channel with an approximately 2.0-percent slope. This reach appears to be actively eroding the toe and downstream side of the landslide deposits. This is a significant source of sediment to downstream reaches. Reach D6 is heavily influenced by the landslide deposit which has created a low slope (less than 0.5 percent) and oftentimes backwatered depositional reach. As inferred from aerial images, NF Prosser Creek at this location is an anastomosing channel with aggradation effects upstream, including formation of a deltaic deposit of sediments entering the reach.

Reach D7 is located at the head of the Upper Carpenter Valley meadow and is a transition reach where the channel slope decreases from upstream to downstream to match the valley floor. Depositional and alluvial fan processes dominate this reach. Meander migration appears active based on interpretation of active bank erosion from aerial imagery. Large unvegetated point bars suggest sediment loading and deposition of material derived from the upper watershed. The degree of channel incision is unknown. Conditions representative of Reach D (D4, D5, D6, and D7) in Upper Carpenter Valley are shown in **Appendix F6**.

Similar to the Lower Carpenter Valley, the Upper Carpenter Valley uplands consist of steep slopes of volcanoclastic deposits and glacial drift—both subject to rapid rilling, gullying and landsliding. From aerial imagery and topographic data, we observe multiple large, unvegetated gullies and landslides on both the north and south facing slopes of the valley.

3.2.5 HEADWATERS: NORTH FORK PROSSER CREEK

Upstream of Reach D, the geology transitions from primarily volcanics to granitics and forms the headwaters of the North Fork of Prosser Creek draining the Sierra Crest. This area was also heavily glaciated and now has abundant exposed bedrock. Several mapped or inferred normal faults bisect the channel. As a result, the channel is steeper and in many cases is a bedrock channel. We identify two main tributaries to the North Fork: Warren Lake Tributary and Coon Canyon Tributary. These headwater channels are designated as Reaches E through K and briefly described below. We note that this area is difficult to access and some areas are private property; therefore, our descriptions of existing conditions are based on review of recent aerial photography (Google Earth, 2018), channel slope measured from LiDAR-derived topography, and views from afar. Representative conditions of Reaches E, F, & G are shown in **Appendix F7**; Reaches H, I, J, & K in **Appendix F8**.

<u>Reach E</u>

Reach E is a short, 1,000-foot long reach defined by the canyon mouth. This reach defines a transition in geology from crystalline granitics to volcanics. The reach is characterized by an alluvial fan with active distributary- flow patterns and sediment deposition. Channel slope is estimated from LiDAR-based topography to be near 3 percent. Aerial imagery depicts high wood loading and deposition (i.e., instream wood jams). Reach E is on private property.

Reach F

Reach F is a roughly 1,000+ feet, straight, bedrock-confined channel with a 1.1 percent slope. The channel is aligned with a mapped/inferred fault (Sylvester and Raines, 2017) suggesting its alignment and planform is structurally controlled. The channel exhibits forced pool-riffle or step-pool morphology from bedrock and high wood loading. Fallen trees span the active channel in this reach. Reach F is on private property.

Reach G

This 1.0-mile long reach is located along the toe of an old alluvial fan feature formed from erosion of a tributary or historical landslide deposit. The channel is confined to the southern edge of the valley, which is mapped as older alluvium. Sediment that forms this depositional landform originates from a straight gully or canyon that coincides with a mapped fault (Sylvester and Raines, 2017). Though unconfirmed, this may likely be another natural sediment source to the North Fork of Prosser Creek. Active, unvegetated sediment bars are visible from aerial imagery. This reach exhibits a 1.2 percent channel slope with pool-riffle and forced pool-riffle morphology. Reach G is on private property.

Reach H

Reach H is a 1.4-mile largely bedrock-controlled channel with a slope of roughly 15 percent. The steep channel exhibits step-pool morphology with both bedrock and instream wood steps. From the aerial imagery, the channel appears to be functioning with little to no evidence of bank failures. A portion of the lower Reach H is on private property and the remaining upper portions are on Tahoe National Forest.

Reach I

Reach I is a 0.43-mile sinuous channel with a 3.4 percent slope that supports a small montane meadow. At this slope, we assume channel morphology exhibits steep riffles or step-pools. The reach appears to be defined by a shallow alluvial-filled glacial cirque. Aerial imagery suggests this channel is in ‘good’ condition with functioning channel-meadow hydrologic connectivity. Reach I is within the Tahoe National Forest.

Reach J

Reach J is a 0.42-mile long headwater channel that exhibits a slope exceeding 20 percent. The channel exhibits steep cascade and step-pool morphology. The channel drains elevations above 7,600 feet elevation, underlain by volcanic breccia and talus, and can be snow covered most months of the year given its northerly aspect. Reach J is within the Tahoe National Forest and largely undisturbed.

Reach K

Reach K includes Devils Oven Lake and Warren Lake, and is a 1.3-mile long drainage and discharges within Reach H. This subwatershed is roadless and remote. Access is limited by foot or ski. The subwatershed is primarily underlain by granitics and glacial till. Slopes range between 3 and 9 percent but can exceed 10 percent in many areas. Morphology is step-pool and often bedrock controlled.

3.2.6 South Fork Prosser Creek

South Fork Prosser Creek drains an 8.4 square mile subwatershed and includes Upper and Lower Euer Valley, Crabtree Canyon, Frog Lake, and a private Reservoir (unofficially, the Tamson Reservoir). We have classified the tributary into 12 reaches, Reaches L through S, including reaches M1-M5. Existing conditions are described below.

Reach L

Reach L is a canyon-confined 0.83-mile reach defined by a nearly an 8 percent slope with boulder and instream wood and forced step-pool morphology. This reach was fully burned over by the 1960 Donner Ridge Fire and likely resulted in the high wood loading observed during our reconnaissance. Reach L representative existing conditions are illustrated in **Appendix F9**.

An approximately 50-acre aspen grove is mapped along Reach L. Limited field reconnaissance suggests that this stand has been extensively invaded by conifers, possibly as a result of the Donner Ridge Fire and subsequent forest management and revegetation actions that occurred following the fire.

Reach M: Euer Valley

Reach M is a 4.39-mile reach of SF Prosser Creek defined in Euer Valley. Euer Valley is narrower and at a slightly higher elevation than Carpenter Valley, and supports a nearly contiguous 190-acre montane meadow that is hydrologically supported by snowmelt runoff and seasonal and perennial springs (**Figure 3-5**).

Reach M is further classified into 5 reaches, as defined according to channel evolution stage of Cluer and Thorne (2013) and as assessed in the field or by recent aerial photographs. Reaches M1, M2, M3 and most of M4 are in Lower Euer Valley and within Tahoe Donner Association property. Reach M5 is located on private property.

Representative conditions of Reach M (M1, M2, M3 and M4) in Lower Euer Valley are shown in **Appendices A10 through A13**. A high-resolution aerial image of reaches M1 through M4 and the Lower Euer Valley meadow is provided in **Figure 3-6a and 3-6b**. The aerial image depicts conditions observed along the channel and meadow on May 15, 2020, after peak snowmelt runoff conditions occurred. Flow was estimated to be between 35 cfs and 40 cfs at the downstream end of Reach M1, approximately the 1-year flood recurrence event or slightly lower, as based on same day flow at regional gaged streams with long periods of record. Since the images were captured after peak snowmelt runoff, we use this image to document the presence or absence of overbank flow. Point bars show evidence of recent higher flow but there is no evidence that in the floodplain was inundated by overbank flows in WY2020. Relic channels or oxbows are ponded, but these features were confirmed to be supported by spring-fed tributaries and/or shallow groundwater conditions.

In general, the SF Prosser Creek through reaches M1 through M4 has a slope equal to or less than 1.0 percent and exhibits single-channel sinuous planforms with pool-riffle morphology. Reach M1 is 0.85 miles in length and exhibits degradation and active widening. The degree of degradation is more measurable downstream of the confluence with Crabtree Canyon, a potential source of excess runoff and sediment. The active channel depth below the meadow surface ranges between 3 and 6 feet. High-water marks from the WY2019 annual peak flow were observed below the meadow surface and contained within the active channel; WY2019 annual peak flow as much higher than WY2020 based on nearby stream gages. Exposed banks are mostly fine-grained silts and clays, but the bed substrate includes sand, gravels, and small cobble. This dichotomy indicates that the meadow was formed under a low-energy environment, but the current flow regime exhibits higher energy, sourcing and transporting larger sediment from upstream. We did not observe beaver activity in M1, but historical beaver dam remnants are present and suggest that periodic floods remove them.

The channel transitions to Reach M2 near the Euer Valley Road Crossing. Reach M2 is a 0.36-mile reach that exhibits some historical incision, but with well-vegetated banks and apparent quasi-stability. Bed substrate is composed of sand and gravels. Instream wood is largely absent from the reach, but beaver dams and activity are present.

A glacial moraine separates reach M2 from reach M3. The moraine provides a natural grade control on the SF Prosser Creek, and therefore maintains a lower slope in Reach M3, a sinuous 0.47-mile channel reach in stable condition with active channel-meadow connectivity, stable, well-vegetated banks, and evidence of active secondary channels. Active beaver activity and dams are promoting frequent overbank flows. The adjacent meadow is verdant and soils are moist with abundant willow habitat. This reach appears to be a good analog for potential future restored low-gradient reaches Euer Valley.

Reach M4 is a 1.38-mile reach that extends upstream into private property. This reach is incised between 4.5 and 6 feet below the meadow surface; in most segments, streambanks are actively failing. Bed substrate are primarily sand and gravel with plane bed or pool-riffle morphology. The reach includes two crossings with culverts used for both summer and winter recreation; banks adjacent to the culverts are eroding and suggest the culverts are undersized for the range of observed flows. Former ranching operations in this reach may have also contributed to bank trammeling and failures. Roads adjacent to or associated with the old ranch appear to be sources of excess runoff and sediment to the channel in this reach. The adjacent meadow exhibits evidence of vegetation conversion from a wet meadow to dry uplands, along with a degree of conifer encroachment.

The uplands of the Lower Euer Valley are steep slopes of volcanic, volcanoclastic deposits and glacial drift—all subject to rapid rilling, gullying and landsliding. In aerial imagery and in the field, we observed multiple large, unvegetated, and actively eroding gullies on south facing slopes of the valley and from Red Mountain. These are natural sources of sediment to the SF Prosser Creek, but the rate or volume of material transported to the meadow is likely exacerbated by historical disturbances such as wildfire, logging, and road building.

Reach M5: Upper Euer Valley

Reach M5 includes 1.33 miles of the SF Prosser Creek through Upper Euer Valley on private property. A glacial moraine divides M4 from M5. Existing conditions were assessed from recent aerial photography (Google Earth, 2018). This reach is a sinuous single channel with a computed slope of less than 0.5 percent and supports a montane meadow. The reach extends up to an elevation of 6,558 feet and receives streamflow from several tributaries including Frog Lake and an unnamed, private reservoir.

3.2.7 Headwaters: South Fork Prosser Creek

Upstream of Reach M, the underlying geology transitions from primarily volcanics to a mixture of granitics and volcanics and forms the headwaters of the SF of Prosser Creek, draining the Sierra Crest from an elevation over 8,000 feet. This area is also heavily glaciated with exposed bedrock and talus fields. We identify two main tributaries to the South Fork headwaters: (a) Frog Lake Tributary, and (b) Tributary to South Fork. These headwater channels are designated reaches N through Q and are briefly described below. Representative conditions of Reaches N, O, & P are shown in **Appendix F14**; Reach Q in **Appendix F15**.

Reach N

This 0.88-mile reach traverses steep granitic terrain and exhibits slope exceeding 10 percent. Channel morphology is primarily step-pool and cascade.

Reach O

This short, 0.45-mile reach occupies a small alluvium-filled bedrock depression or cirque and supports a meandering, pool-riffle channel and meadow that appears to be minimally disturbed and functional, as based on aerial photography and high-resolution topographic mapping. The reach is primarily on TDLT property, but also crosses a portion of private property.

Reach P

This 1.0-mile reach drains the Sierra Crest and exhibits slopes exceeding 20 percent. Channel morphology is primarily boulder-dominated step-pool and cascade, with intermittent slope discharge wetlands. The reach is dominated by and fed by multiple springs and diffuse zones of groundwater discharge at the highest elevations, with approximately 0.5 cfs discharging from multiple points and small channels. Snowfields persist through much of the summer in wind-loaded northeast-facing pockets, and also contribute to flows in these upper headwaters.

Reach Q

This 1.3-mile reach is fed by discharge from Frog Lake and surrounding uplands. Below Frog Lake, the channel slopes exceed 20 percent and channel morphology is boulder-dominated step-pool and cascade, also with intermittent slope-discharge wetlands. Many contiguous segments of the channel support a dense willow scrub riparian.

3.2.8 Crabtree Canyon

Crabtree Canyon is a 1.5 square mile subwatershed to SF Prosser Creek. Crabtree Canyon flows into SF Prosser Creek at Reach M1. Its bedrock geology is exposed and erodible andesite of Red Mountain with lower elevations buried by glacial till. Crabtree Canyon road parallels the creek along much of its length, with two crossings and multiple side tributary crossings. Reaches R and S have been designated along Crabtree Canyon Tributary.

Reach R

Reach R is a 0.4-mile reach that occupies the western edge of an old alluvial fan deposit. The channel slope averages approximately 2 percent, with a single pool-riffle channel. but field evidence suggests this reach may have been more of a braided or distributary system. This area is located within the vicinity of an old mill and railroad which likely influenced the current alignment and existing channel conditions. Representative photos of Reach R are provided in **Appendix F16**.

Reach S

Reach S is the South Fork of Crabtree Canyon, designated as a perennial stream on USGS maps. Channel slopes exceed 10 percent with step-pool morphology and established riparian vegetation along much of its length. Fill from a former railroad grade has narrowed the active channel; currently this grade is maintained and serves as the access road to Frog Lake. Representative photos of Reach S are provided in **Appendix F16**.

3.2.9 Hobart Mills Tributary

The Hobart Mills tributary (officially unnamed) is a small perennial drainage to Prosser Creek Reservoir. The small 4.1 square mile watershed drains an area that was subjected to intensive land-uses including road and railroad-building, logging, water impoundments and diversions, tree-farms, and wildfire. The watershed is classified into 7 reaches described below.

<u>Reach T</u>

Reach T is the mainstem of the Hobart Mills Tributary, a 1.78-mile reach from the Prosser Creek Reservoir upstream to the confluence of the east and west forks. This reach has been subject to changing water base-levels at Prosser Creek Reservoir which appears to have resulted in transitional depositional zones and propagation of knickpoints. The channel is incised and actively widening in several locations with multiple active knickpoints. The reach also supports or once supported an approximately 25-acre contiguous meadow formed on glacial outwash (USFWS, 2020). An earthen dam in the upper segment of the reach was used to create a log pond at the Hobart Mill and regulated flow to this reach. Lindstrom (2020) reports that Sagehen Creek, the watershed adjacent and north of Prosser Creek, was diverted and imported into the Hobart Reservoir. Evidence of former railroads, roads, and ranching operations exist along this reach. Grazing continues today in this reach and adjacent meadow. Representative existing conditions in Reach T are shown in **Appendix F17**.

<u>Reach U (East Fork)</u>

Reach U, also referred to in this assessment as the East Fork of Hobart Mills Tributary, is a spring-fed channel that supports several fens at spring sources, along with an approximately 27-acre meadow (USFWS, 2020). The reach is roughly 1.1 miles in length and supports multiple swales which are actively flowing during the snowmelt runoff period. Surface flow and wet soils were observed well into the fall months in 2020, a dry year. Hobart Mills Road, (aka East Pasture Road), includes a culverted crossing and parallels the meadow along its east side. Reach U joins the West Fork on private property. Although moderately disturbed, the reach is generally functional and in good condition. Representative conditions are shown in **Appendix F18**.

Reach V (East Fork)

Reach V drains the south slope of Billy Hill but has been modified by the alignment of Hobart Mills Road. The uplands are forested but have been subject to a logging history that spans over 125 years. Under current conditions, the lower segment of the channel receives runoff from the road and discharges to the meadow via a single culvert. A representative photo of the lower segment of Reach V is shown in **Appendix F19**.

Reach W (West Fork)

This 0.8-mile reach is a dispersed channel-swale that opens into a 10+ acre meadow, including forest/shrub wetland (USFWS, 2020). The upper segment of the reach is on USFS lands, while the downstream segment of the reach is on private property. The reach currently exhibits some active widening, but a coarse substrate of glacial outwash minimizes incision. This area was historically used for housing at Hobart Mills (aka Ragtown) and incurred disturbances from ranching and ditching and diversion to establish road and railroad grades. Multiple ditches, abandoned grade crossings, and road crossings still exist in the meadow. Representative photos of Reach W are provided in **Appendix F20** and repeat photography of the Ragtown site is shown in **Figure 3-7**.

Reach X (West Fork)

This short 0.74-mile reach is immediately downstream of the former Hobart Mills Reservoir. It exhibits a steep 5 percent slope with step-pool morphology. The channel is adjacent to SR89 and receives stormwater runoff from the highway. Tributaries to this channel are disrupted by numerous abandoned and current road and railroad grades that parallel the reach. Representative photos of Reach X are provided in **Appendix F21**.

Reach Y (West Fork)

Reach Y lies within a fault-controlled valley with a narrow meadow and the former Hobart Mills Reservoir. The USFWS (2020) delineates roughly 6 acres of meadow wetland habitat in this reach, including the former reservoir. Between 1920 and 1940, the reservoir was operated for drinking water and ice harvesting; water was imported from Sagehen Creek (Lindstrom, 2020). Drainage to and from the area is altered from remaining earthen berms, ditches and road impacts. This reach also receives stormwater runoff from SR89. Representative photos of Reach Y are provided in **Appendix F22**.

Reach Z (West Fork)

This is the headwater channel of the West Fork of Hobart Mills Tributary. It expresses a slope of nearly 9 percent and is bedrock controlled in many areas. This area was heavily logged and manipulated by erosion control efforts after the 1960 wildfire. We found limited to no current instability within this headwater reach.

4 DISTURBANCE INVENTORY

In this section we describe and map disturbed areas identified during interpretation of historical maps and photographs, historical aerial imagery, existing documents, historical land-uses, observations in the field, and flow accumulation analysis. Disturbance is defined as areas that show impaired physical processes and loss or impairment of hydrologic and/or geomorphic functions. We describe areas of disturbance from downstream to upstream in channels and uplands. Each location is tabulated and summarized in **Table 4-1** and mapped in **Appendix G,** which includes the flow accumulation analysis.

The disturbance areas will be further assessed with stakeholders in subsequent efforts to identify and prioritize restoration opportunities and management actions.

4.1 Prosser Creek Watershed (General Overview)

Examination of LiDAR bare-earth imagery led to identification of many more unimproved roads than are not shown on published maps and presented in Chapter 1. Moreover, many additional logging and skid roads are apparent in the field but are not easily identified from LiDAR bare-earth imagery. A detailed mapping of every road or historical grade was beyond the scope of this assessment; however, the flow accumulation analysis shows that historical and current roads in the watershed likely have influenced drainage and altered runoff and sediment supply to downstream areas over time and throughout the watershed.

While many of these roads may not exhibit signs of active runoff or erosion today, they may have generated disturbances in the past that led to downstream impacts. Road-related disturbances may also be re-activated in episodic future events. For instance, a rain-on-snow event that exacerbates runoff or concentration of flow may lead to a disturbance-triggered landslide.

Areas underlain by volcanoclastic and flow rocks (Tvc, Tllt, Tpan) or glacial deposits (Till) express higher drainage density and are naturally subject to debris flows and landslides. Sylvester and Raines (2017) map multiple prominent Quaternary-age landslides locally and regionally in areas underlain by volcanoclastics (Tvc), Tioga (Qtim) and Tahoe Till (Qtam). Roads constructed across these lithologies and deposits tend to exacerbate natural erosion and increase runoff and sediment to side channels. Once disturbance initiates gullying or rilling, the areas can be a chronic sediment source long after the activity has been removed. These mass-wasting-prone areas are predominately located in the eastern 60 to 70 percent of the watershed, roughly as far west as the head of Carpenter and Euer Valleys. Upstream of this zone, in the upper 30 to 40 percent of the watershed, the watershed is mostly underlain by crystalline granitic rocks that are more resistant to erosion; these areas are remote with very few roads, and therefore exhibit minimal impacts from historical land-uses.

4.2 Lower Prosser Creek, Reaches A and B

Conditions in Reach A are affected by both natural and anthropogenic disturbances, including: (1) baselevel fluctuations associated with seasonal and annual changes in reservoir water levels, (2) fault alignment and movement; and (3) channelization and floodplain restrictions from construction of the SR 89 crossing.

Water levels in Prosser Creek Reservoir can fluctuate over 50 feet in a single year (USGS 10340300 PROSSER C RES NR TRUCKEE CA). Fluctuating baselevel changes sediment depositional patterns from contributing inflows. During periods of high flow and sediment transport, deposition is typically concentrated at the most downstream location when the reservoir water surface is near its lowest water levels. Rising reservoir levels inundate these depositional zones and generate new base levels and areas of deposition further upstream. Once reservoir releases exceed inflow during the summer and fall period and the reservoir water levels recede, Prosser Creek inflows rework higher base-level sediment deposits and regularly change channel position and planform. Similarly, annual inundation of the lower reach and reworking of sediment deposits prevents establishment of riparian vegetation, limiting both aquatic and riparian habitat (**Appendix G, Sheet 4, D4.4**).

The northwest-striking Polaris Fault crosses the lower portion of the watershed in an alignment that parallels SR 89 (Melody, 2009). The alignment of the fault likely influences the channel alignment and slope of Prosser Creek in Reach A1. Observed erosion of glacial terrace deposits along the north bank may be attributed to fault alignment and movement or widening associated with historical straightening of channel upstream.

A seasonal tributary to Reach A1drains the northern slopes of Prosser Hill and the Prosser Hill OHV area. The flow accumulation analysis illustrates that some of these roads and trails may capture drainage and concentrate runoff on road surfaces and into a single channel. This process typically results in channel erosion and an increase in runoff and sediment to downstream areas. Excessive erosion was not observed from this tributary as reconnaissance was carried out after snow melted out, so this area should be evaluated further during runoff conditions. (**Appendix G, Sheet 3, D3.2**).

Farther upstream, in Reach A2, approximately 0.5 miles of the channel was channelized or straightened to facilitate the SR89 crossing (**Figure 4-1**). LiDAR imagery suggests that fill was placed within the active channel meander corridor and floodplain to shorten the bridge span (**Figure 4-2**). Channelization and constriction of the floodplain has likely increased the capacity of the channel to scour the bed and banks. Upstream, boulder slope protection was placed along the right (south)bank to prevent the channel from re-occupying its historical meander bend and channel corridor. Furthermore, existing riffles located downstream of the crossing appear to be over steepened relative to riffles upstream and downstream, an indication that this reach is actively incising. (**Appendix G, Sheet 4, D4.3**).

Road building and logging with on-contour ditching to control post-fire runoff and erosion was extensive after the 1960 Donner Ridge Fire (Lindstrom, 2020). Historical aerial imagery clearly illustrates the results of these efforts (**Figure 4-3**). A LiDAR-based flow accumulation analysis suggests some of the former logging roads in the uplands that drain to Reach B continue to capture streamflow and concentrate runoff and sediment to tributaries (**Appendix G, Sheet 5, D5.1; Sheet 8, D8.1; Sheet 9, D9.1, D9.2**).

Former road grades and existing active roads associated with established OHV areas and powerline access in the Reach B subwatershed also exhibit existing and potential road capture of drainages and streams, as identified in **Appendix G, Sheet 3, D3.1; Sheet 4, D4.1, D4.2; Sheet 5, D5.3; Sheet 7, D7.2, D7.3; Sheet 8, D8.2**). An example of road capture and erosion in D7.2 is shown in **Figure 4-4**.

A small meadow, adjacent to Reach B, is supported by groundwater discharge and runoff above Carpenter Valley Road; however, the flow accumulation analysis and observations in the field suggest that this road and adjacent FS Road #89-33 likely concentrate runoff and sediment to the meadow (**Appendix G, Sheet 7, D7.1**). Historical imagery and field observations suggests this meadow is also accessed by off-road vehicles (**Figure 4-5**). Driving over a wet meadow can result in compacted soils, concentration of runoff, and erosion of the meadow. Additional field investigation is recommended to develop appropriate protection and/or restoration measures.

4.3 North Fork Prosser Creek, Lower Carpenter Valley, Reach D

NF Prosser Creek supports a 233-acre meadow in Lower Carpenter Valley (UC Davis, 2017). Balance identified reach-wide degraded channel conditions in Lower Carpenter Valley characterized by incision and widening (**Appendix G, Sheet 12, D12.2**). Under these conditions, instream habitat and water quality are impaired while stream-meadow or stream-floodplain functions are limited. Ditching was completed in Lower Carpenter Valley to presumably drain wetlands for grazing purposes (**Figure 4-6; Appendix G, Sheet 12, D12.3**). High-resolution aerial imagery from 2020 continues to show that the ditch has potential impacts to meadow hydrology. Grazing was removed from the Lower Carpenter Valley in the late 1980s (Svahn, J., pers. comm., 2020); but even a 30-plus year absence of grazing the system has not yet recovered completely.

Field measurements of the existing channel exhibit bank heights between 4 and 7 feet measured from the channel bed up to the meadow surface. Normal depth calculations suggest that the existing NF Prosser Creek channel thru much of the Lower Carpenter Valley contains floods with a return periods between 10 and 25 years (**Figure 4-7;** XS-1, XS-3, XS-4; **Figure 4-8**, XS-7, XS-9). A functioning channel through a meadow wetland system typically floods the meadow surface under frequent flow events, such as the 1.5- to 2-year flows.

A landslide that occurred in 1997 effectively dammed the NF Prosser Creek in the Upper Carpenter Valley. Today, the channel actively erodes the landslide deposit and is likely a chronic source of sediment to the Lower Carpenter Valley; however, a reconnaissance completed by Hecht (1983) identified similar channel conditions to those observed today, 14 years prior to the landslide. Further photographic evidence from 1973 shows the channel in similar conditions to those measured today (**Figure 4-9**). These photos and earlier observations suggest that the landslide was not the only source of disturbance to NF Prosser Creek in Lower Carpenter Valley.

Increased drainage connectivity has likely led to channel disturbance and more effective runoff and transport of sediment into and through the meadow. We identified the following multiple lines of evidence to support this condition:

> <u>Evidence #1</u>: Channel bed and bank sediments in relic channels through the meadow are fine-grained and representative of low-energy environment; In contrast, channel bed sediments in the active channel are coarse and representative of a high-energy environment—or modified hydrologic regime.

Evidence #2: Hecht (1983) observed stream and upland conditions after several record flood years (1980, 1982, and 1983) and highest recorded snowmelt runoff on record (1983) for the Eastern Sierra (Kattelmann, 1992). Hecht recalls significant channel changes from these flood events including potential sources of excess runoff and sediment from areas above the valley (Hecht, B., pers. comm., 2020).

Evidence #3: Historical 1939 aerial imagery suggests channel widths were less than 35 feet compared to channel widths measured today between 45 and 55 feet (**Figure 4-10**). Similarly, channel sinuosity, defined as the ratio of channel length to valley length, shows measurable decrease over time (see **Figure 4-10**)—a direct geomorphic response to channel widening. These changes in channel geometry are often a response to increases in discharge and sediment supply (Schumm, 1985).

Evidence #4: Our flow accumulation analysis has identified multiple areas in the subwatershed that suggest roads have altered natural flow paths and potentially concentration hillslope runoff to the valley floor and channel. (**Appendix G, Sheet 12, D12.1; Sheet 16, D16.1**).

Past and current observations and evaluation of processes using fundamental geomorphic principles suggest that the disturbance in NF Prosser Creek is historical, cumulative, and watershed wide. Management and/or restoration may not be sufficient at the reach scale, but instead at a sub-watershed scale or larger. Monitoring of channel conditions or improvements after upland restoration efforts are completed can be used to evaluate appropriate timing of in-channel or reach-scale restoration.

4.4 Headwaters to Carpenter Valley and NF Prosser Creek

Multiple roads and former road grades are present on the northern slopes below Red Mountain on TDLT property. The flow accumulation analysis suggests these roads continue to capture or alter natural drainage patterns, an area that could be partly responsible for the change in runoff and sediment supply to NF Prosser Creek.

We note that a large portion of the upper watershed of NF Prosser Creek is private property. We have neither identified nor assessed potential disturbances on private property.

4.5 Lower Euer Valley, South Fork Prosser Creek, Reach M

Euer Valley supports a 191-acre meadow (UC Davis, 2017) that exhibits evidence of meadow conversion, conifer encroachment, and groundwater depletion. Balance identified multiple disturbed and incised channel reaches in Lower Euer Valley, some of which appear to be actively incising and widening. As with Carpenter Valley, the source(s) of disturbance are complex and are likely the result of cattle and sheep ranching (Lindstrom, 2020), along with the long history of logging and railroads, logging roads, and landings.

Reach M1 is incised (**Appendix G, Sheet 11, D11.5**). Normal depth calculations in this reach indicate that the existing channel requires at least a 10-year flow to overtop the banks (**Figure 4-11**; XS-1, XS-3).

The root causes of incision in Reach M1 are likely related to upstream sources and disturbance in Crabtree Canyon. Crabtree Canyon includes an active road that parallels the creek along most its length with several crossings. A crossing located roughly 1,800 feet upstream from its confluence with SF Prosser Creek is located at the apex of an alluvial fan and convergence of multiple unimproved roads. In summer, the crossing is a ford, while in winter, temporary culverts provide a ski-recreational crossing (**Appendix G, Sheet 11, D11.3**). Downstream of the crossing the channel appears to occupy an historical road alignment, while upstream, several drainages appear to be concentrated into the crossing. These conditions and changes in use often perpetuate a disturbance that leads to channel widening and erosion, along with associated impacts on the adjacent meadow. TDA has identified this crossing as a potential future project with improvements (TDA, 2016). We recommend that areas upstream and downstream of the crossing be included in assessment of crossing improvement alternatives, so that the root causes of disturbance can be concurrently addressed as part of that project.

Farther upstream in Crabtree Canyon, former railroad grade constricted the channel and has now become a sediment source through bank failure and erosion (**Appendix G, Sheet 11, D11.2**). Evidence of old earthen dams, logging crossings, and riparian logging has altered the channel condition in Reach S. TDLT has been implementing road crossing improvements at the time of this assessment, and it is unclear what, if any, additional restoration or erosion control actions may be completed as part of the road improvements. Additional old logging roads identified from LiDAR also suggest road capture and potential disturbances for runoff and sediment to downstream environments (**Appendix G, Sheet 11, D11.1**)

Reach M2 is less disturbed but exhibits an historical period of incision and widening (**Appendix G, Sheet 11, D11.4**). Currently, banks are well-vegetated and stable and beaver activity continues to provide improvements to hydrologic functions. Hydraulic analysis suggests this reach is better condition than downstream is still moderately disconnected from it floodplain. Normal depth calculations indicate that the channel is able to contain the 5-year flow before the banks are overtopped. (**Figure 4-11**, XS-4). Upland roads also appear to contribute to flow concentration and historical degradation of this reach (**Appendix G, Sheet 10, D10.2, D10.3)**.

Reach M4 is also disturbed (**Appendix G, Sheet 10, D10.4**). The lower segment of Reach M4 continues to exhibit channel incision, widening, and bank failures. Hydraulic analysis of the most incised segments in this reach suggest incision has impaired channel-floodplain or meadow functions such that it requires a 50-year flow event flow overbank (**Figure 4-12;** XS-6, XS-8). Tributaries to Reach M4 are also incised, likely due realignment and concentration of multiple tributaries into single road crossings, either for drainage management purposes or to drain wet portions of the meadow. Tributary channel beds are now 4 to 5 feet below the alluvial fan surface.

Sources of degradation in the SF Prosser Creek through Euer Valley are likely associated with upstream and upland historical disturbances, although more localized disturbance may have been initiated by ranching activities and road crossings associated with the old ranch and corral. A review of historical aerial photographs from the 1970s help identify when some of these disturbances were active and sources of runoff and sediment to SF Prosser Creek (**Figure 4-13**). Banks within close proximity to the old corral and barns are heavily trammeled. Roads that serviced the old ranch and corral exhibit measurable erosion while nearby tributaries exhibit incision (**Figure 4-14**) and are likely sources of excess runoff (**Appendix G, Sheet 10, D10.5**).

TDA has recently implemented a 5-year Trail Implementation Plan that included multiple new trails within this area of the watershed with mitigation measures to address potential impacts (TDA, 2016). In preparation of this plan, Shaw and Kulchawik (2015) identified proposed trail crossings that could be improved under the Trails Implementation Plan. While the 2015 assessment was focused on areas where new trails were planned, it did not address watershed-wide areas that have potential hydrologic alterations from existing roads and former logging roads.

Multiple roads cross the slopes above Reach M4 and are maintained today by TDA for recreational purposes. A flow accumulation analysis suggests many of these roads may divert and concentrate flow in some drainages (**Appendix G, Sheet 10, D10.1, D10.5, D10.6)**. Field inspection of S. Euer Road with drainage to Reach M4 identified multiple locations where road capture is occurring (**Figure 4-15**) and restoration actions could provide improvements to these drainages, road conditions, and downstream channel condition and habitat.

4.6 Headwaters to Euer Valley and SF Prosser Creek

Review of historical aerial imagery and results of the flow accumulation analysis show several roads in the upper watershed, above the private Tamson Reservoir, with apparent road capture and flow concentration in several locations (**Appendix G, Sheet 14, D14.1, D14.2**).

We have not assessed or highlighted potential disturbances on private property.

4.7 Hobart Mills Tributary

Reach T once supported a narrow but long and contiguous 20-acre meadow. This reach was subject to a legacy of historical land-uses upstream associated with Hobart Mills. These included logging, road and railroad construction, development of a company town, reservoir construction and operations. In addition, Prosser Creek Reservoir operations have affected channel processes and riparian in the zone of inundation (**Appendix G, Sheet 2, D2.1**, similar to Reach A). In this disturbance reach, knickpoint erosion is present, and the channel appears to be actively widening and downcutting. Balance also observed evidence of intensive grazing in this reach as indicated by the complete removal of surface vegetation in many adjacent meadow areas and sheep manure. Finally, this area is accessible by OHV via the Prosser Creek Reservoir Recreation Area, and ongoing soil disturbance associated with off-trail OHV can further damage resources.

The Hobart Mills Road runs parallel to the East Fork of the Hobart Mills Tributary (Reach U). Road runoff is captured by an inboard ditch and directed to the meadow along Reach U by a several different culverts. Balance observed excessive sediment deposited in the meadow at the outlet of at least one culvert (**Appendix G, Sheet 5, D5.7**) along the drainage from the south slopes of the Billy Hill. The flow accumulation analysis illustrates additional areas of potential road drainage capture from former logging roads, tree farms, and 1960 post-fire erosion control efforts (**Appendix G, Sheet 5, D5.6**).

The West Fork of the Hobart Mills Tributary drains the southwestern slopes of the Sagehen Hills, an area that was heavily logged and altered after the 1960 wildfire. Flow accumulation analysis illustrates high drainage density and road capture (**Appendix G, Sheet 5, D5.2, D5.3**). SR89 also runs parallel to the West Fork and contributes stormwater runoff to the channel via multiple culverts. While stormwater runoff is likely a source of disturbance for channel conditions in the West Fork (Reach W), historical land-uses and abandoned road alignments and railroad grades have also likely contributed to its current degraded condition. The channel is incised and widened in some segments and straightened and ditched along the former SR89 for a short distance (**Appendix G, Sheet 5, D5.5**).

Hobart Mills reservoir was constructed from excavation of a meadow to create an earthen fill dam with outlet works. Today, the reservoir is filled with sediment but the dam, earthen berms, and former SR89 are still present. These features divert natural drainage and likely limit recovery of a former meadow habitat (**Appendix G, Sheet 5, D5.4**).

Farther upstream, flow accumulation analysis suggests FS Road #89-34, a former railroad grade, alters the natural flow patterns to the West Fork of Hobart Mills Tributary. Additional existing or former logging roads uphill may also capture and divert natural drainage (**Appendix G, Sheet 6, D6.1**).

5 PRESERVATION RECOMMENDATIONS

In this section, we describe and map areas that were observed to be functioning well or that provide a source of hydrologic support to downstream habitat. Some areas were based on our interpretations of imagery or previous studies and existing documents. Similar to areas of disturbance, we describe areas to be protected from downstream to upstream in channels and uplands. Each location is tabulated and summarized in **Table 5-1** and mapped in **Appendix G**. These areas will be further assessed with stakeholders in subsequent efforts to identify and prioritize management actions if necessary.

HT Harvey biologists conducted a Lahontan Cutthroat Trout (LCT) habitat assessment to evaluate feasibility of reintroduction to specific stream reaches or tributaries to Prosser Creek (**Appendix H**). They identified sufficient spawning, rearing, and pool habitat to support LCT within surveyed reaches of NF and SF Prosser Creek. Habitat in SF Prosser Creek is generally much better than habitat surveyed in NF Prosser Creek. A successful reintroduction plan will require concurrent and complementary stream and watershed restoration actions that support good habitat suitability of sufficient size and connectivity. The most critical component of physical habitat improvement is managing excess sediment in these reaches. Based on this assessment, sediment sources are watershed-wide and complex. Restoration or management actions should begin to address upland sources and work downstream to reach-scale restoration.

HT Harvey biologists evaluated 19 permanent or perennial waterbodies suitable for Sierra Nevada Yellow-Legged Frog (SNYLF) breeding remotely, using high-resolution aerial imagery from different year types (**Appendix I**). HT Harvey identified 8 ponds or water bodies that may support SNYLF. Two of the 19 already are documented as having SNYLF. Connectivity of the ponds is also an important factor, and analysis of connectivity suggests that the current spatial arrangement of aquatic habitat in the watershed is conducive to establishment of a SNYLF population through dispersal. Additional SNYLF reintroductions should be focused on fish-free lake habitat because smaller ponds are more likely to be negatively impacted by climate change.

We incorporated results from these assessments in our evaluation and illustration of areas to be protected.

5.1 Lower Prosser Creek, Reaches A and B

The Prosser Creek Watershed is dissected by multiple northwest-southeast trending normal faults. Where these faults are exposed at the surface, they often support perennial springs. A spring-supported pond was observed on a terrace adjacent to Prosser Creek with no visible channel or direct source of runoff (**Appendix G, Sheet 4, P4.5**). The uplands and adjacent slopes above Reach B also include multiple springs which provide baseflow support to Prosser Creek (**Appendix G, Sheet 7, P7.4, P7.5, and P7.6**).

Perched above, but adjacent to and south of Reach B is a small 3-acre meadow supported by a small sub-watershed, road runoff from Carpenter Valley Road and groundwater discharge (**Appendix G, Sheet 7, P7.7**). While this meadow is designated as a disturbance area, it also is a functioning meadow that with some management can be enhanced and protected. Evaluations of potential restoration or management strategies in this meadow should protect the existing functionality.

5.2 Lower Carpenter Valley, North Fork Prosser Creek, Reach D

The NF Prosser Creek through Lower Carpenter Valley is impaired in a number of locations; however, the meadow north of the channel is functional (**Appendix G, Sheet 12, P12.4**), but threatened by continued channel widening, groundwater drainage through channel incision, knickpoint erosion propagating up spring-fed tributaries from the NF Prosser Creek, and minor disruption of natural flow patterns from historical drainage modifications in the meadow. Dittes & Guardino Consulting (2017) report that this montane meadow supports high native plant diversity and wildlife habitat and notes that former channel oxbows and relic channels support seasonally flooded areas that sustain wetland communities. HT Harvey biologists also suggested that perennial ponds in this area could support habitat for SNYLF.

This largely functional and contiguous meadow area along the northern side of the channel is supported by multiple springs emanating from Carpenter Ridge and wide dispersal of discharged groundwater across the low-gradient meadow surface (**Appendix G, Sheet 12, P12.5, P12.6, P12.7; Sheet 13, P13.1 and P13.2**), which should be protected in order to maintain flow and hydrologic support for the well-developed wetland communities including fens at the base of the slopes along the meadow edge. CNPS (2016) reports that the fens of Lower Carpenter Valley are rated highly for conservation status as they are relatively undisturbed and support rare vascular plant and moss species.

Additional spring-like features, characterized by alder-willow forests on steep slopes, exist along TDLT property along the south slopes of Carpenter Ridge above Reach D4.

Conditions of these springs could not be evaluated due to the constraints of topography and private property. These springs could also support similar hydrologic conditions and habitat in the valley.

5.3 Headwaters to Carpenter Valley and North Fork Prosser Creek

Fault-derived springs are common along the Carpenter Ridge. This are is steep and mostly inaccessible by road or trail. Review of mapped fault lines and CIR imagery suggests at least one spring area on USFS lands supports baseflow to Upper Carpenter Valley (**Appendix G, Sheet 18, P18.1**).

Drainages north of Frog Lake (Reaches G and H) are within a remote portion of the watershed that appears to have had little to no road building and logging. These areas also are underlain by granitic bedrock and appear to support many springs and seeps from bedrock fractures (**Appendix G, Sheet 16, P16.3, P16.4, P16.5, P16.6 and P16.7**). Hydrology from these areas support dense willow forests along drainages and along the NF Prosser corridor. Flow from these areas may provide hydrologic support for baseflow in NF Prosser Creek.

Further upstream, in more remote areas topographic depressions provide small depositional zones that support perennial ponding even in dry years, based on review of weekly high-resolution satellite imagery. This drainage was not designated as a reach, but is tributary to Reach H. HT Harvey biologists identified these areas as some of the most viable areas for SNYLF habitat. (**Appendix G, Sheet 20, P20.1, P20.2, P20.3, P20.4, P20.5**).

Warren Lake and Devil's Oven Lake are two additional perennial lakes in the Prosser Creek watershed that support perennial aquatic habitat including SNYLF habitat (**Appendix G, Sheet 21, P21.1, P21.2, P21.3, P21.4, P21.5**). Second to the Coon Canyon area, this area exhibits the best habitat attributes for SNYLF.

5.4 Lower Euer Valley, South Fork Prosser Creek, Reach M

Multiple seasonal and perennial springs below Hawks Peak were observed in the field or using false-color infrared aerial imagery (**Appendix G, Sheet 10, P10.7 and P10.8**). These springs support seasonal and perennial drainages and augment baseflow to Reach M (M2, M3, and M4) and were observed to be discharging between 1 gallons per minute (gpm) and 50 gpm in June 2020.

Reach M3 was identified as a well-functioning channel with limited to no evidence of incision or widening. Multiple secondary channels were observed with perennial flow and beaver activity, and this reach appears to provide channel-floodplain/meadow connectivity under frequent flood events, such as the 1- to 2-year flow (see **Figure 5-3**, XS-5). A downstream glacial moraine and bedrock constriction in the valley appears to serve as grade control, protecting to this reach from downstream perturbations such as a migrating knickpoint. We have identified this reach a 'reference reach' that should be protected and used as an analog for design and monitoring of restoration and management efforts in similar reaches.

Reach M2 has undergone historical incision and widening, but the reach also appears to be undergoing natural recovery, mostly attributable to beaver activity (**Appendix G, Sheet 11, P11.8**). Enhancement measures could provide additional benefits to meadow health and aquatic habitat.

We also identified a mature aspen grove along the Crabtree Canyon tributary south of the channel and along Reach L (**Appendix G, Sheet 11, P11.7**). Aspen habitat, because it provides wildlife habitat values not provided by conifers and is comparatively uncommon on the landscape, is important to protect and manage in the watershed. Conifer thinning, coupled with selective burning of cut conifer piles, may be used to encourage aspen regeneration in this stand (Dagley et al. 2016).

5.5 Headwaters to South Fork Prosser Creek and Euer Valley

Review of LiDAR bare-earth imagery and false-color infrared aerial imagery indicates a low-gradient channel with tortuous sinuosity and supporting a willow forest in Reach O. This area is supported by a complex of perennial springs near the crest of the watershed (**Appendix G, Sheet 14, P14.3**). We estimated roughly 0.5cfs flow, across 4 different locations from this spring in July 2020. Other springs may exist along this same sub-watershed. We have identified these tributaries as important headwater streams that support baseflow conditions and aquatic habitat to South Fork Prosser Creek and downstream reaches of Prosser Creek.

Frog Lake and adjacent headwater streams drain a primarily granitic subwatershed that expresses drainage patterns that follow bedrock fracture patterns and glaciated topography (Reach Q). Frog Lake is a body of water formed in a glacially carved bowl from the most recent period of glaciation (**Appendix G, Sheet 15, P15.2**). At an elevation of 7,588 feet, the alpine lake and uplands were too remote and rugged to be included in the multiple periods of logging and road building that occurred in the lower elevations of the watershed. This is an area that is largely intact and functioning well from a hydrologic perspective.

A small depression south and roughly 100 feet higher than Frog Lake also supports a seasonal pond (**Appendix G, Sheet 15, P15.1**). Review of weekly high-resolution satellite imagery shows this seasonal pond is short-lived in dry years such as 2020, but ponding can extend well into the summer months after wetter yeas such as 2019.

This area also contains groundwater discharge zones through bedrock fractures based on review of false-color infrared aerial imagery (**Appendix G, Sheet 15, P15.3, P15.4; Sheet 16, P16.9, and P16.10**). During the summer months, we observed measurable flow from these headwater channels where road crossings exist along the Frog Lake access road (FS Road #780-20). Flow was also observed in channels only 200 feet below the watershed ridge (**Appendix G, Sheet 16, P16.8**). Further downstream, these channels support steep, willow riparian corridors (**Appendix G, Sheet 15, P15.5**)

5.6 Hobart Mills Tributary

The East and West Forks of the Hobart Mills Tributary include some areas that may merit protection. Reach U (East Fork) supports a 20-acre meadow with limited impacts from disturbance (**Appendix G, Sheet 5, P5.9**). Historical grazing and water diversion from this meadow has been documented (Lindstrom, 2020); however, this system appears to have recovered from these disturbances. An ecological meadow assessment has not been completed, but wetland species and presence of perennial water was observed. Adjacent or upland disturbances listed in the above sections can be managed to improve conditions in this meadow and limit sediment delivery to the meadow.

Perennial waters observed in Reach U originate from multiple springs at the northern end of the small valley that discharge at the surface between underlying volcanic rocks and overlying glacial drift (**Appendix G, Sheet 5, P5.10**). These springs also support fens and associated habitats. Finally, an aspen grove is located adjacent to the springs but may require management to enhance the grove for habitat (**Appendix G, Sheet 5, P5.11**). Aspen habitat, because it provides wildlife habitat values not provided by conifers and is comparatively uncommon on the landscape, is important to protect and manage in the Watershed. Conifer thinning, coupled with selective burning of cut conifer piles, may be used to encourage aspen regeneration (Dagley et al. 2016). Preservation and protection of this area would likely include fencing and/or natural features to prohibit

OHV access. There are also many old pipes and remnant structures, evidence that these springs were developed for water use likely during the development and expansion of the Hobart Mills town between the late 1800s and early 1900s.

Reach Y is a fault-controlled reach at the toe of an alluvial fan that support a linear meadow and ponded depression (**Appendix G, Sheet 6, P6.2**). While uplands to this meadow have been identified as disturbance areas, the meadow condition is fair to good. Melody (2009) describes the meadow as a depocenter or a collection area for alluvial fan runoff and not a floodplain meadow typically associated with most Sierran streams. It is therefore subject to less erosion by channel fluvial action. The meadow is underlain by organic clays (Melody, 2009), an indication that this area may have once supported a small pond. In its current non-eroded condition, it supports large contiguous areas of wetland vegetation and habitat.

6 CONCLUSIONS

Prosser Creek Project Watershed is one of the largest tributaries to the Middle Truckee River. Over 150 years of intensive land-uses has altered drainage, forest structure and health, and resulted in cumulative effects in downstream locations.

In 2020, we characterized existing conditions of both streams and uplands using direct field observations, historical information, and desktop GIS and hydrologic analyses. Based on this work, we have identified 41 areas of disturbance across the watershed on lands currently owned or managed by USFS, TDLT, and TDA. Disturbance areas ranged between a few to dozens of acres in size or miles in stream length. We conclude that many of the reach-scale degradation has occurred because of catchment-wide cumulative disturbances, largely a result of drainage capture and flow concentration along roads and abandoned railroad grades, which decrease the time of concentration in runoff and increase the magnitude of frequent flow events. We recommend stakeholders evaluate and prioritize addressing upland or large-scale disturbances prior to or as part of any reach-scale channel restoration efforts.

We also identified 46 areas that may be intact, recovered, or generally functioning well in terms of physical processes or habitat condition. Furthermore, species-specific studies conducted by biologists identified both constraints and opportunities for Lahontan Cutthroat Trout and Sierra Nevada Yellow-Legged Frog. Reintroduction of LCT may require additional considerations and restoration actions; however, SNYLF are shown to occur in the watershed and there are opportunities to protect and further enhance their habitat.

Efforts completed under this assessment will be used to communicate with stakeholders and find consensus on future restoration, management actions or protection opportunities. Additional analysis may be warranted prior to developing a list of potential projects. These may include more detailed roads mapping with LiDAR and field-inspection of drainage to verify or better delineate upland disturbance areas identified in this assessment. In Chapter 3, we develop a list of potential projects and management strategies to address both the root causes and symptoms of degradation in the watershed. Based on input provided by the stakeholders and land managers, we will establish an initial hierarchy of potential projects based on complexity and degree of ease for implementation.

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- Annie Rosenfeld and John Groom (Tahoe Donner Association)
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- Rachel Hutchinson (Tahoe National Forest)
- Kristen Wilson (The Nature Conservancy)

CONTEXT FOR RESTORATION AND PROTECTION OPPORTUNITIES

This Restoration and Protection Opportunities Chapter is the final chapter of three that comprise the Prosser Creek Watershed Assessment. The assessment summarizes existing information, observations, and restoration approaches in three chapters: (1) Watershed Attributes; (2) Existing Conditions and Disturbance Inventory; and (3) Restoration and Protection Opportunities (this document).

The primary objective of this chapter is to leverage stakeholder input and the information from the first two chapters to identify key management actions, restoration projects, or areas in need of protection within the Prosser Creek project watershed. A full list and description of disturbance and protection areas in the watershed are documented in the Existing Conditions and Disturbance Inventory (Chapter 2). This chapter describes 14 selected projects and/or actions to address disturbed areas based on a preliminary set of priorities identified with stakeholders. These 14 selected projects do not address the complete set and range of disturbance identified from the watershed assessment. From this list of 14 projects and/or actions, 7 were selected and detailed as ‘project sheets’. We note that these 7 projects do not imply these are the only work required or suggested from the completed watershed assessment.

The identified potential projects and actions were developed in recognition of dominant watershed processes and watershed condition. Selected projects include disturbance areas that may be sources of downstream degradation and, if implemented, may have ‘passive benefits’ to those disturbed areas downstream.

RESTORATION AND PROTECTION OPPORTUNITIES

In this section, we present 14 stakeholder-supported restoration and protection opportunities and management actions (**Table 1, Figure 1**). These projects do not address the complete set and range of disturbances identified in the watershed, nor do they imply this is the only work identified from the full watershed assessment.

Projects 5, 6, 7, 8, 9, 13 and 14 in **Table 1** are each detailed in a 2-page project sheet, included as **Appendix J**. The remaining projects (1, 2, 3, 4, 10, 11, and 12) are briefly described below.

Table 1 **Projects identified with stakeholders as initial priorities under the Prosser Creek Watershed Assessment** (see Figure 1 for locations)

#	Project	Landowner(s)	Complexity
Prosser Creek, Watershed-Wide			
1	Roads and Trails Inventory and Assessment	TNF, TDLT, TDA	Medium
2	Baseline Monitoring Program	TNF, TDLT, TDA	Medium
Upper Prosser Creek Watershed (general)			
3	Sierra Nevada Yellow-Legged Frog Habitat Protection	TNF, TDLT, TDA	Medium
South Fork Prosser Creek			
4	SF Prosser Creek Meadow and Stream Restoration (Coyote Crossing)	TDA	High
5	**South Euer Valley Road Improvements**	**TDA**	**Medium**
6	**SF Prosser Creek Meadow and Stream Restoration (Cowboy Crossing and Corral Area)**	**TDA**	**High**
7	**Crabtree Canyon Tributary Road and Trail Improvements**	**TDA, TDLT**	**High**
8	**SF Prosser Creek Meadow and Stream Restoration (Euer Valley Main Crossing)**	**TDA**	**High**
9	**SF Prosser Creek Meadow and Stream Restoration (Quickdraw Crossing)**	**TDA**	**Medium**

North Fork Prosser Creek			
10	Lower Carpenter Valley-Unditching	TDLT	Low
11	NF Prosser Creek, Fish Habitat Enhancement	TDLT	High
Lower Prosser Creek Watershed (general)			
12	Prosser Hill West Meadow Restoration	TNF	Medium
13	**Hobart Mills Reservoir Wetland Enhancement**	**TNF**	**High**
14	**Hobart Mills Tributary Meadow and Stream Restoration**	**TNF**	**Medium**

Notes: TDA = Tahoe Donner Association; TDLT = Truckee Donner Land Trust; TNF = Tahoe National Forest; **bold** font indicates projects detailed in 2-page project sheets.

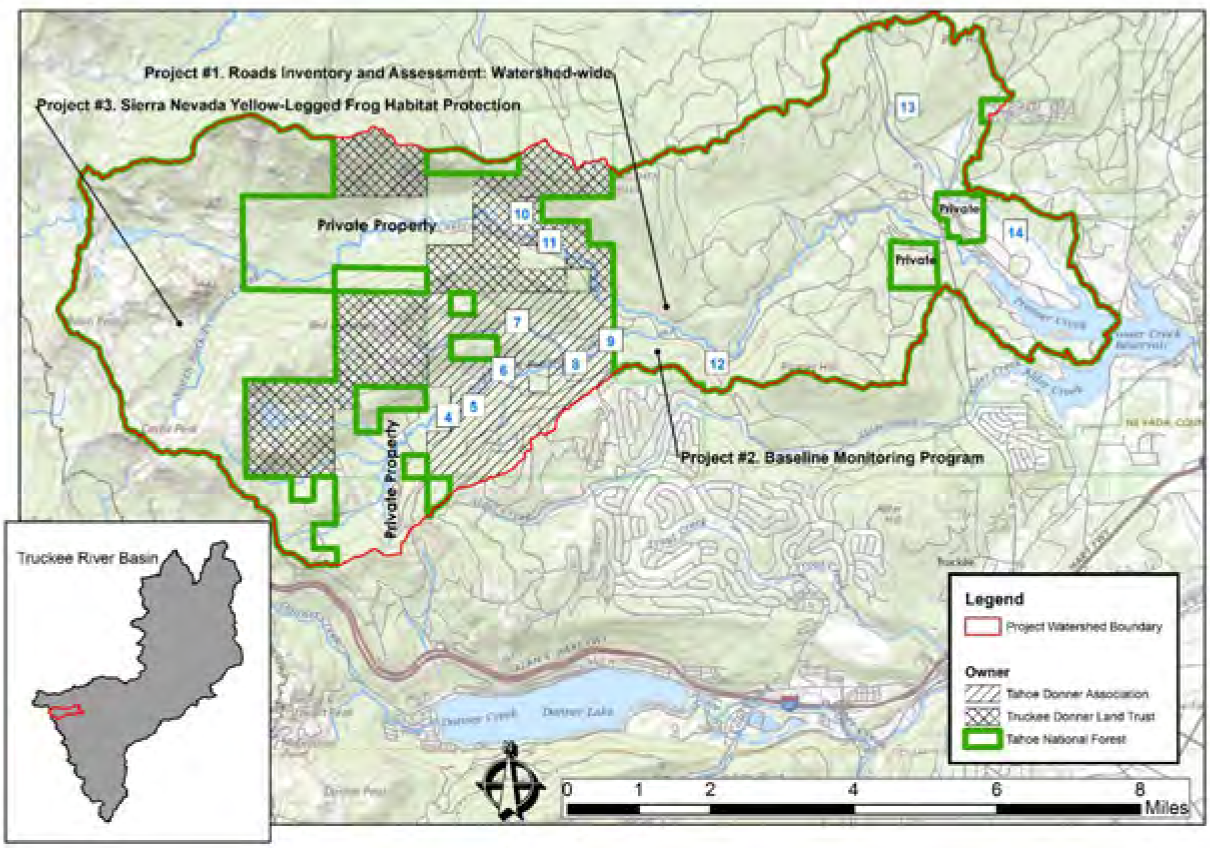

Figure 1 Project Location Map, Prosser Creek Watershed

Project 1: Roads and Trails Inventory and Assessment

The Prosser Creek Watershed Assessment identified a complex network of former and existing road, trails, and railroad grades throughout the watershed. A flow accumulation analysis, completed as part of the watershed assessment, suggests that many roads in the watershed disrupt natural drainage patterns and, in some cases, divert and capture tributary flow. Over time, these modifications to natural drainage have likely increased runoff and erosion. Downstream, these processes impair channel and meadow habitats. For example, channels are heavily widened and incised into meadow surfaces with channel-floodplain functions impaired. An incised channel has promoted a lower groundwater table and compromised meadow condition and habitat.

Project 1 is a management recommendation to conduct a more detailed Roads and Trails Inventory and Assessment than was carried out during the assessment reconnaissance work. We recommend that the flow accumulation analysis be field-verified at each of the locations where roads and trails appear to disrupt natural drainage pathways and additional locations be documented where road capture occurs but may not be reflected through remote sensing. From the detailed field assessment, appropriate management practices and drainage improvement recommendations can be developed and prioritized throughout the watershed. Recommendations may range from road and drainage improvements for recreation or emergency access to road and trail decommissioning or restoration of abandoned roads and railroad grades.

As of October 2021, a Roads and Trails Inventory and Assessment is underway and expected to be completed by Fall 2022.

Project 2: Baseline Monitoring Program

Many of the projects identified in this assessment were selected based on their potential benefits to watershed resources and functions. Reductions in sources of excessive runoff and sediment may improve conditions downstream to the point where future restoration projects are feasible or made more manageable. Therefore, a baseline monitoring program should be planned and implemented to establish baseline conditions and used to evaluate project effectiveness or quantify cumulative benefits from implementation of multiple projects.

Baseline monitoring may include a single landowner/stakeholder or require coordination across different landowners, depending on which projects are implemented. A monitoring plan should address the key target conditions or indicators of change and should be measurable. A monitoring plan should clearly define the goals and objectives, address an appropriate scale both time and space, and select appropriate monitoring elements to address the goals and objectives. For example, if fish habitat enhancement is a goal (Project 11), appropriate metrics to measure physical and biological habitat should be selected for measuring change. These may include repeat surveys to assess spawning and rearing habitat, pool conditions, cover, and benthic macroinvertebrates. H.T. Harvey & Associate's LCT Assessment (2020) may be included as a baseline monitoring summary. Similarly, if channel-meadow hydrologic connectivity is a goal (Projects 4, 6, 8, 9, and 14), establishing repeat surveys of geomorphic cross-sections and high-water marks could be a simple metric for measuring changes in channel geometry and frequency of meadow flooding. Establishing a stream-gaging station could also provide context for flood magnitude, frequency and duration across different year types (i.e., dry, average, wet).

A baseline monitoring program typically uses the 'before-after' approach to evaluate how a project affects its environment; however, if baseline monitoring is limited to a short period (e.g., single year) and that year is characterized as an outlier or extreme it may not provide a good basis for comparison. In this case, some monitoring programs expand to a 'before-after, control-treatment' monitoring approach. This approach adds a control site to the monitoring and is evaluated over the same time to account for environmental variability and temporal trends found in both the control and treatment areas, and thus, increases the ability to differentiate treatment effects from natural variability. However, selection of a 'control' site is sometimes difficult or unavailable. In either case, monitoring can increase our understanding of how projects on a watershed scale interplay with downstream areas and inform future restoration opportunities.

Project 3: Sierra Nevada Yellow-Legged Frog Habitat Protection

In 2020, H.T. Harvey & Associates identified multiple areas in the upper watershed as existing or potential Sierra Nevada Yellow-Legged Frog (SNYLF) habitat. The assessment documented only a few locations with known occurrences; however, it also identified multiple areas that may support SNYLF habitat. Locations with the highest ranking are located on Tahoe National Forest lands in the headwaters of North Fork Prosser Creek.

Many of the areas are remote; however, recreation and wildfire may present threats to habitat. Future trail development should take protection of these areas into account, including avoiding potential SNYLF habitat and a buffer around that habitat. Open water habitat may be subject to sediment filling after a severe wildfire. Therefore, habitat contributing areas should be delineated and forest health assessed to identify if management actions to reduce the severity of wildfire can be implemented, or if other actions can be taken to reduce the likelihood of sedimentation following a fire. Finally appropriate post-fire restoration plans should be developed and implemented to reduce the amount of time that habitat may be impaired following a severe wildfire.

Project 4: South Fork Prosser Creek Meadow and Stream Restoration (Coyote Crossing)

A year-round recreational trail crosses the South Prosser Creek at the western boundary of Tahoe Donner Association (TDA) property in Euer Valley and is informally known as the 'Coyote Crossing'. The trail bisects a wet meadow and crosses the creek using multiple culverts and boards. The existing infrastructure and trail alignment is causing meadow and stream degradation.

As of early 2021, TDA, in partnership with TRWC, is moving forward on an improved stream crossing and trail realignment design. Project implementation is anticipated in 2023.

Project 10: Lower Carpenter Valley—Unditching

Multiple seeps and springs originate along the lower hillside of the northern edge of the Lower Carpenter Valley meadow complex. Perennial flow from these features supports the meadow, which was recently acquired by the Truckee Donner Land Trust in order to preserve one of the largest meadow complexes in Northern California. Historical ranching activities in the 1960s created ditches across the meadow (**Figure 2**). Restoration of the natural swale geometry and flow paths across the meadow would further enhance the existing meadow and restore the natural hydrology. This project is simple in scope and can likely be executed by hand labor.

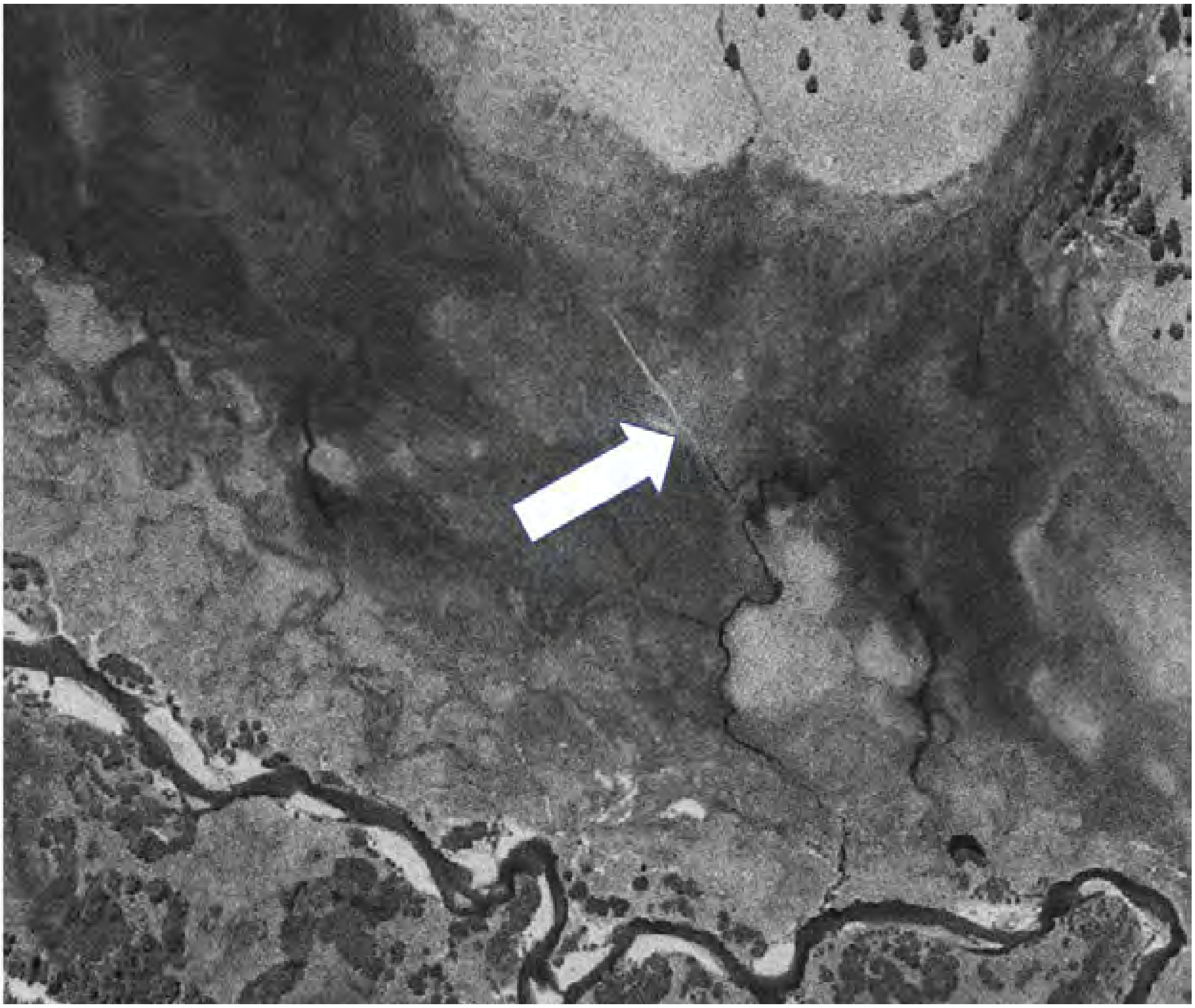

Figure 2 Project 10, Historical aerial imagery showing an example of ditching across Lower Carpenter Valley, Prosser Creek Watershed

Project 11: North Fork Prosser Creek, Fish Habitat Enhancement

H.T. Harvey & Associates evaluated the feasibility of reintroducing Lahonton Cutthroat Trout (LCT) to the North Fork Prosser Creek in Lower Carpenter Valley and found that reach supports abundant spawning habitat but is limited in rearing habitat. Furthermore, low-flow refuge is extremely limited with a high percentage of failing banks and sparse cover. Reintroduction of LCT was found to be infeasible based on the habitat condition and length of contiguous habitat available. However, TDLT has identified recreational fishing of existing non-native species as a public benefit.

Project 11 is a could be implemented to enhance and restore fish habitat. Introduction of instream wood and bankside vegetation would generate more complex habitat and cover in the short term. However, we would also suggest prioritization of upland restoration to mitigate the sources of channel degradation through Carpenter Valley.

Project 12: Prosser Hill West Meadow Restoration

Road drainage and vehicle trespass have degraded a 3.8-acre meadow supported by groundwater discharge and natural runoff located at the junction of Carpenter Valley Road and Forest Service Road 89-33 (**Figure 3**). Both roads are unpaved, incur heavy use, and have insufficient drainage. Carpenter Valley Road concentrates runoff into an inboard ditch and discharges towards the meadow at two existing culverts. Flow from adjacent hillsides that would otherwise reach the meadow is captured by FS 89-33 and diverted to an adjacent drainage. Erosion of the road surface and inboard ditch contributes excess sediment to the meadow, resulting in sediment deposition and associated impacts to meadow habitat. Finally, vehicle trespass has generated ruts and soil compaction in multiple areas of the meadow.

Restoration opportunities include: (1) improving road drainage, (2) sediment capture, and (3) restricting vehicle access. An expanded project could address nearly 2.0 miles of FS-89-33, which is degraded in many locations by stream capture, measurable erosion, and alteration of natural flow pathways.

Figure 3 Project 12, Prosser Hill West Meadow, Prosser Creek Watershed

LIMITATIONS

The objective of this report is to provide the Truckee River Watershed Council and stakeholders with a summary of restoration and protection opportunities identified through a desktop and field-focused watershed assessment and collaboration with stakeholders in the Prosser Creek Watershed. This report it is not intended to serve as a basis for flood management or detailed floodplain planning, both of which are conducted by well-defined and separate procedures, and which frequently require multiple lines of evidence. Use of these results for purposes other than those identified above can lead to significant environmental, public-safety or property losses.

We do encourage those who have knowledge of other events or processes which may have affected the project sites or channel system since they were assessed in 2020 to let us know at the first available opportunity.

CHAPTER 1

FIGURES

FIGURES

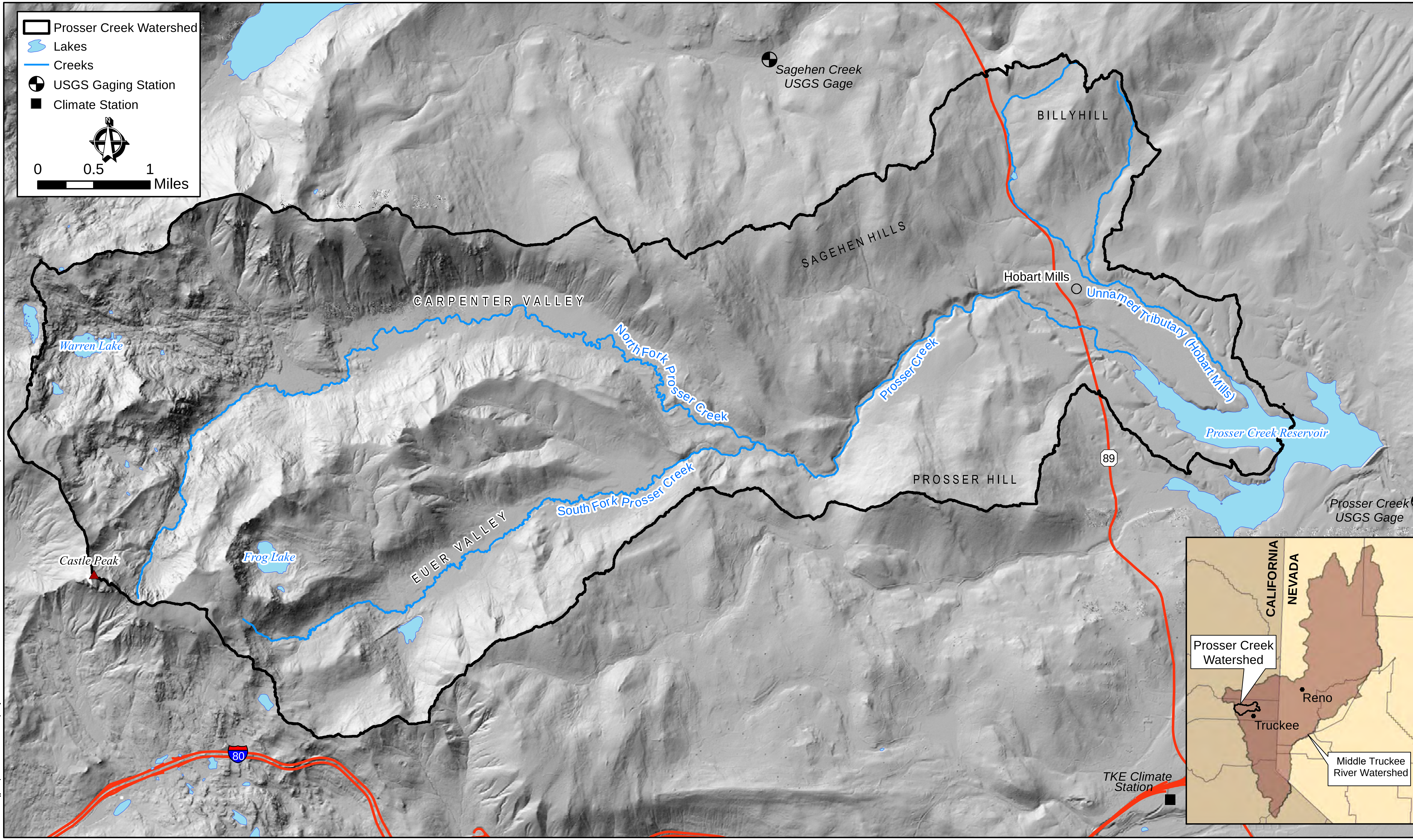

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Figure 2-1. General Location Map, Prosser Creek Watershed, Nevada County, California

Basemap Source: USFS LiDAR 2014

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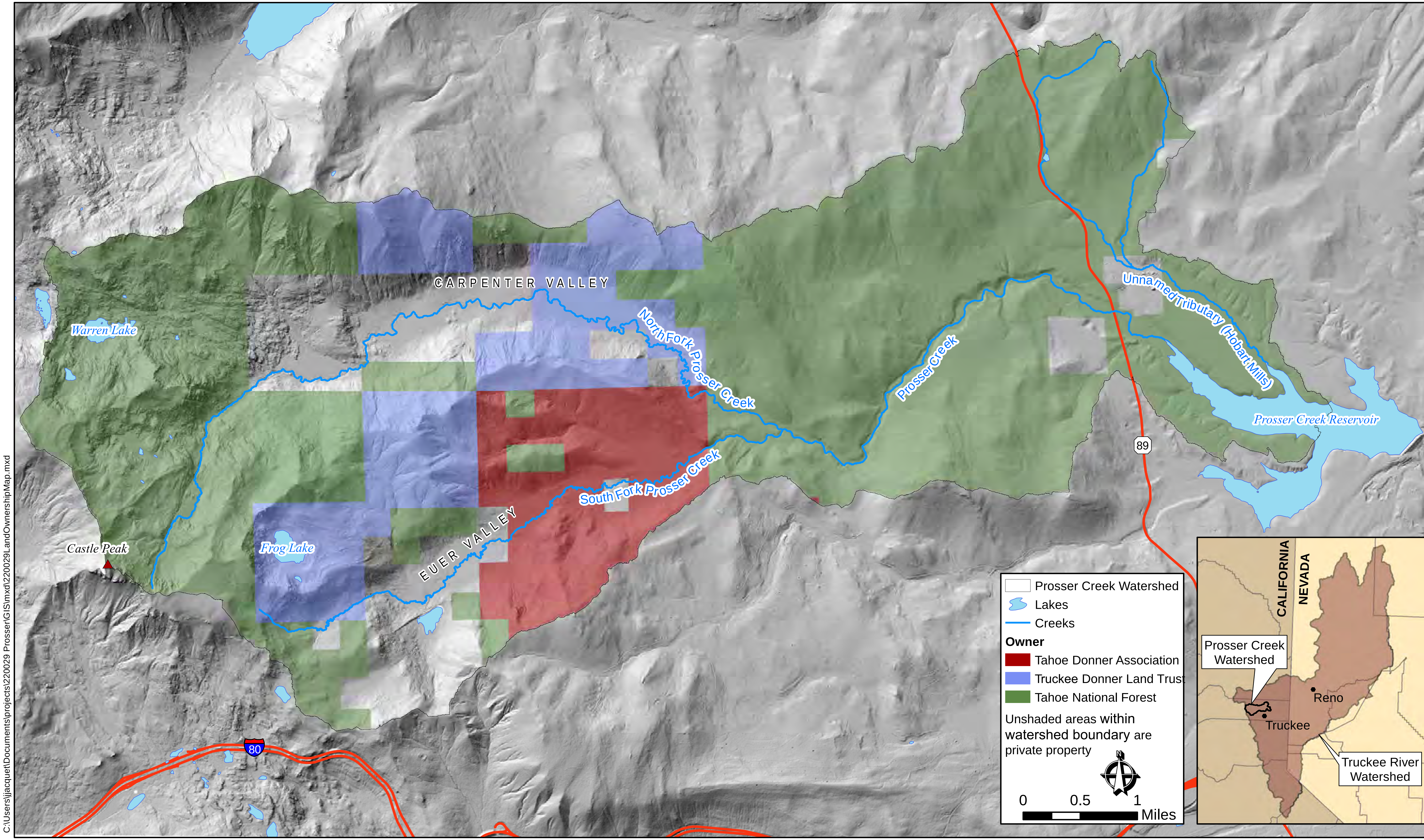

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Figure 2-2. Land Ownership Map, Prosser Creek Watershed, Nevada County, California

Basemap Source: USFS LiDAR 2014

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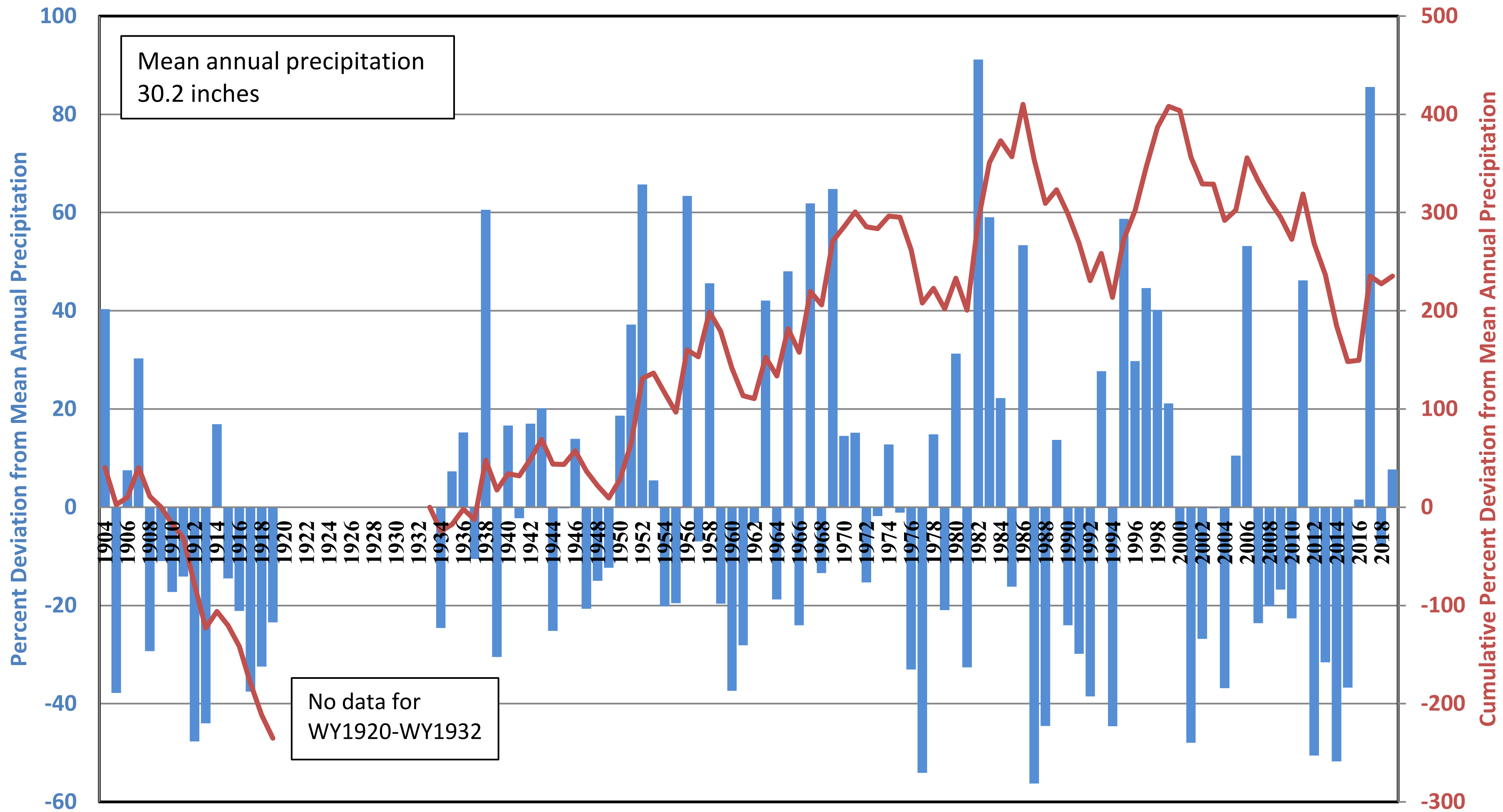

Source: station TKE(Truckee), US Forest Service, 6,020 feet elevation, California Data Exchange Center (CDEC)

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Figure 2-3. Percent Deviation and Cumulative Percent Deviation from Mean Annual Precipitation, Truckee Ranger Station, Truckee, California, WY1904-WY1919, WY1934-WY2019. The record illustrates alternating wet periods and dry periods; but more importantly, the period WY2000-WY2015 was one of the driest in this period of record with a dramatic decline in cumulative precipitation (deviation from mean), punctuated by periods of extreme precipitation, rain-on-snow events and other episodic events.

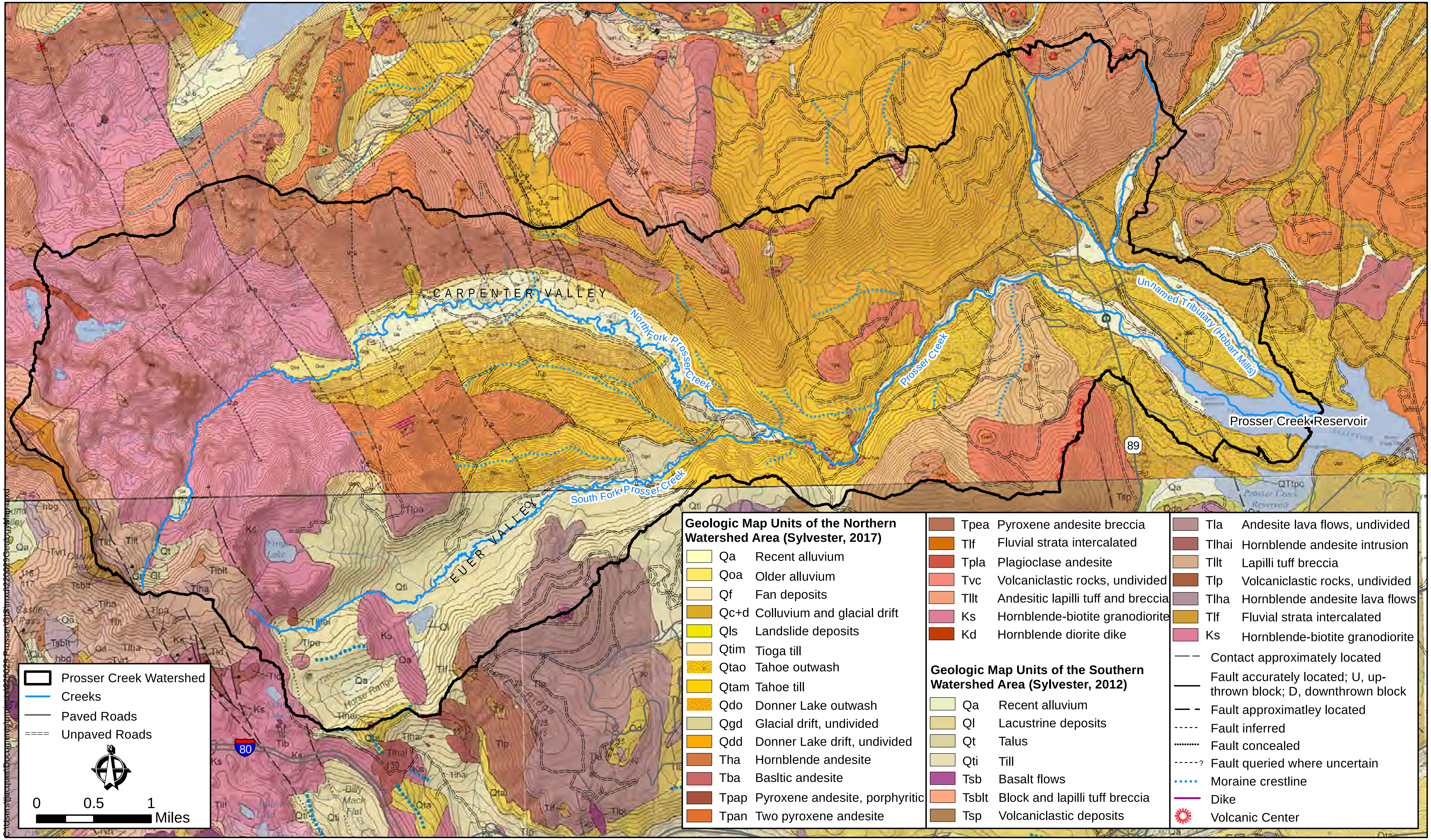

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Figure 2-4. Geology Map, Prosser Creek Watershed, Nevada County, California

Basemap Source: Geologic Map of the Independence Lake and Hobart Mills Quadrangle (Sylvester, 2017).
Geologic Map of the Tahoe-Donner-Pass Region (Sylvester, 2012)

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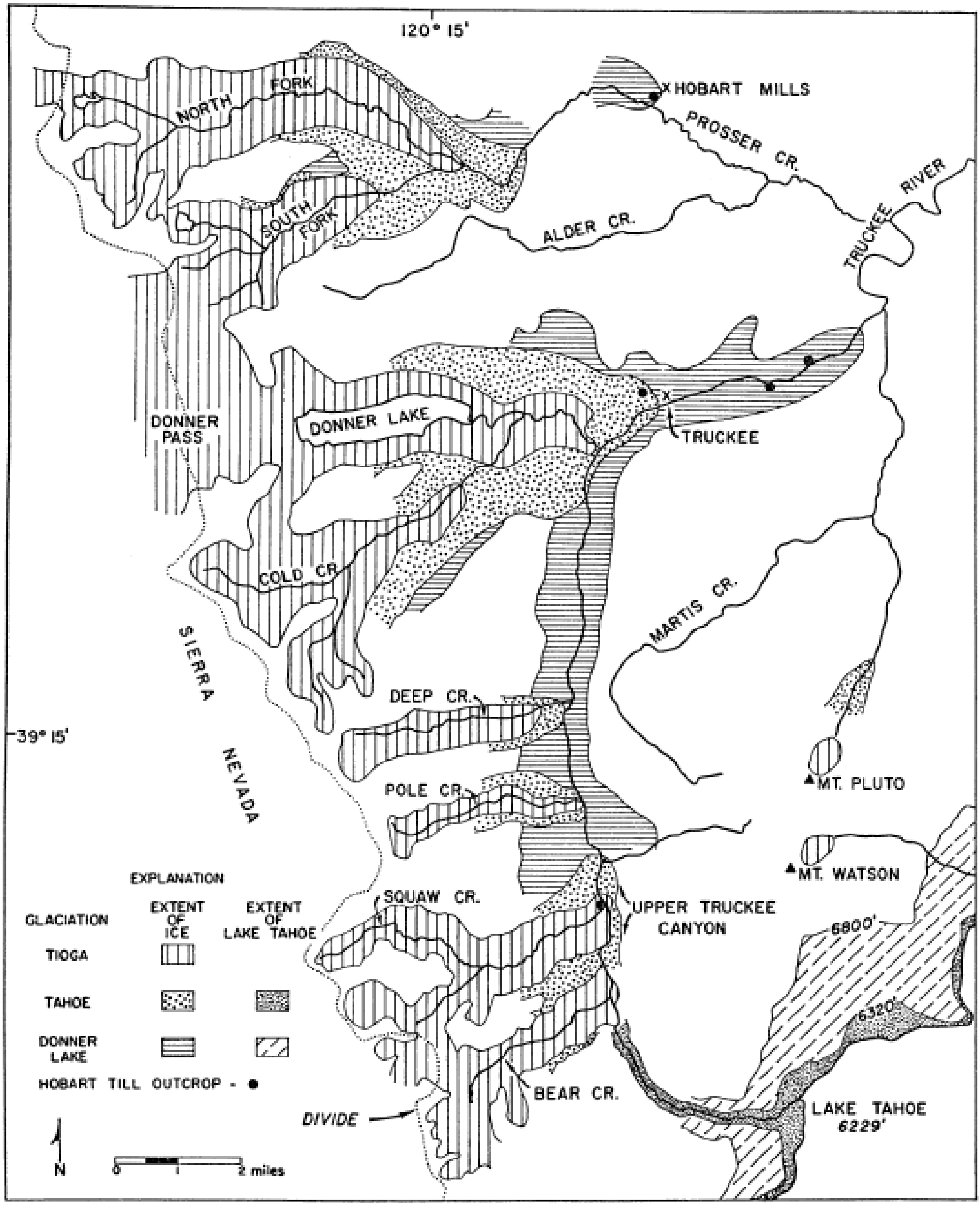

Source: Birkeland, 1964

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Figure 2-5. **Extent of Ice during Major Glaciations, Prosser Creek and Region, Nevada-Placer Counties, California.** Adapted from Birkeland, 1964

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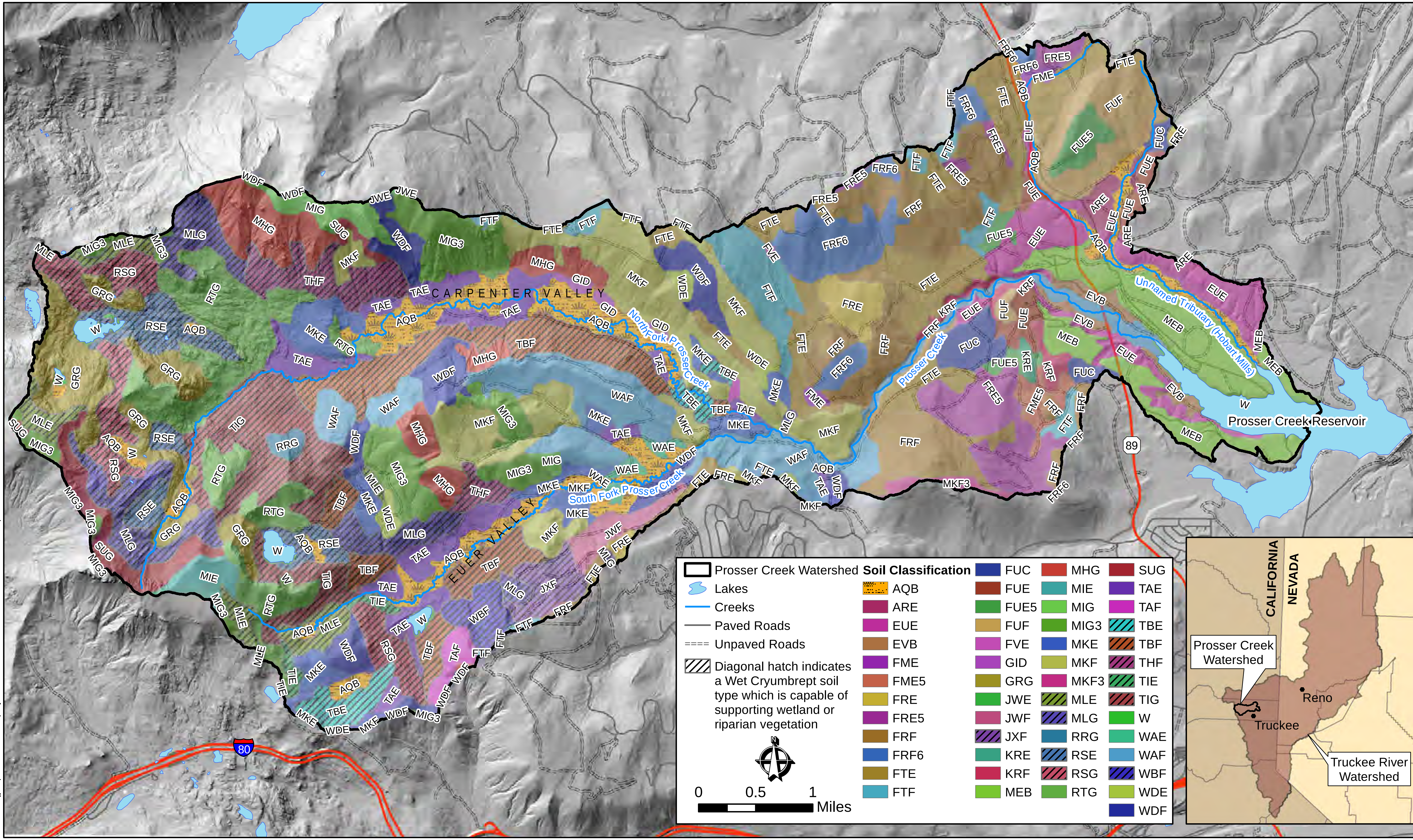

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Figure 2-6. Soils Map, Prosser Creek Watershed, Nevada County, California

Basemap Source: Hanes, 2002

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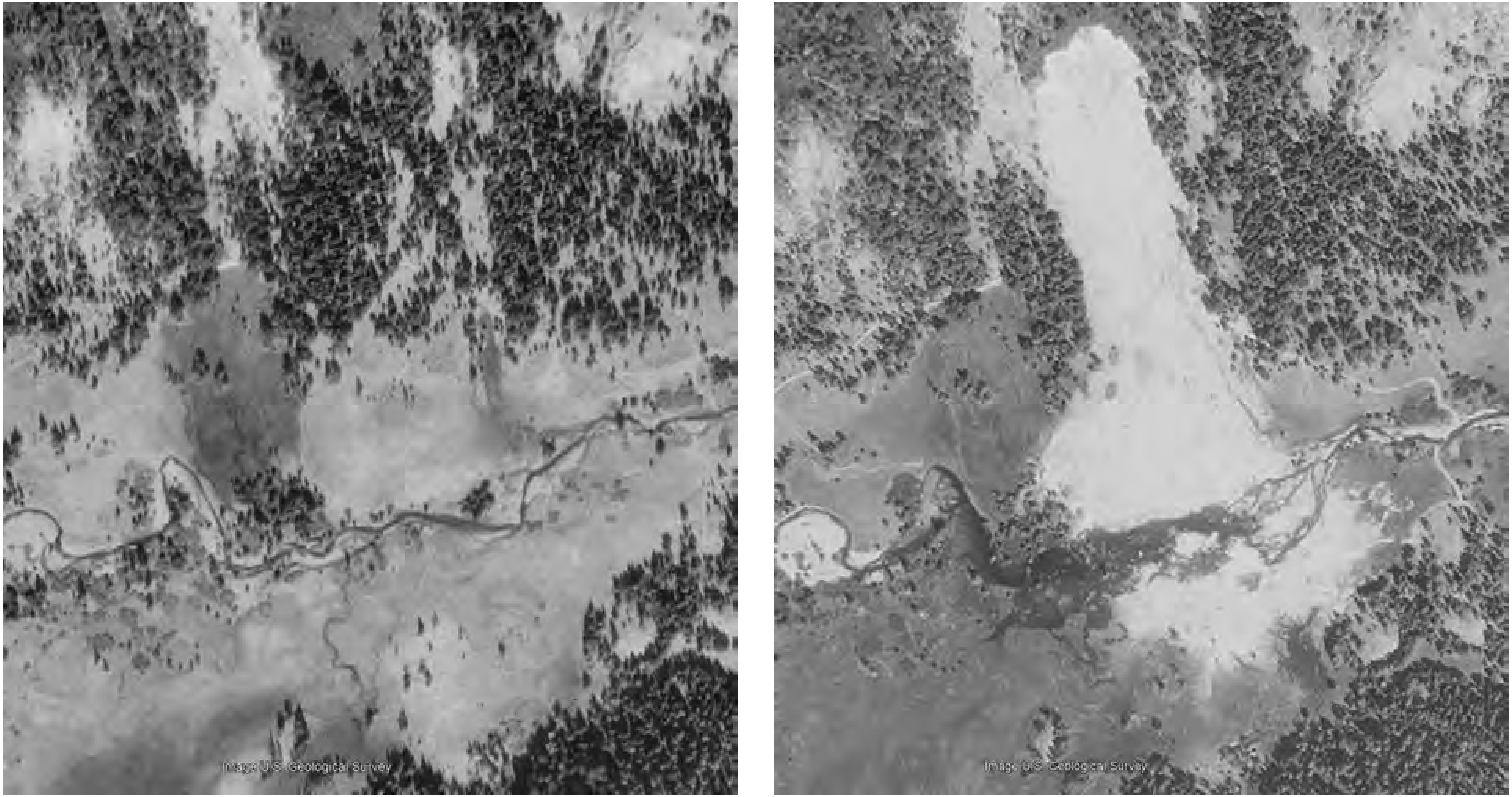

September 1993

August 1998

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Figure 2-7. Historical Aerial Imagery Showing Pre- and Post-Landslide, North Fork Prosser Creek, Nevada County, California

A landslide occurred in 1997 on the south slope of Carpenter Ridge measuring 2,300 feet long from crown to toe and 1,000 wide in the Valley. The landslide effectively dammed the North Fork of Prosser Creek.

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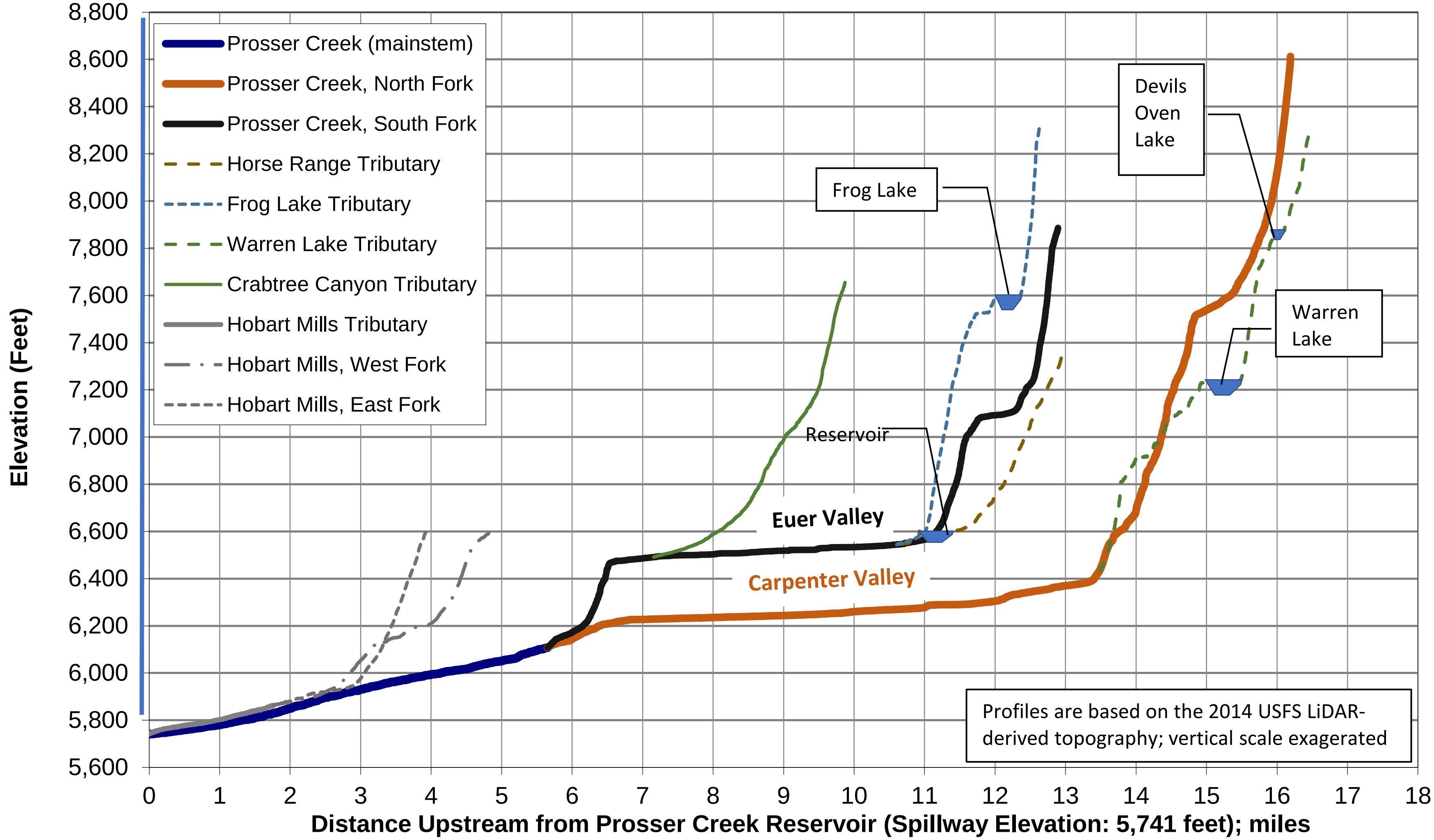

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Figure 2-8. **Longitudinal Stream Profile, Prosser Creek and Tributaries, Nevada County, California.**

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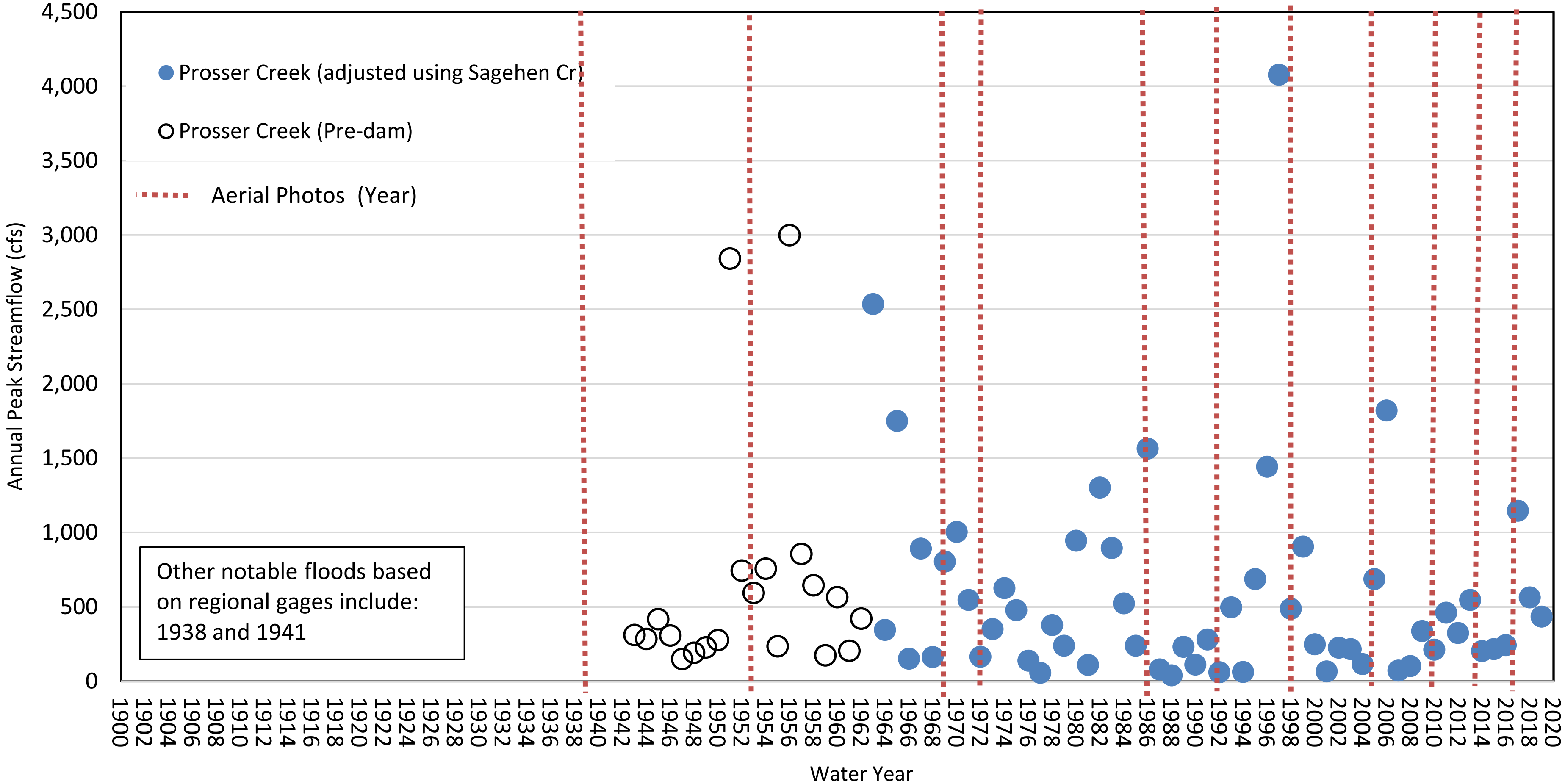

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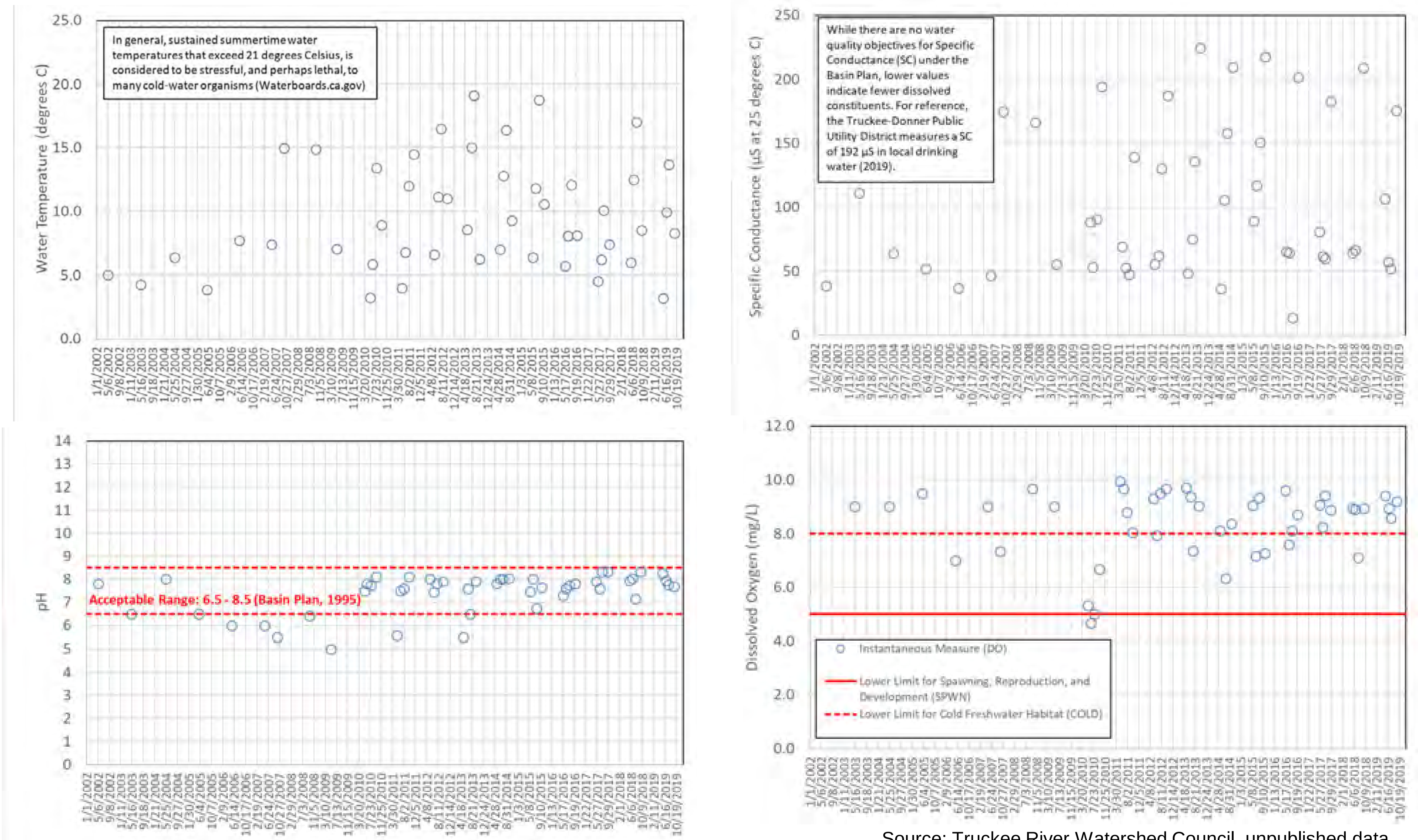
Figure 2-9. **Computed annual peak streamflow, Prosser Creek project watershed (34.8 sq. mi) Nevada County, California, Water Years 1943-2019**
Values are computed using unit-discharge from: (1) pre-dam Prosser Creek (USGS 10340500) and (2) Sagehen Creek (USGS 10343500). Available aerial photographs (dates) are shown as dashed vertical lines.

(c) 2020 Balance Hydrologics



Source: Truckee River Watershed Council, unpublished data

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Figure 2-10. Measured Water Quality, Prosser Creek at State Road 89, 2002-2019, Nevada County, California

Volunteer collected data exists for roughly 18 years for general water quality parameters.

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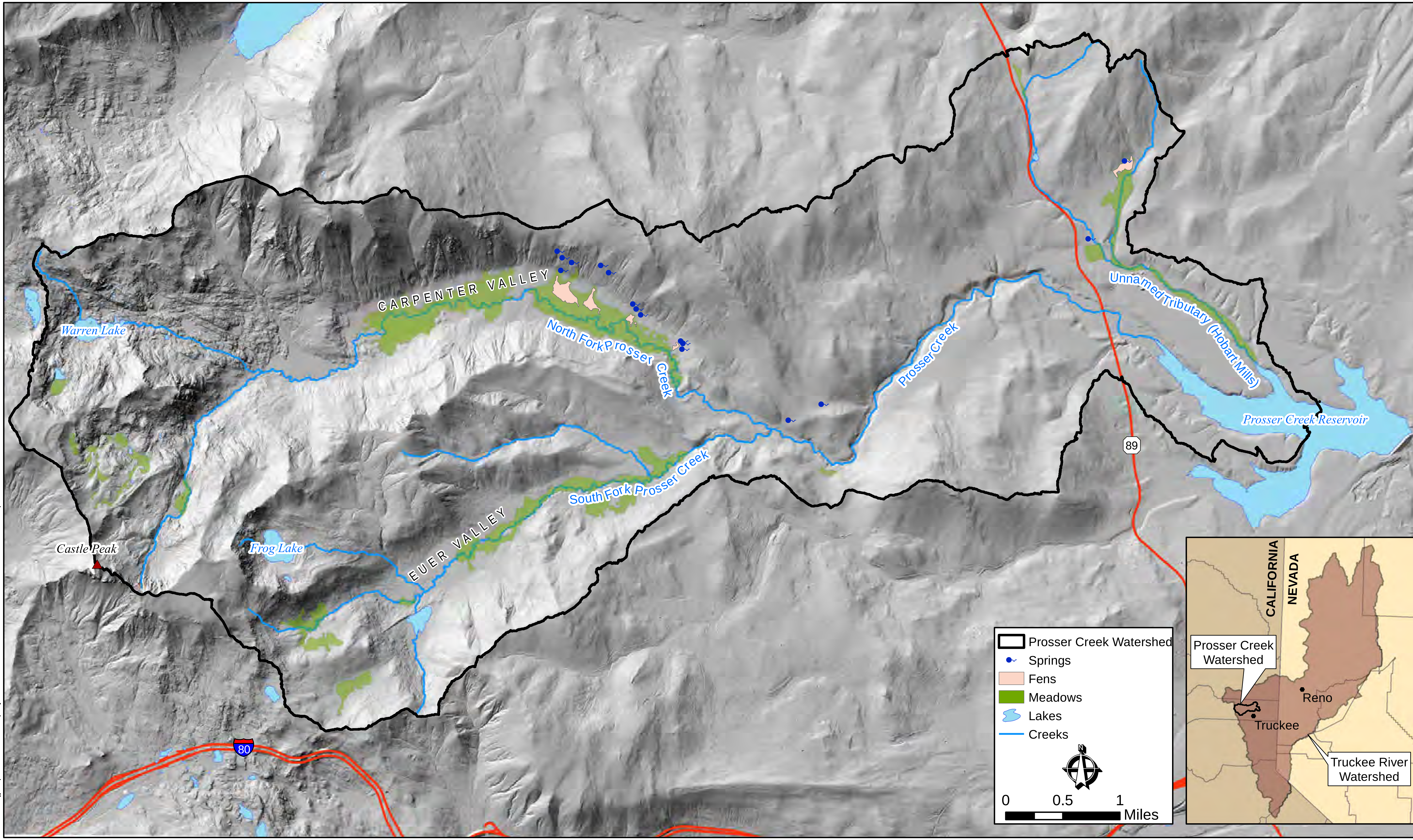

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Figure 2-11. Previously Mapped, Meadows, Fens, and Springs, Prosser Creek Watershed, Nevada County, California

Basemap Source: USFS 2014 LiDAR
Feature Sources: Dittes and Guardino, 2017; USFS, 2013

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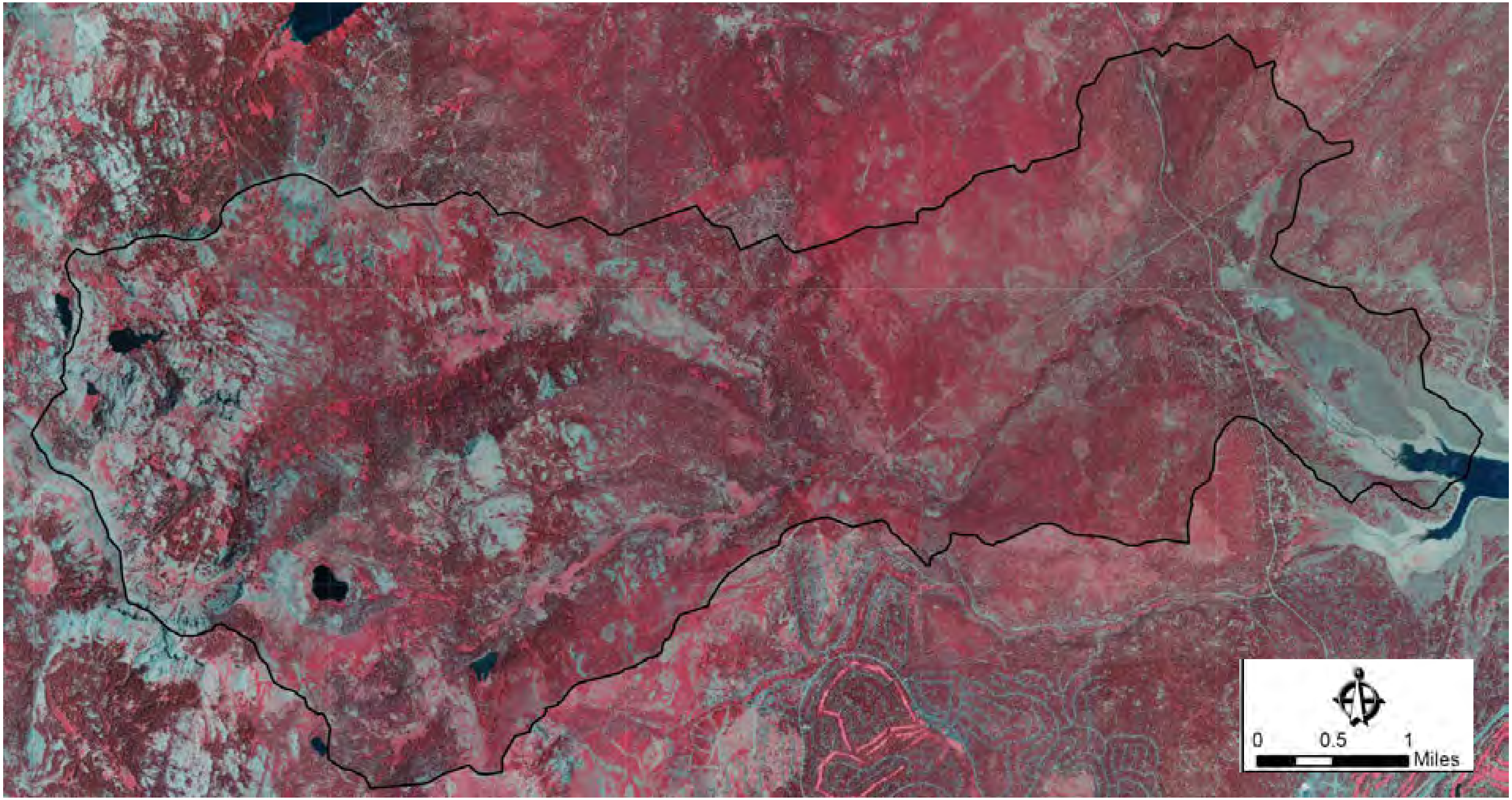

Source: Caltopo.com, NAIP, 2016

Figure 2-12. False-Color Infrared Aerial Imagery Showing Areas of Potential Shallow Groundwater or Vibrant, Healthy Vegetation (red), Prosser Creek project watershed, Nevada County, California

Bright red areas may indicate or suggest groundwater supported vegetation or habitats. Many of these areas include meadows, fens, and perennial channels that originate from hillside springs. Dark or black areas indicate bodies of open water (e.g., lakes, reservoirs).

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Source: Susan Lindstrom, 2020

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Figure 3-1. Hobart Mills, circa 1910s, Nevada County, California

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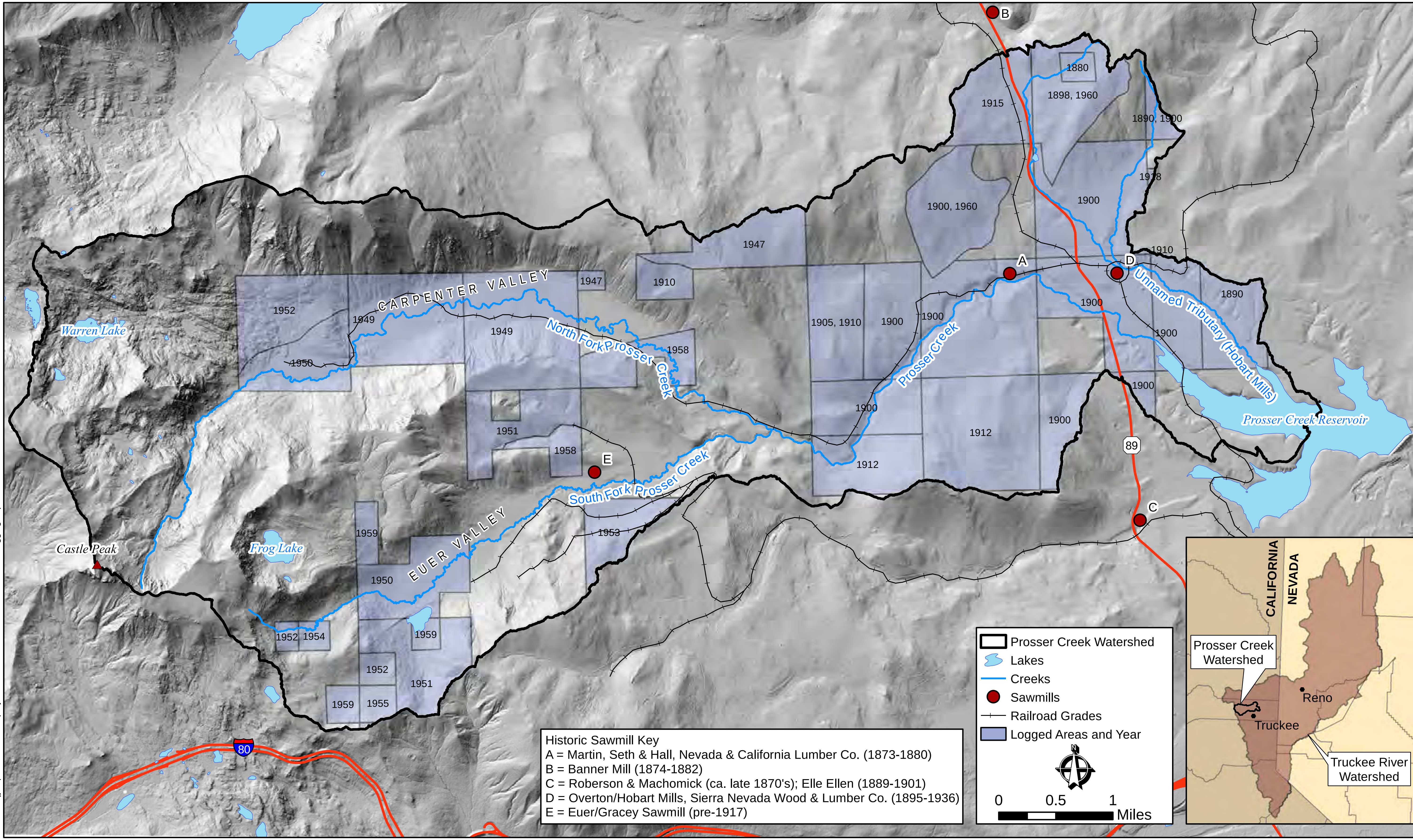

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Figure 3-2. Local and Regional Railroads, Sawmills, and Logged Areas, 1880-1963
Prosser Creek Watershed, Nevada County, California
Basemap Source: USFS LiDAR 2014
Historic Features Source: Lindstrom, 2020

© 2020 Balance Hydrologics, Inc.

Source: Susan Lindstrom, 2020

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Figure 3-3. Logging Railroad near Hobart Mills, (Date Unknown), Nevada County, California

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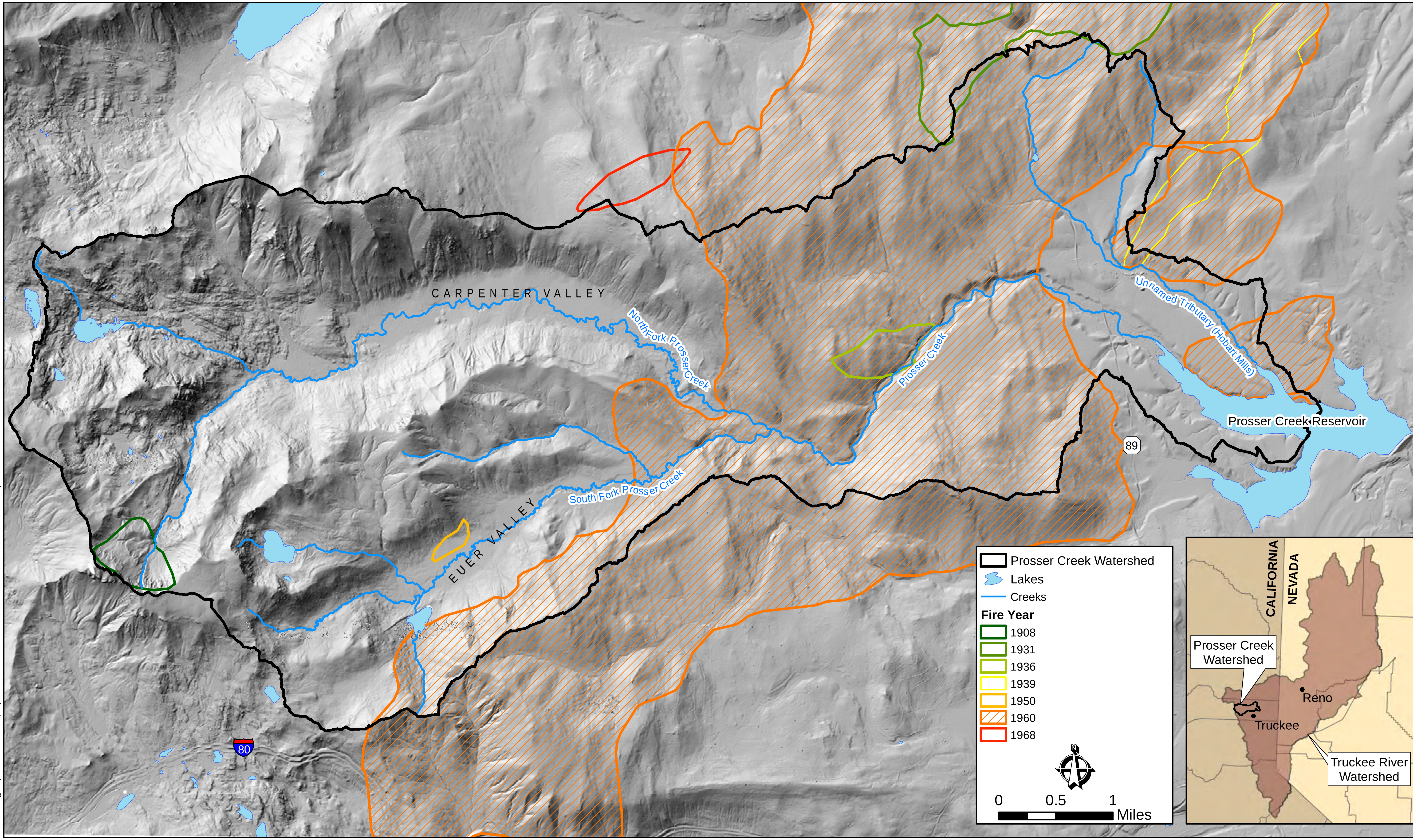

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Figure 3-4. Fire Perimeter Map, Prosser Creek Watershed, Nevada County, California

Basemap Source: USFS 2014 LiDAR and CAL FIRE 2019

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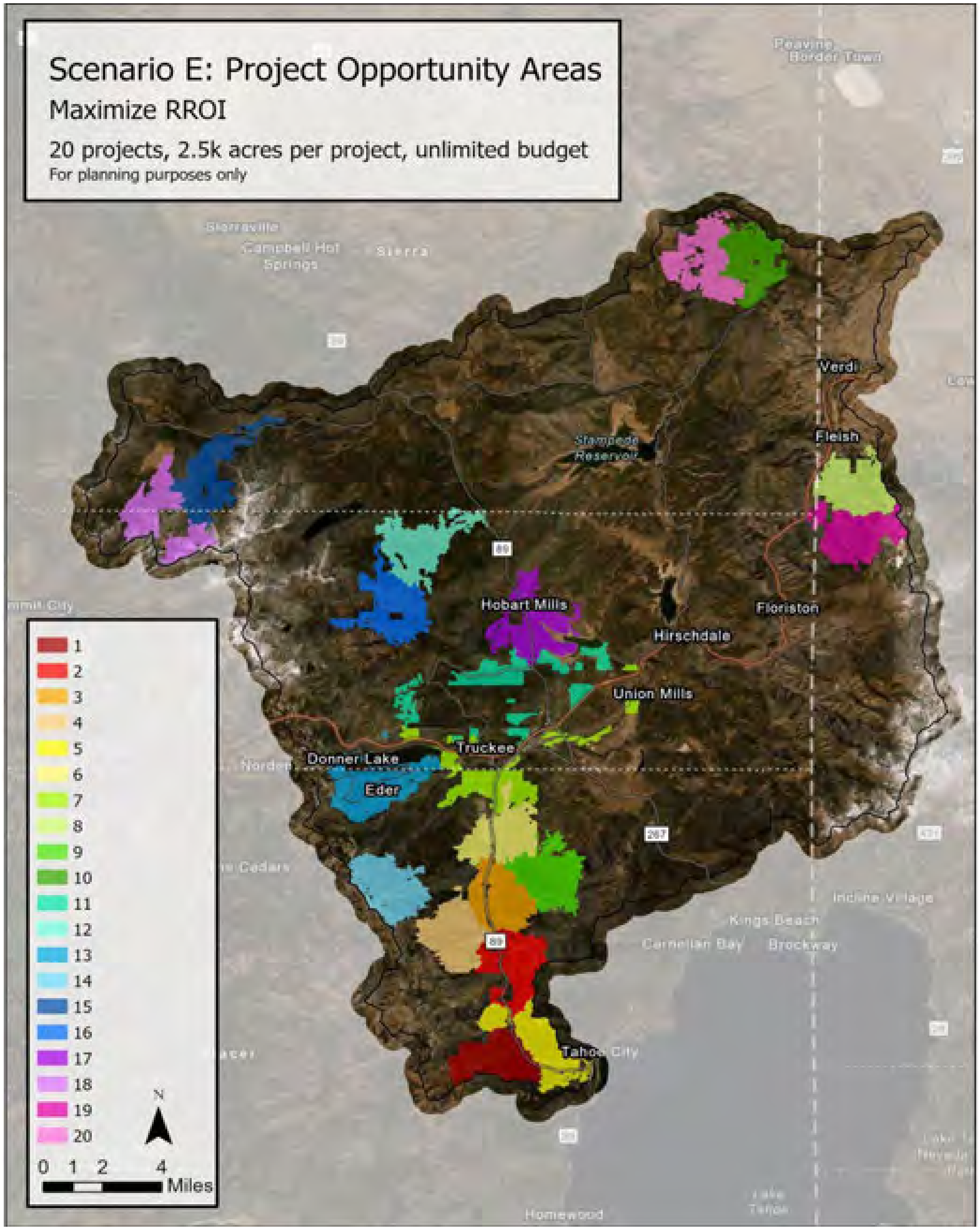

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Figure 3-5. **One of several scenarios from Middle Truckee River Watershed Forest Health Assessment , Technical Report (2022) showing parts of the Prosser Basin as the high priority for treatment.**

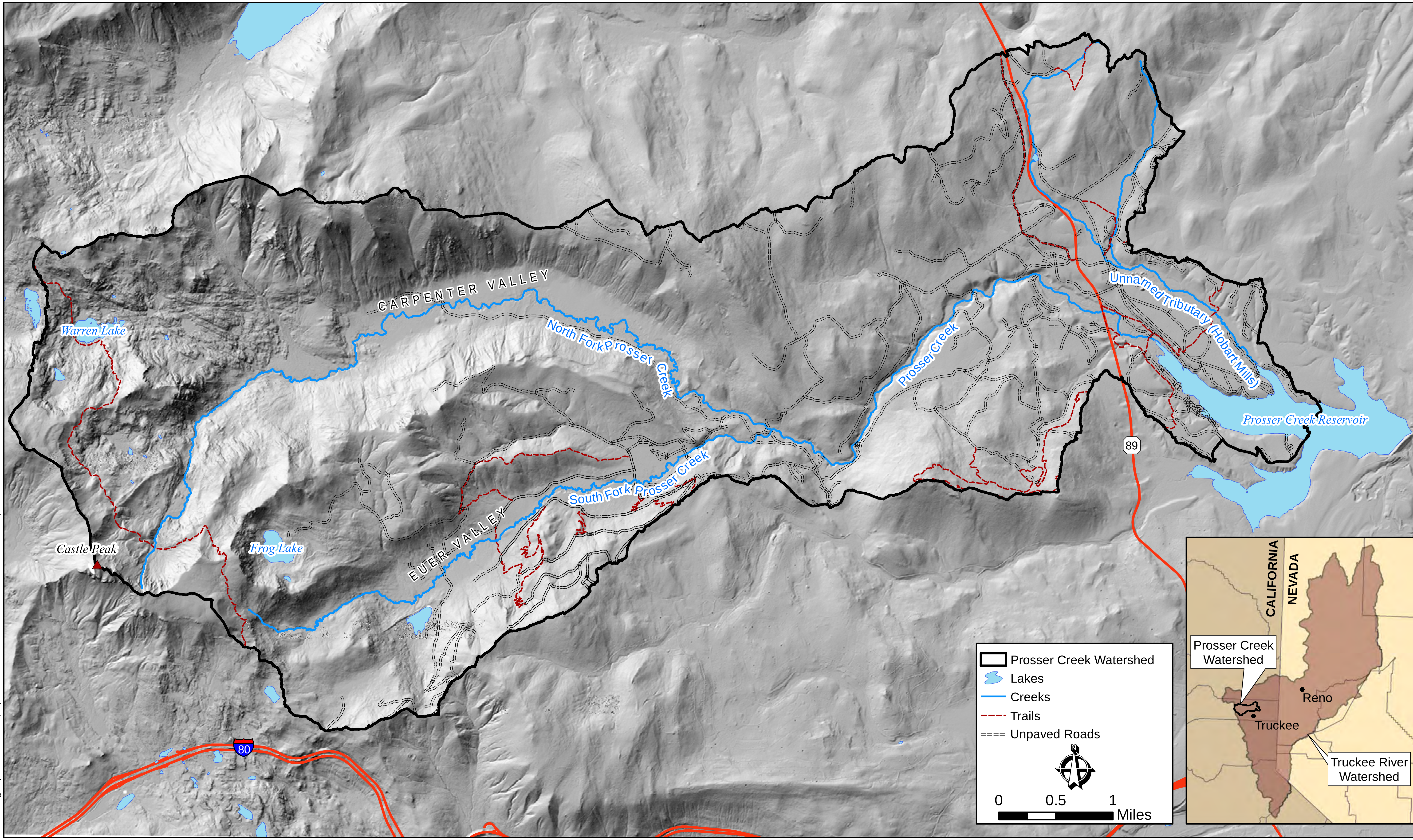

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Figure 3-6. Roads and Trails Map, Prosser Creek Watershed, Nevada County, California

Basemap Source: USFS LiDAR 2014

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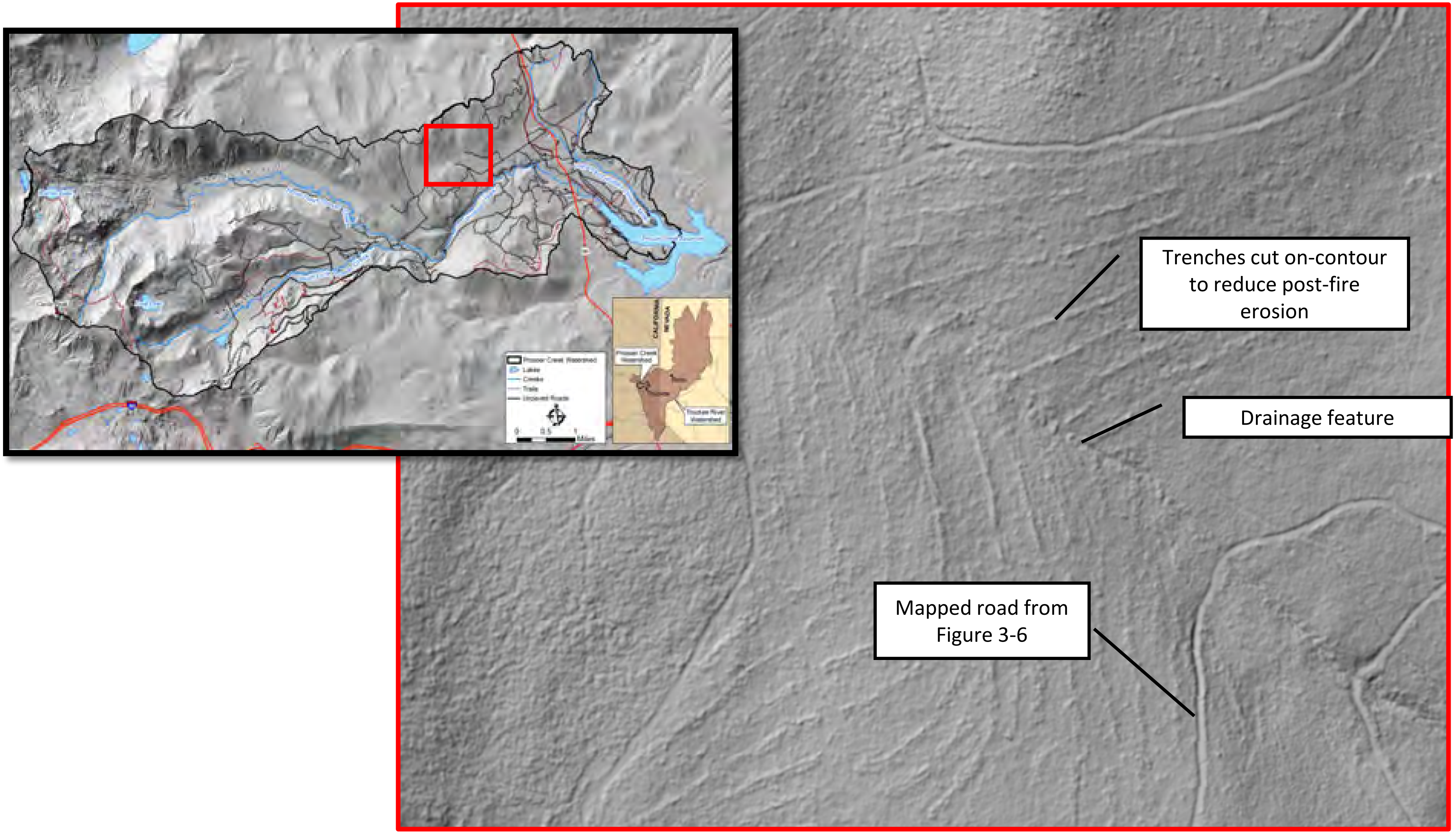

Source: OpenTopography.org

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Figure 3-7. Ground Disturbance Identified using LiDAR-Based Hillshade Map Sagehen Hills, Prosser Creek Watershed, Nevada County, California

© 2020 Balance Hydrologics

Source: Susan Lindstrom, 2020

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Figure 3-8. Sheep Grazing in Upper Carpenter Valley (looking west), Circa 1901
Nevada County, California

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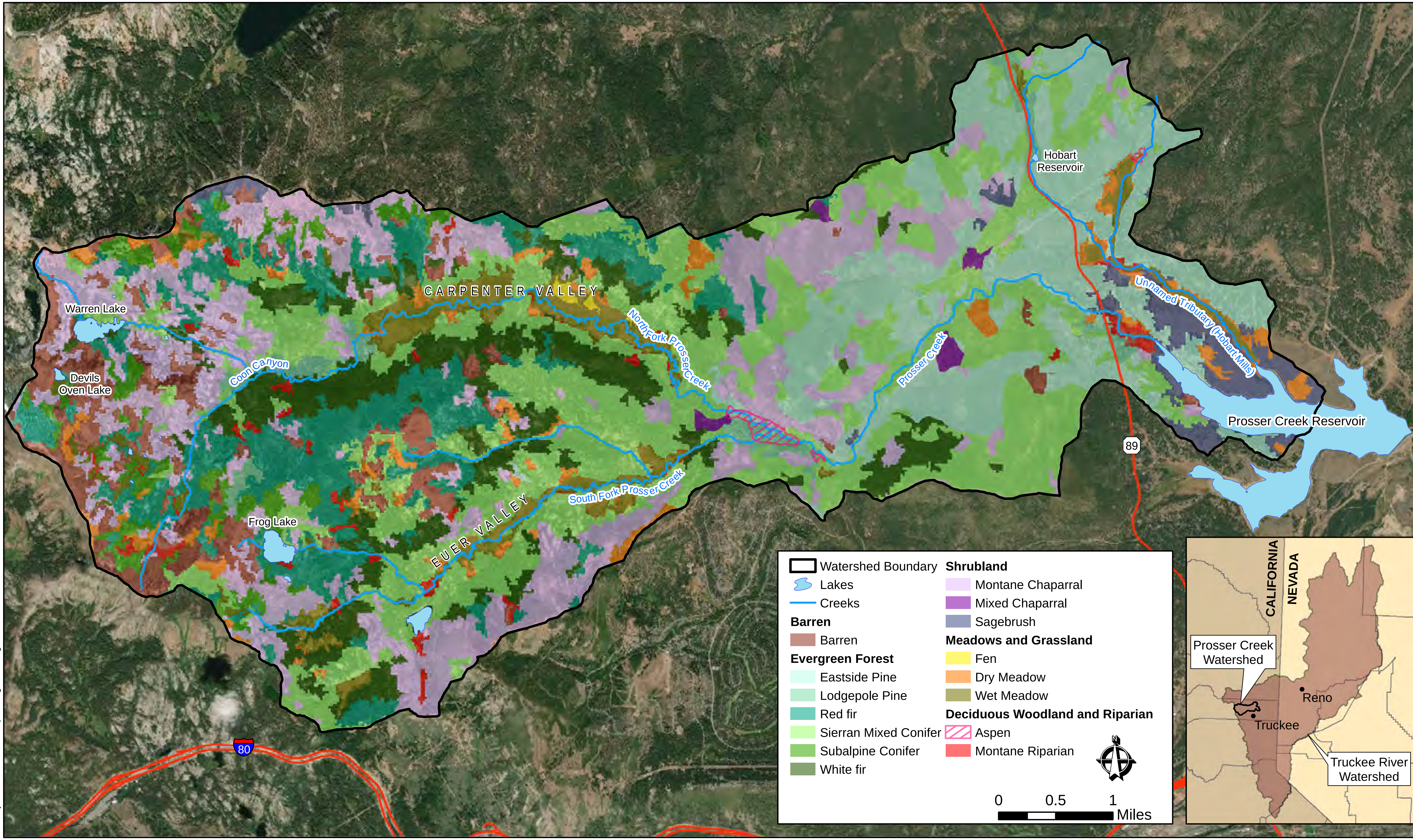

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Figure 4-1. Vegetation Communities
Prosser Creek Watershed, Nevada County, California

Basemap Source: Esri, Digital Globe

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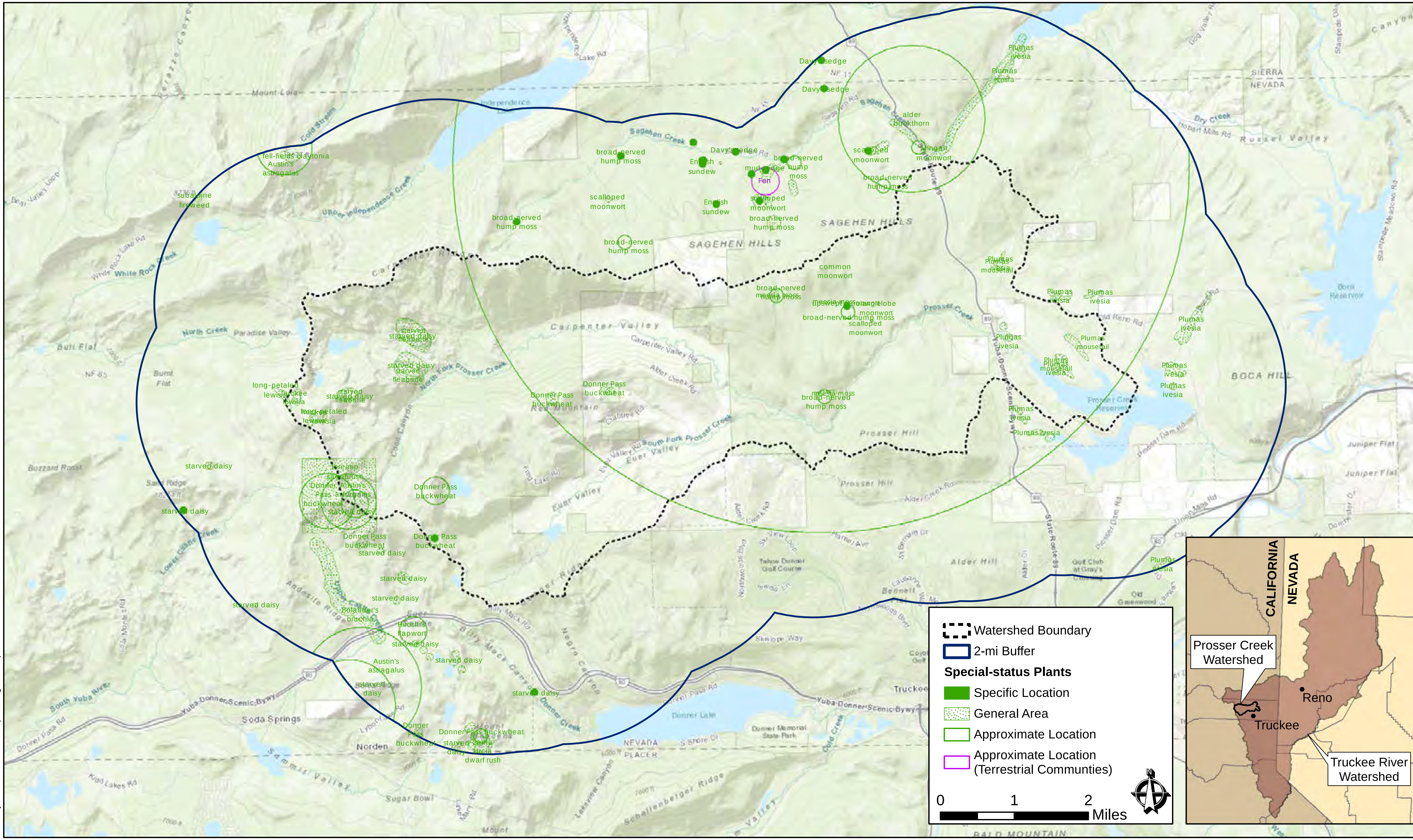

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Figure 4-2. Special-status Plants
Prosser Creek Watershed, Nevada County, California
Basemap Source: Esri, Garmn
Data: CNDDB, Tahoe NF NRIS

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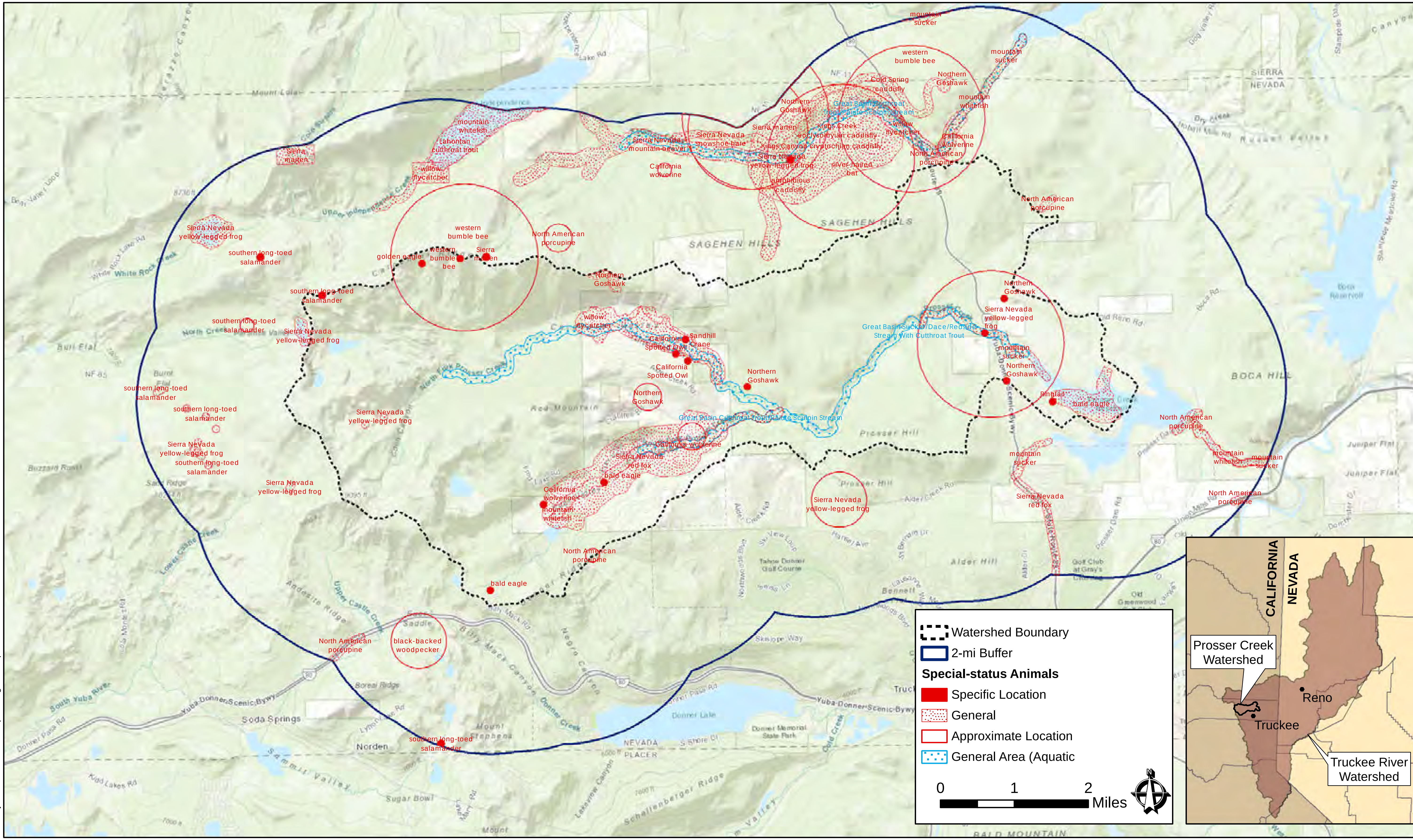

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Figure 4-3. Special-status Animals
Prosser Creek Watershed, Nevada County, California

Basemap Source: Esri, Garmn
Data: CNDDB, Tahoe NF NRIS

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CHAPTER 1 APPENDICES

APPENDIX A

History, Culture, and Historical Land-Use (Lindstrom, 2020)

PROSSER CREEK WATERSHED ASSESSMENT
A CONTEXTUAL HISTORY OF HUMAN LAND USE
AND ENVIRONMENTAL CONDITIONS

WORKBOOK

(U.S. Forest Service Report Number: R2020051700049)

report prepared by

Susan Lindström, Ph.D. (RPA), Consulting Archaeologist

Truckee, CA

report prepared for

Balance Hydrologics, Inc.

Truckee, CA

on behalf of

Truckee River Watershed Council

Truckee, CA

September 2020

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HISTORIC MAPS

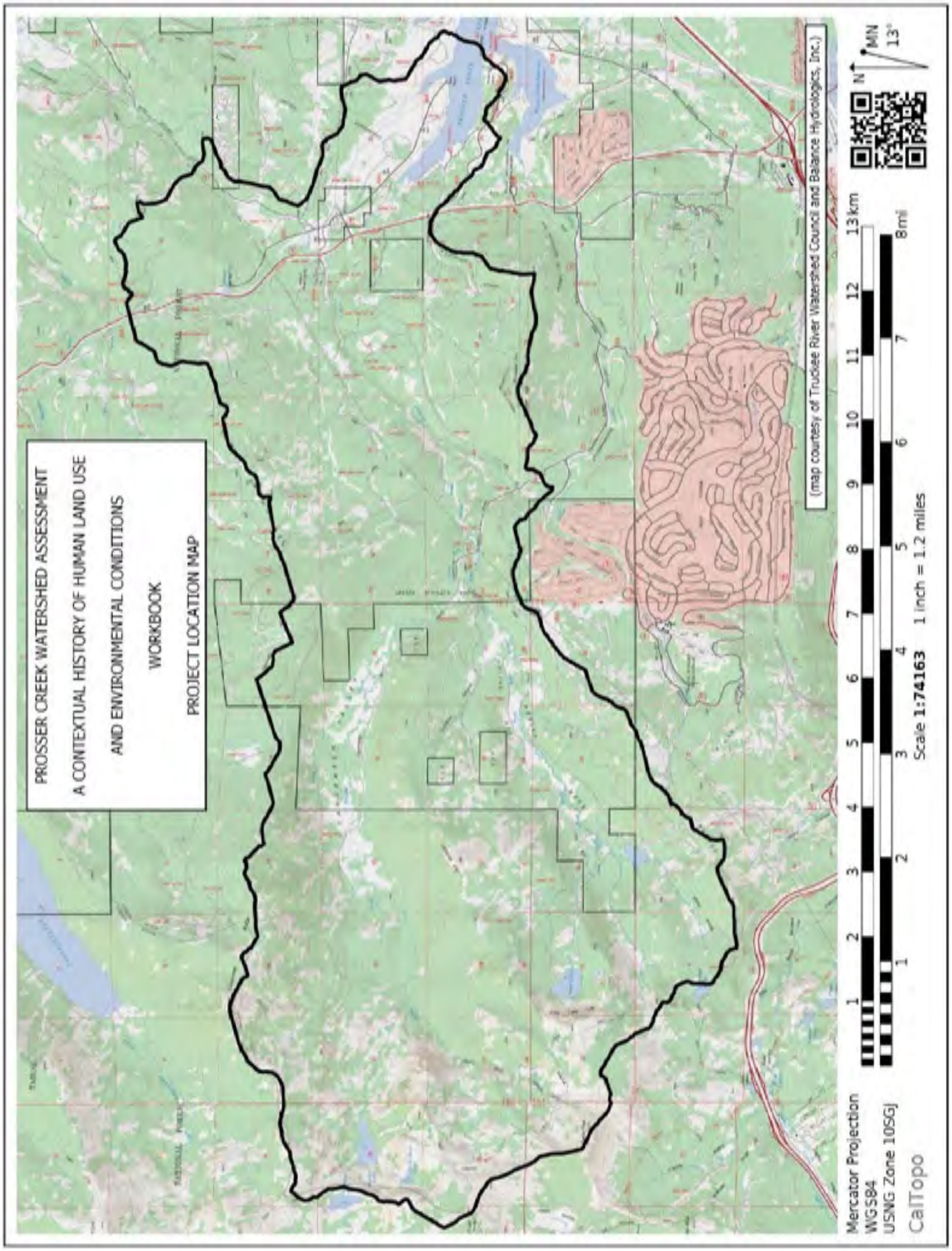
PROJECT DESCRIPTION AND SCOPE

The Prosser Creek sub-basin encompasses an approximate 35-square-mile watershed that drains into the Middle Truckee River watershed. It is situated within the Truckee Basin approximately three miles north of the Town of Truckee, Nevada County (see figure). The study area falls within the following legal locations: Township 18 North, Range 14 East, sections 24, 25, 35, 36; Township 17North, Range 14 East, Section 1; Township 18 North, Range 15 East, sections 13-17, 20-29, , 32-36; Township 17 North, Range 15 East, sections 2-4; and Township 18 North, Range 16 East, sections 9-11, 13-33, M.D.M. (Hobart Mills, Independence Lake, Norden, Truckee 7.5' quadrangles).

The Prosser Creek Watershed Assessment Project is part of a coordinated water management strategy sponsored by the Truckee River Watershed Council to analyze existing physical, social and historical conditions in the watershed and identify areas of disrupted natural functions in the forest, meadow and stream habitats, and develop restoration, recreation, and management and protection opportunities designed to provide the science and policy information needed to direct restoration and protection projects. To accomplish this, several key watershed attributes are addressed: hydrology, geology, geomorphology, biological resources, water quality, and current and historic land use. This information is then used to identify areas in the watershed where natural processes have been disrupted through anthropogenic actions (past or present), assess hydrologic, geomorphic and/or biological responses to these anthropogenic disturbances (largely associated with natural resource exploitation involving logging, grazing and recreation) and estimate future impacts. Using these data, existing watershed conditions are documented for areas where the ecosystem is functioning well and areas that are impaired. Results are incorporated into a prioritized list of future large- and small-scale restoration, management, and protection recommendations.

Although most of the study area is situated on federal land under the jurisdiction of the U. S. Forest Service (USFS) Tahoe National Forest (TNF) Truckee Ranger District (TRD), multiple private parcels are also included. Private land within the historic Hobart Mills, although excluded from field investigations, is of special interest as historical context for public lands surrounding the former sawmill townsite. The outlying network of logging railroads and logging camps that were based out of the mill town are important to the overall investigation in their impacts to stream zones and meadowlands throughout the upper and middle reaches of the Prosser Creek drainage. In addition, large portions of the Upper Prosser Creek watershed (e.g., Lower Carpenter Valley, Euer Valley, Frog Lake, Red Mountain, and other ridgeline properties) previously under private ownership have become or are in the process of becoming accessible to the public through efforts of the Truckee Donner Land Trust and opening the door for more comprehensive watershed planning.

To accomplish this work, the Truckee River Watershed Council retained a multidisciplinary team led by Balance Hydrologics, Inc. to evaluate the hydrology, biological resources and history of the Prosser Creek drainage to better assess prior and on-going impacts to its water quality and habitat. The Prosser Creek watershed embodies the consequences of a long legacy of human and environmental history. It follows that interdisciplinary science team collaboration is a productive means to explore the direct link between culture history and contemporary restoration project design and implementation and provide the science and policy information needed to establish a baseline to direct restoration and protection projects within the watershed.


PROSSER CREEK WATERSHED ASSESSMENT
A CONTEXTUAL HISTORY OF HUMAN LAND USE
AND ENVIRONMENTAL CONDITIONS
WORKBOOK
PROJECT LOCATION MAP
(map courtesy of Truckee River Watershed Council and Balance Hydrologics, Inc.)
Mercator Projection
WGS84
USNG Zone 10SGJ
CalTopo
Scale 1:74163
1 inch = 1.2 miles
13 km
8 mi
MN
13°

This report serves as the cultural component of this multidisciplinary study, presenting a contextual history of human land use disturbances and past environmental conditions whereby historic conditions might be linked to contemporary environmental restoration and protection efforts. Human land disturbances were initiated by millennia of low-intensity land management by Washoe Indians and their prehistoric predecessors. Within a century's time, indigenous practices were replaced by profound resource exploitation by incoming Euroamerican populations. Human disturbances range widely in scale, from pruning a patch of native shrubs to clear-cutting thousands of acres of timberland (Lindström et al. 2000).

This report also identifies the relative cultural resource sensitivity of lands targeted for watershed restoration improvements with regards to prehistoric and historic archaeological sites and Native American and Euroamerican traditional cultural properties and outlines the appropriate cultural resource protocol in their identification, protection and management. To accomplish this task, archaeological, ethnographic and historic background data have been assembled to assist project planners in assessing potential restoration opportunities and constraints attendant to any alteration of the existing hydrological/geomorphical/bioilogical condition in the Prosser Creek sub-basin.

Cultural data are compiled into a "workbook" format, in anticipation that additional archival and field research would follow. This workbook appears as an appendix to the larger Prosser Creek watershed assessment study and is intended to serve as supplemental information with which to gain a better understanding of the cultural component of the physical environment. It has been prepared as a stand-alone report, which according to standard archaeological protocol, is to be filed independently with the state and federal government (i.e., USFS-TNF, North Central Information Center at California State University, Sacramento, an adjunct of the State Office of Historic Preservation master archaeological inventory). Findings presented in this workbook are preliminary. Follow-up archaeological records searches and field surveys would be conducted as part of subsequent project-specific restoration design and environmental review (CEQA, NEPA).

DATA SOURCES AND CONTACTS

To accomplish this cultural/environmental study, Balance Hyrologics, Inc. contracted with Susan Lindström, Ph.D., Consulting Archaeologist. Lindström exceeds the Secretary of Interior's Professional Qualifications Standards in archaeology, history and related disciplines (48 FR 44738-44739). She has over four decades of professional experience in regional prehistory and history, holds a doctoral degree in anthropology/archaeology and since 1982 has maintained certification by the Register of Professional Archaeologists (RPA, former Society of Professional Archaeologists/SOPA). (See attached resume.)

Research involved a broad-based literature survey of pertinent historic and prehistoric themes and a selective review of prior regional archaeological investigations to assess the overall archaeological nature and sensitivity of the study area. The contextual discussion is drawn from the existing literature, supplemented by personal notes and experience. The overview is far from exhaustive and data are uneven.

RESEARCH ARCHIVES AND CONTACTS

Individuals who were contacted for their historical knowledge of the project are listed as follows. Information these individuals provided is cited in this report, and so they are credited on the contact list. Unfortunately, closures of federal offices and historical society archives due to restrictions associated with the COVID-19 pandemic prohibited more focused research regarding timber, rangeland and recreation resources.

- Don Behrens, retired Range Ecologist, Forest Range Conservationist and Zone Range Conservationist 1973-1999), USFS, TNF, 1973-1999 (personal communication 8/15/20)

- Darrel Cruz, Tribal Historic Preservation Officer, Washoe Tribe of Nevada and California (personal communication 8/19/20)

- Bill Howdyschell, Tahoe Donner Forester (personal communication 5/22/20)

- John Kennedy, retired Resource Officer Range/Timber (1971), USFS, TNF, Truckee Ranger District (personal communication 8/17/20)

- Abel and Judy Mendegia, Basque sheepherder and permittee within the Prosser Creek watershed (1956-1991, personal communication 8/17/20)

- Chaun Mortier, Research Historian, Truckee Donner Historical Society (8-9/20); historical society files to locate pertinent historical photographs, maps, aerial photographs, oral histories, newspaper accounts, and other unpublished resources

- Bill Oudegeest, Donner Summit Historical Society (personal communication 8/22/20); historical society files and photographs to include the "Scott Wall Collection"

- Norm Sayler, Donner Summit Historical Society (personal communication 8/21/20)

- Carrie Smith: Heritage Program Coordinator, USFS, TNF, Truckee Ranger District (personal communication May-September 2020)

- Heidi Sproat, Truckee Donner Historical Society

- Matt Wacker, Ecological Consultant for H.T. Harvey & Associates, personal communication 9/2/2020)

A collection of oral history interviews investigating the lives of the people who lived and worked at Hobart Mills during the 1920s-1930s sponsored by the TNF was reviewed in search of personal localized recollections pertaining to watershed hydrology, geomorphology, biology, fire history, and prior human disturbances associated with logging, grazing and/or recreation. Included in this series is a sketch map of the company town and mill complex, drawn from memory by William H. Otis (Map X). The *Tahoe National Forest Working Plan for the Truckee-Sierraville* District prepared by the USFS District Ranger in 1915 provided valuable comparative detail on forest conditions of the time.

Photo libraries on file with the Truckee Donner Historical Society and the Donner Summit Historical Society photo library were examined by research historians Chaun Mortier and Bill Oudegeest to locate relevant images portraying historic landscapes. Aerial photographs, on file with the USFS-TNF and dating from 1939, 1952, 1966 and the 1970s through 2000, were also reviewed.

Historic documents, photographs, and maps assembled and curated by Dr. Lindström in her personal library were also consulted. In addition, general local and state histories, regional inventories, miscellaneous unpublished manuscripts, and newspaper articles were examined. These references are listed in the bibliography at the end of this report. Historic maps are listed below:

- *General Land Office Survey Plat* 1865
- *Topographic Map of Lake Tahoe* by Ferdinand von Leicht & J. D. Hoffmann 1874
- *1st. Lieut. Geo. M. Wheeler, Corps of Engineers, U.S. Army* 1876-77
- *USGS Truckee Sheet* 1889
- *USGS Truckee Quad* 1889 (1897 reprint)
- *USGS Truckee Quad* July 1895(April 1914 reprint)
- *Tahoe National Forest* 5/1/1911 by "Gallaher"
- *Tahoe National Forest California and Nevada* 1915
- *Denny's Pocket Map of Nevada County 1916*
- *Tahoe National Forest* 1921
- *Tahoe National Forest*1924
- *Tahoe National Forest* 1926
- *Tahoe National Forest* 1930
- *Tahoe National Forest* 1937
- *Metsker's Map of Nevada County* ca. 1938
- *USGS Truckee Quad 1940* (1946 reprint)
- *Tahoe National Forest* 1947
- *USGS Truckee Quad 1940* (1951 reprint)
- *USGS Norden and Truckee* 15' quads 1955
- *USGS Norden and Truckee 7.5'* quads 1955
- *USGS Truckee* 7.5' Quad photo revised 1969
- *USGS Independence Lake* 7.5' Quad 1981
- *Hobart Mills/ Independence Lake/Norden/Truckee* 7.5' quads 1986 (USFS "brown lines")
- *Truckee District, Tahoe National Forest* 1962
- Miscellaneous USFS-TNF grazing/range maps

RECORDS SEARCH RESULTS

The USFS-TNF is the primary landowner within the study area. TNF Heritage Program Coordinator, Carrie Smith, kindly conducted a record check of prior archaeological studies and known cultural resources on federal lands within the Prosser Creek watershed. Results disclosed that 71 archaeological studies, encompassing 23.77 square miles have been conducted on USFS land within the Prosser Creek watershed study area that covers 34.27 square miles. Roughly 70 per cent of the study area has been subject to some level of archaeological survey coverage. Within that area, about 26 archaeological sites (polygons) have been inventoried to include: prehistoric lithic scatters (some with milling activities); historic structural remains, including a railroad camp, livestock scaling building near Hobart Mills and the 1872 Seth Martin Sawmill; several historic refuse scatters and accompanying features; a historic reservoir, dam and ditch; and arborglyphs (Basque aspen tree carvings). Three historic linear sites (lines) recorded within the watershed include a flume along Prosser Creek, the Old Reno Road and a network of logging railroad grades constructed by the Sierra Nevada Wood and Lumber Company/Hobart Estate Company. Although the study area also contains private lands, the limited project scope precluded a formal records search at the master archaeological data center located at the North Central Information Center. This search, along with an update of TNF cultural files, would be conducted on a project-specific basis for any future restoration work on private land.

NATIVE AMERICAN OUTREACH

Federal agencies are charged through the Section 106 process to contact with Indian tribes concerning the identification of sites of religious or cultural significance and consult with individuals or groups who are entitled to be consulting parties or have requested to be consulting parties. Once specific restoration projects are developed, government-to-government consultation would occur at the discretion of the U.S. Forest Service under Section 106 and NEPA protocols.

For projects involving private lands, mandates under State of California Assembly Bill 52 (AB52) specify that a project with an effect that may cause a substantial adverse change in the significance of a tribal cultural resource is a project that may have a significant effect on the environment. AB52 directs a lead agency (or their designated representative) to consult with the Native American Heritage Commission and request a search of the Sacred Lands Files. To complete the AB52 requirements, follow-up communications with all groups/individuals on the Commission's contact list are generally recommended to incorporate tribal opinions, knowledge and sentiments regarding the project. Native American outreach would be a part of future watershed restoration projects occurring on private land.

The Washoe Tribe of Nevada and California has been recognized as an important stakeholder in the Prosser Watershed Restoration Project. Accordingly, the Tribal Historic Preservation Officer, Darrel Cruz, was initially contacted by the Truckee River Watershed Council and tribal input at the initial stakeholder meetings was invited. As a follow up, Mr. Cruz was again contacted as part of this study (personal communication 8/19/20) in hopes of engaging members of the Washoe Cultural Committee and other Washoe Elders early on in the planning process in hopes of obtaining information regarding past land use practices within the Prosser Creek watershed and any current concerns regarding future project restoration activities. Unfortunately, due to COVID-19 restrictions, Mr. Cruz's direct involvement in any projects involving traditional Washoe territory have been substantially curtailed and Cultural Committee meetings have remained canceled since February 2020. Therefore, future involvement with members of the Washoe Tribe has necessarily been deferred to a later date once specific restoration projects are developed, and pandemic restrictions have been lifted.

PHYSICAL ENVIRONMENT

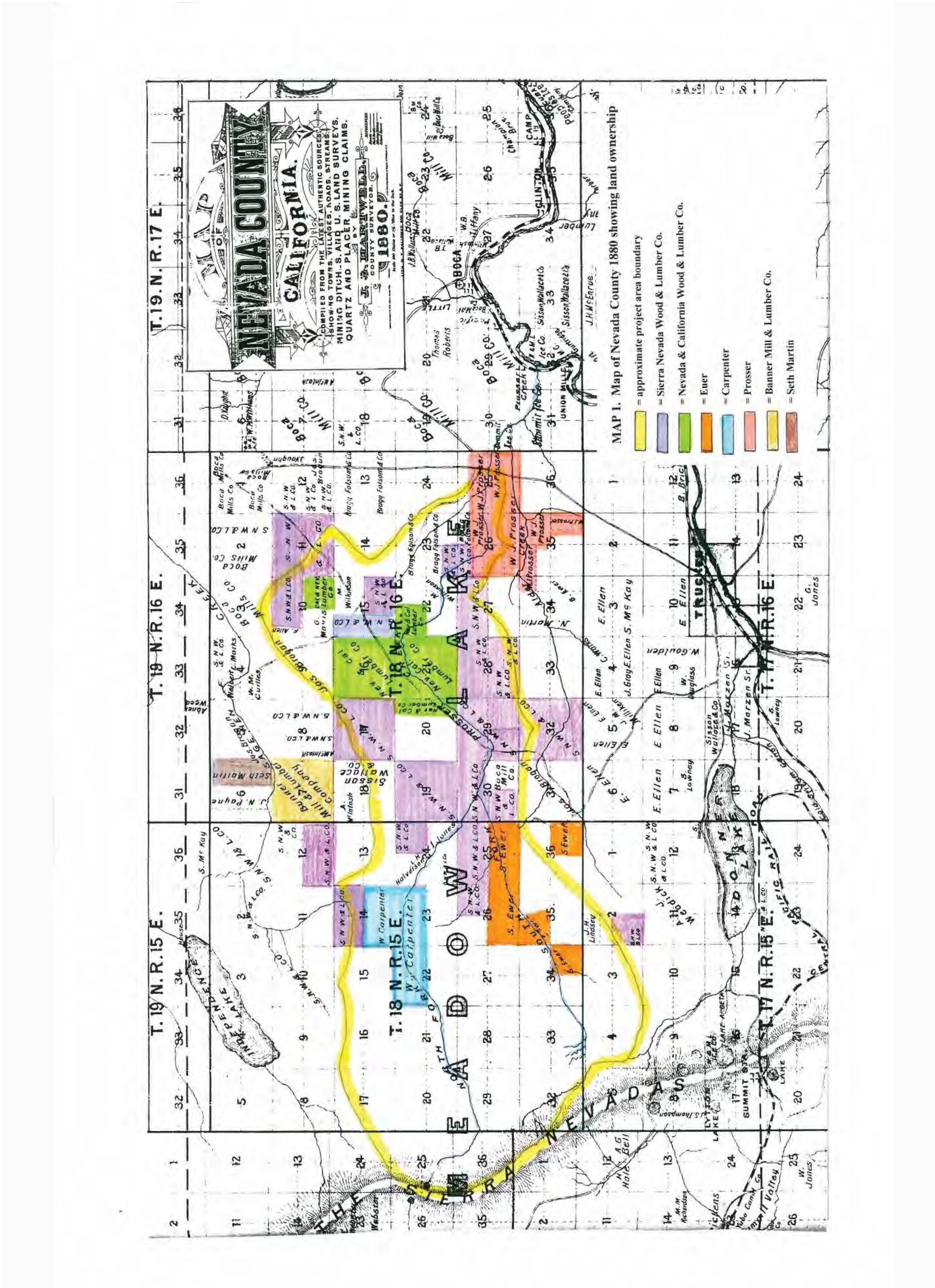
Select ethnographic and historic accounts describing past environmental conditions involving flora and fauna, and forestry, range and fire management practices are provided as an independent and corroborative baseline (albeit limited) to better assess and understand current environmental conditions and guide environmental restoration and protection efforts.

GEOGRAPHIC PLACE NAMES

Place names called out on historic maps point to spheres of past human activities and disturbances. Some of the more prominent place names within the Prosser Creek watershed are summarized below and discussed in detail later in this report. Changing land ownership patterns that encompass these geographic locales are graphically represented on maps dating from 1880 (Map 1), 1913 (Map 2) and 1986 (Map 3). Changes in land ownership are directly reflective of changing land uses, particularly regarding historic logging and grazing activities. Viewed on a landscape scale and from a watershed perspective, the trend and gradual transition from private to public ownership may have implications for interpreting differences in land use disturbances.

Carpenter Valley. Carpenter Valley, an unincorporated community in Nevada County, is drained by the north fork of Prosser Creek (photos 1-2). A branch of the Emigrant Trail is alleged to have passed by the mouth of the valley (Map 4). Carpenter Valley is referenced as "Twin Valley" on 1865 General Land Office (GLO) Survey Plat (Map 5), the 1876 Wheeler Map (Map 6) and the 1889 USGS Truckee Quad (Map 7). Carpenter Valley and Euer Valley are sometimes jointly referred to as "Twin Valleys" in the period press. A road into Carpenter Valley accessing at least two structures appears on the 1876 Wheeler Map (Map 6) and the 1889 USGS Truckee Quad (Map 7). Structures are labeled "Carpenter" on the 1876 map. Areas encompassing the W. Carpenter land holdings appear on Map 1. In 1890 the valley was considered as a candidate for inundation within a system of reservoirs to be constructed as part of the historic Newlands Project.

> "Prior to going to Donner Mr. Newlands, Mr. Fulton and Mr. Tiffany visited Carpenter's Valley, eight miles from Truckee, and found a splendid location for a reservoir site, but the owner wanted the earth for it and they didn't buy it" (*Daily Alta California* 7/25/1890).


MAP OF NEVADA COUNTY CALIFORNIA
1880.
MAP 1. Map of Nevada County 1880 showing land ownership
= approximate project area boundary
= Sierra Nevada Wood & Lumber Co.
= Nevada & California Wood & Lumber Co.
= Euer
= Carpenter
= Prosser
= Banner Mill & Lumber Co.
= Seth Martin
TRUCKEE
BOCA
CLINTON
MEADOW LAKE
SIERRA NEVADAS

Euer Valley. The South Fork of Prosser Creek drains Euer Valley, which is referenced as "Evers Valley" on 1865 GLO plat (Map 5) and "Ever Valley" on the 1876 Wheeler Map (Map 6) and 1880 Map of Nevada County (Map 1). The name is corrected to "Euers Valley" on the 1889 USGS Truckee Quad, where ranch buildings appear (Map 7). Euer family land holdings appear on maps 1 and 2. Euer and Carpenter valleys are sometimes referred to as "Twin Valleys" in the period press.

Crabtree Canyon. Crabtree Canyon remains undesignated on early historic maps, marked on the 1865 GLO plat as a "stream" running through it and a road accessing the valley at its convergence with "Evers Valley" (Map 5).

Castle Peak. Castle Peak, which bounds the watershed on the western sierra crest, is designated early on, appearing on the 1865 GLO plat (Map 5). The name did not become official until 1949.

> "Five nameless features on the east slope of California's Sierra Nevada…have been given identities…[one being] Castle Peak…The board also approved these variations of names already in use…Euer Valley…not Euers or Ewer's or Evers Valley" (*Santa Cruz Sentinel* 2/17/1949).

Castle Peak was used as a strategic observation point for survey parties in some of the earliest topographic mapping efforts. During the early 1870s, the peak was even considered as a possible site for construction of an observatory.

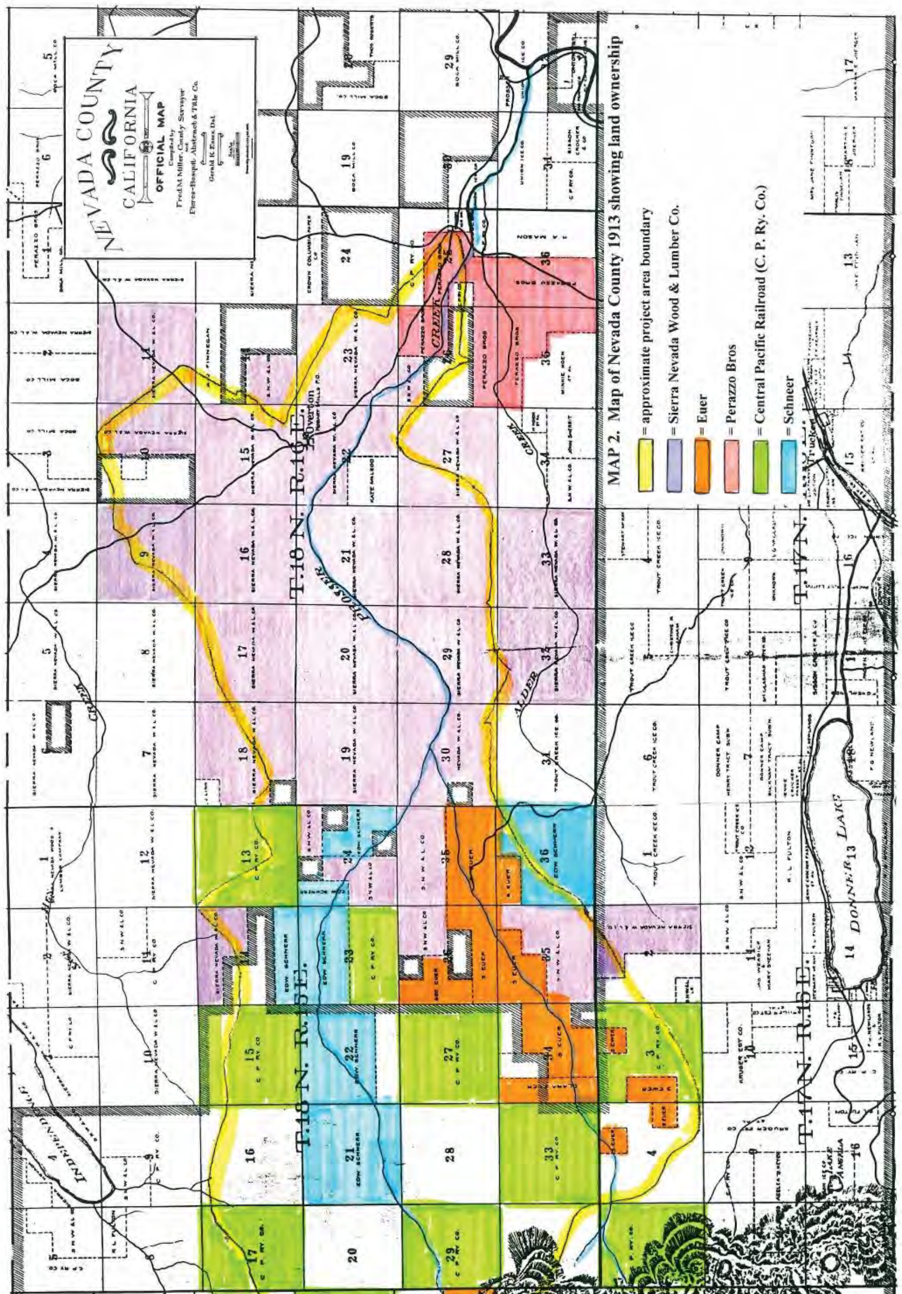
> "Castle Peak…was examined by Professor Davidson with the view of making it the place for the observatory, but the atmosphere from the peak was found to be too hazy, and the mountain itself too difficult of access to make it a desirable place for astronomical, barometrical,, and atmospherical [sic] observations" (*Salisbury Connecticut Western News* 11/29/1872).

> "On the crest of Castle Peak is a small weather-proof box, containing names of visitors on notes of paper. Among them…[the peak was] occupied as [a] Top Station by Lieutenant G.M. Wheeler (Map 6), U.S. surveying party, July 23d, 1877" (*Truckee Republican* 8/2/1882).

Its virtues as an early recreational destination did not go unnoticed.

> "Castle Peak mountain, the highest of the Sierras in this section of country, was visited Sunday by a party of thirteen. The ascent was made from Ewer's dairy ranch, in Town [Twin] Valley, on horseback. The party consisted of Mr. Ewer…[and other Truckee prominent business people] …The ropes formerly used have disappeared, and the climbing had to be done without them. Six of the party tried the adventure and succeeded" (*Truckee Republican* 8/2/1882).

Castle Peak is shown and called out in a 1901 photo scrapbook, along with an image of Warren Lake (Photo 3), situated inside a cirque due east of the peak.


NEVADA COUNTY CALIFORNIA
OFFICIAL MAP
MAP 2. Map of Nevada County 1913 showing land ownership
= approximate project area boundary
= Sierra Nevada Wood & Lumber Co.
= Euer
= Perazzo Bros
= Central Pacific Railroad (C. P. Ry. Co.)
= Schneer
T.18N. R.16E.
T.18 N. R.15E.
T.17N. R.15E.
T.17N.
DONNER LAKE

Sagehen Hills. Sagehen Hills forms the Prosser Creek watershed boundary on the north. While outside the watershed study area, its railroad logging history is closely tied to events in the Prosser Creek drainage. The Sagehen Hills and Sagehen Creek watershed lie entirely within the Sagehen Experimental Forest. Research has been a major management focus for the Sagehen basin since the founding of Sagehen Creek Field Station in 1951 (https://en.wikipedia.org/wiki/Sagehen_Hills).

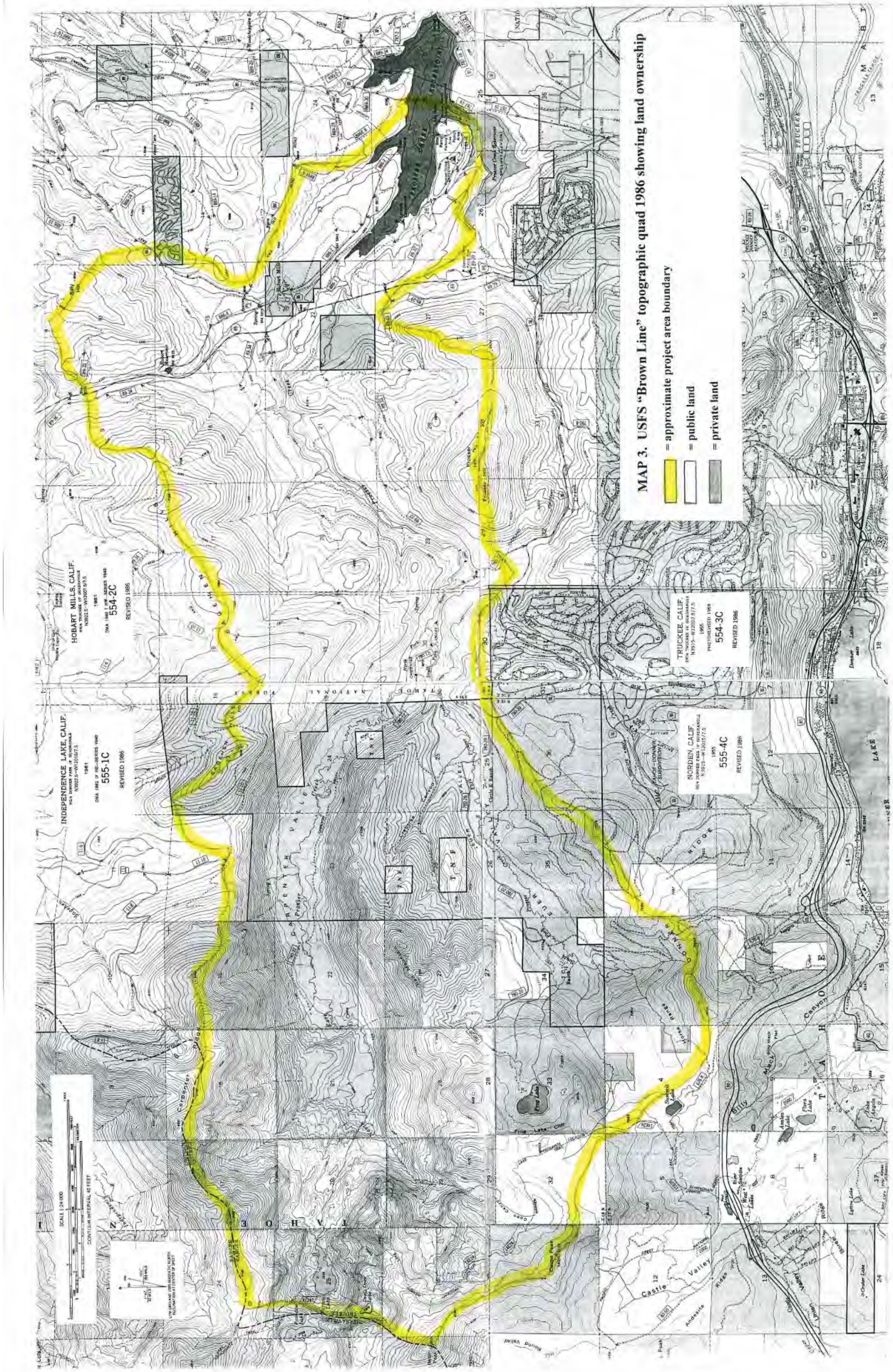
Prosser Creek Dam and Reservoir. Located on lower Prosser Creek, the reservoir was completed in 1962 as a feature of the Bureau of Reclamation's Washoe Project. The dam, located about 1.5 miles above the confluence of Prosser Creek and the Truckee River, impounds a surface area of approximately 750 acres at full reservoir storage capacity (https://www.go-california.com/Prosser-Creek-Reservoir). Both the North and South forks of Prosser Creek appear on the 1865 GLO plat (Map 5). The name "Prosser" is shown on the von Leicht-Hoffman Tahoe map of 1874. According to Williams' *The Pacific Tourist* (1876:224), a man by that name operated a hotel there 'in the early days.' One Wm. Jones Prosser, a native of England and resident of Truckee, is listed in the Great Register of 1872, but he could not be identified with the place" (Gudde 1969:257). The 1876 Wheeler Map (Map X) references "Johnson" at the same place is referenced as "Prosser House" on the 1889 USGS Truckee Quad (Map 7).

Hobart Mills. Hobart Mills is the center point of historic logging activities within the Prosser Creek watershed, a point to and from which some of the most consequential human landscape disturbances were tethered. A post office was established about 1900 and it was named after the Hobart Mills, which had been operating there since 1897 (Gudde 1969:141). Hobart Reservoir, located about one mile to the northwest, served as an important source of water for the historic mill town (Photo X).

GEOMORPHOLOGY

The project area is situated along the western edge of the Truckee Basin, an alluviated structural basin west of the Carson Range and east of the main crest of the Sierra Nevada. Topography within the watershed is varied and changing from flat valleys and wet meadows, such as Carpenter Valley (photos 1-2), to dry, steep, rocky ridges and glacial lake basins, such as Warren Lake (Photo 3). Project elevations range from around 9,000 feet along the sierra crest at Basin and Castle peaks down to about 5,800 feet in the vicinity of Prosser Reservoir.

Landforms in the project area have been influenced greatly by Pleistocene volcanic activity that occurred between 2.3 and 1.2 million years ago and soils are largely residual volcanics (Birkeland 1963). The cinder cone of Alder Hill rises to the south of the project above Alder Creek. The importance of Alder Hill as a regional prehistoric toolstone source and quarry has been documented in several archaeological studies. Each basalt source (for example Alder Hill) retains a distinctive geochemical signature or "fingerprint" that can be traced back to its original volcanic flow. The distribution of artifacts made from a specific basalt source provides important clues to the movement of raw or finished materials through a region and affords insights to regional cultural paleogeography. Archaeologists working in the region have shown that many artifacts from archaeological sites throughout the northern Sierra are fashioned of basalt sourced to Alder Hill (Bloomer et al. 1997; Lindström 2000b; McGuire et al. 2006).


MAP 3. USFS "Brown Line" topographic quad 1986 showing land ownership
= approximate project area boundary
= public land
= private land
HOBART MILLS, CALIF.
554-2C
REVISED 1986
INDEPENDENCE LAKE, CALIF.
555-1C
REVISED 1986
TRUCKEE, CALIF.
554-3C
REVISED 1986
NORDEN, CALIF.
555-4C
REVISED 1986

HYDROLOGY

The project area is drained by Prosser Creek and its tributaries. Although Alder Creek ultimately drains into Prosser Creek on the southeast, the drainage is excluded from the watershed study area. Nevertheless, historical events within the Alder Creek drainage are closely tied to human land disturbances evident within the Prosser Creek drainage. Both creek outflows empty into the Truckee River.

The Prosser Creek basin is the third largest sub-watershed in the Middle Truckee River watershed. The basin is home to two major meadow systems – Carpenter Valley and Euer Valley, along with numerous other meadows. Both meadows have experienced a long history of grazing, logging, and road building. Beyond the meadow resources, the watershed includes over 20 stream miles, forested uplands, and other important wildlife habitat areas. Preliminary observations by the Truckee River Watershed Council indicate that there is stream channel incision, floodplain disconnection, and meadow degradation. However, both these meadow systems also support high quality habitat, and protection of these high functioning areas is important. Overviews of Carpenter Valley taken in 1901 provide good context on the condition of the North Fork of Prosser Creek and surrounding meadowlands (photos 1-2).

Photo 1. Overview of Carpenter Valley, 1901 (courtesy of Truckee Donner Historical Society)

Photo 2. Overview of Carpenter Valley, 1901 (courtesy of Truckee Donner Historical Society)

FAUNA

Typical fauna associated with the watershed are described in Storer and Usinger (1971) and include mule deer (*Odocoileus hemionus*), black bear (*Ursus americanus*), and a variety of small mammals and fish.

Fish were a reliable, productive and well-timed food source for both prehistoric and historic populations (d'Azevedo 1986; Lindström 1992, 1996). Fish constituted one of the most important subsistence resources for the Washoe and their prehistoric ancestors, a resource that may have allowed for extended stays in the upper reaches of the Prosser Creek watershed, even into the early winter season. Men held claims to premier fishing locations by maintaining fishing "houses" and other improvements on streams.

Photo 3. Overview of Warren Lake at the headwaters of the North Fork of Prosser Creek, 1901; notes written in the photo scrapbook point out surrounding landmarks ("Monumental P.", "Castle P.", "Carpenter Valley") and the fact that "Warren Lake (has fish);" (courtesy of Donner Summit Historical Society)

Of special interest, the area is within the historic range of Lahontan cutthroat trout (LCT), in addition to several other sensitive Sierra Nevada species. As throughout the Great Basin the native fishery was among the first and arguably most important aboriginal subsistence industry affected and eventually eradicated by Euroamerican encroachment. The historic LCT fishing industry produced food for the local communities and far-reaching settlements until 1917, when the California legislature banned commercial fishing. Since the 1860s excessive commercial fishing, dam construction, disturbance of spawning grounds, obstruction of spawning runs, pollution of the watershed, and competition from introduced species combined to cause the demise of the native cutthroat trout (Lindström, 1992, 1996; Townley 1980). The string of brook trout caught by visitors to Carpenter Valley in 1901 (as identified by Matt Wacker, Ecological Consultant for H.T. Harvey & Associates, personal communication 9/2/2020) documents that non-native species were well established in the Prosser Creek watershed early in the 20th century (Photo 3). By 1929 the LCT could no longer migrate up the Truckee River and by 1938 both Tahoe and Pyramid lakes strains of cutthroat trout were extinct. The watershed has been identified as a potential LCT reintroduction site and future assessment would include an evaluation of the potential for LCT reintroduction and analysis of habitat availability for these species.

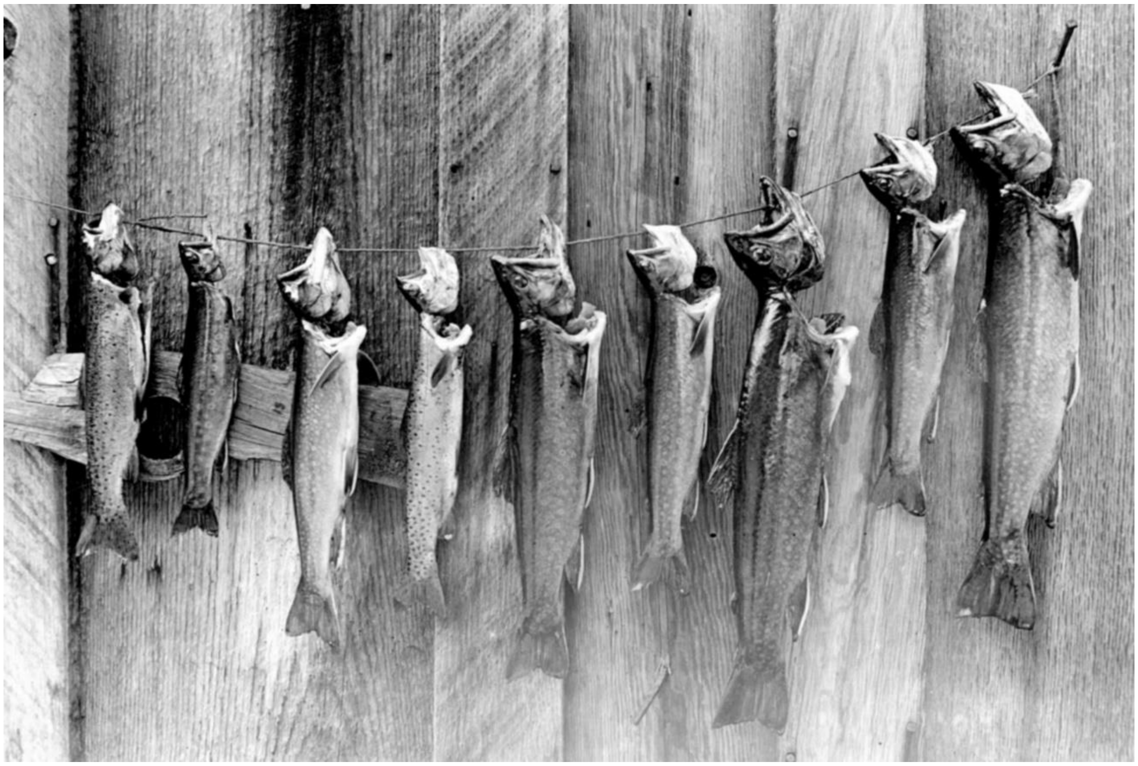


Photo 4. String of brook trout caught in Carpenter Valley on the North Fork of Prosser Creek in 1901 (courtesy of Donner Summit Historical Society)

As part of an oral history program sponsored by the USFS-TNF, former employees and residents at Hobart Mills during the 1920s-1930s were interviewed about their daily lives and natural setting in which they lived. Several accounts highlighted "excellent" deer hunting and fishing for non-native trout (Photo 4) in the Prosser Creek drainage (Cardinal 1992; Dundas 1992; T. Dundas 1992; McLeod 1992). "You just couldn't beat it anywhere" (Dundas 1992 V2:56). "We used that [fish] to supplement our food quite a bit…(McLeod 1992:16).

> Sagehen, where our drinking water came from, was closed to fishing but every other stream around there was open. The limit was twenty-five trout and you could catch twenty-five trout in an hour-and-a-half to two hours. And no problem whatsoever…Prosser Creek split off and there was a little stream by the name of Little McLeod and kids really loved to fish that stream because it was very small, lots of fish. I would say an average Hobart Mills fisherman could probably get his limit in two hours (McLeod 1992:32, 34).

> We'd put our eight hours in [at the mill] and, since Prosser Creek was just about five hundred yards from the last house, we'd just go over to the house and grab our fishing poles and go down over the hill. We'd be down there maybe twenty to thirty minutes [and] we'd have a limit of fish. Prosser Creek was just alive with fish. Beautiful fish. [About eighteen inches?] Yeah. We'd go down and catch four or five fish and come [home]. My daughter said she ate so many fish up there she don't want any more fish in her life…[mostly] trout. Rainbows, Dolly Vardens…(McLeod 1992:30, 31).

"…we'd fish in the streams and we'd [catch fish]" (Thelma Dundas 1992 V2:31).

"…fished in Prosser Creek and we got the right size German Brown or Eastern Brook trout or Rainbow trout" (Cardinal 1992 V2:19).

Deer hunting was also a noteworthy and a successful pursuit.

"…that was some of the best deer country in the whole area (McLeod 1992: 31).

"I got my deer every year. Like I say, my kids were raised on buck meat and beans" (McLeod 1992:31).

"Deer hunting was about the only thing that was up there. There were some grouse, but grouse hunting wasn't too good. We got a few, but deer hunting was the main thing" (McLeod 1992:16).

VEGETATION

Lower elevations of the project area are characterized as a Jeffrey pine/bitterbrush vegetation community type, lying within Storer and Usinger's (l97l) Yellow Pine/Jeffrey Pine Belt. In the Truckee Basin, Jeffrey pine (*Pinus jeffreyi*) dominates forest stands and in the study area it shares dominance with ponderosa pine (*P. ponderosa*), white fir (Abies condolor), and lodgepole pine (*P. murrayana*). Understory species include manzanita (*Arctostaphylos* spp.), sagebrush (*Artemesia tridentata*), bitterbrush (*Pursia tridentata*), current (*Ribes* spp.), various species of *Ceanothus*, and assorted forbs and grasses. Wet meadows and riparian zones are marked by willow (*Salix* spp.) and aspen (*Populus tremuloides*). Upper elevations of the project area fall largely within Storer and Usinger's (l97l) Subalpine Belt (Hudsonian Zone). Here, whitebark pine (*Pinus albicaulis*), lodgepole pine (*Pinus contorta*), red fir (*Abies magnifica*), mountain hemlock (*Tsuga mertensiana*), and sierra juniper (*Juniperus occidentallis*) dominate the forest stands. Understory species include mountain ash (*Sorbus sitchensis*), red mountain heather (*Phylladoce breweri*), western chokecherry (*Prunus demissa*), manzanita (Arctostaphylos spp), *Spirea* spp., and *Ceanothus* spp. Wetlands also support willow (*Salix* spp.), alder (*Alnus tenuifolia*) and assorted grasses and forbs. Rocky cracks and crevices sustain low-growing succulents.

Washoe Traditional Plant Management Practices

It is doubtful that modern plant and animal communities closely resemble their pristine composition due to past human disturbance. In former times the area is thought to have supported a luxuriant growth of native bunch grasses that allowed an abundant large game population (deer and antelope) and provided a nutritious source of seeds for use by prehistoric peoples. Potential human modifications to these habitat types and plant-animal associations began with the aboriginal management of plants and animals. Managing and gathering plants for food, medicinal use and raw material for many manufactured items was an intensive effort from spring through fall (d'Azevedo 1986: 473-477). An increasing body of ethnographic work indicates that thousands of years of sustained and systematic gathering, fishing and hunting would have exerted at least localized influences on the biotic resources and ecology. Existing data include testimonies from Washoe people about resource use and principles of conservation practices, along with an expanded list of plants of cultural interest to the Washoe. Named camping locations and resource catchment areas appear in some ethnographic accounts and thereby signal out locales where the potential effects of aboriginal resource use and relative environmental manipulation may be evident. There has been little research focused on specific harvesting techniques or horticultural and conservation practices. Where it has occurred (specific locales in the Tahoe Basin for example), there is compelling evidence of extensive and systematic ecosystem management. Unfortunately, there is little detail in the collective Washoe memory regarding traditional land use practices in the Prosser Creek watershed. While the Washoe had held the Truckee-Tahoe Sierra crossroad for millennia, their tenure in the study area was relatively short-lived in the early historic period, likely due to conflicting land usage in the face of the increasing intensity of logging and grazing activities. As such, anecdotal accounts of traditional land use practices shared by Washoe consultants who were able to sustain a presence in the Tahoe Basin can been applied to the adjoining Truckee Basin.

> "Washoe recall the laments of their mothers and grandmothers, worried about the degree to which plants were affected by grazing animals, drought, urbanization, and competing exotic plants, but also neglect" (Rucks 1989-1999 In Lindström et al. 2000:36).

Washoes were not only opportunistic foragers, but their subsistence tactics verged on horticulture. Plants used for food, medicine and raw materials were repeatedly harvested, dug, thinned, pruned, aerated, replanted, and even periodically burned. Washoe families and family groups, maintained jurisdiction over specified gathering areas, recognized by others as "cared for" and thus "claimed."

Forests

Forest Composition and Reforestation

Forests within the watershed were intensively harvested from the early 1870s into the 1960s. Historic records and dendroecological studies suggest that virgin forest stands in the project vicinity were more open, less dense, and composed of trees that varied widely in diameter (Taylor 1997). Historic chronicles describing these forests are typically written in the superlative, with trees portrayed in unbelievable size and bounty. Early 19th century harvesting in the Truckee Basin targeted stands that had matured during the mid-1600s to mid-1800s, a period of generally cooler and wetter conditions coincident with an event known as the "Little Ice Age." This unique climatic event may, in part, account for the notably large stem diameters and overall forest vigor of virgin stands.

Historic eye-witness descriptions of prior forest composition, logging techniques, and prescriptions and protocol for forest treatment and management combine to frame a better understanding of existing conditions within the Prosser Creek watershed. For example, the *Working Plan for the Truckee-Sierraville District*, prepared by Forest Examiner Gallaher in 1915, summarized the local forest conditions of the time and identified primary "Timber Working Circles" (Table 1) and cutover areas by township, range and section; some of these areas fall within the Prosser Creek watershed study area (USFS 1915). In essence, this forester was largely describing the logging legacy left behind by the early 20th century operations of the Sierra Nevada Wood and Lumber Company/Hobart Estate Company, which executed the most intensive and extensive timber cutting in the Prosser Creek watershed. Two "working circles" were established for the TNF, one for the Jeffrey pine forest type (characteristic of lower elevations and encompassing the majority of the watershed) and one for red fir (characteristic of higher elevations). Each working circle was based on the class of material produced and differing silvicultural treatment and management with the former yielding saw timber and the latter pulpwood (USFS 1915:38).

Hobart Mills sawmills principally consumed the yellow pine, i.e., Jeffrey and ponderosa pine. Little sugar pine went through its mills because it did not grow readily in the area. Occasionally white fir was included for box production, but it was generally avoided and instead delivered to the Floriston Pulp and Paper Mill (Rowley and Rowley 1992:144).

Table 1. "Working Plan for the Truckee-Sierraville District: Timber Estimate, Jeffrey Pine Working Circle, M.B.M" (USFS 1915:13)

T/R	**Total Area (ac)	Jeff	White Pine	Inc. Fir	Sugar Cedar	Dgls. Pine	Red Fir	Lodg. Fir	White Pine	Pine
18/15	413.00		4146	1030	50	-	-	25	5	-
18/16	1716.71	3106	2186	-	-	-	765	84	-	
17/15	767.00		3101	2117	50	-	-	134	20	25
17/16	3444.62	1556	1155	41	-	-	81	215	-	

*The area given includes total area of all public land within the working circle.

In addition to projected acreages and board feet measures, the report elaborated in more detail on the forest type as of 1915.

> "The [Jeffrey pine] stand is an old selection forest composed chiefly of over-mature and mature trees with a corresponding understocking of the younger age classes" (USFS 1915:17).
>
> "Reproduction in the virgin forest is deficient, taking the type as a whole. This is caused partly by fire and partly by the great difficulty experienced by seedlings in establishing themselves under adverse conditions" (USFS 1915:18).
>
> "In composition reproduction is 60% white fir and 40% Jeffrey pine. The white fir, however, is in clumps and compact groups so dense that very few out of the total number will succeed" (USFS 1915:18-19).
>
> "The diameter of the average Jeffrey pine is 36 inches, the range in diameter being from 1 to 60 inches. The trunks are straight, full boled [sic], and generally free from branches for 30 to 50 feet, and with a total height of 110 – 130 feet, at maturity. …the total height may be as much as 150 feet" (USFS 1915:19). The average age of Jeffrey pine was estimated at 273 years, given a sampling range 130-350 years (USDFS1915:21).
>
> "White fir in this type averages slightly smaller than pine. It is rarely free from branches for more than 1/3 its height…" (USFS 1915:20). The average age of white fir was found to be 209 years, within a sampling range of 128-255 years. (USFS 1915:22).

> “The other associated and less abundant species are never of great importance. Sugar pine produces lumber inferior to Jeffrey pine because it is usually shaky or rotten and more knotty. Incense cedar is defective. Even when present in merchantable quantities lodgepole pine is not cut because the logs are so heavy that they sink in the mill ponds” (USFS 1915:20).

The report also outlined “injuries” caused by insect infestations.

> “Jeffrey pine is attacked to some extent by false mistletoe (*Razoumofaskya cryptopoda*), which is especially noticeable on cutover areas and seedling growth. The heart rot fungi (*Polyporus schweinitzii, Trametes pini* and *Fomes laricis*) are present. The insect Ips (*Oregoni* [?]) is reported to have caused considerable damage during the past few years…Various species of dendrootonus are also present (*Dendrootonus valens, D. monticola, D. jeffreyi*, and *D. brevicomis*). White fir is infected with *Echinodontoum tinctorum* and to a lesser extent by *Polyperus schweinitzii*. Mistletoe (*Phoradendron bolleanum*) and false mistletoe (*Razoumofaskya occidentalis*) have a weakening effect upon the tree. This species is also much damaged by windshake and frostcrack. Other species are attacked by their usual enemies” (USFS 1915:20-21).

The report concluded, overall, that by 1915 the Jeffrey Pine Working Circle had already been overcut, and recommended that the federal government work to consolidate private lands into the public domain to better insure sustainable forestry practices. The eventual shift from private to public land ownership is abundantly clear in comparing landownership patterns in 1880 (Map 1), 1913 (Map 2) and 1986 (Map 3).

> “Its [Jeffrey Pine Working Circle] merchantability is controlled by the lumber companies who own the land surrounding the relatively small areas of virgin public timber. Its production is entirely absorbed by the general markets. This circle will continue to be cut as rapidly as possible…The…object of management should be the consolidation of the scattered blocks of public land. For the most part this is impracticable, at the present time, because of the small value and area of the unpatented ground as compared with the privately owned land” (USFS 1915:32).

> “A sustained annual yield is impractical within the Working Circle in which this type [Jeffrey Pine Type] occurs. A large percentage of the timber is on privately owned land and has been or will be cut in the near future. Undoubtedly such lands will ultimately come under the management, if not directly into the ownership, of the Government…It will place the stand in the best possible condition for reproduction and future growth regardless of sustaining yield…(USFS 1915:35).

The rate of timber consumption on private property far surpassed that on the national forest land, even though the number of USFS timber sales steadily increased. Despite USFS policy of marking trees to ensure a second cut within 30 to 40 years, when reforestation of the cut-over land would provide timber for future generations, there was little attempt on the part of lumbermen to engage in scientific forestry practices. ‘They were concerned with getting the timber out and producing the most profit they could”(Jackson et al. 1982:136). By 1910 most of the timber in the Tahoe-Truckee basin was stripped off; by then the focus of operating had shifted north into the region north and east of the Little Truckee River and into Sierra Valley. Within 25 years, the lumber companies had denuded their properties. They eventually sold much of their cut-over acreage to the

USFS during the depression years as the companies could not afford to assume the heavy tax burden on non-harvestable timber lands (Jackson et al. 1982:136).

The TNF position regarding questionable forestry practices on private lands was collaborated in a 1912 report by the State Forester who specifically commented on the Sierra Nevada Wood and Lumber Company's operations.

> "It is apparent, from a partial study, that this company is not practicing forestry on its holdings. No rotation of crops has been established and the cut is made without reference to yield. The area is cut so close that no seed trees are left to produce a second crop. No system of fire protection has been established. No real disposal is made of the slash. A small percent is removed for stove wood, but the remainder is left to form a constant menace to reproduction (*Fourth Biennial Report of the State Forester* 1912:49 in Barry-Schweyer 1998:12).

In response, the prescription for federal management of the Jeffrey Pine Type from 1915 forward was to remove all mature and over-mature timber, which amounted to "clear cutting and leaving only scattered seed trees" (USFS 1915:33-34). Although the more rapid growth of fir made it almost as valuable to the forester as pine, the object of management was to reproduce an equal mixture of both (USFS 1915:35).

> "The following marking rules will be followed: Jeffrey pine and white fir are mature and will be cut when 24 inches and 27 inches respectively in diameter, leaving scattered seed trees. Trees under maturity will be cut when integrity has been compromised (physical damage, insects, etc.). Subordinate species will be treated under the same marking policy" (USFS 1915:42).

> "A few minor attempts at experimental forestation have all been mainly unsuccessful…further forestation will not be attempted until the time when the best methods have been definitely established at the experiment station…" (USFS 1915:42).

> "The protection of the timber, then, will be the first and most important object of management… yet, in consideration that the forest is the source of water for agricultural, reclamation and hydro-electric power interests, as well as scenic beauty" (USFS 1915:31).

As a curious postscript, the report deduced: "The danger from erosion is so slight that no timber need be withheld from the market for the purposes of watershed protection" (USFS 1915:11).

Tree Plantations

John Kennedy, retired Timber Resource Officer for the Tahoe National Forest graciously shared information on reforestation policies during his multi-decade tenure with the TNF beginning in 1971 (personal communication, 8/19/20). Although reforestation had begun 10 years prior and immediately after the 1960 "Donner Ridge Fire", there was still much work to be done. He was charged was expanding tree plantations on higher slopes, namely on Carpenter Ridge. Although new roads had been constructed to facilitate post-burn logging and reforestation efforts, roads were generally bad, made worse in the absence of water bars or other erosion control features. (To remedy the situation, the USFS later included the implementation of erosion control measures as required elements of timber sale contracts.) In the wake of the fire, tree plantations were developed with planting policy objectives designed to grow timber by the fastest means possible, i.e., grow cubic feet. At the time, the best scientific forest management was aimed at producing even age stands, which could then be clear cut after 70 years or so. To enhance the survivability of seedlings on plantations, instead of using non-local seed sources, the USFS increasingly began using local seed sources from compatible seed zone locations grown in nearby nurseries/orchards, such as the one in Foresthill. TNF foresters were even hired to climb trees near a burn to gather cones. Planting seedlings had far higher success rates than just dropping them by helicopter, although the latter method was also done. Seedlings, about 8-10 inches tall, were closely planted every 10 feet to reduce competition from grass and brush. Brush was typically killed with herbicides, where now it is controlled by repeated mastication treatments. Close-interval planting resulted in crowded young stands and there was rarely funds to selectively thin. Planting intervals were increased to 12 feet later in the 1970s. This method of harvest was gradually phased out due to environmental concerns and public outcry.

Rangelands

With the decline of logging in the Truckee Basin by the mid-20th century, cut-over lands were sold to ranchers for grazing; upland meadows were used for both sheep and stock and dairy cattle (Photo 5). Rangelands east of the sierra divide were the focus of a widespread seasonal livestock grazing industry, as described in annual reports prepared by the Tahoe National Forest during peak years of grazing between 1911 and 1917. Truckee and Hobart Mills were pivotal livestock shipping points.

> "The number of carloads of stock received here this year exceeds by far the number of shipments received here in any other one season. To date 140 carloads have been received, 120 cars being sheep and 20 cars being horses and dairy cattle" (*Truckee Republican* 7/8/1911).

> "Supervisor Bigelow of the Tahoe National Forest has received information that the secretary of agriculture has authorized the grazing of 7,700 horses and cattle, 56,300 sheep, and 200 swine on the Tahoe forest during this grazing season of 1912...Following are the number allowed in the various districts [of the Tahoe National Forest]...Sierraville 600 cattle and horses; [and] 11,400 sheep and goats. Truckee: 800 cattle and horses, [and] 16,300 sheep and goats... (*Truckee Republican* 1/11/1912).

> "The Secretary of Agriculture has authorized the grazing of 7800 cattle and horses, 100 swine and 59,500 sheep and goats on the Tahoe National Forest for the grazing season of 1916. The number of stock allowed in each district are as follows...Truckee 1200 [cattle]… 30,000 [sheep]... (*Truckee Republican* 1/20/1916).

> "There were 133,442 more cattle and horses, 605,338 more sheep and goats using the National Forests in 1916 than in 1915. This increase was in spite of large eliminations of grazing lands from the Forest. It is accounted for by improved methods of handling the stock and by more intimate knowledge of the forage on the ranges and their carrying capacity" (*Truckee Republican* 1/4/1917).

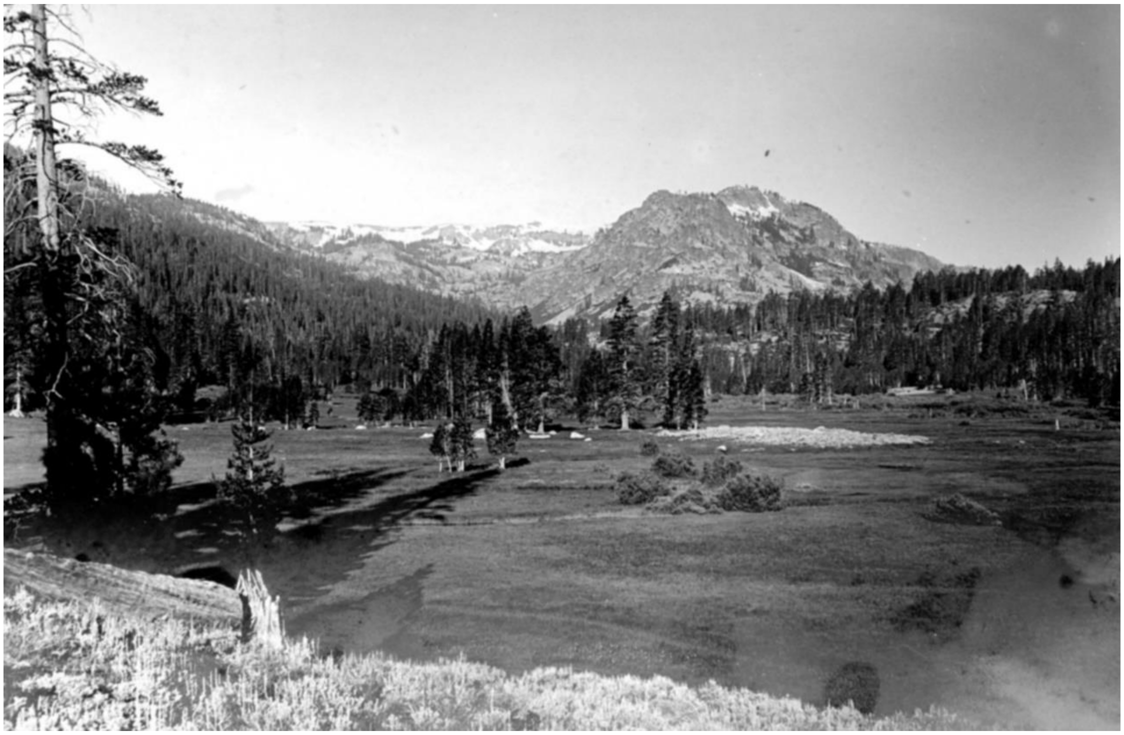


Photo 5. Flock of sheep grazing in Carpenter Valley, 1901 (courtesy Donner Summit Historical Society)

Excessive over-feeding exterminated native browse species, promoted erosion, and hindered forest regeneration. Local Native American populations were especially affected by the impacts of livestock grazing that caused declines in many important plants. Sheep were singled out as more destructive than cattle.

> "During this year [1906] the residents and also the cattle men, will not be molested by the sheep men, on account of the government setting aside most of this section as a forest reserve. The lumbermen as well as the cattlemen are glad to get rid of the bands of sheep…because after the sheep pasture over land, cattle will not graze over it" (*Truckee Republican* 1/20/1906).

On the other hand, the controlled grazing of livestock served to clear the understory and help control the spread of brush, as stated by Basque permittee sheepherder, Abel Mendegia, who grazed his flocks on USFS lands encompassing the Prosser Creek Watershed study area between 1968 and 1991 (Abel and Judy Mendegia, personal communication 8/17/20). In a recent visit to his former sheep allotment along Prosser Creek, he commented on the "crowded" understory and overstory he attributed in part to the reduction in livestock grazing, exclaiming in broken English: "The countryside is getting so dirty!", pointing out that sheep can eat 8-10 pounds of forage per day, including a variety of brush species. He believed that more livestock grazing would help to "thin" the landscape and prevent disease (Judy and Abel Mendegia, personal communication 8/17/20).

FIRE

The natural fire regime was initially augmented by millennia of purposeful micro-burning by Native Americans to clear the ground, making areas more accessible and enhancing the growth of seeds and feed for animals and people. However, the practice was discouraged and even prosecuted by incoming Euroamericans, even though it had likely served to keep down fuel loads and resulted in lower-intensity fires.

Natural fire regimes were furthered altered by accidental and unchecked historical blazes created by sparks from wood-fired engines along the transcontinental railroad over Donner Pass. Historic timber cutovers and landings where cordwood or lumber awaited shipment were also set ablaze by sparks from logging equipment and fueled by logging slash and debris.

Sheepherders were not only criticized for denuding the highlands but for deliberately setting fires upon leaving "fed-out" seasonal grazing lands to improve the range and facilitate movement of sheep through the forest.

> "Among the lumbermen, it is believed that the majority of the forest fires are the result of the sheep herders setting underbrush afire to burn over the territory in order to have good pasture for the following season. It will be remembered that last summer considerable territory was burned over and nearly every individual owning timber lands believed that the origin of the fires were from the hands of men herding large bands of sheep" (*Truckee Republican* 1/20/1906).

Charles H. Shinn, a forester for the U.S. government, visited the Tahoe Basin in 1902, and reports sighting many small and smoldering fires, viewing four to ten in one day's travel. It is reasonable to project that conditions may have been similar in the adjacent Truckee Basin. Public agency control dramatically changed land use patterns in the Tahoe Sierra after 1900, especially regarding fire suppression where, prior to this time, there had been no coordinated attempt. By the mid-1920s, all national forests (and national parks) in California and the Sierra had fully developed policies, procedures, and organizations to suppress fire in their jurisdictions. Before the adoption of a fire suppression policy, a debate ensued whether to allow "light" or "Indian burning" versus total suppression. Ultimately, it was resolved that repeated small fires caused progressive damage to the forest, inhibiting effective regeneration of mixed forests, the sources of a sustainable commercial timber supply. In 1924 a congressional act was passed clearly establishing fire exclusion as a national policy. Fire suppression formed the basis of USFS policy until the 1960s, after which time doubt over the merits of total suppression led the national forests to employ the reintroduction of fire as a management strategy.

A review of newspaper coverage of wildfires within and surrounding the Prosser Creek watershed between 1900 and 1965 suggests that fires tended to be less devastating and of shorter duration than the catastrophic blazes witnessed throughout the West during the last half of the 20th century and now into the 21st century. Based on the available information (excerpted below), there was no major conflagration within the Prosser Creek watershed until the Donner Ridge Fire of 1960.

“The forest fire that has been burning out toward Alder Creek has been working over this way. Last night it got up near Sherritt Bro’s wood camp, where they have their winter wood cut and they had men out all night fighting the fire to save the wood (*Truckee Republican* 9/2/1901).

“A forest fire broke out in the woods near Russell Valley Sunday and it was necessary yesterday to send out a force of men to fight the fire. No serious damage was done” (*Truckee Republican* 7/16/1902).

“A forest fire is burning in the vicinity of the Ellen mill today on Trout Creek” (*Truckee Republican* 7/23/1902).

“…considerable wood destroyed and much young timber ruined. To careless campers is ascribed the cause of a forest fire that has been burning close to Truckee for the past four days. The fire is still burning. The blaze started a mile or more from town Wednesday afternoon. At first no attention was paid to it until the blaze headed toward the Truckee lumber company’s property when a force of men was sent out and succeeded in changing the course of the destructive element which made its way around the hill destroying about 100 cords of wood belonging to John Rosserini as well as about fifty cords belonging to other parties. Thursday night the flames began eating their way up the densely timbered hill just west of town. About eight o’clock the blaze reached the summit of the mountain and for a time it looked as if the fire would continue down and into the residence portion of the town. So great did the danger seem that preparations were made to call out the fire department, as well as other citizens for the purpose of fighting the flames. Several persons went to the scene and battled with the fire and it is due to their efforts that the course of the flames was again changed, and much valuable property saved from destruction. Yesterday the firefighters succeeded in getting the flames under control. But today it has taken a renewed vigor and is burning fiercely. Much timber land was burned over, though the trees for the most part are second growth…The damage will amount to several hundred dollars to the persons whose wood was destroyed, while the loss to landowners will figure up quite a sum” (*Truckee Republican* 8/8/1903).

“The forest fire that started near here last week is still burning though doing but little damage. A strip of land about one-half mile in width and several miles in length has been burned over. The blaze yesterday was on the east side of the hill west of town” (*Truckee Republican* 8/12/1903).

“Three hundred men working hard for nearly four days finally conquered a forest fire that had been burning about twelve miles north of Truckee on the land owned by the Sierra Nevada Wood and Lumber Company. The fire started last Monday morning from a campfire built by some of the workmen. Before they could get the workmen to the camp and blacksmith shop, twelve small houses and a strip of land over a mile square was burned over before the fire was conquered. The lumber company estimates the damage to be about $10,000” (*Truckee Republican* 7/2/1910).

"The forest fire which broke out Tuesday just west of the ranger's station of the forest service at Prosser Creek…is now out. About four or five acres of timber land was burned over...fire was caused by a lightning striking a tree. Five men were out at work fighting the fire...about midnight the fire was under control" (*Morning Union* 6/13/1912).

“A large forest fire has been burning in the hills near the Hobart Mills logging camps, but it is now extinguished. It was stated that the fire was ignited from sparks that came from a fire over a mile away. It burned over 200 acres" (*Truckee Republican* 8/6/1914).

"A great forest fire is raging at one of the lumber camps 15 miles from Hobart Mills, 20 miles from Truckee. The camp has been destroyed and as the telephone wires were put out of service no definite news can be received. The fire is known to have started in the cut-off land of the Hobart Lumber Company, and quickly spread to a fine body of timber" (*Sacramento Union* 8/3/1915).

"A forest fire in the vicinity of Camp No 2 [on Prosser Creek] of the Sierra Nevada Wood and Lumber Company of Hobart Mills about 12 miles from Hobart caused considerable excitement last Monday, but proved to be only of short duration...The fire was soon put under control by the men sent to fight it from the different camps" (*Truckee Republican* 8/5/1915).

“Snow has helped the firefighters to control a forest fire that has been burning near Hobart Mills since Thursday" (*Sacramento Union* 11/5/1916).

"Bob Euer was...in town last week rebuilding the dairy house [in Euer Valley] which was destroyed by a forest fire this fall" (*Truckee Republican* 11/8/1917).

"The fire which has burned for several days at Camp 5 on the Hobart Estate Company land, is reported to be under control. The fire has done considerable damage before being put out. It was started by sparks from a donkey engine" (*Truckee Republican* 8/18/1921).

"The fire in the Truckee region is racing up Prosser creek, near the town, but the town itself is not believed to be in danger" (*Stockton Independent* 6/26/1924).

"Two hundred men were fighting a forest fire in the Euer valley today as it swept through valuable red fir and pine and showered sparks on Hobart Mills. CCC workers, Hobart Mills lumber crew members and forest rangers were pressed into the battle against the blaze. H.I. Snider, forest ranger in charge of operations, said there appeared little danger of the spars spreading fire in Hobart Mills" (*Santa Cruz Sentinel* 9/18/1936).

“…fire was reported north of Truckee burning in Trout Creek Valley. At the time the report was received seven of the government forest men were stopping at the New Whitney. Every man left immediately for the scene and soon had the fire under control” (*Truckee Republican* 9/18/1936).

"Hundreds of acres of brush and timberland near Hobart Mills, abandoned lumber town near Truckee, burned briskly tonight despite Tahoe national forest reports it was under control, and 200 fresh men were rushed into the region to replace wearied firefighters. Forest Supervisor DeWitt Nelson…reported the situation well in hand tonight but said extra precautions were being taken because he feared a high wind in that area

> tomorrow. The forest fire started when the nearby forests caught from burning lumber camp buildings yesterday afternoon" (*San Bernardino Sun* 7/1/1939).
>
> "Castle Peak, Carpenter, Martis and Cold Stream areas fair-to-high fire hazard" (*Healdsburg Tribune* 9/20/1956).
>
> "...crash near Truckee June 25......misjudged clearance distance during a run to drop borate fire suppressing material on a forest fire near Prosser Dam..." *(Santa Cruz Sentinel* 1/8/1965).

Fire was endemic to sawmilling communities. Therefore, Hobart Mills paid great attention to their water supply, which came from a pipeline extending several miles up the mountain to Sagehen Creek, "a clear spring-fed mountain stream." Hydrants were placed at critical points throughout the town and in the mill…water passed through pressure-reducing valves before entering each house (Rowley and Rowley 1992:139-140). To better meet fire emergencies, locomotives carrying water and hose were strategically stationed in the woods (*The Timberman* 1926c). Locally, the Forest Service and the Sierra Nevada Wood and Lumber Company/Hobart Estate developed early cooperation in fire protection, taking note that out of the total population of Hobart Mills, 200 men were available for firefighting (USFS 1915:8). After a bad fire in 1926, the Forest Service entered into a cooperative agreement to watch for and fight fire in the company's entire holdings, except for the actual logging area and a strip along the logging railroads. The USFS provided lookout observation at one cent per acre on its operating tracts around Hobart (Biglow 1936 in Rowley and Rowley 1992:141). Ultimately, the mill caught fire in 1937, burning up the entire sawmill, box factory and light plant, but sparing the houses, many of which were later moved to Truckee (Dundas 1992 V21:60). Years later, the few remaining residents at Hobart Mills were evacuated during the 1960 Donner Ridge Fire (Jessie Payen letter In Fox 2015:18).

"Donner Ridge Fire"

> "More than 2,200 men fought to gain control today over a huge forest fire...The blaze...has blackened more than 35,000 acres of forest...burned out of control along a 56-mile perimeter in the area of Donner Lake...the Donner fire was 60 per cent contained and...a control line had been established to protect a populated area extending from Hobart Mills, Calif., to Highway 40" (*Madera Tribune* 8/23/1960).

Extensive areas along the northern and western portions of the Prosser Creek Watershed project were burned by the 1960 "Donner Ridge Fire" or "Donner Burn." The Donner Ridge Fire is reported as "Truckee's largest fire to date" (Fox 2015:18). (Note that retired Forester, John Kennedy, recalled relatively few catastrophic fires during his long employ with the Tahoe National Forest and that the "Donner Burn" was unusual in comparison to what has become the contemporary norm (personal communication 8/19/20.)

The fire started on August 20, 1960 in Negro Canyon above Donner Lake and the Armstrong Tract subdivision. It was ignited by embers from slash burn piles created during construction of Interstate 80 and was fueled by 60-70-mile wind gusts. It raged in a northeasterly direction over a 65-mile perimeter that was 23 miles long, engulfing large portions of the Prosser Creek watershed from the northwest quadrant of the Tahoe Donner Subdivision, across Carpenter Ridge, and through parts of Stampede, Sardine and Dog valleys (Sproat 2015:4).

> "This swath of land was severely impacted during the fire suppression activities and subsequent timber salvage logging. The current landscape is dominated by pine plantations, tall, thick brush, and wide bulldozer constructed terraces that were created on all slopes to prevent erosion" (Baldrica et al. 2012:18).

The cost of fire suppression for the Tahoe National Forest alone tallied over $6.9 million in today's dollars, and over $39,970,000 lost in about 150,000 board feet in blackened timber. Firefighting involved over 3,200 men, five borate planes, 74 bulldozers, 49 tank trucks, two light planes to spot flare-ups, six helicopters, and seven standby aerial spray planes (Sproat 2015:5). According to a Sacramento Channel 3 documentary (Atkinson 1960), Fibreboard lost two thousand acres of timber and pulpwood and acres of Christmas tree farms.

Shortly after the 1960 fire, Fibreboard Corporation initiated an intensive program of salvage logging in a race against insect infestations, harvesting about 17 million board feet of timber (Houdyschell, personal communication in Lindström 2016). To facilitate post-fire logging, in 1960-1961 the company constructed miles of tractor-truck logging roads, skid trails, log landings, etc. It is likely that, following the railroad logging era of the 1920s, stands had not been re-entered until 1960-1961 and immediately following the Donner Burn (Houdyschell, personal communication November 13, 2015).

The fire's immediate aftermath induced erosion and sedimentation of streams with accompanying loss of trout habitat due to increased alkalinity of water and introduction of debris. The lack of stabilizing vegetation resulted in the collapse of stream banks with sudden changes in courses of streams (Atkinson 1960). Over time, burned areas are now marked by expansive brush fields interspersed by former tree plantations that now support acres of even-aged, densely packed timber.

PREHISTORIC LAND USE

Human beings have been a component of the Truckee-Tahoe Sierra for at least 8,000 years, as summarized in a prehistoric context presented by Waechter and Lindström (2014). A large view divides the prehistory of the Sierra Nevada and adjoining regions into intervals marked by changes in adaptive strategies that represent major stages of cultural evolution (Elston 1982,1986). Current understanding of northern Sierra Nevada and western Great Basin prehistory is framed within a chronological sequence spanning nearly 12,000 years that is drawn from paleoclimatic and archaeological studies throughout the western Great Basin, eastern Sierra front and the Tahoe-Truckee area (especially see Elston 1971, 1982, 1986; Elston et al. 1977, 1995; Grayson 1993; Heizer and Elsasser 1953). In broadest terms, the archaeological signature of the Tahoe Sierra is interpreted against a paleoenvironmental model that marks a trend from hunting-based societies in earlier times to more dispersed populations that were increasingly reliant upon diverse resources by historic contact. The change in lifeways is attributed partially to factors involving paleoclimatic fluctuations, a shifting subsistence base, and variable demographics.

Pre-Archaic remains suggest occupation by at least 9,000 years ago in the Tahoe Sierra during the Late Pleistocene/Early Holocene (~12,500-8,000 years ago) as glaciers retreated, pluvial lakes shrank, and climates warmed (Elston's et al. 1977 "Tahoe Reach Phase"). Early populations were highly mobile in the pursuit of large game animals.

Pre-Archaic to Early Archaic occupation dates from about 7,000-5,500 years ago during the Middle Holocene (~8,000 to 5,500 years ago). Increased warming and drying caused diminished creek flows and lake levels in Tahoe and other regional lakes to drop, allowing trees to grow in areas that were once inundated (Lindström 1990, 1997; Lindström et al. 2000). This period is characterized by a decrease in the number of archaeological sites that may reflect declining resources and populations in the Tahoe Sierra.

The "Early" Late Holocene dating between 5,500 and 2,000 years ago (Elston's et al. 1977 "Early Martis Phase") witnessed the end of the Mid-Holocene droughts, with a consequent expansion of forests and woodlands and a rise in Lake Tahoe and other regional lakes and streams that drowned ancient forests along the shoreline (Lindström et al. 2000). This was the most intensive period of prehistoric occupation in the region.

A warming and drying trend with a decline in winter precipitation during the "Middle" Late Holocene between 2,000 and 1,000 years ago (Elston's et al. "Late Martis" / "Early Kings Beach" phases) coincided with profound cultural changes.

Around 1,000 years ago during the Late Holocene (Elston's et al 1977 "Kings Beach" Phase), much of the west was affected by frequent and dramatic fluctuations in temperature and precipitation marked by prolonged and severe droughts (Stine 1994). Late Archaic human populations continued to rise and stressed by periodic but extreme warm and dry conditions (known as the "Medieval Climatic Anomaly"), shifted away from large game hunting to the further pursuit of foods previously ignored (e.g., plants, fish and small game). This period is reflected archaeologically in more intensive use of all parts of the Tahoe Sierra landscape, with more dispersed and ephemeral settlement patterns allowing for year-round residence in the Tahoe highlands at sometimes and prohibiting even seasonal occupation at other times. These changes may reflect the arrival of incoming Numic-speaking populations (e.g., Paiute groups) into an area that had been occupied for thousands of years by Hokan-speakers (Jacobsen 1966), the protohistoric ancestors of the Washoe Indians (Elston's et al 1977 "Late Kings Beach Phase"). It is estimated that the prehistoric Washoe once had one of the highest population densities in the western Great Basin. Relatively high estimates are attributed to the bountiful environment in which they lived (Price 1962:2). Historic declines in Washoe population and traditional resource use were caused by disruptions imposed by incoming Euroamerican groups.

The Washoe regard all "prehistoric" remains and sites within the Tahoe-Truckee basins and environs as associated with their own past. In support of this contention, they point to the traditions of their neighbors (the Northern Paiute, Sierra Miwok and Southern Maidu) that include stories about migrations and movement, whereas theirs do not (Rucks 1996:6). However, use by these neighboring groups is not ruled out (Bloomer and Lindström 2006:10).

Archaeological excavations at the prehistoric Alder Hill basalt quarry complex, located immediately south of the Prosser Creek watershed study area (near the Junction of State Route 89 and Prosser Dam Road) confirmed that the quarry served as a major source of toolstone for prehistoric groups occupying the Tahoe/Truckee region for most of the last eight to nine thousand years (McGuire et al. 2006). This remarkable finding documented early Holocene occupation of the local area based on the recovery of projectile points, adding to the growing awareness that this and other higher-elevation contexts in the central and northern Sierra Nevada were the scenes of an ancient and surprisingly substantial occupation.

WASHOE LAND USE

The Prosser Creek drainage is most firmly established within Washoe territory or *Wa She Shu*, with primary use by the northern Washoe or *Wélmelti'* (Downs 1966; Nevers l976; Stewart 1966). Washoe land use is best characterized as generally following a seasonal cycle, moving from low elevation winter villages to high elevation summer camps and back again, but not everyone moved from their lowland villages. Northern Washoe traditional territory encompasses the Truckee Basin and Donner sub-basin, the Sierra Valley, the Truckee Meadows (Reno), Washoe Valley, and points in between. The town and the river were named by non-natives for "Captain Truckee", the Northern Paiute Indian who famously guided the first emigrant party from eastern Nevada over Donner Pass to California in 1844. The Truckee River which bears his name, was a travel corridor and conduit of resources (i.e., fish) and communication between *Wélmelti'* and their Northern Paiute neighbors. The place where the Town of Truckee is located is also known as *Dawbayóyabuk,* translated as "flowing through a narrow place or passage" (Merriam 1904). *K'ubüna[u] detdéyi?* refers to the settlement on the south side of the Truckee River across from Commercial Row (d'Azevedo 1956: #130). In 1902 the village was described as: "Indian camp across the river. Washoe people. Bedrock mill and ponderous pestles of granite. The arbor shelter on the sun side" (Hudson 1902). *Dat'sa sut ma'lam detde'yi'* describes a Washoe encampment near Gateway (d'Azevedo 1956:51, 55). *Péle? má'lam detdéyi?* is the name of an old Washoe settlement at the confluence of Trout Creek and the Truckee River (d'Azevedo 1956: #131). Washoe elders recall a settlement either along or at the mouth of Prosser Creek, but its name is no longer known by contemporary elders (Davenport 2019:316; Dixon, Schablitsky, and Novak 2011, 257).

By the l850s Euroamericans had permanently occupied Washoe territory and changed traditional lifeways. Mining, lumbering, grazing, commercial fishing, tourism, and the growth of settlements disrupted traditional Indian relationships to the land. As hunting and gathering wild foods were no longer possible, the Washoe were forced into dependency upon the Euroamerican settlers (Lindström et al. 2000, 2007). Washoes survived by trading goods and services to the dominant Euroamerican population (selling baskets, catching fish and game, and working as domestic laborers, wood cutters, ice harvesters, caretakers, game guides, etc.). In exchange Washoes arranged for camping privileges on traditional lands with access to what resources remained. Traditional plant management continued on the fringe of "white" settlements, but on a very reduced scale, and many established patronage relationships with incoming Euroamerican residents. Oral history interviews with former employees of Hobart Mills include brief recollections of encounters with Washoe and Paiute Indians living on the outskirts of the mill town during the 1920s and 1930s and suggesting that some may have been working for the company.

> "Ragtown had a few houses…probably five houses…Ragtown got its name because of an Indian Tribe that had lived there, and some of the remnants of it came back in the summertime, pitched tents, and camped out there. So from the tents it was named Ragtown" (Dundas 1992 V2:37).
>
> "Paiute and Washoe Indians sold roasted pinenuts and smoked fish in Hobart Mills (Otis 1992:A8, K4; D. Dundas 1992:30-32; McLeod:21,25).
>
> "They [Indians] stayed to themselves. The Indians were pretty exclusive. They didn't hobnob too much with anybody. When they finished work they'd march home and stay to themselves

pretty well. They were only there for two or three years, and then they stopped coming up and we never saw any more of them" (Dundas 1992 V2:40).

Beginning in 1917, the Washoe Tribe began acquiring back a small part of their traditional lands (Nevers 1976:90-91). The Washoe remain as a recognized tribe by the U. S. government and have maintained an established land base. Its tribal members are governed by a tribal council that consists of members of the Carson, Dresslerville, Woodfords, and Reno-Sparks Indian colonies, as well as members from non-reservation areas. Even into the 21st Century, the Washoe have not been completely displaced from their traditional lands. The contemporary Washoe have developed a Comprehensive Land Use Plan (Washoe Tribal Council 1994) that includes goals of reestablishing a presence within the Tahoe Sierra and re-vitalizing Washoe cultural knowledge, including the harvest and care of traditional plant resources and the protection of traditional properties within the cultural landscape (Rucks 1996:3).

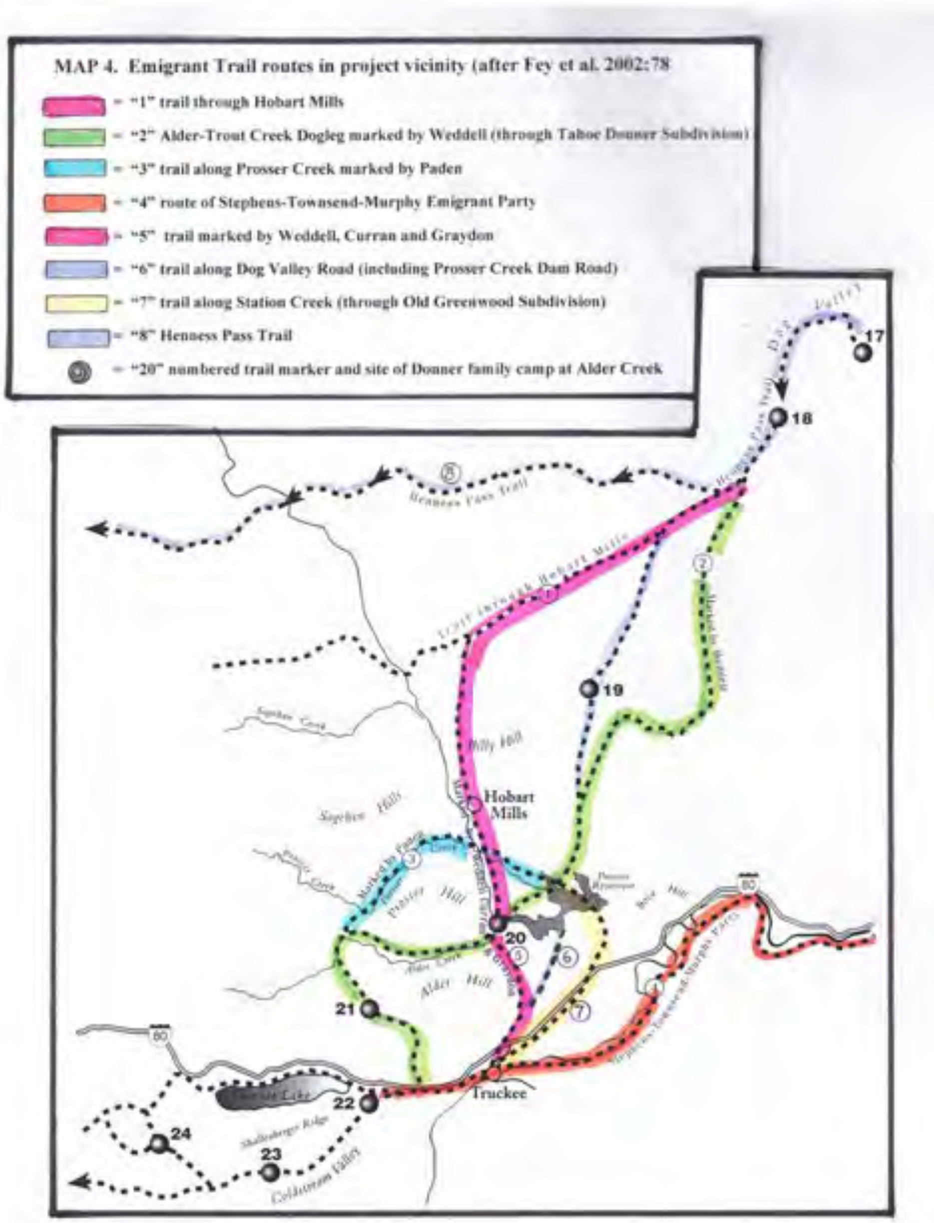
EUROAMERICAN LAND USE

A history of the community of Truckee is marked by the arrival of Joseph Gray, who built a stage station along the main trans-sierra travel route near the present-day downtown in l863. Gray was soon joined by a blacksmith named S. S. Coburn, and the fledgling settlement of Gray's Toll Station was renamed Coburn's Station. In 1868 Coburn's Station burned, and the name was changed to Truckee. This tiny way station grew from two structures into a thriving town, which accommodated emigrants, stagecoach travelers and freight wagons in route westward to California's gold fields and eastward to the Comstock Lode in Nevada. The completion of the transcontinental railroad in l869 gave rise to other developments in the transportation, lumbering, ice, agriculture, livestock ranching and dairying, and tourism industry, which were to become the essential economic bases of Truckee. The Central Pacific Railroad Company (comprised of Leland Stanford, Charles Crocker, Mark Hopkins, and Collis P. Huntington) was chosen to build the rails east. The company was granted a strip of land on both sides of the right-of-way and one square mile of land for each mile of railroad completed, to be awarded in a checkerboard pattern on alternating sides of the track. The company could then sell this land to raise more money, which it proceeded to do for its Truckee holdings. Land holdings by the "C.P.Ry.Co." are shown on Map 2. The "checkerboard" pattern of ownership continues into the modern period, as depicted on Map 3.

TRANSPORTATION

Emigrant Travel

Some of the first Euroamerican visitors to the Truckee area were members of the Stephens-Townsend-Murphy Party, who ascended the Truckee River and arrived at its confluence with Donner Creek in mid-November of l844. Hundreds of emigrant trains soon followed, the most notable being the Donner Party. The ordeal of starvation and cannibalism, endured by their members in the winter of l846-47 at Donner Lake and Alder Creek, is a well-known and tragic episode in the American settlement of the West. The lake camp is memorialized at Donner State Historic Park. The camp at Alder Creek, located due south of the Prosser Creek watershed project area (Map 4: Map Trail Marker #20), is now managed by the USFS-TNF as the "Donner Stumps Picnic Area." It was here that the Donner family camped, not near the lake that bears their name. Delayed by a broken wagon axle and a serious injury inflicted during its repair, the Donners had to spend the winter at Alder Creek.



MAP 4. Emigrant Trail routes in project vicinity (after Fey et al. 2002:78
= "1" trail through Hobart Mills
= "2" Alder-Trout Creek Dogleg marked by Weddell (through Tahoe Donner Subdivision)
= "3" trail along Prosser Creek marked by Paden
= "4" route of Stephens-Townsend-Murphy Emigrant Party
= "5" trail marked by Weddell, Curran and Graydon
= "6" trail along Dog Valley Road (including Prosser Creek Dam Road)
= "7" trail along Station Creek (through Old Greenwood Subdivision)
= "8" Henness Pass Trail
= "20" numbered trail marker and site of Donner family camp at Alder Creek
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Hobart Mills
Truckee
Henness Pass Trail
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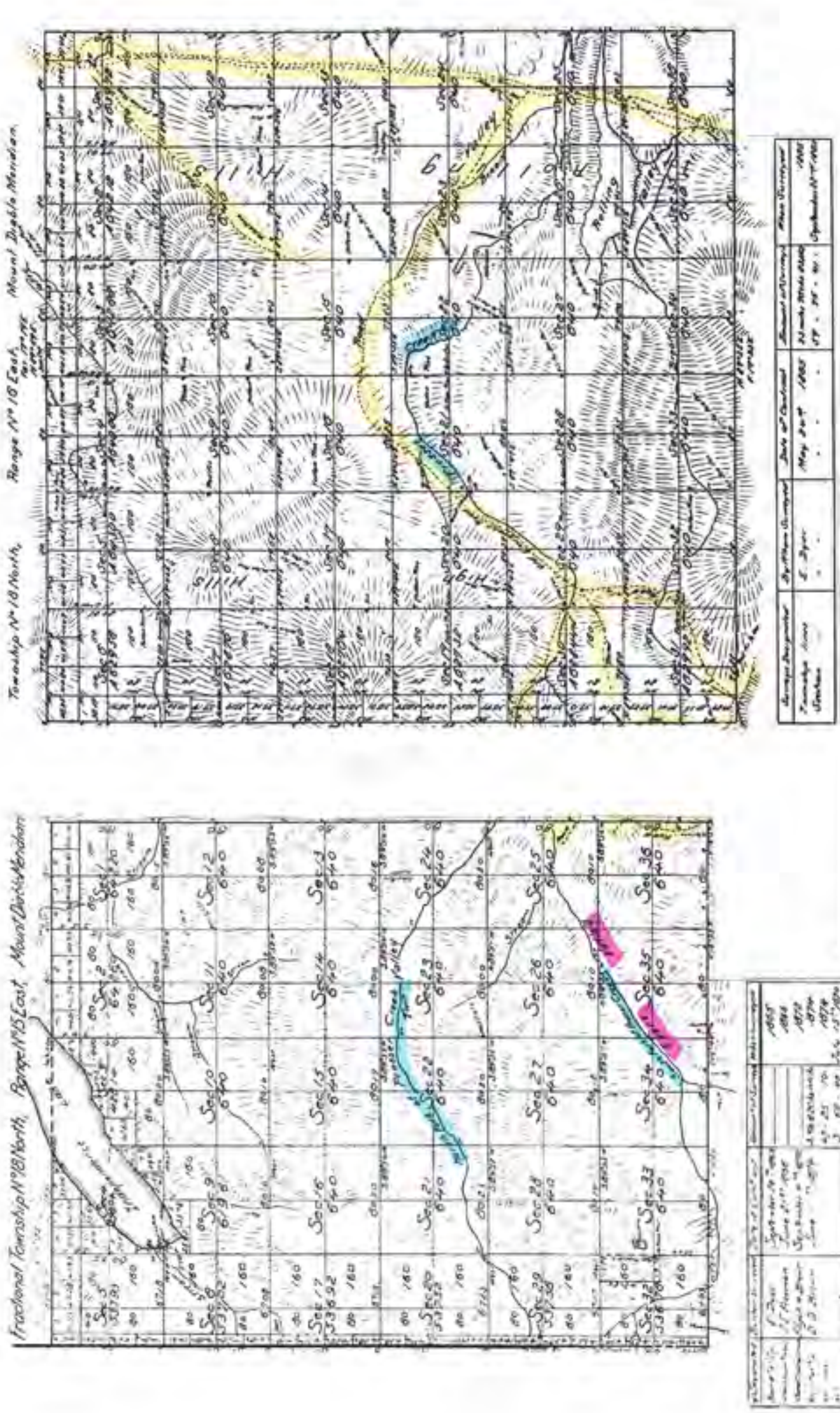


MAP 5. General Land Office Plat 1865

Subsequent emigrant travelers followed an alternate route to avoid the rugged Truckee River canyon endured by the Donner Party, leaving Nevada in the vicinity of Dog Valley (north of the Truckee River) and then angling back down to the Truckee River through present-day Prosser Reservoir and east of the current alignment of State Route 89. This route is known as the Truckee Route of the Emigrant Trail. This earliest trail system generally followed Prosser Creek, with branching trails crossing the confluence of the North Fork into Carpenter Valley and the South Fork into Euer Valley (maps 4-5). Several leading Emigrant Trail historians have identified and marked alternate trail routes in the project vicinity (Map 4). The effort was led by Peter Wedell in the 1920s, followed by Paden (1943), Curran (1982), Graydon (1986), and Fey et al. (2002), among others. The route up main Prosser Creek is first shown on the 1865 GLO plat (Map 5) and later identified by Paden (1943). The trail/road continues to appear as an access route to the abandoned Martin, Seth & Hall/Nevada and California Lumber Company sawmill (1873-1880) up until a 1915 TNF map.

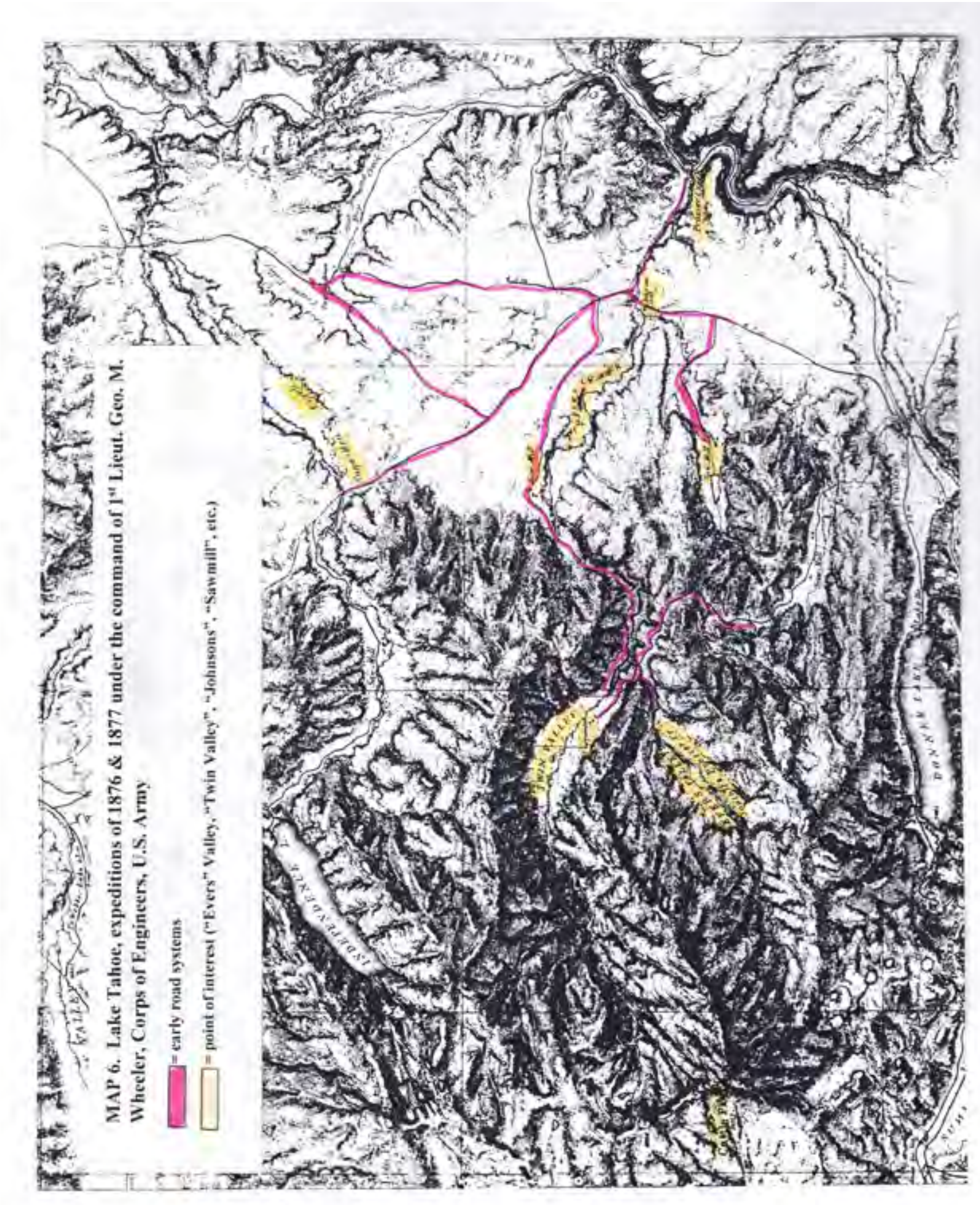
Paden (1943) also endorsed another route up Alder Creek through the Tahoe Donner Subdivision, with the trail entering the Town of Truckee at the present location of Truckee High School. Posts marking the route of the Emigrant Trail (referenced as the "Alder-Trout Creek Dogleg" by Graydon,1986:33,) are set along Northwoods Boulevard and signage for the Emigrant Trail has been posted along the lower reach of Alder Creek that flows through USFS land. This route also appears on the 1865 GLO plat (Map 5) and is supported by Bryant's 1846 diary. Although this route was included in Weddell's early mapping, he favored a more direct route to Truckee in his later maps (Fey et al. 2002:93). Curran (1982:162) wrote that by1845, most of the emigrants did not go up Alder Creek but took instead the shorter, more direct, and easier route along present-day State Route 89 to the present town of Truckee and the Truckee River, as indicated in the Nicholas Carriger diary.

> "Left Prosser Creek and its tributary Alder Creek and crossed a small hill to reach Donner Creek about where it enters to Truckee near present Truckee" (Curran 1982:162).

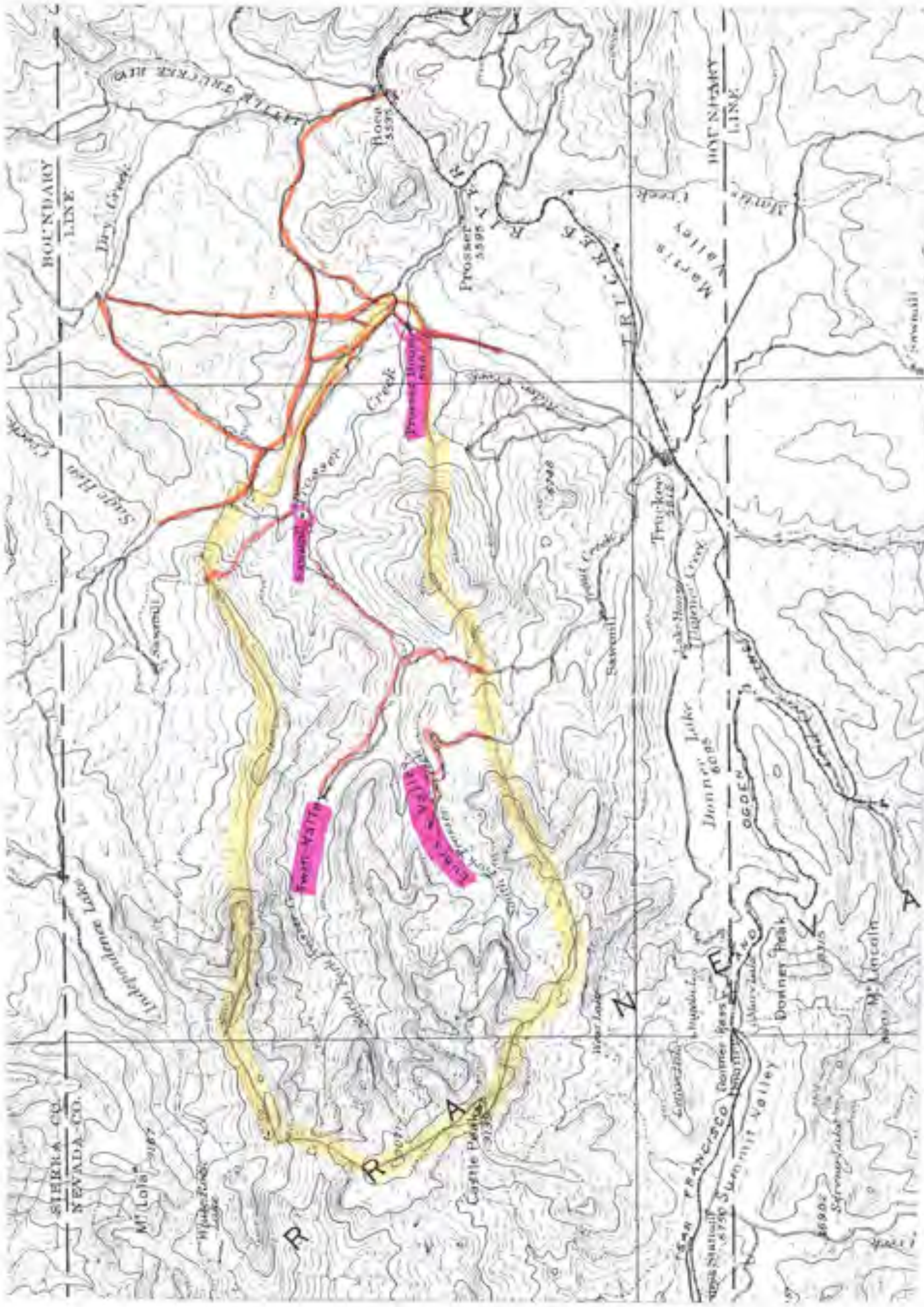
Logic holds that the relatively open terrain south of Stampede Reservoir as far as Prosser Creek could have permitted several wagon routes and probably several were used (Graydon 1986:28). Dams at Stampede and Prosser reservoirs and the far-reaching network of logging roads make it difficult to track the Emigrant Trail through this area. Nonetheless, it is likely that after the emigrants came out of Dog Valley, they descended to the Little Truckee River ("Wind River"), crossed it, and traveled without any trouble to Prosser Creek ("John's Creek") and Alder Creek. The trail probably closely followed the old Dog Valley road from Reno to Truckee, as suggested in Snyder's 1845 diary entry:

> "It is 9 miles to Wind River from the spring branch where we camped, 9 miles from Wind River to John's River, & 6 miles from John's River to the waters of Truckeys [sic] River - Jacob R. Snyder, 1845" (Graydon 1986:28).

Today, most Emigrant Trail historians agree that there never was a single trail to California. Rather, the route evolved as a complex system of established roads and risky cutoffs – likened to several strands of a frayed rope united as a single intermingled cord only for the passage of the Rocky Mountains, and then diverging widely apart at either end. "The way" was actually many ways… (Fey et al. 2002:21).

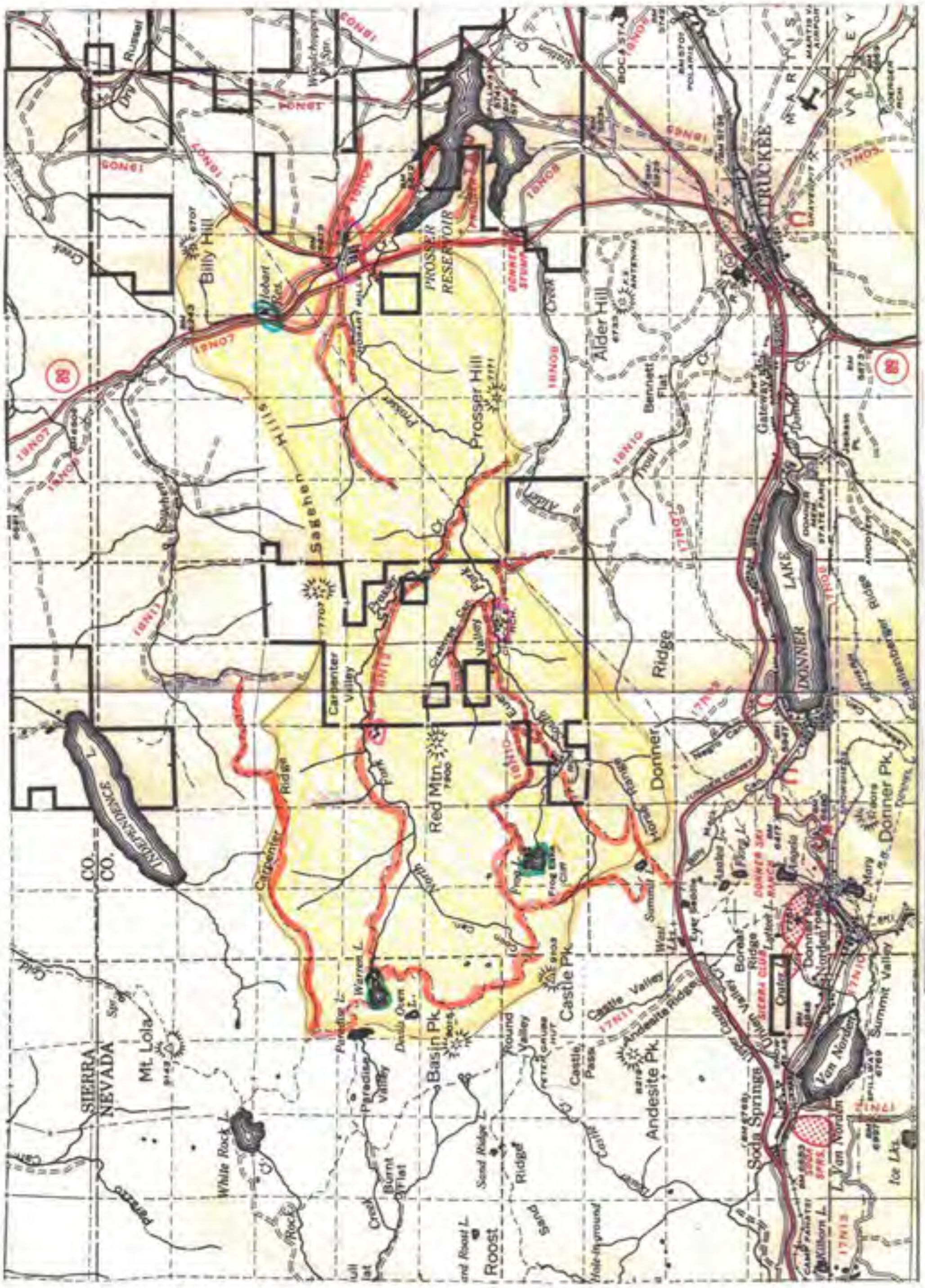


MAP 6. Lake Tahoe, expeditions of 1876 & 1877 under the command of 1st Lieut. Geo. M. Wheeler, Corps of Engineers, U.S. Army



MAP 7. USGS Truckee Quad 1889

- = approximate project area boundary
- = early road systems
- = point of interest ("Euers Valley", "Twin Valley", "Prosser House", Sawmill", etc.)



MAP 8. Tahoe National Forest, Sierraville Ranger District 1962

= approximate project area

= modern system of roads and trails

Dutch Flat Donner Lake Wagon Road/Lincoln Highway (Dog Valley Road)

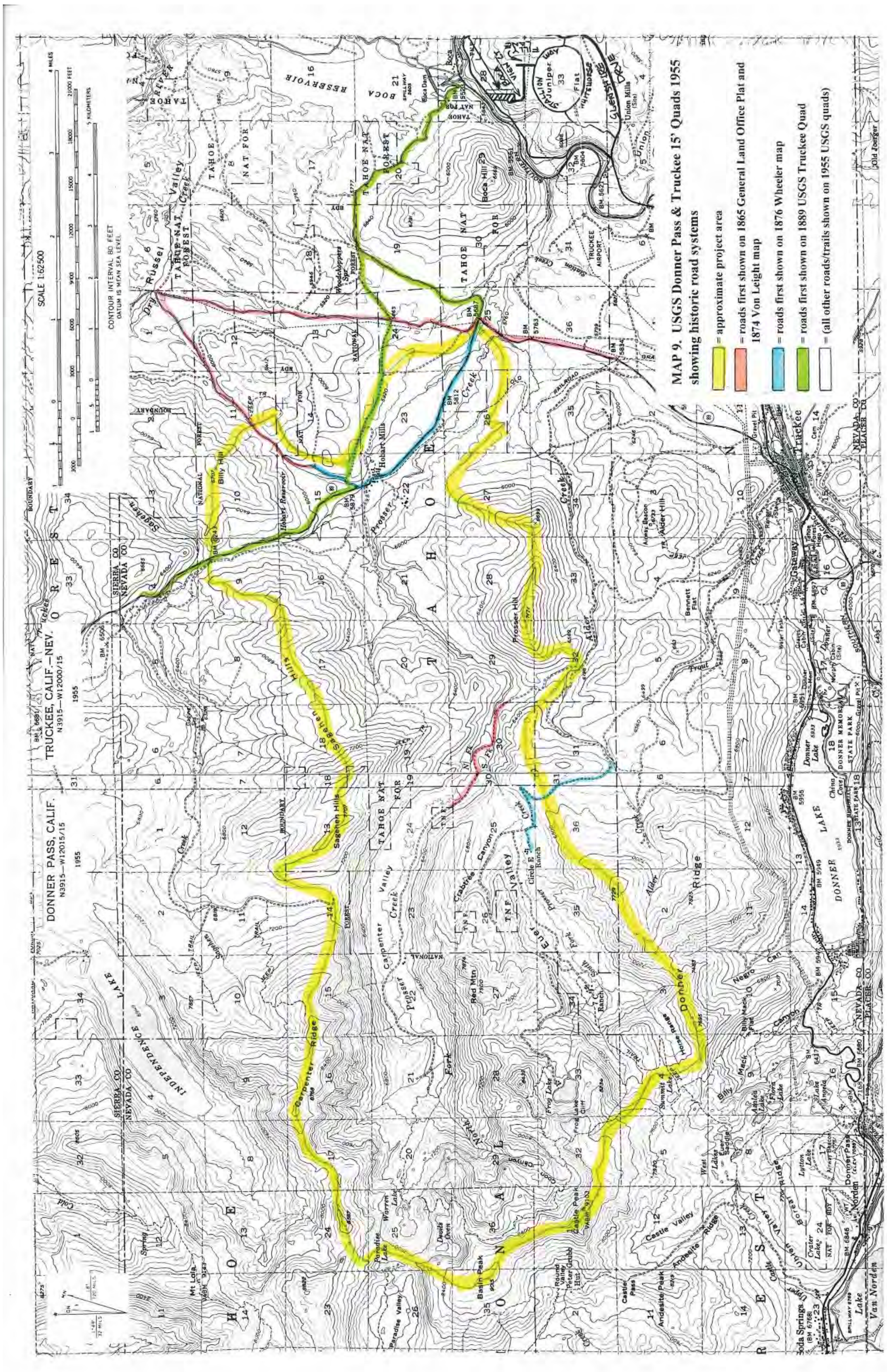
Community development and Truckee's emergence into a recreation-based economy were boosted by the completion of multiple generations of roadways over Donner Pass. This historic transportation corridor is now occupied by Donner Pass Road through Truckee and by the Old Dog Valley Road (present-day Prosser Dam Road) north of town, both following basically the same route through the Truckee Basin that the earliest emigrants had traveled along the Truckee Route of the Emigrant Trail. The main branch of the Dog Valley Road crosses through the southeast corner of the Prosser Creek watershed project area; several branching/connecting secondary roads pass through the eastern extremity of the project in the vicinity of Hobart Mills or are now inundated by Prosser Reservoir (maps 5-8). This historic road is first shown on a map dating from 1865 (Map 5) and on subsequent historic maps dating from 1876 (Map 6), 1880 (Map 1), 1889 (Map 7), and 1913 (Map 2). A composite of historic road alignments that coincide with road systems established by 1955 is shown on the 1955 USGS Donner Pass and Truckee 15' quads (Map 9). By 1962 this historic thoroughfare was bypassed in the project vicinity by the modern route of State Route 89 (Map 8).

The Dutch Flat Donner Lake Wagon Road opened in 1864 and was designed to facilitate the transport of supplies to points along the transcontinental railroad. It formed the final link in a continuous freight and passenger road from Dutch Flat in California's gold fields to the Comstock mines near Virginia City (Hoover, Rensch and Rensch l966:267).

To the north of Truckee, Henness Pass Road through Dog Valley (Map 4) was pioneered in 1850, as a remarkably easy crossing of the divide between the Great Basin and the Pacific slope (Howard 1998: 69), and traffic was diverted away from Donner Pass. Trans-sierran traffic dropped dramatically and was reduced to local travel with the construction of the Central Pacific Railroad over Donner Pass in 1869. The Henness Pass routes did not survive into the auto age -- apart from the paved section between Webber Lake and Jackson Meadows.

In 1913-1914 the old Dutch Flat Donner Lake Wagon Road was transformed into the nation's first transcontinental auto road, the "Lincoln Highway." With the promotion and development of the Truckee-Donner route, as simultaneously part of the Lincoln Highway, Truckee citizens and prominent business leaders succeeded in getting the road constructed eastward through town and altered the route from its historic grade north of Truckee along Dog Valley Road. As noted above, this old grade passed through the Prosser Creek watershed study area, along the modern alignment of Prosser Dam Road to Prosser Reservoir, before proceeding northeast to Dog Valley, Verdi, and Reno. The new road and present route of Interstate 80 was completed down the Truckee River Canyon in 1926, paralleling the Truckee River to Reno within the same corridor followed by the Donner emigrant party in 1846.

Early on, a network of secondary roads branched out from the main thoroughfare of the Dutch Flat Donner Lake Wagon Road, as is evident in the vicinity of Hobart Mills (Map 9) and along Prosser Creek. Roadhouses and hotels sprung up along the route. "Johnson" is shown between Prosser and Alder Creek (Map 6). "Prosser House" (now beneath the reservoir) was strategically located on the main road to Dog Valley at intersection of several branching secondary roads (Map 7). Free "auto camps" were informally established in fields or openings adjacent to the roadway to publicize the Lincoln Highway and promote its use. The areas later became attractions for hunters or as migratory camps frequented by transients (Lindström 2000).


MAP 9. USGS Donner Pass & Truckee 15' Quads 1955 showing historic road systems
= approximate project area
= roads first shown on 1865 General Land Office Plat and 1874 Von Leight map
= roads first shown on 1876 Wheeler map
= roads first shown on 1889 USGS Truckee Quad
= (all other roads/trails shown on 1955 USGS quads)
DONNER PASS, CALIF.
TRUCKEE, CALIF.-NEV.
SCALE 1:62500

LOGGING

Logging was first initiated in the Truckee area after the discovery of the Comstock Lode in l859. When production began to fall in the mines in l867, the lumbering business also began to suffer. A new market for lumber was found in the nation's first transcontinental railroad. As the rails reached Donner Summit in l866-1867, many mills established operations in the Truckee Basin to supply the railroad with cordwood for fuel, lumber for snow shed construction and ties for the roadbed. After the completion of the railroad in l868-1869 lumber companies diversified and grew as new markets were opened to them. Eighteen or more sawmills were operating in the Truckee area during the late l9th century, along with a chair factory, a furniture factory, shingle mills, and a thriving cordwood and charcoal industry.

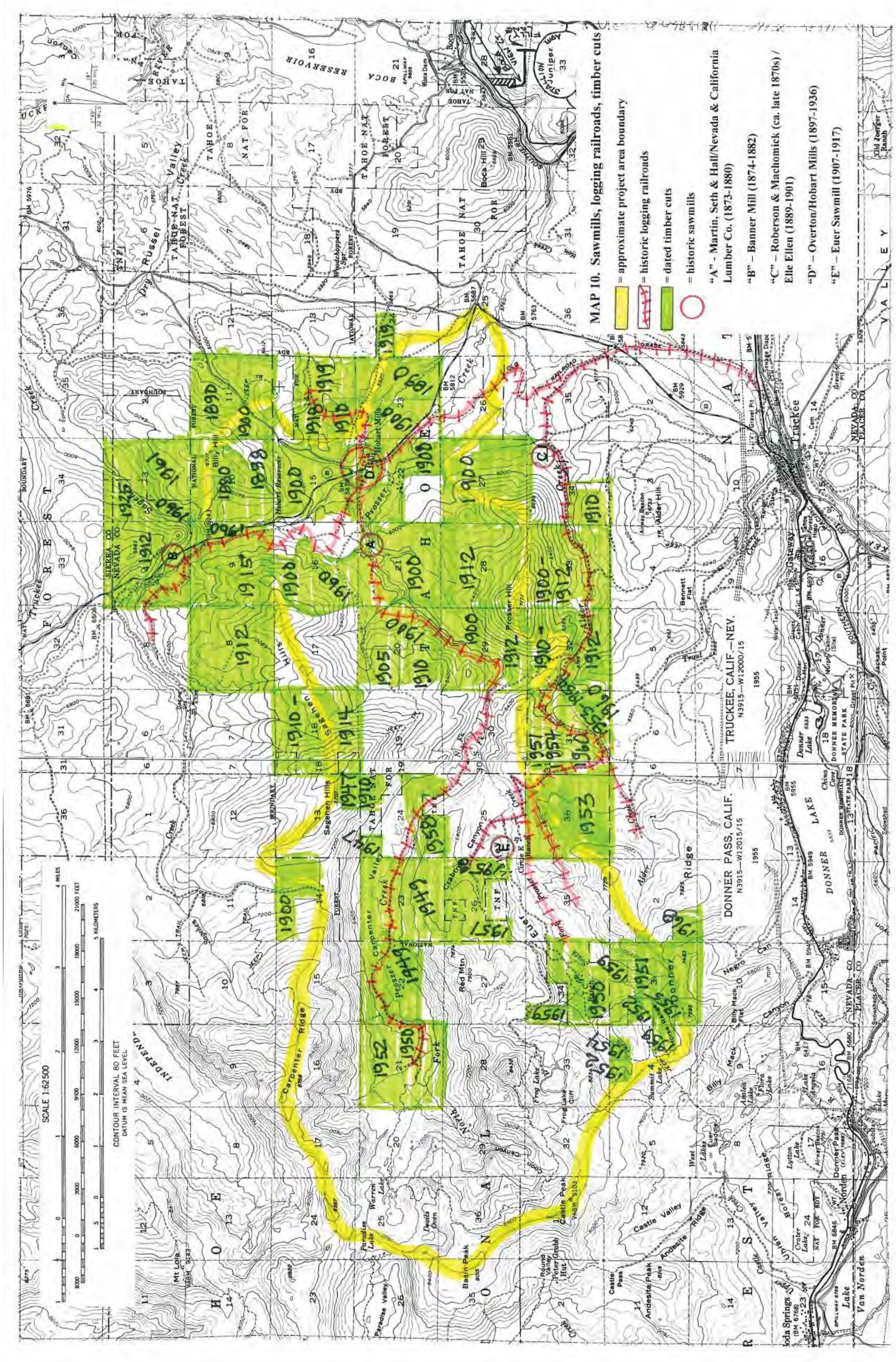
Cordwood formed a principal aspect of the 19th century lumber business and fueled engines on logging railroads and along the main transcontinental line. Large trees were cut down from which only one good sawlog; the remaining pine scrap, along with fir wood, was salvaged for cordwood. Most of the fuelwood was cut by Chinese.

Like fuelwood, charcoal production also functioned as an important adjunct to the 19th century lumber industry and the product was railed to the mines of Nevada and Utah, where wood was a more limited commodity. Charcoal production in the Truckee Basin was done principally by Chinese colliers in both earthen and brick kilns. Nearly 200 earthen kilns have been inventoried within a few-mile radius of the Prosser Creek watershed (Lindström 2000, 2002; Lindström and Waechter 2007).

Knowles (l942) describes several of these lumbering operations in the vicinity of Truckee, including smaller sawmills along Prosser and Alder creeks and the massive enterprise of the Sierra Nevada Wood and Lumber Company/Hobart Estate Company; based out of Hobart Mills, the company dominated early 20th century logging activities in the Prosser Creek watershed. Detailed company histories prepared by Barry-Schweyer (1998), Jackson et al. (1982) and Rowley and Rowley (1992) provide detailed background information. Mill locations, logging railroads and timber cutting areas appear on historic maps (for example see maps 5-7) and have been transposed onto a schematic composite map that draws from these historic sources (Map 10).

Small Scale Lumber Operations

During the 1870s, a few individuals staked smaller timber claims to supply the handful of sawmills established to outfit local needs, as well as the growing demands and opportunities presented by the newly constructed transcontinental railroad. The earliest lumber and fluming operations were small in scale, soon to be eclipsed by larger lumber companies with sizeable capital and land base.


MAP 10. Sawmills, logging railroads, timber cuts
= approximate project area boundary
= historic logging railroads
= dated timber cuts
= historic sawmills
"A" - Martin, Seth & Hall/Nevada & California Lumber Co. (1873-1880)
"B" - Banner Mill (1874-1882)
"C" - Roberson & Machomick (ca. late 1870s) / Elle Ellen (1889-1901)
"D" - Overton/Hobart Mills (1897-1936)
"E" - Euer Sawmill (1907-1917)
TRUCKEE, CALIF.—NEV.
DONNER PASS, CALIF.

Seth Martin and Hall (1872) and Lonkey and Smith/Nevada and California Lumber Company (1873)

In 1872 Seth Martin and Hall built a mill six miles north of Truckee on Prosser Creek where it was crossed by the Dutch Flat Donner Lake Wagon Road (Map 10). Land ownership appears on Map 1. In 1873 they sold their mill to Lonkey and Smith of the Nevada and California Lumber Company (and later owners of the Verdi Lumber Company). The "sawmill" on Prosser Creek appears on the 1876 Wheeler Map (Map 6) and the 1889 USGS Truckee Quad (Map 7). The mill used a water-powered turbine to output 30,000 feet of lumber daily. Lumber was flumed to Prosser Creek Station on the transcontinental railroad 5 ½ miles away. From their mill on Prosser Creek, Lonkey & Smith, continued throughout the 1880's to supply lumber for their factory and planning mill at Verdi and for their large box factory and lumber yards at Camp 16, as well as their yards at Virginia City (Knowles 1942:44; Wilson 1992:74).

Seth Martin also established Banner Mill on Sagehen Creek (maps 6-7), which operated on and off until 1902 (Wilson 1992:74). A historic photo of "Banner Junction" shows the mill and typical layout of an early logging railroad (Photo 6). Lonkey and Smith took over the Banner Mill on Sagehen Creek from Martin in 1882 (Knowles 1942:44). The company constructed a 4 ½ - mile flume from Sagehen Creek to a yard next to the transcontinental line. Their output during the 1880s's ranged from two million feet to seven million feet. By 1883 the Banner Mill had cleared about four 160-acre sections of land out of 20 sections (Knowles 1942:44). The *Nevada State Journal* (7/2/1885) reported the Banner Mill was "nearly consumed by fire in 1885. The stable, boarding house, blacksmith shop and a portion of their flume and all the outbuildings were burned with an estimated loss of $8,000. In 1889 the flume to Banner Mill was crushed by winter snows (Knowles 1942:44).

Lonkey and Smith operated the Banner Mill on Sagehen Creek along with the Prosser Creek Mill (Knowles 1942:44). By 1883 about a third of the timber in the tract on Prosser Creek had been cut over (Knowles 1942:44). In July of 1889 the mill on Prosser Creek burned (Knowles 1942:44).

Euer Sawmill (1907-1916)

The "Euer Mill" appears on an undated working map of logging railroad grades compiled by the USFS-TNF. Its general location is shown in this report on Map 10. The same Forest map depicts a section of railroad grade in Euer Valley. In addition, a narrow-gauge logging railroad is reported above the south side of Euer Valley, with a bed at a two percent grade (Huisman, personal communication 1/21/15 in Lindström 2016). It is likely that the railroad grades are not associated with the Euer Valley Mill but with logging operations conducted during the 1920s by the Crown-Willamette Paper Company.

Photo 6. "Banner Junction" ca. 1880s showing sawmill and typical layout of logging railroads (courtesy Truckee Donner Historical Society)

Sawmilling activities at the Euer Mill are reported in local press coverage dating from 1907 until 1916, when equipment from the abandoned mill was sold and relocated. A steam engine with 10-inch saw blade reportedly once sat on the mill's concrete foundation near the Euer Valley Road. A combination flume/ditch diverted water from Red Mountain to the steam engine. Hot water overflowed into a pit lined with lava rock, which remains (Huisman, personal communication 5/27/15 in Lindström 2016). Various milling events in Euer Valley are documented in the *Truckee Republican* as follows.

> "…Those who will erect new mills this fall are Mr. Crabtree and the Euer Brothers. The Euer Brothers will erect their mill in Euer Valley. On the land they own in that section there is sanding about 20,000,000 feet of pine timber. They will erect a mill with a capacity of 20,000 feet per day. They have already engaged their machinery and intend to build this fall" (*Truckee Republican* 8/14/1907).

> "Mr. Laity has been engaged the last two weeks in unloading off the cars and hauling to its destination at Euer Valley an immense amount of machinery for the new sawmill about completed by the Euer Brothers of the above place. They will not be able to cut lumber for export this season but will have everything ready for nearly start next spring" (*Truckee Republican* 10/23/1907.

"The Euer Valley Lumber Company celebrated Thanksgiving day by giving their employees a fine dinner of turkey, cranberry sauce and the usual accessories…Prizes were awarded…This lumber company is a recent organization whose members are Messrs. David Evans and Horace Richards of Truckee and Robert and George Euer of Clarksville" (*Truckee Republican* 12/7/1907.

"The Euer Valley Lumber Company have recommenced work on their sawmill which was partially completed last fall, when the winter storms compelled a cessation of their work. This company has also leased from the Richardson Estate the factory site at the east end of town and will erect a factory for the manufacture of the products of their sawmill" (*Truckee Republican* 5/9/1908).

"The Euer Valley Lumber Company started operations Thursday" (*Truckee Republican* 6/5/1909), the same time that "…a petition for a permit for a license to conduct a saloon in the Euer Valley Grocery Store, in Euer Valley, in Nevada Co., Cal…" (*Truckee Republican* 6/5/1909).

"R.S. Euer stated…he will be ready by the first of next month to start his saw mill in Euer Valley" (*Truckee Republican* 5/15/1910).

"…the Euer Valley lumber company, incorporated…January 13, 1908…April 21, it was resolved by a vote of all the stockholders to dissolve partnership hence the filing of the petition to that effect" (*Truckee Republican* 5/3/1911).

"The Euer Brothers sawmill in Euer Valley has been purchased by R. C. Gracey and moved to Deep Creek, five miles above Truckee. Gracey is an experienced Tillman, having operated and owned a mill at Pine, and having worked for a large lumber concern" (*Truckee Republican* 10/28/1916).

Sawmill in Crabtree Valley (ca. 1907)

Available reports of lumbering in Crabtree Valley, although limited, indicate the presence of a sawmill that is consistent with the timing and scope of the sawmilling in Euer Valley.

"…Those who will erect new mills this fall are Mr. Crabtree and the Euer Brothers…Mr. Crabtree has already started on his mill. He also has a largest tract of land, and according to reports has sold all the product that his mill will cut" (*Truckee Republican* 8/14/1907).

Roberson & Machomick Sawmill (1869-1889) / Elle Ellen Sawmill (1889-1901) on Alder Creek

Although Alder Creek falls outside the Prosser Creek watershed project area, it technically falls within the Prosser Creek drainage; logging activities there have bearing on environmental/historical events in the study area. Renowned local lumberman, Elle Ellen opened his third mill along Alder Creek (maps 7-10), sawing from 1883 to 1901 (Knowles 1942:37). He operated two circular saws, a shingle machine and a planning mill, all steam powered. His daily cut was 40,000 board feet in 12 hours, with an annual output of about a million feet during the 1890s. Ellen is alleged to have purchased the sawmill in 1889 from Charles E. Roberson and James Machomick, who acquired it from A. Proctor in 1869 (Wilson 1992:77).

Sierra Nevada Wood and Lumber Company/Hobart Estate Company (1897-1936)

Significant changes occurred in the industry during the last decade of the 19th century, where the trend was away from many small independent mills toward concentration of ownership and vertical integration of the industry (Jackson et al. 1982:134).

> "Formerly small mills with a capacity of 25,000 board feet per day were the rule…The small concerns are gradually going out of business with the exploitation of the private timber and within a comparatively short time only the large mills will remain" (USFS 1915:28).

By the 1890s, only timber operators with a substantial land base and a vertically integrated business model to take advantage of the economy of scale could seriously compete in lumbering operations after the turn of the century (Rowley and Rowley 1992:145). On the eastern side of the TNF, where the majority of the logging took place from 1906 to 1940, the most successful lumber companies were those that expanded their operations to include all phases of transportation and production, from cutting the trees to producing and distributing finished products. Mills hired their own fallers and yarded their own logs, although some logs were obtained by hiring private logging contractors (*The Timberman* 1926 in Rowley and Rowley 1992:143-144). Independently operated flumes gave way to company-owned railroads as the chief means of carrying lumber to the mill. Large mills operated drying kilns, ran box factories, planning mills, and sash and door plants. Expanded operations allowed companies to process poorer grades of pine and white fir and even sawdust found a profitable market (Jackson et al. 1982:140, 142).

The largest of the big three lumber companies cutting on the TNF was the Sierra Nevada Wood and Lumber Company (SNWLC), later incorporated as the Hobart Estate Company (HEC). Based out of Hobart Mills, the company intensively logged areas within and surrounding the Prosser Creek watershed, although the bulk of later cutting was concentrated to the north in the vast timbe stands they owned in Sierra County. The company owned more than 100,000 acres of timberland in California and Nevada (Rowley and Rowley 1992:47) with ownership of 40,000 acres in Sierra, Nevada, and Placer counties at the time they built their mill in 1897. By 1912 the HEC owned over 65,000 acres some 12 miles northwest of Hobart Mills (Jackson et al. 1982:140; Knowles 1942:43). By the mid-1920s the extent of their timberland totaled an area of 85,000 acres, principally pine (Knowles 1942:49). From 1917 cutting entered the smaller tracts of timber owned by the TNF, where they purchased parcel after parcel of timberland from the Forest Service until they ceased to cut timber in 1936. The USFS acquired the cut-over lands of the HEC under provisions of the Weeks Act (Jackson et al. 1982:144). (Maps 1 and 2 track the company's gradual increase in land holdings.)

Peak cutting for the SNWLC/HEC occurred during the 1910s (Rowley and Rowley 1992:145). For example, during the 1910 to 1919 decade they cleared off their Sierra County timber at the rate of over 18 million feet during 1910, 30 million feet in 1916 and again in 1917, 32 million feet during 1918, and over 23 million feet in 1919 (Knowles 1942:48). The annual cuts during the 1920s ranged from about 20 million to 28 million feet (Knowles 1942:49). Over 90 percent came from the 65,000 acres of company lands, only 10 percent of its total cut came from timber sales conducted on land owned by the USFS-TNF (Rowley and Rowley 1992:138; Wilson 1992:60). During this period, the Hobart enterprise was the only company with substantial holdings of timber, enough to ensure continuity of operation for more than a decade. All significant competitors had cut out timber by the early1900s (Wilson 1992:60). During the final period of lumbering the last of the virgin pine forests were cleared off and almost all the operators were even cutting some second growth timber (Knowles 1942:43). Hobart Mills ceased logging at the end of the 1936 season, having maintained an annual cut of about 25 million feet a year since 1897. During their 40 years in operation they cut about one billion board feet (Knowles 1942:49). In 1898 it was estimated that it would take 75 years for the company to deplete these timber resources (*Pacific Coast Wood and Iron*, October 1898:184, cited in Barry-Schweyer 2003 and Rowley and Rowley 1992:47). That would have occupied the company operations in the Truckee Basin until 1973. In fact, the Hobart operation only lasted four decades, closing during the depths of the Great Depression due to largely depleted local timber stands. With the timber cut over, the mill was dismantled and all activity along the narrow-gauge feeder lines and the standard gauge main line ceased.

Logging Technology

Although the environment imposed some limits about where and how railroad logging harvest could economically take place, most companies after the turn of the century overcame many obstacles with improving technologies. A brief description of period logging practices is provided below as background with which to better interpret the enduring consequences of these technologies across the landscape. Published documents, company records, oral histories, and physical evidence generally suggest that railroad logging firms held little regard for the natural environment, and for the first several decades, railroad logging practices were unregulated (Tamez et al. 1998:25). For example, in a series of environmental studies, the TNF concluded that the system of historic railroad grades constructed by the SNWLC:

> "…heavily impacted many aspects of riparian and meadow environments…directly causing degradation of the watershed…by causing streams to down-cut, and by causing head-cuts. In turn, this has caused a lowering of the meadow water table and a loss of meadow habitat…The significance of the damage is notable because the terrain is relatively flat and the grade construction simple cleared path, raised bed or benched grade construction…Restoring the hydrologic health of the watershed requires removal of the historical features that caused the damage, and in the process the hydrological studies provided information important to understanding environmental consequences of their construction" (McLemore 2003:14).

Photo 7. Yarding and skidding with oxen (courtesy Nevada Historical Society In Wilson 1992:12)

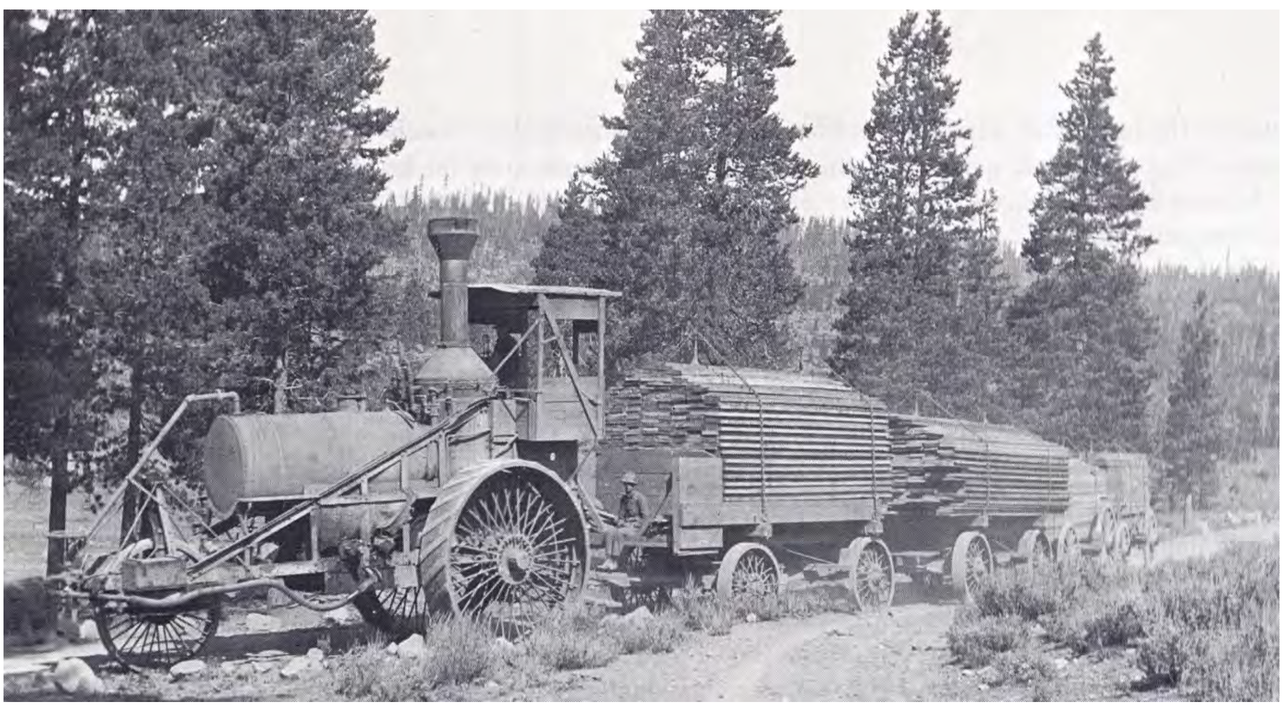


Photo 8. Hobart Mills lumber hauled by steam tractors such as the *Best* (courtesy George D. Oliver Collection In Myrick 1962:444).

Nineteenth-century mills were usually steam-powered portable operations and therefore more temporary, moving when an area's timber supply was exhausted. Logs were hauled from the woods to the mill using animal power (oxen, horse, mule) and transported along wagon roads, flumes and log skidways with adjacent animal tow path (photos 7-11). Early 20th century operations relied on steam power in the form of steam donkeys and logging railroads, replacing a former heavy reliance on flumes. Steam power permitted a company to extend farther into previously unharvested areas and supply stationary mills for longer periods of time. *Dolbeer* and *Willamette* steam donkeys were employed by Hobart operations to yard logs from the woods to the railroad (Photo 9). Logs were positioned onto flat rail cars using a *McGiffer*t loader (Photo 10). By 1928 the company was testing out tractor logging and replacing the steam donkeys with "*Caterpillars*" (Jackson et al. 1982:134; Knowles 1942:49; Rowley and Rowley 1992:143-144).

Throughout the 1920s, most large-scale companies on the TNF logged with donkey engines and railroads (Jackson et al. 1982:140). The logging season for railroad logging was typically from mid-May through mid-October (Barry-Schweyer 1998:10-11). From the patent of the *Dolbeer* steam donkey in 1882, technology developed more powerful machines like the *Willamette* with stronger engines and more reliable wire rope (Jackson et al. 1982). Steam donkeys comprised a steam engine and winding drum (or winch) mounted on a wooden sled with large runners. Steam donkeys, although efficient, were limited in range and the introduction of logging railroad (Photo 9) combined with steam donkeys and draft animals provided the most effective means of hauling timber from remote stands to sawmills further away (Rowley and Rowley 1992:143-144).

A typical donkey and railroad logging layout as it existed around 1907 is described as follows (Photo 9). Cables were laid up to 4,000 feet along a main chute running up a gulch or draw. A "bull" donkey or main haul engine positioned at the bottom of the chute, awaited logs brought by "yarding" donkeys from up to 1,800 feet in the woods paralleling the main chute. Once at the chute, "swing" donkeys took logs from the yarder and dragged them into the main chute, where logs were hooked together by cable and collected into trains. The bull donkey drum pulled the cable with several logs in tow down the chute to the railroad for loading with a steam donkey or *McGiffert* loader (Photo 10; Ayer 1958:38; Jackson et al. 1982:139). Instead of steam donkeys, the company sometimes employed up to 10 or 12 horses to pull the string of logs along traditional log chutes to nearby narrow-gauge rails for loading (Photo 11). A man rode on the head log with a bucket of grease and a swab to lubricate the chute (*The Timberman* 1926 In Rowley and Rowley 1992:143-144).

The 1920 *Directory of the Logging Industry for the Pacific Coast* listed nine steam donkey engines working for the Hobart Company. By 1926 the company had 12 *Willamette* donkeys and a *McGiffert* loader. That same year, the company announced the purchase of a caterpillar tractor for wood hauling (*The Timberman* 1926d In Rowley and Rowley 1992:143-144). By the start of the season of 1928 the trade press reported that company camps had started up and the donkeys had been replaced by *Caterpilla*r tractors, which made skid logging possible (Knowles 1942:52; *The Timberman* 1928 In Rowley and Rowley 1992:143-144). That move placed Hobart Mills among the first in the eastern Sierra to adopt that skidding technique" (Wilson 1992:60). By the 1930s gasoline-powered tractors came into more general use (Ayres 1958:35-37; Jackson et al. 1982:140). In 1934 Hobart operated six *Caterpillar 60's* and two *Willamette-Ersted* arched tractors in the woods. New railroads were constructed by steam shovels and tractor and bulldozer for grading and a locomotive was employed in laying track (*The Timberman* 1934 In Rowley and Rowley 1992:143-144).

Photo 9. The *Dolbeer* steam donkey skidded logs through the woods more efficiently than oxen and could hoist logs onto rail cars (courtesy George D. Oliver Collection In Myrick 1962:444)

Photo 10. The *McGiffert* loader greatly speeded up log loading onto rail cars (courtesy Nevada Historical Society In Wilson 1992:13)

Photo 11. Horse teams were also used to skid timber in log chutes to inclined log decks, like this one along the Sierra Nevada Wood & Lumber Co.'s narrow gauge line (courtesy George D. Oliver Collection In Myrick 1962:444)

Historic techniques of yarding (i.e., over the ground movement) of logs had varied consequences on erosion and sedimentation of the watershed. Twentieth-century steam-powered yarding and tractor skidding were more destructive than 19th century animal-powered yarding, where the negative effects of erosion were slightly less. Steam donkeys were highly efficient but left dendritic patterns of chutes/skids permanently carved into the soil. However, destructive effects of various logging methods on residual trees, on log utilization, seed production, and other factors varied according to the layout of the logging operation and the overall forest context. In general, the unregulated activities of post-1950s tractor logging were more destructive than either steam lor animal powered logging (Rowley and Rowley 1992:143-144).

> "With adequate [log] chute layouts and reasonable operation of power, steam logging resulted in damage to the residual timber stand that was not seriously greater than damage by animal logging. When skidding was performed without chutes - with logs being dragged indiscriminately across the terrain - damage to the residual stand was naturally greater than with chutes. And some of the steam-powered logging…was of that kind. Inevitably, the cables that systematically and swiftly dragged logs across the terrain did more damage to immature trees than did skidding by animals. Seedlings were ripped out, saplings broken or mangled, thus adding to the denudation contributed by the slash from trees that were harvested. Consequently, on some sites, decades elapsed before second growth established" (Wilson 1992:54).

Photo 12. Sierra Nevada Wood & Lumber Co.'s narrow gauge logging railroad pulling into Hobart Mills (courtesy George D. Oliver Collection In Myrick 1962:445)

Overton/Hobart Mills and Outlying Settlements and Infrastructure

Walter S. Hobart's Sierra Nevada Wood and Lumber Company (SNWLC) relocated from the Lake Tahoe Basin to the Truckee Basin in 1896 after most of the timber lands there had been cutover, bringing their railroad and sawmill equipment with them. Overton (later known as Hobart Mills) became the headquarters for the lumber company's operations (maps 11-12; photos 13-18). That same year, a new narrow-gauge railroad was built between Overton and Truckee to service the new facilities and an extensive network of logging railroads were subsequently built to bring saw logs to the mill (maps 11-12). Overton became Hobart Mills in 1917 when the SNWLC was dissolved, and all properties were transferred to the Hobart Estate Company (HEC), principal stockholder of the predecessor corporation (Myrick 1992:441).

During its heyday, Overton/Hobart Mills had a hotel, post office, dairy, barber shop, company store, school, boarding house, theater, hospital, residential housing, and sewer system. The mill itself consisted of a large sawmill, plaining mill, box factory, sash and door mill, shingle mill, light plant, lathe mill, dry kiln, welding shed, carpenter shop, paint shop, lumberyard, two large sheds for finished lumber, yard office, machine shop, blacksmith shop, donkey shed, and roundhouse. By 1924 there were about 500 men employed at the mill and living in the adjacent town, many with their wives and children.

Photo 13. Overview of Hobart Mills showing the organized layout of the company town with its narrow-gauge railroads, commercial yards and residential neighborhoods (courtesy Truckee Donner Historical Society)

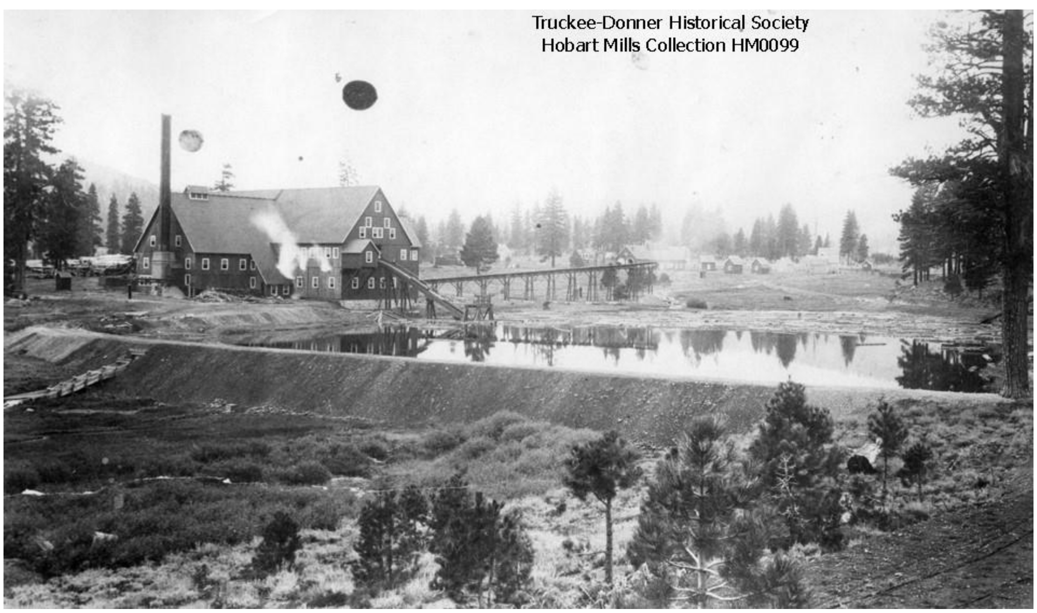
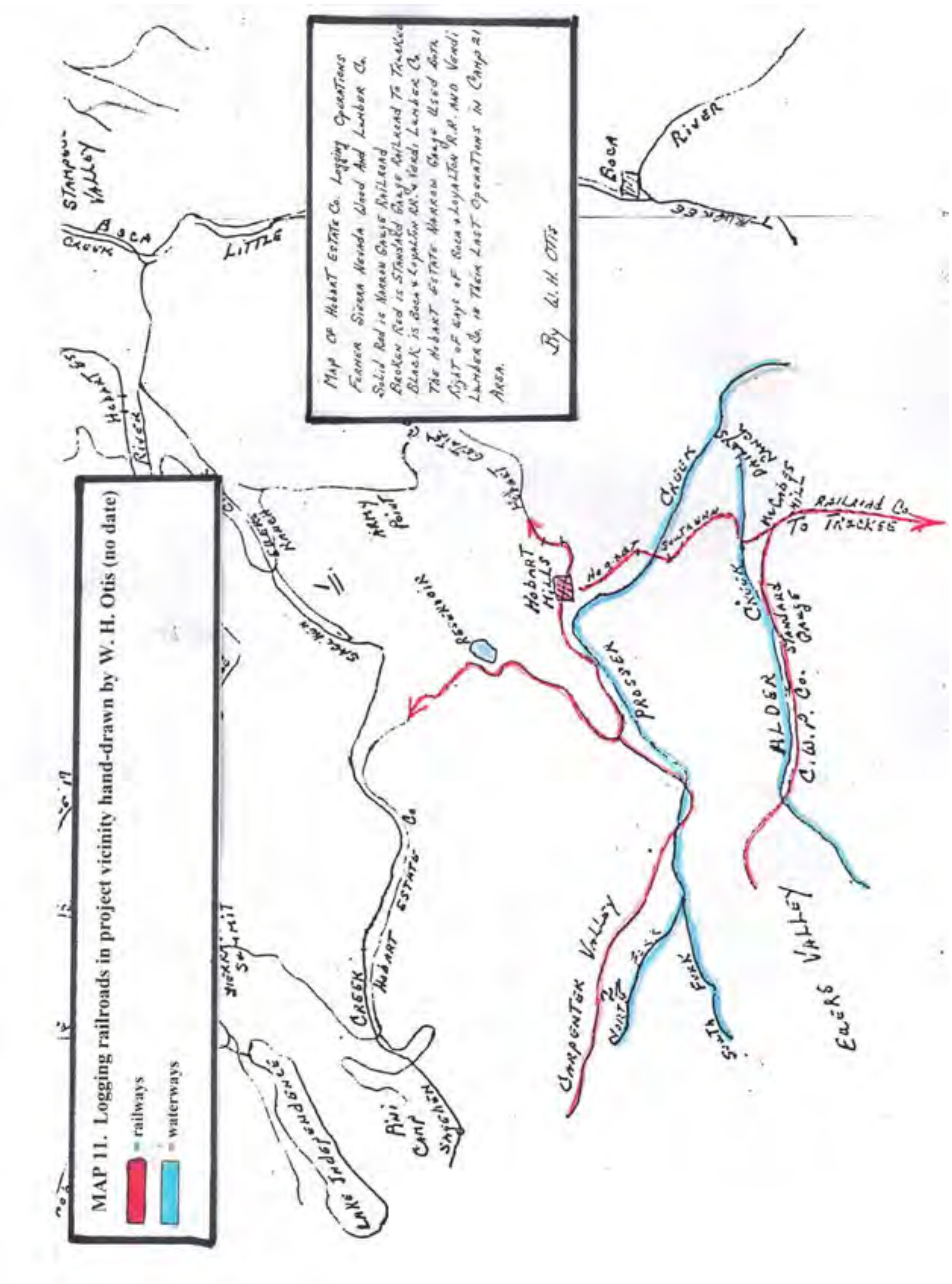


Photo 14. Hobart Mills sawmill and mill pond (courtesy Truckee Donner Historical Society)



MAP 11. Logging railroads in project vicinity hand-drawn by W. H. Otis (no date)

Hobart Mills burned in 1937 and most residents left. The mill town, once characterized as one of the largest lumber camps in the West (Rowley and Rowley 1992:144), is noteworthy as a planned, blueprinted town, designed to meet the human needs of housing, health services, sanitation and transportation and whose infrastructure was developed before the arrival of the population (Rowley and Rowley 1992:117). The mill town assumed a “resort-like setting” and became the backdrop for movies requiring a snowy, wilderness or mountainous setting and was frequented by celebrities such as Jack London and Clark Gable who stayed in the community on assignments (Rowley and Rowley 1992:118).

Outside the main mill and company town were smaller “neighborhoods” that were not built as part of the company town but were on land owned by the company (Barry-Schweyer 1998). These settlements were named Flumetown (or Flumeville), Ragtown and Tent Hill. (Otis 1992:A10,K61).

Tent Hill, on the southern edge of the main town, was an area where the company constructed approximately six individual wooden tent foundations several feet off the ground, perhaps as housing for the workers while more permanent structures were being built. The wooden floor tent structures had a kitchen in the back of each and outdoor privies (Otis 1992:A10,K6 In Barry-Schweyer 1998:6).

Flumetown, located on the southern edge of town, got its name from the flume that ran from Lonkey and Smith’s Mill to the transcontinental railroad at the mouth of Prosser Creek (Otis 1992:A10,K61). Flumetown consisted of “maybe three or four houses” located “down [the] railroad track past the slab pile” (C. Otis 1992:48). These are shown on W.H. Otis’ map of Hobart Mills (Map 12) as houses 23,24, and 25.

Photo 15. View of Ragtown on the outskirts of Hobart Mills, 1910 (courtesy Truckee Donner Historical Society)

Another of these small neighborhoods was Ragtown (Photo 15), shown on W.H. Otis' map (Map 12) as lying to the northwest of town along both sides of "Little Reservoir Creek" and west of the "Road to Sierraville and [Hobart] Reservoir." Ragtown was about a quarter of a mile, or a quarter to a half mile, from Hobart Mills – "sort of a suburb of Hobart Mills" (Dundas 1992 V2: 24). The Otis map (Map 12) shows five houses and the "Dan Salle Winery" (a bootlegger's still and wine vat) at Ragtown. Bootleggers made moonshine in a shack in Ragtown (Dundas 1992 V2:26). Ragtown was where the workers lived while the town was being constructed (Otis 1992:A10,K61). The name came from an Indian group that lived there in the summers before Hobart Mills was established. A small group of Indians continued to camp there in their tents, and it became known as Ragtown from the tents. There were about four or five families who continued to camp in that area until 1928 or 1929 (D. Dundas 1992b:37,40). Just to the east was a "Garbage Dump" and an old sawmill (Otis 1992: A10, K61), and a locale marked on the Otis map (Map 12) as "Arrow Heads." Archaeological excavations were conducted near Ragtown in 2013 (Waechter 2013:12-13).

The company owned a campground that was located on Prosser Creek off the road to Klondike, a stage-stop across Prosser Creek from Hobart Mills (Map 12). During the summer, tourists camped and fished there (Otis 1992:P:K30). The company also owned Independence and Webber Lakes. They operated a small hotel during the summer at Independence Lake. Webber Lake was later leased to the Olympic Club of San Francisco who built a resort (Otis 1992:H10 in Barry-Schweyer 1998:7).

Several logging camps were established in the woods outside Hobart Mills. Camp No. 1 on Sagehen Creek used steam tractors to haul logs to the railroad (Otis 1992:D17). Camp No. 2, called Prosser Creek Camp, was located northwest of Hobart Mills about two miles up Prosser Creek where horses were employed to skid timber through log (Otis 1992:C61). Sugarpine Camp was situated about two and one-half miles east of Hobart Mills, just before Camp No. 1. Horse logging was also used at this camp (Otis 1992:D23 in Barry-Schweyer 1998:14). Verona Camp, established approximately three miles north of Hobart Mills and just above Hobart Reservoir, used horse logging in the area around 1905 (Otis 1992:D27 in Barry-Schweyer 1998:14).

Water was supplied to Hobart Mills from Hobart Reservoir (Photo 16) approximately one mile north of town. Water for the reservoir was piped from Sagehen Creek (Dundas 1992 V2:7)

> "Sagehen, where our drinking water came from, was closed to fishing" (McLeod 1992:32). "They took water out of Sagehen Creek and then they put in a pipeline. They just elevated that thing and brought it up over a ridge and then down. There was a big reservoir on this side that had the water. Yes, we had lots of good fresh water…" (McLeod 1992:31).

Ice was cut in 300-pound blocks from Hobart Reservoir, floated in a canal, over a shoot, stored in the insulated icehouses just below the reservoir, and packed in sawdust (Otis 1992:K1; D. Dundas 1992 V2:7-8; McLeod 1992:21 In Barry-Schweyer 1998:5). Spring thaw was drained through heavy wood culverts covered with dirt. Water emptied into ditches and ultimately into Prosser Creek" (Otis 1992:K5, K31; D. Dundas 1992:28 in Barry Schweyer 1998:5). The sewer plant, located about a half mile below town, consisted of a wooden frame-settling tank with a roof. The overflow ran into Prosser Creek (Otis 1992:JK36, P1; Edwards 1992:30 in Barry-Schweyer 1998:5).

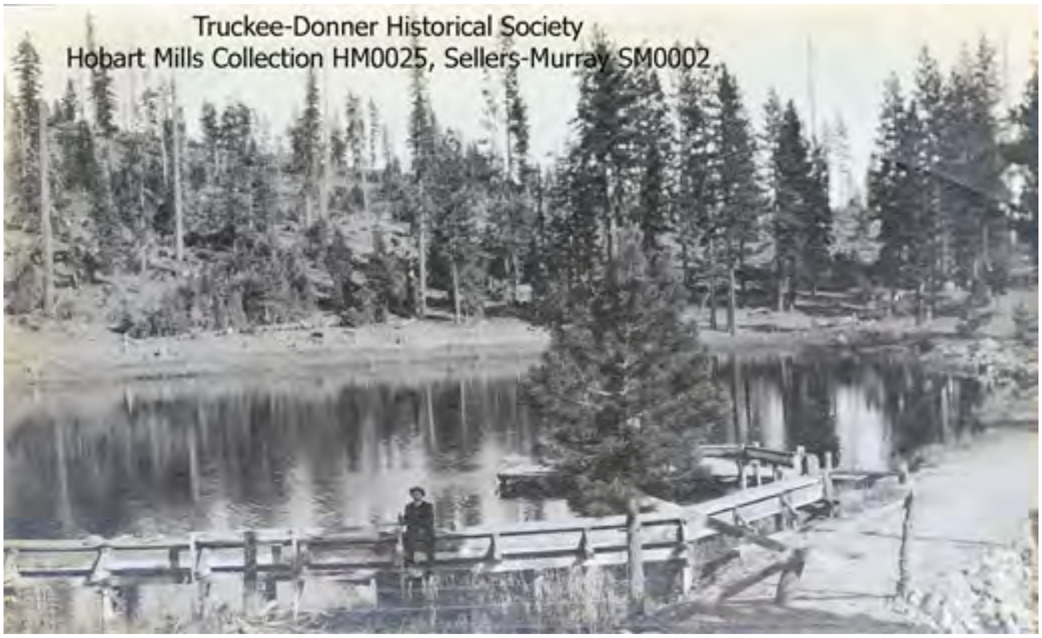
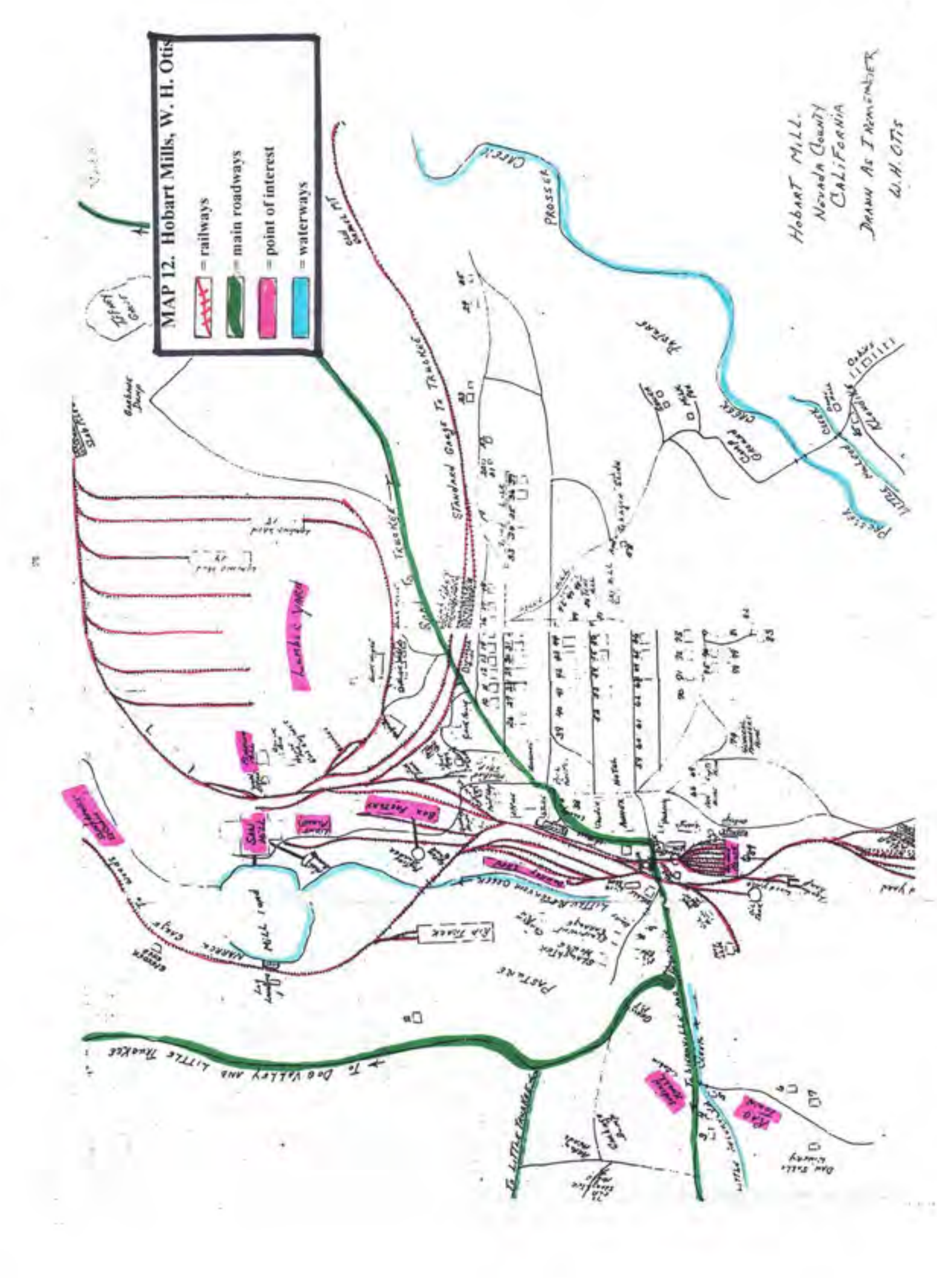


Photo 16. Hobart Reservoir ca. 1920s-1930s (courtesy Truckee Donner Historical Society)

Progression of Timber Cutting and Expansion of Logging Railroads

As the company continued to reach into more remote timber stands that it owned and those of the Forest Service, it also expanded its narrow-gauge logging railroad system. Seven miles of standard gauge track initially connected Hobart Mills with the transcontinental railroad mainline in Truckee. This line had two trestles, the largest (about a thousand feet long) was over Prosser Creek. Apart from its main line to Truckee, logging operations surrounding Hobart Mills were developed by a system of narrow-gauge railroads. In 1899 there were only between four and five miles of logging road (*American Lumberman* 1899). By 1908 the logging railroad expanded to 20 miles, with 26 to 28 miles in 1923, and 32 miles by the time of Hobart Mills' closure in 1936 (*American Lumberman* 1889b; Knowles 1942:49; Myrick 1962; Adams 1961). The immediate area around Hobart Mills contains 3.5 miles of railroad grade, less than three percent of the grand total that was used from 1896-1900 (Baldrica et al. 2012:12).

The first line of Hobart's narrow-gauge railroad was built up Sagehen Creek to its junction with the Little Truckee River. A second line carried timber from Carpenter Valley down the North Fork of Prosser Creek (Jackson et al. 1982:144; Myrick 1962). The two logging grades reported up the South Fork of Prosser Creek and into Euer Valley (Lindström 2016 and shown on Map 10) remain unconfirmed. Hobart sawmill is shown on maps 10 and 11 in relation to the standard gauge line to Truckee, and its primary logging railroad surrounding the mill and into Carpenter Valley and possibly Euer Valley. The Sagehen line was ultimately extended northward to near the headwaters of Sagehen Creek, Independence Creek, Independence Lake, and continuing to follow the Little Truckee River to its source at Webber Lake, with branches into Onion Creek, Onion Valley and Rice Canyon. These meandering routes also skirted Kyburz Flat area. Later branches extended west into Cold Stream Canyon, north of the Little Truckee and east towards Verdi (Myrick 1962; Jackson et al. 1982).


MAP 12. Hobart Mills, W. H. Otis
= railways
= main roadways
= point of interest
= waterways
HOBART MILL
Nevada County
California
Drawn As I Remember
W.H. Otis

During the following decade, railroad construction was extended to the northeast to Merrill, at Davis Creek, and on north to Sardine Valley, with branches extending in all directions into virgin timber stands. Many of the standard-gauge roadbeds of the abandoned Boca and Loyalton (1916) and Verdi Lumber Company (1927) railroads were reutilized during the last phase of Hobart narrow-gauge railroad building (Jackson et al. 1982:144; Myrick 1962; Rowley and Rowley 1992:138-139).

In 1912 the company's narrow-gauge railroad hauled logs from two logging camps located 12 miles northwest of Hobart Mill (*California State Forester* 1912). The earliest logging was close to town, and then expanded by rail to the northeast to Camp No. 1, where the railroad crossed Sagehen Creek. Camp No. 2 was located to the northwest in Carpenter's Valley on the upper reaches of Prosser Creek. Twenty-one camps in all were established during the Hobart operations (Otis n.d.:A6 in Barry Schweyer 1998:10).

Floriston Pulp and Paper Company/Crown Willamette Paper Company/Fibreboard Corporation

With the introduction of paper mills, forest stands were re-entered to harvest fir for use as pulpwood for paper mills. In addition to supplying timber for its own sawmill, Hobart Mills also furnished quantities of white fir to the Floriston Pulp and Paper Company, a forerunner of Fibreboard Products (Jackson et al. 1982:144; Knowles 1942:49). Organized primarily by the Fleischhacker Brothers, the company processed pulpwood at their Floriston mill down the Truckee River Canyon near the California/Nevada state line, the second largest paper mill in the United States during its period of operations between 1900 and 1930. In 1912 control of the Floriston Pulp and Paper Company went to Crown Columbia Paper Company, known in 1914 as Crown Willamette Paper Company, and later ownership was under the Crown-Zellerbach Corporation. The company held considerable land holdings within the Prosser Creek watershed.

During the 1920s (ca. 1924-1928), the Crown-Willamette Paper Company built a standard gauge line seven miles long, off the Hobart main line up Alder Creek with a branch line into Euer Valley (Otis 1992:P: G3, G16 in Barry-Schweyer 1998:11). The rail line was used in conjunction with the Hobart Company but was abandoned in the 1930s (Myrick 1962:442-443; Knowles 1942:50). The rail lines appear on three maps. An undated, untitled hand-drawn sketch map by W. H. Otis shows the "C.W.P.Co. Standard Gauge" railroad passing along Alder Creek from the Hobart Mills railroad up into the vicinity of "Euers Valley" (Map 11). An undated map of logging railroads on file at the Truckee Donner Historical Society identifies this railroad as "Floriston Paper Mill Logging RR, Standard Gauge 1924-1928." This map shows railroad grades extending into the headwaters of Alder Creek from Hobart Mills railroad (west of the current downhill ski area), with a lower and upper branch extending above Euer Valley and another branch reaching into northward into Crabtree Canyon. A second undated map of logging railroads on file at the Truckee Donner Historical Society shows the same railroad, referenced as the "Hobart Southern Alder Creek Branch Standard Gauge (1901-02)" extending up Alder Creek. At least five logging camps associated with this rail line are reported active during the 1920s (Bill Houdyschell, personal communication with John Euer In Lindström 2016 and Lindström et al. 2018).

Photo 17. Aerial view of Hobart Mills ca. 1962-1966; the mill town burned in 1937 and was largely abandoned; most remaining buildings were demolished or relocated to Truckee (courtesy Truckee Donner Historical Society)

Photo 18. Aerial view of Hobart Mills ca. 1962-1966 after Prosser Reservoir was built and before the 1966 earthquake, which damaged/destroyed most remaining buildings (courtesy Truckee Donner Historical Society)

Hobart Mills closed in 1936 and most of the buildings burned in 1937. The Los Angeles Iron and Steel Works bought all the metal and scrapped the Hobart Southern Railway track between Hobart and Truckee in 1937. Hobart Mills was sold to Fibreboard Products, Inc. following World War II and a new, smaller sawmill was constructed by Fibreboard at Hobart Mills, a sawmill that was modern for its time (*Sierra Sun* 1989:2). In 1946 a new standard gauge railroad was built on the old right-of-way of the former Hobart Southern Railway. With a change in milling technology and a shift to paper production, the Fibreboard operations at Hobart Mills ceased in 1955 and the railroad grade between Hobart Mills and Truckee was once again removed (Barry-Schweywer 1998:15). The railroad was dismantled about the same time that Fibreboard constructed its new sawmill in Truckee. The Truckee Fiberboard Mill was torn down during the 1980s. In 1989 Fibreboard applied to relocate its downtown Truckee sawmill and return to a 121-acre site at Hobart Mills. The new mill was designed as a state-of-the-art operation to accommodate small diameter logs, producing approximately 30 million board feet of lumber annually from Fibreboard-owned trees. The sawmill, occupying about 280,000 square feet of buildings, was projected to run year-round and hire up to 80 employees (*Sierra Sun* 1989:2). The project fell-through. Today, the property remains privately owned and is currently operated as a rock, gravel, soil, and bark quarry/staging area for an excavation company (Baldrica et al. 2012:24-25).

LIVESTOCK GRAZING

Among the many stockmen who owned lands in the counties of Sacramento and El Dorado, and who also owned summer ranges in the Truckee Basin, the *Pacific Rural Press* (6/28/1902) recognized the following men as being at or near the top of their list: G. W. Mills, William Carpenter, S. Ewer (i.e., Euer), and the Perazzo Bros. All ran livestock within the Prosser Creek watershed.

From June until October, livestock was initially driven overland or transported by rail to and from the summer range surrounding Truckee, the supply point and headquarters for "drovers and herders" (Edwards 1883:76). At Truckee, livestock was loaded and unloaded at the railroad stockyards located on the main transcontinental line; it is uncertain if they were ever transported short distances on the Hobart Southern Railway or on the Sierra Nevada Wood and Lumber Company's logging railroad. Later, livestock was moved to pasture by truck (Sawyer 1971:81-83) and herds from Truckee allotments were usually trucked out of Hobart Mills (Don Behrens, personal communication 8/15/20; Judy and Abel Mendegia, personal communication 8/17/20USFS 1965; USFS various[b]).

Stock men exercised virtual ownership over thousands of acres of the public domain. Although the first grazing regulations imposed by the USFS became effective in 1905, seldom was the right to use the public land questioned before passage of the Taylor Grazing Act in 1934. From that time onward, public land agencies such as the USFS directed efforts toward range restoration to improve poor and deteriorating conditions (Behrens, personal communication 2009 and Mendeguia, personal communication 2009 in Lindström et al. 2009; Mendeguia, personal communication 3/8/16). Summer pasture was rented and rates per head were established each season (Sawyer 1971:144). Bedding areas were regulated (Don Behrens, personal communication 8/15/20). To enhance livestock distribution, water developments and programs to control poisonous plants and infectious diseases, as well as predator eradication, were coordinated between stock-growers and the federal government (Jackson et al. 1982:168). Grazing was increasingly curtailed in the last half of the 20th-century due to stricter regulations and competition for grazing lands by recreational and residential/commercial development in the Sierra Nevada (Baker 2004:13; Jackson et al. 1982). Herders were directed to stay off recreational trails and beyond sight of the recreating public (Don Behrens, personal communication 8/15/20).

Sheep

At the height of the sierran sheep industry, herders grazed the lower-quality grasslands in the Truckee Basin along the Sierra east slope and up to its crest. The seasonal transhumance of the herds sometimes involved treks of several hundred miles. Basque sheepherders dominated the industry from the 1890s until the 1970s (Anon n.d.a[a-b]; Anon n.d.b). The Basque reputation for excelling as shepherds, combined with the fact that herding sheep was often unappealing to non-Basques (due to the risks involving physical safety, mental stability and sexual frustration within the context of social isolation), rendered Basque sheep herders as indispensable to the sheep industry of the American West (Douglass and Bilbao 1975:407).

The federal government designated the timing and seasonal movement of sheep and the "flockways" or stock "driveways" to be followed (Sawyer 1971:82, 89-90). Bands then diverged into their assigned ranges, which were occupied year after year by the same flock (*Truckee Republican* 9/5/1878). For grazing administration purposes, designated areas were subdivided into allotments that became the basic unit of apportioning grazing privileges amongst individuals and sheep companies. Allotment boundaries were commonly drawn in conformance with natural landforms. The Prosser Creek watershed study area is included primarily within the TNF grazing unit known as the Boca Allotment (Don Behrens, personal communication 8/15/20; Judy and Abel Mendegia, personal communication 8/17/20), although a 1979 USFS map ("Mendeguia & Laborde Sheep Co." 5/16/79) also includes the Euer Valley Allotment in the watershed.

During the last quarter of the 19th century, an average of 75,000 to 100,000 head of sheep were annually pastured in the Truckee Basin (Edwards 1883:76). Wartime demand increased the number of livestock permitted on public lands between 1914 and 1918. The Great Depression hit the livestock industry and herd numbers dropped throughout the 1930s (Jackson et al. 1982:168) but rose again during the 1940s.

A permittee could run up to five to six bands (Judy and Abel Mendegia, personal communication 8/17/20). Bands were large, numbering at least 1,000 head (Mallea-Olaetxe 1992:30) or even 1,600 sheep (Judy and Abel Mendegia, personal communication 8/17/20), although there was no set number of sheep per band. In higher elevations bands were smaller and restricted to 500-700 sheep; lower elevation bands could support more containing 800-1,000 head (Don Behrens, personal communication 8/15/20).

As early as 1878, 120,000 sheep were reported within 15 miles of Truckee, with herd counts in areas that now encompass and adjoin the Prosser Creek watershed reported as follows.

> At Tom's Valley, just above Donner Lake, Mr. Mills has 1,600 head of sheep; Talbott has 2,500 on the ridge above Hot Springs; Mrs. Thomalson, above Donner Lake, has 1,500; …Bigford & More, on the White Rock range, near Castle Peak, have 2,000; …Prosser, at his ranch three miles from Truckee, has at least 5,000; Elliott, on the Little Truckee, has probably 4,000; Jack Bellhops 3,500 on Sage Hen creek…"

(*Truckee Republican* 9/5/1878).

Wool growers were attracted to the region's rich rangelands.

> From June until October every mountain side is covered with droves of sheep driven here by the wool growers to take advantage of the excellent pasture which covers the entire surface of the ground during the Summer months. (Edwards 1883:76).

> The fall clip of wool is therefore shipped from Truckee. This wool crop amounts annually to some 300,000 pounds,..Bunch grass, wild parsnip, and in some places clover, are abundant, and sheep always return to the valleys fat, healthy and in splendid condition (*Truckee Republican* 9/5/1878).

> An estimated 100,000 head of sheep were pastured throughout the area in 1905, producing 139,623 pounds of wool (*Truckee Republican* 1/20/1906).

There was considerable seasonal grazing around Hobart Mills (Don Behrens, personal communication 8/15/20). Sheep were grazed on Hobart Company property by Basque shepherds who rented the land. Their cabins were located below the millpond and on "Indian Knoll" on the east side of Ragtown (McLeod 1992:59; Otis 1992:K31 In Barry-Scheweyer 1998:4; also see Map 12). The company in turn purchased their mutton.

> "Mutton was more or less the mainstay up there for me in the summertime. Especially, I remember, there was lots of it mainly because a lot of the sheepherders brought their flocks up there and rented land from the Hobart Estate Company to run the flocks. So Hobart Estate in turn bought sheep from them for meat for the cookhouse and the hotel, and there was a lot of it sold in the store" (Dundas 1992 V2:32).

Basque grazing activities within the Boca Allotment, as well as other many other allotments within the Truckee and Sierraville ranger districts of the TNF, were based out of the Russell Valley Sheep Camp. This base camp was operated seasonally from 1894 until 1991 (Baker 2004:22) and permittees included: George Washington Mills, his wife Elizabeth Mills and their son Milburn Mills, who took over the business in 1936; Pete Laborde and Abel Mendeguia; Abel and Judy Mendeguia; and the Little Panoche Sheep Company (Waechter and Lindström 2009).

The renowned Mills family ran some of the largest sheep herds in northern California; they owned a ranch on Prosser Creek. They may have leased and owned land in the Truckee Basin by 1882 and may have run sheep in the Prosser Creek watershed area as early as 1894 (Baker 2004:49).

> "Geo. W. Mills, sheep and cattle owner of Cosumnes, in the Sacramento Valley, has arrived in this section to spend the summer months on his Prosser Creek ranch...for at least two months. Mr. Mills is one of the largest owners of sheep and cattle in the state. His cattle are now grazing in this section" (*Truckee Republican* 6/15/1910).

In 1911, Mills grazed about 1,200 sheep (*Truckee Republican* 6/10/1911). In 1939 and again in 1941, Forest Service records show Mills had a permit to run 2,000 sheep on the Little Truckee and Boca allotments (Baker 2004:24). In 1948 Mills was running about 7,500 sheep, primarily on the Boca Allotment, which he leased, and on the White Rock Allotment, which he owned (Baker 2004:23, 25).

In 1966 Milburn Mills took on a partner, a Spanish/Basque named Pete "J.P." LaBorde (Behrens, personal communication 2009, 8/15/2020), and by 1968 Mills and Laborde were running 2,500 sheep out of Nevada and on to the TNF (Baker 2004:26), including the Boca Allotment. In 1968 Mills sold out to LaBorde, who then partnered with a fellow Spanish/Basque named Abel Mendeguia (Baker 2004:26). From Mills, Laborde and Mendeguia acquired about 6,000 sheep, along with the lease rights to the Boca, Kyburz, Sagehen, White Rock, and Summit allotments, in addition to grazing leases on private lands owned by railroad and timber companies (Baker 2004:27). Their bands were moved between Russell Valley, Sierraville, Castle Peak, and Mt. Rose (Baker 2004:27).

In 1982 the Mendeguias bought out LaBorde's interest and, together, Abel and his wife Judy grazed the Boca Allotment until retiring in 1991 (Baker 2004:32; Behrens, personal communication 2009; /15/2020; Judy and Abel Mendegia, personal communication 8/17/20). They grazed generally 5-6 thousand head of ewes and lambs on Truckee allotments (Judy and Abel Mendegia, personal communication 8/17/20). In 1984 they had a permit from the TNF to graze 5,000 sheep on four allotments, running 1,167 sheep on the Boca Allotment alone. The Mendegia bands were focused more on the Boca and Sagehen allotments around Prosser and Stampede reservoirs, moving herds on pre-set flockways up towards Castle Peak (Don Behrens, personal communication 8/15/20). They avoided private land in Carpenter Valley, where there was little grazing pressure at that time (Don Behrens, personal communication 8/15/20). A historic photo dating from 1901 (Photo 5) shows a large flock of sheep grazing in Carpenter Valley.

In 1991 the Mendegias sold their sheep outfit to fellow Basques, Victor Albert Erratchu and Bernard Etcheverry of the Little Panoche Sheep Company (Mendegia, personal communication 2009; 8/17/2020). Thereafter, operations were much scaled-down and centered in the Boca Allotment (Behrens, personal communication 2009; 8/15/2020; Judy and Abel Mendegia, personal communication 8/17/20). Ray Talbot, of CHM Corrals from Los Banos, currently runs three bands on the allotment (Judy and Abel Mendegia, personal communication 8/17/20).

Dairying and Stock Cattle

While higher elevations and the eastern slope were relegated primarily to sheep men, dairy and beef stock were grazed in upland meadowlands on both sierran flanks. The pattern of transhumance practiced by cattlemen, with the seasonal migration of livestock between lowlands and adjacent mountains, was well adapted for the establishment of dairy herds, whereby cows were bred to calve in the spring months, resulting in an abundant milk supply for the summer months spent in the high country. Here, the dairy business in the Truckee Basin flourished on a large scale from the 1860s until about 1930 (McGlashan 1982:13-17). At one time there were 15 to 20 dairy farms near Truckee that produced 60,000 pounds of mountain butter annually (Edwards 1883:69). After the turn of the century, many converted their dairy cattle to less labor-intensive beef stock (McGlashan 1982:17). Following the creation of the national forest system in 1906, profits for dairymen were eventually cut by regulations on the use of federal grazing lands. The industry was further curtailed by subsequent improvements in the 1920s and early 1930s in the distribution of perishable items through the expansion of truck transportation and refrigeration methods, which brought an end to the need for small and localized dairies.

Carpenter Valley

Photos taken in 1901 show an "Upper Dairy" in Carpenter Valley (Photo 19). Newspaper accounts report on dairying activities in the valley between 1905 and 1920. Dairy operations were carried out by the partnership of W. Carpenter and G. Russi; the nature and scale of these operations is unclear.

Photo 19. "Upper Dairy" in Carpenter Valley, 1901 (courtesy Donner Summit Historical Society)

> "Those who have already brought their cattle here are …W. Carpenter…Mr. Carpenter and Russi have entered into a partnership combining their interests. Both men are heavy owners of stock and grazing land in this section of the county…both men will share alike. With a radius of twenty miles some of the cattle men here believe that fully 10,000 head of cattle and about 40,000 head of sheep will graze on ranges of the Sierras this summer" (*Truckee Republican* 5/31/1905).

> "G. Russi a dairyman of Carpenter Valley returned the early part of the week from the lower country, Mr. Russi's wife and family came up with him on Friday, the stock arriving the next day" (*Truckee Republican* 6/12/1913)

> "Grover Russi, dairyman, has arrived for the summer. His cattle will soon be on their range in Twin Valleys [Euer and Carpenter valleys are sometimes referred to as "Twin Valleys" in the period press]" (*Truckee Republican* 6/3/1920).

Map 3 depicts sizeable land holdings by Edward Thomas Schnerr, including some sections owned by W. Carpenter in 1880. Schneer is reported as residing at "Carpenter Ranch." It is unclear if he was a stockman, dairyman, sheepman, or none of the above. Born in 1867, he was living in Missouri in 1880, but by 1900 he is listed as a Sacramento resident; the same applies to the 1910 and 1920 census records. According to his "death notice" he died in 1941 at age 74 at his "Carpenter Valley Ranch" and "summer home" (*Folsom Telegraph* 8/1/1941).

Euer Valley

Newspaper accounts mention two dairymen in Euer Valley, J. Bickford and S. Euer. A "Bigford & More" are mentioned as grazing 2,000 sheep "on the White Rock range, near Castle Peak" (*Truckee Republican* 9/5/1878). Bickford is again referenced in newspaper accounts in 1902 (*Pacific Rural Press* 6/28/1902) and in 1913, otherwise, little additional information was found regarding Bickford's grazing activities.

> "J. Bickford, a dairy man of Euer Valley has returned to his ranch near Folsom" (*Truckee Republican* 10/16/13).

Sophary Euer (aka Samuel Safariel von Euer) was one of the leading dairymen in the Truckee Basin. The Euer's drove their cattle over Donner Summit and down into Euer Valley in the vicinity of the 7C's Ranch (Huisman, personal communication 1/21/15 in Lindström 2016). The family operated two dairies, one in Euer Valley and another in the "Little Truckee Valley on the Prosser place."

> "Euer Bros. who conduct two dairies in this state during the summer season, arrived here Sunday, with 285 head of cattle after a journey of seven days from Folsom ranch to Truckee. They conduct one ranch in Euer Valley and another in the Little Truckee Valley on the Prosser place. They milk 174 cows making butter and manufacturing cheese" (*Truckee Republican* 6/8/1910).

Dates are conflicting as to exactly when the family settled Euer Valley (1868 according to the *Sierra Sun* 1993:5; 1872 according to *Moonshine Ink* 2012:18). The earliest patent issued to a member of the Euer family was in 1876 (Sharon Waechter, personal communication 8/28/20). After San Euer died, sons Robert, George and Frank continued dairying, finally owning all land in Euer Valley (*Sierra Sun* 1993:5). Robert split the valley into the 7-C Ranch at the valley's west end and Frank added a dude ranch on the 7-C property in the 1930s (*Sierra Sun* 1993:5). The Euers seven children are the namesake for "7-C Ranch. With the sale of their 482 acres in Euer Valley to the Tahoe Donner Association on in 2012, the family ended about 140 years of dairying. The last cattle round up was in 2014 (Huisman, personal communication 5/27/15 In Lindström 2016). The family still maintains a 40-acre property in center of valley known as the "Circle E Ranch." Horse camps established by the Euers continue to be used by equestrian groups (Rosenfeld, personal communication 6/8/15 In Lindström 2016).

Euer's was a Grade B dairy as they made butter and cheese like their Swiss forebears (*Sierra Sun* 1993:5). In 1881 Sam Euer produced 17,000 pounds of butter (McGlashan 1982:16). Milking was done in corrals, not in barns (McGlashan 1982:13-14). A water-powered mill on the South Fork of Prosser Creek powered the churner at the butter house (Huisman, personal communications 5/27/15 In Lindström 2016). Although in the mountains, meadows still had to be irrigated later in the season. This was accomplished through a network of water impounding and diverting dams and wing walls, water gates, and miscellaneous earthen water works.

A "narrow gauge train" stopped at Euer's Ranch dairy three times a week to pick up milk for the Hobart loggers (Otis 1992:B2 in Barry-Schweyer 1998:14). Yet, Hobart Mills operated their own dairy (McLeod 1992:26; Otis 1992:C60 in Barry-Schweyer 1998:13) and "Daly's Ranch and "milk farm" was located only three miles south of Hobart Mills (Otis 1992:ii; also see Map 11).

Perazzo Bros.

Historic newspapers report that the Perazzo Bros. (Peter, Joseph and Jack) made butter on their dairy ranch near Webber Lake (*Truckee Republican* 6/24/1882) along the Little Truckee River (Sierra County). According to the 1870 Census, Pete Perazzo was living in Truckee. Bureau of Land Management land records document entries between 1879 and 1909 for Perazzo land holdings in Sierra County. The 1913 Map of Nevada County (Map 2) indicates considerable land holdings by the "Perazzo Bros" along Prosser Creek and in the vicinity of present-day Prosser Reservoir. Land acquisitions in Nevada County must have occurred after 1909. The period press followed their seasonal movements of dairy cattle and cows between Folsom and their mountain ranch (*Folsom Telegraph* 5/27/1899). Joseph Perazzo died in 1933 at age 79 (*Sacramento Bee* 3/7/1933); Peter died in 1928; and Jack died in 1920.

CULTURAL RESOURCES PROTOCOL

AUTHORITY

The preceding overview of human land use within the Prosser Creek watershed study area serves as a contextual background to assist initial planning efforts in developing a series of restoration alternatives for consideration by the Truckee River Watershed Council. It is intended as a work in progress to be followed by additional archival and field research that target project-specific restoration design and environmental review. Once a specific restoration project has been defined with plans to proceed, the Watershed council is required to consider potential project impacts on cultural resources in compliance with guidelines established by Nevada County under the California Environmental Quality Act (CEQA Section 5024, Public Resource Code). If project activities involve federal lands under the jurisdiction of the USFS-TNF, a cultural resource study sufficient to initiate consultation for compliance with Section 106 of the National Historic Preservation Act of 1966 (as amended) is also required.

Cultural resource studies are customarily performed in a series of phases, each one building upon information gained from the prior study.

PHASE 1 INVENTORY: First, archival research and an archaeological field reconnaissance are performed to inventory and record known cultural resources and identify potential project constraints. *Phase 1A* of the inventory involves prefield research, Native American consultation and the required records search at the appropriate archaeological clearing house. A *Phase 1B* field survey to identify surface sites, features, buildings, and/or artifacts follows. If cultural resources are discovered, *Phase 1C* field documentation is initiated.

PHASE 2 EVALUATION: Once cultural properties are recorded and if they may be subject to project-related impacts, their significance is evaluated according to eligibility criteria in the National Register of Historic Places and/or California Register of Historical Resources. For significant resources, a determination of project impacts is assessed and detailed measures to mitigate impacts are proposed. If project redesign to avoid impacts is unfeasible, then mitigation measures are recommended to recover the significant information contained within these cultural properties prior to project ground disturbance activities.

PHASE 3 IMPACT MITIGATION AND DATA RECOVERY: A final phase may involve the implementation of mitigation measures recommended during the prior evaluation phase. Mitigation, or data recovery, typically involves additional archival research, field excavation, photo documentation, mapping, archaeological monitoring, etc.

Federal Guidelines

The National Historic Preservation Act of 1966 (as amended 16 USC§ 470 *et seq*.) is the primary federal legislation that outlines the federal government's responsibility to cultural resources. A cultural resource is a broad term that includes prehistoric, historic, architectural, and traditional cultural properties. Section 106 of the Act requires the federal government to take into consideration the effects of an undertaking on cultural resources listed in or eligible for inclusion in the National Register of Historic Places. Those resources that are on or eligible for inclusion on the National Register are referred to as historic properties. The Section 106 process is outlined in the federal regulations at 36 Code of Federal Regulations Part 800. These regulations describe the process that the federal agency takes to identify cultural resources and the level of effect that the proposed undertaking would have on historic properties. In summary, an agency must first determine if the action is the type of action that has the potential to affect historic properties. If the action is the type of action to affect historic properties, the agency must identify the project area, determine if historic properties are present within that area, determine the effect that the undertaking would have on historic properties, and consult with the State Historic Preservation Office (SHPO), to seek concurrence on the agency's findings. In addition, the agency is required through the Section 106 process to consult with American Indian tribes concerning the identification of sites of religious or cultural significance and consult with individuals or groups who are entitled to be consulting parties or have requested to be consulting parties.

State Guidelines

The CEQA process is outlined in CEQA Guidelines Section 15060-15065. For the purposes of CEQA, significant "historical resources" and "unique archaeological resources" are defined as (Section 15064.5[a]):

(1) A resource listed in or determined to be eligible by the State Historical Resources Commission, for listing in the California Register of Historical Resources (Pub. Res. Code SS5024.1, Title 14 CCR, Section 4850 et seq.).

(2) A resource included in a local register of historical resources, as defined in section 5020.1(k) of the Public Resources Code or identified as significant in an historical resource survey meeting the requirements section 5024.1(g) of the Public Resources Code, shall be presumed to be historically or culturally significant. Public agencies must treat any such resource as significant unless the preponderance of evidence demonstrates that it is not historically or culturally significant.

(3) Any object, building, structure, site, area, place, record, or manuscript which a lead agency determines to be historically significant or significant in the architectural, engineering, scientific, economic, agricultural, educational, social, political, military, or cultural annals of California may be considered to be an historical resource, provided the lead agency's determination is supported by substantial evidence in light of the whole record.

CULTURAL RESOURCE SENSITIVITY

From the foregoing discussion of human land use in the Prosser Creek watershed study area, it can be surmised that cultural resource sensitivity ranges from low to high, depending upon the locale. Prior archaeological work within and adjacent to the Prosser Creek drainage corroborates this assessment. To further refine the relative cultural resource sensitivity of the of the watershed, the following discussion: (1) recaps the types of cultural resources according to various heritage themes likely to occur within the study area; (2) briefly summarizes their projected archaeological manifestations; and (3) addresses relative cultural resource sensitivity according to (a) resource type and (b) locale within the watershed. Potential constraints to future restoration projects are discussed in relation to cultural resource significance. Significant resources are "sensitive" resources that are determined eligible (or potentially eligible) for listing in the National Register of Historic Places (in the case of federal lands) and/or California Register of Historical Resources (in the case of private and state lands). (State criteria for inclusion in the California Register are generally less rigorous than National Register criteria.) An eligibility determination for listing in either register has implications for future management of the resource and potential restoration project constraints. "Eligible" resources are generally protected from any direct project-related ground disturbance activities or indirect alterations of environmental/historical setting. "Ineligible" resources need not be protected or preserved during project activities and are no longer considered in the environmental review process For unevaluated resources, until eligibility has been established, cultural properties must be treated as potentially sensitive resources and protected. Determinations are typically made on a project-specific basis after a resource has been inventoried and evaluated.

Confidential cultural resource location maps (in GIS format with shape files) kindly provided by the USFS-TNF have been, and will be, used exclusively by project planners to identify areas where archaeological sites (polygons) and linear features (lines) occur and, thereby, identify relative cultural resource sensitivity and potential constraints to future restoration projects. At the request of USFS-TNF heritage staff, these cultural resource location maps have not been included as a confidential appendix accompanying this report. However, this report does include schematic maps (maps 9 and 10) showing general cultural resource locations to provide a graphic contextual aid and alert project planners to areas of potential cultural concern. Information displayed on these maps is generalized, being drawn from multiple historical sources; precise locations require future "ground-truthing" and formal recording. Map 9 depicts historic transportation routes throughout the study area. Map 10 shows historic logging activities, to include railroad grades, mill sites and dated cut-over areas.

Native American Theme

Native American sites, features and artifacts are considered sensitive resources and must be assessed on a case-by-case basis in consideration of their archaeological research potential and Native American traditional cultural values. At the most general level, zones of greatest sensitivity fall along on knolls and elevated benches above Prosser Creek and its tributaries and at meadow margins and wet meadows along tributary creeks, within boulder rock out-crops, and on ridge lines. Moderate cultural resource sensitivity is attributed to forest-valley-meadow ecotones and mid-slope benches. Areas of lower sensitivity encompass steep forested slopes. In terms of traditional Washoe land use, domestic camps, complete with permanent bedrock kitchen facilities such as milling stations, were located in the vicinity of streams, "near but not at the water" (Nevers 1976:9), where families maintained the prerogatives of first rights to fish and to harvest nearby plant resources. Communal fishing and processing areas and individually owned locations where men constructed their "fishing houses" were adjacent to the stream. Elevated benches along the Prosser Creek corridor, especially within the mid to lower reaches of the watershed, contain archaeological remnants of these camps marked by prehistoric flaked stone and milling feature complexes. Most prehistoric sites previously inventoried by the TNF fall within this zone. Ridgetops that bound the western margin of the watershed are prime locales for prehistoric hunting blinds, game-drive rock-cairn features, and small scatters of flaked stone. Prehistoric quarrying activities center around Alder Hill, due south of the Prosser Creek watershed study area; residual volcanic flows emanate from this source into the study area where suitable toolstone was quarried at various locales (McGuire et al. 2006). These quarries are manifest archaeologically by thousands of basalt preformed tools and waste flaked stone debris.

Transportation Theme

The main branch of the historic Dutch Flat Donner Lake Wagon Road/Lincoln Highway/Dog Valley Road crosses through the southeast corner of the Prosser Creek watershed project area; several historic branching/connecting secondary roads pass through the eastern extremity of the project in the vicinity of Hobart Mills or are now inundated by Prosser Reservoir. The road alignments, along with associated roadhouses/hotels, auto camps and roadside refuse deposits are considered sensitive cultural resources, to be protected pending an evaluation of significance on a project-specific basis. A segment of the "Old Reno Road" has been inventoried by the TNF.

Logging Theme

Railroad Grades and Associated Features

Early to mid-20th century logging is the primary historic theme for the Prosser Creek watershed and logging railroad grades and associated features dominate the cultural resource inventory. Historically logged landscapes, crisscrossed by a network of logging narrow gauge railroads, characterize forest stands in the mid to lower reaches of the watershed. Ties and rails are absent, and grades are marked by raised linear earthen berms. Their presence fits directly into an assessment of the cultural sensitivity of an area, whereby higher sensitivity is ascribed to locales paralleling these historic lines (Dixon et al. 1997:17). These earthen linear features constitute the link between isolated logging sites, features and artifacts that parallel the alignments, with higher probabilities of finding logging resources along their routes. Badly decayed remains of ditches and flumes and log chutes that systematically contour around slopes and through draws constitute a second class of linear features that also link seemingly isolated workstations. Log chutes are often marked by scatters of barrel staves and rusted remains of grease buckets to lubricate the chutes. Archaeological traces of steam donkey layouts comprise iron pieces (large gear wheels, drums, glass steam pressure gauges, wire rope logging cables, etc.) and log chutes or earthen skids occur without the accompanying grade for draft animals. Workstations and work camps are tethered to rail grades and log loading areas (i.e., steam donkey tender/watchman's residence). Portable structures (living and cooking buildings) were constructed on skids that could be loaded by steam donkey onto rail flatcars and transported to the next temporary camp. Worker housing is defined archaeologically by level pads/flats and milled board scatters associated with domestic artifact deposits (furnishings represented by lamps, bed springs, small stoves, tableware) and work-related items (saws, axes, splitting wedges, files, etc.). Sawmill sites were oriented primarily along main streams, such as Prosser Creek and its tributaries. This pattern insured easy access to water to power machinery, to supply boilers, to float logs or lumber, as well as for domestic use.

The TNF has assessed a total of 136 miles of logging railroad grades operated by the Sierra Nevada Wood and Lumber Company/Hobart Estate Company on the Truckee and Sierraville ranger districts, resulting in 24 miles of grade evaluated (Baldrica 1994; Dixon et al. 1997; McLemore et al. 2003a, 2003b; Snyder 1998). Evaluations were prompted by a series of Forest projects designed to mitigate some of the environmental damage caused by construction of these historic grades, where segments built within sensitive wetlands were slated for removal. Excepting about four miles of grade preserved on federal land in the Sagehen Basin, all railroad grades were determined ineligible for listing in the National Register of Historic Places. As noted above, an "ineligible" status has implications for future management of the resource in that railroad grades need not be protected or preserved during project activities on federal lands, recognizing that:

> "It is possible that additional railroad grade segments may be discovered in future cultural resource inventories. However, this would not change the opinion of the TNF that the railroad grades are ineligible for inclusion in the National Register of Historic Places as the railroad grades are highly fragmented and they do not retain sufficient linear continuity and integrity to convey their historic function as transportation resources" (Baldrica et al. 2012:18).

The network of remnant historic railroad grades within the watershed is not considered culturally sensitive. With this precedent in place, historic railroad grades located on future restoration projects occurring on federal lands should not present a constraint to project activities. However, the evaluation applies only to railroad grades; it excludes other associated features on federal land such as trestles, logging camps, etc., that must be managed as potentially significant resources pending assessment on a case-by-case basis. Historic railroad grades and associated features located on private or state lands, still require evaluation on a project-specific basis according to state standards and accompanying eligibility criteria for listing in the California Register of Historical Resources. Until eligibility has been established, railroad grades (and associated features) are sensitive and must be treated as potentially important resources.

Historic Logging Landscapes

Much of the Prosser Creek watershed study area can be characterized as a 20th century logging landscape. A logging landscape considered as a whole, encompasses archaeological sites/features/artifacts (as discussed above), as well as environmental elements such as remnant high- and low-cut stumps, furrowed ground, slash, etc. Those dating as late as 1970 are technically considered historic (being over 50 years of age). These environmental features are ubiquitous in the watershed and could present a constraint to the implementation of future restoration projects. That said, they need not necessarily be treated as potentially culturally sensitive resources.

One of the most characteristic environmental features of the earlier 20th century logging landscape are deteriorating historic high-cut stumps, cut waist high by a two-man saw ("misery whip") before the introduction of the portable chainsaw and its widespread use in the 1940s-1950s. In the past, historic high-cut stumps have been protected and managed for their research potential for archaeology and dendrochronology/dendroecology, especially when studied in conjunction with the distribution and nature of historic logging sites (e.g., Lindström and Waechter 1996). However, dendrochronological study of tree-ring specimens derived from historic stumps requires that stumps have good integrity, i.e., the outside growth ring must be present and a minimum of 50-100 years of growth rings exhibiting interannual ring-width variability must be intact. Today, rarely are stumps sufficiently preserved except under the most unique circumstances. Microenvironmental factors operating over time (e.g., effective moisture, aspect, slope, elevation, and soils) have degraded the stumps rendering them unsuitable for analysis and likely ineligible for either the National or California Register due to their lack of research potential. Therefore, deteriorated historic high-cut stumps located on future restoration projects occurring on federal, state or private land within the watershed are not considered culturally sensitive and should not present a constraint to future restoration activities.

The historic logging landscape within the study area also contains environmental features typical of mid-20th century logging (e.g., low-cut stumps and slash, furrowed ground, bull-dozed areas, landings, skid trails, etc.). Generally, these elements are non-diagnostic and an age greater than 50 years (i.e., historic status) cannot be confidently authenticated based on surface archaeology and the limited archival work typically afforded in a standard inventory-level cultural study. (As a notable exception, 1960 post-Donner-burn logging landscape features, e.g., logging roads, log landings and staging areas, skid trail and roads, mechanically scarred boulders and scarred trees, drainage and erosion control features such as culverts, water bars, etc., have been easily dated as older than 50 years using aerial photos, Lindström et al. 2018.) These mid-20th century logging features are redundant and widely broadcast throughout the Prosser Creek watershed. Given the limited resources for cultural resource recordation and management, mid-20th century logging resources do not warrant the careful recordation and management as their 19th century counterpart, where archival and archaeological information is uneven and knowledge of animal-era and/or steam-era logging is far more limited than tractor logging technology. In short, mid-20th century environmental landscape features do not involve important research questions that historical research has shown can be answered only with archaeological methods, hence requiring their physical preservation. Therefore, excepting unusual circumstances, these environmental features do not appear eligible for listing in either the National or California Register; they are not considered culturally sensitive and should not present a constraint to future restoration activities.

Grazing Theme

Overall, archaeological sites, features and artifacts associated with the grazing theme are potentially eligible for either register. They are considered sensitive resources and warrant consideration on a case-by-case basis according to their archaeological research potential and traditional cultural values held by contemporary ethnic groups and descendants of pioneer ranching families.

Twentieth-century Basque camps and carved aspens have been inventoried in the Prosser Creek watershed study area. Basque sheepherders personalized the landscape and "arborglyphs" comprise an art form disclosing the names, dates and narratives that chronicle historical land use and provide modern researchers with a general idea of land capacity, forage yield and overuse (Baldrica and Smith n.d). Mature aspen groves typically contain sheep camps and related trash scatters. Sheep driveways (or flockways) led out of Euer and Carpenter valleys up to Castle Peak and over to the western side of the crest. Along these trails/roads, Basque herders piled rock cairns that marked the way and set grazing allotment boundaries.

Archaeological remnants of the Euer family ranching/dairying activities survive on the Euer Valley landscape as weathered structures and refuse scatters. The old butter house concrete foundation, paddocks, barn and cattle guard remain in the valley, along with drift fencing above its south side. The Euers irrigated their meadowlands, as evidenced by remnant ditches, cisterns and creek diversions in Euer Valley (Forrest Huisman interview with Paul Lange, caretaker for the Euer family between 1994 and 2014; Huisman, personal communication 5/27/15 in Lindström 2016). Family arborglyphs dating from 1900 remain carved into surrounding lodgepole pines. The gravesite of George Euer is located on top of Red Mountain (Bill Houdyschell, personal communication 5/27/15 In Lindström 2016).

RECOMMENDATIONS

Impacts to cultural resources could result with implementation of the various project restoration alternatives under consideration. As a follow-up to this cultural overview, additional archaeological tasks are recommended as part of NEPA and/or CEQA project actions. These tasks involve standard archaeological protocols outlined in state antiquities guidelines under the California Environmental Quality Act (CEQA Section 5024, Public Resource Code) and federal guidelines under Section 106 of the National Historic Preservation Act of 1966, as amended (16 USC§ 470 *et seq*.) and 36 CFR 800. Recommendations are outlined below in the appropriate order of their completion. The relative level of effort and timing for completion of each of these archaeological tasks would be determined as specific restoration proposals are developed. All work would be conducted by a qualified archaeologist and/or architectural historian; a local Native American representative would be involved as appropriate.

(1) On-going Consultation

- contact with tribal representatives (Washoe)

- oral history interviews with individuals knowledgeable in local history (Truckee Donner Historical Society and Donner Summit Historical Society)
- on-going consultation with USFS cultural resource staff

(2) Archival Research

- on a project-specific basis, update records search at the North Central Information Center, California State University, Sacramento
- on a project-specific basis, update records search of USFS files

(3) Archaeological Field Research

- field verification of known archaeological sites to assess their current content and integrity
- in areas not previously subject to archaeological coverage or where prior coverage is older than 10 years, conduct project-specific archaeological field reconnaissance to detect any newly discovered archaeological resources within the project area and assess the integrity of previously recorded resources

(4) Preparation of Final Report

- final cultural resource inventory report must comply with Section 106 of the National Historic Preservation Act (NHPA) of 1966 (as amended 16 USC§ 470 *et seq*.) and guidelines established by Placer and Nevada counties under the California Environmental Quality Act (CEQA Section 5024, Public Resource Code)
- review and concurrence by agency personnel (USFS), in consultation with the State Historic Preservation Officer (if appropriate) and other interested parties (including Washoe and Nisenan tribal representatives).

(5) Archaeological Monitoring

- public access into the study area is likely to grow over time and the potential for increased archaeological site vandalism should be monitored on a periodic basis
- monitoring of archaeological sites during the implementation of restoration projects may be required; a Native American monitor may be required on or near prehistoric sites

(6) Public Interpretation

- selected archaeological sites (that have been studied/stabilized and where vandalism is not likely to occur) should be developed as part of a program to further educate the public regarding the prehistory and history of the Prosser Creek sub-basin; details of any public outreach program would be developed on a project-specific basis.

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APPENDIX 1:

Timeline of Human Land Use in the Prosser Creek Watershed

TIMELINE OF HUMAN LAND USE

PROSSER CREEK WATERSHED

Date	Event
CULTURAL SETTING	
Prehistory	
9,000 BP-1840s	prehistoric occupation; Alder Hill basalt quarry complex – major source of toolstone for millennia; prehistoric encampment reported near the mouth of Prosser Creek
Washoe History	
1920s-1930s	small number of Washoe Indians living on the outskirts of Hobart Mills ("Ragtown") and working at the mill
Transportation	
1845-1850s	emigrant trains travel along current route of Dog Valley Road/Prosser Dam Road, southward along Prosser Creek and present alignment of State Route 89 (SR 89) to Truckee; branching emigrant route follows Alder Creek through the modern Tahoe Donner Subdivision
1864	Dutch Flat Donner Lake Wagon Road opened between the California gold fields and Nevada's Comstock Lode, passing over Donner Summit and through Truckee into the SR 89 corridor and along the current route of Dog Valley Road/Prosser Dam Road
1865-1889	earliest toad systems developed between Truckee and Dog Valley and northwestward through Hobart Mills and Hobart Reservoir to Sierra Valley; "Prosser House" way station established at the road crossing of Prosser Creek
ca. 1895	"Old Reno Road" crosses Prosser Creek to Hobart Mills, then tracks northward along current route of SR 89
1913-1914	Dutch Flat Donner Lake Wagon Road designated as a segment of the Lincoln Highway, America's first transcontinental road
ca. 1955	by the 1950s the network of roads/trails expands throughout the watershed
ca. 1962	SR 89 relocated away from Old Reno Road/Hobart Mills/Dog Valley Road/Prosser Dam Road west of Prosser Creek to its present alignment
Logging	
Small-Scale Sawmills	
1870s-1900	era of small-scale sawmilling with an average capacity of about 25,000 board feet per day

1872-1889	Seth Martin and Hall establish small sawmill near where SR 89 crosses Prosser Creek; Lonkey and Smith of the Nevada and California Lumber Co. bought the Prosser Creek Mill
ca. 1880s-1902	Lonkey and Smith of the Nevada and California Lumber Co. operated the Banner Mill on Sagehen Creek (near its crossing of SR 89) along with the Prosser Creek Mill
1889	Prosser Creek Mill burns
1907-1916	Euer Sawmill operated by Euer brothers in Euer Valley; R.C. Gracey purchasesd milling equipment in 1917 and relocated the mill to Deep Creek on the Truckee River between Tahoe City and Truckee
1907	Mr. Crabtree established a sawmill on a large track of land in Crabtree Valley

Sierra Nevada Wood & Lumber Co./Hobart Estate Co. (i.e., Hobart company)

1900-1930s	era of large-sale sawmilling with an average capacity upwards of 175,000 board feet per day
1897-1936	Hobart company. operates a mill at Overton/Hobart Mills; owned 86,000 acres in Nevada and Sierra counties with an average annual cut of about 25 million feet

Progress of Logging Railroad Construction and Timber Cutting:

1896	construction of 7-mile main rail line between Overton/Hobart Mills and Truckee
1899	Hobart company built 4-5 miles of logging railroad; first line built up Sagehen Creek (Camp No. 1); second line was built up Prosser Creek (Camp No. 2) to Carpenter Valley; a total of 21 logging camps were established
1900	timber cutting focused around Hobart Mills
1900-1910s	company has 3.5 miles of logging railroad immediately surrounding Hobart Mills
1908	logging railroads expand to 20 miles
1910s	peak cutting by the Hobart company
1910s-1930s	cutting focused northward into Sierra County
1910	company cut 18 million feet in Sierra County
1915	forest becoming “overcut”
1916	company cut 30 million feet in Sierra County
1917	company cut 30 million feet in Sierra County
1917	cutting entered smaller tracts of timber owned by USF-TNF; Hobart company steadily purchased these federal parcels until cutting ceased in 1936
1918	company cut 32 million feet in Sierra County
1919	company cut 23 million feet in Sierra County

1920s	Hobart company annual cuts ranged from 20-28 million feet; over 90% from the 65,000 acres of company lands, only 10% from USFS-TNF lands
1923	Hobart company logging railroads expand to 26-28 miles
1936	Hobart company logging railroads expand to 32 miles
ca 1930s	last virgin pine forests cleared off, some cutting now in second growth timber
1936	Hobart company ends operations; USFS purchases cut-over Hobart lands under provisions of the Weeks Act
1937	Hobart Southern Railway between Hobart Mills and Truckee abandoned
1937	Hobart Mills burns

Logging Technology:

1900s-1920s	Hobart company logging with steam donkey engines and logging railroads
1930s	Hobart company gasoline-powered tractors and skid logging comes into general use

Fibreboard Corporation

1900-1930	Floriston Pulp and Paper Co. (a forerunner of Crown-Willamette Paper Co.) operated a pulp and paper mill at Floriston, the second largest paper mill in the US; the company controlled considerable timberland in the project vicininty
1924-1928	Crown-Willamette Paper Co. (a forerunner of Fibreboard Corp.) operated a railroad up Alder Ck and into Euer Valley and possibly into Crabtree Canyon to supply Floriston Pulp & Paper Co.; five logging camps were in upper Alder Creek
1946	new standard gauge railroad built by Fibreboard on old Hobart Southern Railway right-of-way between abandoned Hobart Mills and Truckee
1955	Fibreboard operations cease at Hobart Mills and railroad grade to Truckee dismantled
1955	Fibreboard establishes sawmill at Truckee
late 1940s-1950s	timber harvesting continues within the watershed
1960-1961	Fibreboard conducts intensive salvage logging on their land after 1960 Donner Ridge Fire
1980s	Fibreboard dismantles sawmill at Truckee
1989	Fibreboard applies to Nevada Co. to build new mill at Hobart Mills; project falls through

Grazing

1911	number of carloads of stock grazing on TNF far exceeds any other season

1912	TNF authorizes annual grazing of 7,700 cattle/horses, 56,300 sheep, 200 swine
1916	TNF authorizes grazing of 7,800 cattle/horses, 59,500 sheep/goats, 100 swine; 1,200 cattle, 30,000 sheep on Truckee District alone; stock grazing on National Forests increased over 1915

Sheep

19th century	average of 75,000-100,000 sheep annually pastured in Truckee Basin; 5-6 bands run per permittee with 500-700 sheep per band in higher elevations and 800-1,600 sheep in lower elevations
1878	120,000 sheep reported within 15 miles of Truckee including 2,000 sheep around Castle Peak; 5,000 at Prosser; 4,000 along the Little Truckee; 3,500 around Sagehen Creek
1905	100,000 sheep pastured around Truckee, producing 139,623 pounds of wool
1911	George Mills grazed 1,200 sheep on Little Truckee and Boca allotments
1930s	sheep herd numbers dropped during Great Depression
1939	Mills grazed 2,000 sheep on Little Truckee and Boca allotments
1941	Mills grazed 2,000 sheep on Little Truckee and Boca allotments
1940s	sheep herd numbers rise in the post-WWII era
1948	Mills grazed 7,500 sheep on Little Truckee and Boca allotments
1966	Mills and Pete LaBorde graze 2,500 sheep on TNF
1968	LaBorde and Abel Mendegia acquired 6,000 sheep along with lease rights to the Boca, Kyburz, Sagehen, White Rock, and Summit allotments; bands were moved between Russell Valley, Hobart Mills, Sierraville, Castle Peak, and Mt. Rose
1982	Mendegia acquired LaBorde's interest and grazed 5,000-6,000 sheep on Truckee allotments
1984	Mendegia ran 1,167 sheep on Boca Allotment moving sheep along pre-set flockways up to Castle Peak (avoiding private land in Carpenter Valley where there was little grazing pressure)
1991	Mendegia sold sheep outfit to Victor Erratchu and Bernard Etcheverry of Little Panoche Sheep Co.; thereafter, operations were much scaled-down and centered in the Boca Allotment; Ray Talbott, of CHM Corrals, currently runs 3 bands on the allotment

Dairy/Stock Livestock

ca. 1868, 1872 or 1876	Euer settles in Euer Valley and operates dairy with water-powered mill on S. Fork Prosser Creek to power butter churner
1901	"Upper Dairy" shown in dated photo of Carpenter Valley

1901	grazing sheep shown in dated photo grazing in Carpenter Valley
1905	W. Carpenter and G. Russi reported as dairymen in Carpenter Valley; within a radius of 20 miles they have 10,000 cattle and 40,000 sheep to graze in the sierra
1913	J. Bickford also reported as a dairyman in Euer Valley

PHYSICAL SETTING

Flora and Fauna

pre-19th century	area supported luxuriant growth of native bunch grasses
1878	bunch grass, wild parsnip and clover are abundant for sheep forage
1920s-1930s	residents of Hobart Mills report the best deer hunting in the whole area

Forest Composition

pre-European era	virgin forest
1915	40% Jeffrey pine, average diameter=36"/height=110'up to 150'/age=273 yrs (130-350-yr range); 60% white fir, slightly smaller size, average age=209 yrs (128-255 yr range)
1915	minor attempts at reforestation
1961-1970s	major reforestation efforts post-1960 "Donner Ridge Fire;" USFS focused on Carpenter Ridge

Fishing

1860s-1917	commercial fishing of native LCT in the Truckee River Drainage Basin
1917	California legislature banned commercial fishing due to excessive over-fishing
1920s-1930s	residents of Hobart Mills report excellent fishing of non-native species, catching a limit of trout (25 trout, up to 18 inches long) in ½ hour to 2 hours
1929	native LCT could no longer migrate up Truckee River and its tributaries
1938	both Tahoe and Pyramid lakes strains of LCT were extinct due to commercial over-fishing, disturbance of spawning grounds, obstruction of spawning runs, pollution of watershed, competition from introduced species

Fires

pre-1960s	for millennia Washoe Indians and their prehistoric predecessors purposefully micro-burned to clear the ground and enhance growth of edible and medicinal plants and animal feed
1900	initial government attempts at fire suppression
1902	Government Forester, Charles Shinn, reports sighting up to 10 small fires in Tahoe Basin in a day; Truckee Basin might have experienced similar conditions
9/1901	wildfire "toward Alder Creek"; put out that night
7/1902	wildfire near Russell Valley; no serios damage done

7/1902	wildfire on Trout Creek
8/1903	wildfire on Trout Creek due to careless campers; burned area ½ mile wide and several miles long for 4+ days but little damage done
1/1906	Basque sheepherders criticized for deliberately setting fires to improve range forage and facilitate movement of sheep
7/1910	wildfire started by loggers' campfire 12 miles north of Truckee on Hobart land; 300 firefighters; burned over a mile square for 4 days; $10,000 damage
6/1912	wildfire near USFS ranger station on Prosser Creek; caused by lightning strike; 4-5 acres burned; five men put it under control by midnight
8/1914	wildfire near Hobart Mills ignited from embers from a fire over a mile away; burned over 200 acres
8/1915	wildfire on Hobart cut-over land 15 miles from Hobart Mills; destroyed lumber camp
8/5/1915	wildfire of short duration on Hobart Camp No. 2 (on Prosser Creek]; put out by men sent in from different lumber camps
11/5/1916	wildfire near Hobart Mills; snow helped firefighters to control
11/8/1917	Euer's dairy barn destroyed by forest fire in the fall
8/18/1921	wildfire at Hobart Camp No. 5 started by sparks from a steam donkey; burned for several days
6/26/1924	wildfire racing up Prosser Creek near town
1924	congressional act passed establishing fire exclusion as a national policy
mid-1920s	government fire suppression policy in place
9/18/1936	wildfire in Euer Valley (or "Trout Creek Valley"); showered sparks on Hobart Mills; 200 firefighters
7/1939	wildfire near Hobart Mills burned hundreds of acres; 200 firefighters brought fire under control within 1 day; started when burning abandoned lumber camp buildings
9/1956	Castle Peak, Carpenter, Martis and Cold Stream areas fair-to-high fire hazard
8/1960	"Donner Ridge Fire" ignited by embers from slash burn piles along I-80; wildfire burned 35,000+ acres over a 55-mile perimeter and 23 miles long engulfing portions of Prosser Creek watershed and Carpenter Ridge; required over 3,200 firefighters, 5 borate planes, 2 light planes, 7 standby aerial spray planes, 6 helicopters, 74 bulldozers, and 49 tank trucks to put it out
1/1965	borate plane crashed putting out wildfire near Prosser Dam
1960s	USFS employ reintroduction of fire as a management strategy

APPENDIX 2:

Native American Outreach

Susan Lindström, Ph.D.
Consulting Archaeologist

P.O. Box 3324
Truckee CA 96160
530-587-7072
530-713-1920 (cell)
susanglindstrom@gmail.com

DATE: August 13, 2020

TO: Darrel Cruz, Tribal Historic Preservation Officer, Cultural Resources Department
919 Highway 395 South, Gardnerville, NV 89410
darrel.cruz@washoetribe.us; 775-782-0014; 775-546-3421 (cell)

RE: Prosser Creek Watershed Assessment Project, Cultural Resource Study

The Truckee River Watershed Council is conducting an environmental assessment of the Prosser Creek watershed above Prosser Creek Reservoir (see attached map). The assessment aims to identify forest, meadow, stream, and other habitat restoration, recreation, and management opportunities. The goal of the Prosser Creek Assessment is to conduct an analysis of existing conditions in the watershed, identify areas of disrupted natural functions, and identify restoration, management, and protection opportunities.

As I understand, Beth Christman, the Truckee River Watershed Council has been in contact with you, recognizing that the Tribe is an important stakeholder in this planning process. Future stakeholder meetings are scheduled for November and another one next summer.

I have been retained by the Watershed Council to prepare a contextual background of the study area and offer whatever information I find regarding past human land use (and abuse) of the watershed. Therefore, some historical assessment of the project will be important, including traditional Native American land use practices, as well as knowledge of any potentially sensitive locales and areas of concern within the watershed that the restoration team should be aware of. Note that most of the project area falls within the Tahoe National Forest and a records search of previously recorded archaeological sites has been accomplished. These known sites would be protected from any future project ground-disturbance restoration activities.

I'm hoping you can spare a moment to discuss the project in more detail, especially in the event that we might engage any Washoe Elders to help us better understand traditional land management practices of the past and also ones that might be employed in future restoration activities. Is there a convenient time we might talk? (As always, you can reach me on my land line, 530-587-7072, or on my cell, 530-713-1920.)

Thank you very much.

Susan Lindström, Ph.D.
Consulting Archaeologist

Gmail

Susan Lindstrom <susanglindstrom@gmail.com>

Prosser Creek Watershed Assessment

1 message

Susan Lindstrom <susanglindstrom@gmail.com> Thu, Aug 13, 2020 at 2:57 PM
To: Darrel Cruz <darrel.cruz@washoetribe.us>
Cc: Beth Christman <bchristman@truckeeriverwc.org>, Brian Hastings <bhastings@balancehydro.com>

Hi Darrel;

Attached please find a project description and map for the upcoming Prosser Creek Watershed Assessment Project. As the Washoe Tribe is a recognized stakeholder in this project, I believe you've already been contacted by Beth Christman of the Truckee River Watershed Council.

I'm following up with you, in hopes we can discuss Washoe history of the project area in more detail. I've already found some interesting oral history accounts of Washoes employed at Hobart Mills during the 1920s-1930s and their residence just outside the mill town during that time. Wondering if any of the Elders might have more information regarding this or other aspects of the Prosser Creek drainage that could be helpful to the Watershed Council in planning their restoration efforts. (Boy, it's especially times like these that I sure miss JoAnn's comprehensive knowledge and input of traditional Washoe ways!)

When it's convenient, I hope you can find the time to give me a call to discuss (530-587-7072 or 530-713-1920). If I don't hear from you within the next week or so, I'll give you a jingle. Thanks!

Susan G. Lindstrom, Ph.D.
Consulting Archaeologist

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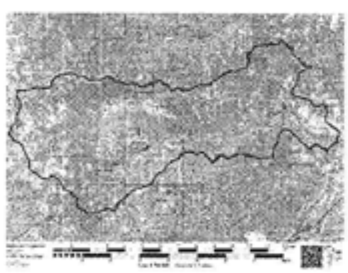
2 attachments



Watershed map.jpg
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Prosser WA Cruz.docx
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APPENDIX 3: RESUME

RESUME

Susan Lindström, Ph.D.
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Education

Ph.D. Archaeology 1992 - University of California Davis
M.A. Anthropology 1978 - University of California Davis
B.A. Anthropology 1972 - University of California Berkeley

Expertise

Cultural Resource Management
Archaeology (prehistoric and historic period)
History and archival records research
Ethnography, ethnohistory, oral history
Native American consultation
Interpretation and public education

Professional Organizations

Register of Professional Archaeologists (member since 1982)
Society for Historical Archaeology
Society for California Archaeology
Various county and regional historical societies

Lindström's qualifications include archaeological field work and analytical and archival research in the prehistory and history of the western United States including California, the northern and western Great Basin in Nevada and Oregon, and the Cascade Range and the Columbia River Plateau in Oregon and Washington. Her area of expertise is centered in the north-central Sierra where she has over 43 years of experience in historic preservation matters on a local, state and federal level. She has resided in the Tahoe Sierra and accrued full-time professional experience here since 1973.

Heritage Resource Management -- As Forest Archaeologist from 1973 until 1978 for the Tahoe National Forest and "zone" Archaeologist for the El Dorado National Forest and Lake Tahoe Basin Management Unit, and as District Archaeologist for the Bureau of Land Management in 1978 (Burns, Oregon), Lindström initiated and implemented heritage resource programs for the inventory, protection, management and interpretation of prehistoric and historic heritage resources. She conducted training sessions on heritage resource identification and on antiquities legislation.

Contracting and Consulting -- Between 1980 and the present time, as a private consultant, Lindström has conducted and/or supervised fieldwork, data analysis, archival research, and report preparation for hundreds of federal, state, county, and private projects within the north-central Sierra and adjoining regions in California and Nevada. During this time, she has served as an expert witness on historic and prehistoric resources involving California State Supreme Court cases within the Tahoe Sierra.

Teaching -- Lindström instructed introductory level courses in cultural and physical anthropology and archaeology at the University of Nevada, Reno and the University of California, Davis and was appointed as an adjunct professor to the University of Nevada, Reno in 2010.

****Research, Publications and Papers*** -- Academic and heritage management reports pertain to regional prehistory and history, as well as print and video publications for the popular audience (including research findings on the Donner Party, California gold mining, Washoe Indians, and California ethnobotany).

Secretary of Interior Standards: Archaeology and History (Prehistory, Ethnography, Ethnohistory, Ethnobotany, History, Paleoenvironmental Studies)

Lindström's 43 years of full-time professional experience in archaeological research, administration and management at the supervisory level involves the study of resources of the prehistoric, ethnographic, ethnohistoric, and historic period. In the Lake Tahoe Basin and Truckee Basin alone, Lindström has supervised and/or participated in the cumulative survey of nearly 50,000 acres. Her work in the adjoining sierran foothills and valleys approaches an additional 25,000 acres.

Prehistory. Experience in prehistoric archaeology largely pertains to the study of hunter-gatherer groups in the far west. Her surveys and excavations center upon the prehistoric ancestors of the Washoe and Maidu Indians of the north-central Sierra.

Lindström's Ph.D. dissertation focused on Washoe fishing in the Truckee River Drainage Basin. Her M.A. thesis explored high-elevation prehistoric land use in the Truckee-Tahoe Sierra.

During the 1990s she participated in the development of a research design for the Framework for Archaeological Resource Management (FARM), a heritage resource management document used by all north-central sierran forests.

She is presently a reviewer for the *Journal of California Archaeology*.

Ethnography, Ethnohistory, Ethnobotany. Lindström has developed an extensive knowledge of Washoe and Maidu territory and has maintained a good working relationship with these groups beginning in 1973. Since 2000 she has collaborated with prominent Washoe ethnographers such as Warren D'Azevedo and Merideth (Penny) Rucks. Lindström conducted and coordinated ethnographic research to develop a management plan for Cave Rock, a high-profile Washoe Traditional Cultural Property within the Lake Tahoe Basin. She authored a chapter on Native Californian ethnobotany that appears in a standard source book on California vegetation.

History. Experience in historic sites archaeology has focused on resources associated with the study of mining, logging, ranching, transportation, and water management resources. Since 1991 Lindström has conducted excavations at several rural work camps and industrial sites, many involving Chinese wood cutters and colliers. In 1987 and 1990 she field-directed excavations at two Donner Party camps (Murphy's Cabin and Alder Creek) and co-authored a book detailing the archival research, archaeology, architecture, dendrochronology, and zooarchaeology surrounding the tragedy.

Paleoenvironmental Studies. Lindström is a contributor to the 1997 congressionally funded, multi-disciplinary study assessing the environmental health and ecosystem management of the Sierra Nevada (*Sierra Nevada Ecosystem Project* [SNEP]) and the pilot case study focusing on the Lake Tahoe Basin.

She is also a contributor to the *Lake Tahoe Watershed Assessment* study, published in 2000 by the Pacific Southwest Research Station, USDA Forest Service, in collaboration with the Pacific Southwest Region of the USDA Forest Service, the Tahoe Regional Planning Agency, the University of California at Davis, the University of Nevada at Reno, and the Desert Research Institute, Reno, Nevada. The study was mandated as part of former President Clinton's actions to protect Lake Tahoe.

Through a series of snorkel and SCUBA surveys during the 1980s and 1990s in Lake Tahoe and its tributary lakes, Lindström investigated lake level changes and explored submerged remnant forests and prehistoric milling features as paleoenvironmental indicators over the past 6000 years. She presented her findings in scientific journals as a co-author with geologists, hydrologists and limnologists. Her work was also featured in *National Geographic* magazine (March 1992).

Secretary of Interior Standards: Closely Related Fields

Lindström's 43 years of full-time experience also entails research, writing, inventory, evaluation, data recovery, and management in closely related fields pertaining to the "built environment." Her work falls within the historical context of mining, logging, water supply engineering, and ranching landscapes, as well as transportation and communications networks, and town sites. Evaluation and data recovery have been directed to 19th and 20th century structural remains for the following resource types: Chinese/Basque/miner cabins; bake ovens/hearths; sawmills; railroad grades and camps; flumes; ditches; pipelines; dams; reservoirs; water tanks; ice works; ranch complexes; charcoal kilns; mine features; trails/roads/highways; utility lines; and fences.

For her projects involving more complex structural properties such as intact standing buildings, bridges and other architectural features, Lindström has had the opportunity to collaborate and learn from prominent architectural historians, beginning in the early 1980s with the Town of Truckee National Register District nomination process up until the present time.

Lindström also has experience with several historic preservation projects. She authored the heritage resource components for local community plans (from 1989 through 2005) and for county general plans (beginning in 1991). During the 1980s she served as a charter member of the Truckee Historical Preservation Advisory Council. She assisted in the preparation of the Truckee Historic Preservation Plan in 2009, followed by the formal National Register District nomination and subsequent Truckee Streetscape project. She served as a member of the "Placer County Department of Museums Collections Management Task Force" in 2000 and is currently an advisor to the California Department of Parks and Recreation (Sierra District) for their upcoming museum at Donner Memorial State Historic Park.

*available upon request

APPENDIX B

eBird Records List

Species	eBird	Sagehen Field Station
American Avocet	X	
American Crow		X
American Coot	X	
American Dipper	X	X
American Kestrel	X	X
American Pipit	X	
American Robin	X	X
American White Pelican	X	X
American Widgeon	X	
Ash-throated Flycatcher		X
Audubon's Warbler		X
Bald Eagle	X	X
Band-tailed Pigeon	X	X
Barn Swallow		X
Belted Kingfisher	X	X
Bewick's Wren	X	
Baird's Sandpiper	X	
Barn Swallow	X	
Bank Swallow	X	
Black Phoebe	X	X
Black-necked Stilt	X	
Black-backed Woodpecker		X
Black-billed Magpie		X
Black-chinned Hummingbird		X
Black-headed Grosbeak		X
Black-throated Gray Warbler		X
Blue Grosbeak		X
Blue-headed Vireo		X
Bonaparte's Gull	X	
Brewer's Blackbird	X	X
Brewer's Sparrow	X	X
Brown Creeper	X	X
Brown-headed Cowbird	X	X
Bufflehead	X	
Bushtit		X

Species	eBird	Sagehen Field Station
California Gull	X	X
California Quail		X
Califonria Scrub Jay	X	
California Spotted Owl		X
Calliope Hummingbird	X	X
Canada Goose	X	X
Canvasback	X	
Caspian's Tern	X	
Cassin's Finch	X	X
Cassin's Vireo	X	X
Chestnut-sided Warbler		X
Chipping Sparrow	X	X
Cinnamon Teal	X	
Clark's Grebe	X	
Clark's Nutcracker	X	X
Cliff Swallow	X	X
Common Goldeneye	X	
Common Loon	X	
Common Merganser	X	X
Common Nighthawk	X	X
Common Poorwill		X
Common Raven	X	X
Common Yellowthroat	X	X
Cooper's Hawk	X	X
Dark-eyed Junco	X	X
Double-crested Cormorant	X	
Downy Woodpecker		X
Dusky Flycatcher	X	X
Dusky Grouse		X
Eared Grebe	X	
Eastern Kingbird	X	
European Starling	X	X
Evening Grosbeak	X	X
Flammulated Owl		X
Fox Sparrow	X	X

Species	eBird	Sagehen Field Station
Forester's Tern	X	
Gadwall	X	
Golden Eagle	X	X
Golden-crowned Kinglet	X	X
Golden-crowned Sparrow		X
Gray Flycatcher	X	X
Great Blue Heron	X	X
Great Egret	X	
Great Gray Owl		X
Great Horned Owl	X	X
Greater White-fronted Goose	X	X
Greater Yellowlegs	X	
Greater Scaup	X	
Green-tailed Towhee	X	X
Green-winged Teal	X	X
Hairy Woodpecker	X	X
Hammond's Flycatcher	X	X
Hermit Thrush	X	X
Herring Gull	X	
Hermit Warbler	X	X
Hermit Thrush		X
Hooded Merganser	X	
Horned Lark	X	X
Horned Grebe	X	
House Finch	X	X
House Wren	X	X
Killdeer	X	X
Lark Sparrow	X	
Lazuli Bunting	X	X
Least Sandpiper	X	
Lesser Goldfinch	X	X
Lesser Yellowlegs	X	
Lewis's Woodpecker	X	X
Lincoln's Sparrow	X	X
Loggerhead Shrike		X

Species	eBird	Sagehen Field Station
Long-billed Dowitcher	X	
Long-eared Owl		X
MacGillivray's Warbler	X	X
Mallard	X	X
Merlin	X	
Mountain Bluebird	X	X
Mountain Chickadee	X	X
Mountain Quail	X	X
Mourning Dove	X	X
Nashville Warbler	X	X
Northern Flicker	X	X
Northern Goshawk		X
Northern Harrier	X	
Northern Pintail	X	
Northern Pygmy-Owl	X	X
Northern Rough-winged Swallow	X	
Northern Red-shafted Flicker		X
Northern Saw-whet owl		X
Northern Shoveler	X	
Olive-sided Flycatcher	X	X
Orange-crowned Warbler	X	X
Osprey	X	X
Pacific-slope Flycatcher	X	X
Pacific Wren		X
Painted Bunting		X
Peregrine Falcon	X	
Pied-billed Grebe	X	
Pileated Woodpecker		X
Pine Grosbeak	X	X
Pine Siskin	X	X
Prairie Falcon	X	
Purple Finch		X
Pygmy Nuthatch	X	X
Red Crossbill	X	X
Redhead	X	

Species	eBird	Sagehen Field Station
Red-breasted Nuthatch	X	X
Red-breasted Sapsucker	X	X
Red-necked Phalarope	X	
Red-shouldered Hawk	X	
Red-tailed Hawk	X	X
Red-winged Blackbird	X	X
Ring-billed Gull	X	X
Ring-necked Duck	X	
Rock Wren	X	X
Ruby-crowned Kinglet	X	X
Rudy Duck	X	
Rufous/Allen's Hummingbird	X	
Rufous Hummingbird	X	X
Sandhill Crane		X
Say's Phoebe	X	
Savannah Sparrow	X	X
Sharp-shinned Hawk	X	X
Semi-palmated Plover	X	
Snowy Egret	X	
Snow Goose	X	X
Song Sparrow	X	
Sora		X
Spotted Sandpiper	X	X
Spotted Towhee	X	X
Steller's Jay	X	X
Swainson's Thrush		X
Townsend's Solitaire	X	X
Townsend's Warbler	X	X
Tree Swallow	X	X
Tundra Swan	X	
Turkey Vulture	X	X
Varied Thrush		X
Vaux's Swift	X	X
Vesper Sparrow	X	X
Violet-green Swallow	X	X

Species	eBird	Sagehen Field Station
Virginia Rail		X
Warbling Vireo	X	X
Water Pipit		X
Western Bluebird	X	X
Western/Clark's Grebe	X	
Western Kingbird	X	X
Western Meadowlark	X	X
Western Tanager	X	X
Western Wood-pewee	X	X
Western Sandpiper	X	
Western Screech-owl		X
Western Scrub-jay		X
White-faced Ibis	X	
White-breasted Nuthatch	X	X
White-crowned Sparrow	X	X
White-winged Scoter	X	
White-headed Woodpecker	X	X
White-throated Swift	X	X
Williamson's Sapsucker	X	X
Willow Flycatcher	X	X
Willit	X	
Wilson's Phalarope	X	
Wilson's Snipe	X	X
Wilson's Warbler	X	X
Wood Duck	X	
Yellow-headed Blackbird	X	
Yellow Warbler	X	X
Yellow-rumped Warbler	X	X

APPENDIX C

Special-Status Plants

Species	Status[1]	Communities, Soils, Elevational Range, and Blooming Period	Potential for Occurrence in Plan Area
Threetip sagebrush *Artemisia tripartita* ssp. *tripartita*	2B.3	Upper montane coniferous forest (openings). Rocky, volcanic. Elevations from 7,215–8,530 feet. Blooms in August.	**Known to Occur.** This species has been recorded in Euer Valley (Dudek 2016).
Austin's astragalus *Astragalus austiniae*	1B.3	Alpine boulder and rock field, subalpine coniferous forest. Rocky. Elevations from 8,005–9,745 feet. Blooms from (May)July–September.	**Known to Occur.** This species has been recorded at the upper edge of Coon Canyon on the ridge of Castle Peak (CNDDB 2020).
Woolly-leaved milk vetch *Astragalus whitneyi* var. *lenophyllus*	4.3	Alpine boulder and rock field, subalpine coniferous forest (rocky). Elevations from 7,000–10,005 feet. Blooms from July–August.	**Could Occur.** Recorded in Norden USGS quad and additional records nearby in North Tahoe-Truckee area (Calflora 2020). Suitable habitat occurs in the Watershed.
Upswept moonwort *Botrychium ascendens*	2B.3, TNF-S	Lower montane coniferous forest, meadows and seeps. Mesic. Elevations from 3,655–9,990 feet. Blooms from (June)July–August.	**Known to Occur.** This species has been recorded in Lower Prosser Creek (USFS).
Scalloped moonwort *Botrychium crenulatum*	2B.2, TNF-S	Bogs and fens, lower montane coniferous forest, meadows and seeps, marshes and swamps (freshwater), upper montane coniferous forest. Elevations from 4,160–10,760 feet. Blooms from June–September.	**Known to Occur.** This species has been recorded in Lower Prosser Creek (USFS).
Common moonwort *Botrychium lunaria*	2B.3, TNF-S	Meadows and seeps, subalpine coniferous forest, upper montane coniferous forest. Elevations from 6,495–11,155 feet. Blooms in August.	**Known to Occur.** This species has been recorded in Lower Prosser Creek (CNDDB 2020).
Mingan moonwort *Botrychium minganense*	2B.2, TNF-S	Bogs and fens, lower montane coniferous forest, meadows and seeps (edges), upper montane coniferous forest. Mesic. Elevations from 4,770–7,150 feet. Blooms from July–September.	**Could Occur**. The closest CNDDB record is located less than 2 miles north of the Watershed at the lower end of Stampede Reservoir (CNDDB 2020) and suitable habitat occurs in the Watershed.
Western goblin *Botrychium montanum*	2B.1, TNF-S	Lower montane coniferous forest, meadows and seeps, upper coniferous forest. Mesic. Elevations from 4,805–7,150 feet. Blooms July–September.	**Less Likely to Occur.** Suitable habitat occurs in the Watershed, but species is not known from vicinity with closest records occurring near Homewood and in the Desolation Wilderness (Calflora 2020).

Species	Status[1]	Communities, Soils, Elevational Range, and Blooming Period	Potential for Occurrence in Plan Area
Bolander's bruchia (moss) *Bruchia bolanderi*	4.2, TNF-S	Lower montane coniferous forest, meadows and seeps, upper montane coniferous forest. Damp soil. Elevations from 5,575–9,185 feet.	**Could Occur**. The closest CNDDB record is located approximately 1 mile outside the Watershed along Upper Castle Creek, southwest of Coon Canyon (CNDDB 2020). Suitable habitat occurs in the Watershed.
Davy's sedge *Carex davyi*	1B.3	Subalpine coniferous forest, upper montane coniferous forest. Elevations from 4,920–10,500 feet. Blooms from May–August.	**Known to Occur.** This species has been recorded in Euer Valley (Dudek 2016).
Mud sedge *Carex limosa*	2B.2	Bogs and fens, lower montane coniferous forest, meadows and seeps, marshes and swamps, upper montane coniferous forest. Elevations from 3,935–8,860 feet. Blooms from June–August.	**Known to Occur.** This species has been recorded in Lower Carpenter Valley (CNPS 2016).
Fresno Ceanothus *Ceanothus fresnensis*	4.3	Cismontane woodland (openings), lower montane coniferous forest. Elevations from 2,950–6,900 feet. Blooms from May–July.	**Less Likely to Occur.** Several observations reported south of Watershed, generally on west slope of Sierra Nevada (Calflora 2020). Marginally suitable habitat occurs in the Watershed.
Fell-fields claytonia *Claytonia megarhiza*	2B.3	Alpine boulder and rock field, subalpine coniferous forest (rocky or gravelly). In crevices between rocks. Elevations from 8,530–11,590 feet. Blooms from July–September.	**Could Occur**. The nearest CNDDB record is located approximately 2 miles outside the Watershed on Mount Lola, north of the North Fork upper watershed (CNDDB 2020). Suitable habitat occurs in upper Watershed.
Fiddleleaf hawksbeard *Crepis runcinata*	2B.2	Mojavean Desert scrub, pinyon juniper woodland. Mesic, alkaline. Elevations from 4,100–6,480 feet. Blooms from May–August.	**Unlikely to Occur.** Suitable habitat for this species is limited in the Watershed, and the closest species records are near Dog Valley, Sierra Valley, and Loyalton (Calflora 2020).
Clustered-flower cryptantha *Cryptantha glomeriflora*	4.3	Great Basin scrub, meadows and seeps, subalpine coniferous forest, upper montane coniferous forest. Granitic or volcanic, sandy. Elevations from 5,905–12,305 feet. Blooms from June–September.	**Could Occur.** Several records exist near the Watershed along the Middle Truckee River upstream of Prosser Creek and near Boca Reservoir. Suitable habitat occurs in lower Watershed near Prosser Reservoir.

Species	Status[1]	Communities, Soils, Elevational Range, and Blooming Period	Potential for Occurrence in Plan Area
English sundew *Drosera anglica*	2B.3	Bogs and fens, meadows and seeps (mesic). Elevations from 4,265–7,400 feet. Blooms from June–September.	**Known to Occur.** This species has been recorded in Lower Carpenter Valley (CNPS 2016).
Subalpine fireweed *Epilobium howellii*	4.3	Meadows and seeps, subalpine coniferous forest. Mesic. Elevations from 6,560–10,235 feet. Blooms from July–August.	**Could Occur**. The closest CNDDB record is located approximately 2 miles northwest of the North Fork upper watershed (CNDDB 2020) and suitable habitat occurs in the upper Watershed (e.g., upper Coon Canyon).
Oregon fireweed *Epilobium oreganum*	1B.2	Ultramafic. Bogs and fens, lower montane coniferous forest, meadows and seeps, upper montane coniferous forest. Mesic. Elevations from 1,640–7,350 feet. Blooms from June–September.	**Less Likely to Occur.** Reported from Hobart Mills quad (CNPS 2020), but suitable habitat generally lacking in the Watershed.
Starved daisy *Erigeron miser*	1B.3, TNF-S	Upper montane coniferous forest (rocky). Elevations from 6,035–8,595 feet. Blooms from June–October.	**Known to Occur.** This species has been recorded in the North Fork upper watershed (USFS) and at the upper edge of Coon Canyon (summit of Castle Peak) (CNDDB 2020).
Donner Pass buckwheat *Eriogonum umbellatum* var. *torreyanum*	1B.2, TNF-S	Meadows and seeps, upper montane coniferous forest. Volcanic, rocky. Elevations from 6,085–8,595 feet. Blooms from July–September.	**Known to Occur.** This species has been recorded in the South Fork upper watershed (USFS).
Slender cottongrass *Eriophorum gracile*	4.3	Bogs and fens, meadows and seeps, upper montane coniferous forest. Acidic. Elevations from 4,195–9,515 feet. Blooms from May–September.	**Known to Occur.** This species has been recorded in Lower Carpenter Valley (CNPS 2016, Dittes & Guardino 2017).
Alkali hymenoxys *Hymenoxys lemmonii*	2B.2	Great Basin scrub, lower montane coniferous forest, meadows and seeps, subalpine coniferous forest. Elevations from 785–11,120 feet. Blooms from June–August(September).	**Less Likely to Occur.** Suitable habitat occurs in the Watershed, but closest observations locally occur near Loyalton and Sardine Peak (Calflora 2020).
Sierra Valley ivesia *Ivesia aperta* var. *aperta*	1B.2, TNF-S	Great Basin scrub, lower montane coniferous forest, meadows and seeps, pinyon juniper woodland, vernal pools. Vernally mesic, usually volcanic. Elevations from 4,855–7,545 feet. Blooms from June–September.	**Unlikely to Occur.** Species distribution generally limited to Sierra Valley and environs, well north of the Watershed.

Species	Status[1]	Communities, Soils, Elevational Range, and Blooming Period	Potential for Occurrence in Plan Area
Plumas ivesia *Ivesia sericoleuca*	1B.2, TNF-S	Great Basin scrub, lower montane coniferous forest, meadows and seeps, vernal pools. Vernally mesic, usually volcanic. Elevations from 4,295–7,220 feet. Blooms from May–October.	**Known to Occur.** This species has been recorded in Hobart Mills (USFS, CNDDB 2020).
Santa Lucia dwarf rush *Juncus luciensis*	1B.2, TNF-S	Chaparral, Great Basin scrub, lower montane coniferous forest, meadows and seeps, vernal pools. Elevations from 980–6,695 feet. Blooms from April–July.	**Less Likely to Occur**. The closest CNDDB record is located less than 2 miles south of the Watershed, near Donner Pass Road east of Norden (CNDDB 2020). Suitable habitat occurs in the lower Watershed, but is limited in extent.
Hutchison's lewisia *Lewisia kelloggii* ssp. *hutchisonii*	3.2, TNF-S	Upper montane coniferous forest. Openings, ridgetops, often slate, sometimes rhyolite tuff. Elevations from 2,510–7,745 feet. Blooms from (April)May–August.	**Unlikely to Occur.** Several records reported within Tahoe National Forest, but all are located on the west slope of the Sierra Nevada (Calflora 2020).
Kellogg's lewisia *Lewisia kelloggii* ssp. *kelloggii*	3.2, TNF-S	Upper montane coniferous forest. Openings, ridgetops, often slate, sometimes rhyolite tuff. Elevations from 4,805–7,760 feet. Blooms from (April)May–August.	**Unlikely to Occur.** Several records reported within Tahoe National Forest, but all are located on the west slope of the Sierra Nevada (Calflora 2020).
Long-petaled lewisia *Lewisia longipetala*	1B.3, TNF-S	Alpine boulder and rock field, subalpine coniferous forest (mesic, rocky). Granitic. Elevations from 8,200–9,595 feet. Blooms from July–August(September).	**Known to Occur.** This species has been recorded in the North Fork upper watershed (USFS) and at the upper edge of Coon Canyon (Castle Peak summit) (CNDDB 2020).
Three-ranked hump moss (moss) *Meesia triquetra*	4.2	Bogs and fens, meadows and seeps, subalpine coniferous forest, upper montane coniferous forest (mesic). Soil. Elevations from 4,265–9,690 feet. Blooms in July.	**Known to Occur.** This species has been recorded in Lower Carpenter Valley (CNPS 2016).
Broad-nerved hump moss (moss) *Meesia uliginosa*	2B.2, TNF-S	Bogs and fens, meadows and seeps, subalpine coniferous forest, upper montane coniferous forest. Damp soil. Elevations from 3,965–9,200 feet. Blooms in July and October.	**Known to Occur.** This species has been recorded in Lower Prosser Creek (USFS).
Sagebrush bluebells *Mertensia oblongifolia* var. *oblongifolia*	2B.2	Great Basin scrub, lower montane coniferous forest, meadows and seeps, subalpine coniferous forest. Usually mesic.	**Less Likely to Occur**. The closest CNDDB record is located approximately 6 miles outside the Watershed, north of the North Fork upper

Species	Status[1]	Communities, Soils, Elevational Range, and Blooming Period	Potential for Occurrence in Plan Area
		Elevations from 3,280–9,845 feet. Blooms from April–July.	watershed (CNDDB 2020). The species has been reported near Independence Lake, near Sierraville, and on the road to Webber Lake (Calflora).
Hiroshi's flapwort (liverwort) *Nardia hiroshii*	2B.3	Meadows and seeps. Damp soil with granitic bedrock. Elevations around 7,200 feet.	**Could Occur**. The closest CNDDB record is located less than 1 mile outside the Watershed, just south of I-80 southwest from Euer Valley (CNDDB 2020), and suitable habitat occurs in numerous locations throughout the Watershed.
Tall alpine-aster *Oreostemma elatum*	1B.2	Bogs and fens, meadows and seeps, upper montane coniferous forest. Mesic. Elevations from 3,295–6,890 feet. Blooms from June–August.	**Unlikely to Occur.** Species generally limited to areas in Plumas County, well north of the Watershed.
Rayless mountain ragwort *Packera indecora*	2B.2	Meadows and seeps (mesic). Elevations from 5,250–6,560 feet. Blooms from July–August.	**Could Occur.** Species occurs in Sagehen Creek Watershed, and suitable habitat occurs in the Watershed.
Stebbins' phacelia *Phacelia stebbinsii*	1B.2, TNF-S	Cismontane woodland, lower montane coniferous forest, meadows and seeps. Elevations from 2,000–6,595 feet. Blooms from May–July.	**Less Likely to Occur.** The closest CNDDB record is located approximately 6 miles outside the Watershed, southwest of Euer Valley (CNDDB 2020). Most observations reported on west slope of Tahoe National Forest, well outside Watershed boundary.
White-stemmed pondweed *Potamogeton praelongus*	2B.3	Marshes and swamps (deep water, lakes). Elevations from 5,905–9,845 feet. Blooms from July–August.	**Less Likely to Occur.** Several records reported around Webber Lake and Catfish Lake, north of the Watershed, but suitable habitat in the Watershed generally is limited.
Robbins' pondweed *Potamogeton robbinsii*	2B.3	Marshes and swamps (deep water, lakes). Elevations from 5,015–10,825 feet. Blooms from July–August.	**Less Likely to Occur.** The closest CNDDB records are located less than 3 miles outside the Watershed, at the northern end of Independence Lake (CNDDB 2020), but suitable habitat in the Watershed is generally limited.

Species	Status[1]	Communities, Soils, Elevational Range, and Blooming Period	Potential for Occurrence in Plan Area
Sierra starwort *Pseudostellaria sierra*	4.2	Chaparral, cismontane woodland, lower montane coniferous forest, upper montane coniferous forest. Elevations from 4,015–7,200 feet. Blooms from May–August.	**Less Likely to Occur.** Reported in Truckee USGS Quad (Calflora 2020), and marginally suitable habitat occurs in the Watershed. However, most observations reported from Plumas County near Quincy (Calflora 2020).
Sticky pyrrocoma *Pyrrocoma lucida*	1B.2, TNF-S	Great Basin scrub, lower montane coniferous forest, meadows and seeps. Alkaline clay. Elevations from 2,295–6,400 feet. Blooms from July–October.	**Unlikely to Occur.** Distribution generally limited to Sierra Valley, north into Plumas County.
Alder buckthorn *Rhamnus alnifolia*	2B.2	Lower montane coniferous forest, meadows and seeps, riparian scrub, upper montane coniferous forest. Elevations from 4,490–6,990 feet. Blooms from May–July.	**Known to Occur.** This species has been recorded in Lower Carpenter Valley (Dittes & Guardino 2017).
Tahoe yellow cress *Rorippa subumbellata*	SE, 1B.1	Lower montane coniferous forest, meadows and seeps. Decomposed granitic beaches. Elevations from 6,200–6,250 feet. Blooms from May–September.	**Unlikely to Occur.** Species distribution restricted to shoreline of Lake Tahoe.
Marsh skullcap *Scutellaria galericulata*	2B.2	Lower montane coniferous forest, meadows and seeps (mesic), marshes and swamps. Elevations up to 6,890 feet. Blooms from June–September.	**Less Likely to Occur**. Suitable habitat exists in the Watershed, but the closest CNDDB record is located less than 4 miles outside the Watershed in the Town of Truckee, along the Truckee River (CNDDB 2020). Most records regionally reported from south shore of Lake Tahoe.
Western campion *Silene occidentalis* ssp. *occidentalis*	4.3	Chaparral, lower montane coniferous forest, upper montane coniferous forest. Dry open sites, sometimes rocky. Elevations from 4,035–6,855 feet. Blooms from June–August.	**Unlikely to Occur.** Distribution generally limited to west slope of Sierra Nevada and Cascade Range in areas typically at lower elevations than occur in the Watershed (Calflora 2020).
Water awlwort *Subularia aquatica* ssp. *americana*	4.3	Upper montane coniferous forest. Lake margins. Elevations from 6,230–10,170 feet. Blooms from July–September.	**Could Occur.** Numerous historic observations surrounding Donner Lake (Calflora 2020), and suitable habitat occurs in the Watershed.
Lemmon's clover *Trifolium lemmonii*	4.2	Great Basin scrub and lower montane coniferous forest.	**Could Occur.** Numerous records around Boca Reservoir, Dog Valley, Sattley,

Species	Status[1]	Communities, Soils, Elevational Range, and Blooming Period	Potential for Occurrence in Plan Area
		Elevations from 4,920–6,005 feet. Blooms from May–July.	Loyalton, Antelope-Smithneck Wildlife Area. Suitable habitat exists in eastern Watershed.
Lesser bladderwort *Utricularia minor*	4.2	Bogs and fens, marshes and swamps (assorted shallow freshwater). Calcium rich water. Elevations from 2,625–9,515 feet. Blooms from (May–June)July–August.	**Known to Occur.** This species has been recorded in Lower Carpenter Valley (CNPS 2016, Dittes & Guardino 2017).

[1] Status Codes

California Department of Fish and Wildlife

SE: State Endangered

California Rare Plant Rank (CRPR)

1B = Plants rare, threatened, or endangered in California and elsewhere.

2B = Plants rare, threatened, or endangered in California, but more common elsewhere

3 = More information needed

4 = Plants of limited distribution — a watch list

Threat code extension

.1 = seriously threatened in California

.2 = fairly endangered in California

.3 = not very endangered in California

Region 5 United States Forest Service Tahoe National Forest (USFS 2013)

TNF-S = Designated Sensitive Species

APPENDIX D

Special-Status Wildlife

Species	Status[1]	Habitat	Potential for Occurrence
Birds			
Northern goshawk *Accipiter gentilis*	CSSC, TNF-S	Mature coniferous forest with large diameter trees and high canopy closure. Frequently forages along meadow edges or in aspen/willow shrub communities.	**Known to Occur.** This species has been recorded in multiple locations within the Watershed (CNDDB 2020, TNF 2020).
Golden eagle *Aquila chrysaetos*	CFP	Cliffs or trees on hillslopes, often overlooking grasslands. Frequently forages in open rangelands, grasslands, oak savannas, open woodlands, and chaparral.	**Known to Occur.** This species has been recorded in the North Fork upper watershed (CNDDB 2020, TNF 2020).
Vaux's swift *Chaetura vauxi*	CSSC	Nests and roosts in hollow trees found in mature conifer forest. Forages above streams and throughout a variety of other habitat types.	**Could Occur.** Suitable habitat present in the Watershed. Noted as a possible breeder in the Sagehen Field Station (Morrison et al. 1985) and reported locally (eBird 2020).
Norther harrier *Circus hudsonius*	CSSC	Forages in marshes, grasslands, meadows, and treeless habitats. Nests on ground in patches of dense, tall, vegetation.	**Could Occur.** Suitable breeding habitat widespread in Watershed and noted as present in eBird (2020).
Olive-sided flycatcher *Contopus cooperi*	CSSC	Conifer forests, burns, and clearings. Breeds in coniferous forest of higher mountains, around edges of open areas such as bogs, ponds, and clearings.	**Could Occur.** Suitable breeding habitat occurs throughout the Watershed and noted as present in eBird (2020) and as an uncommon breeder at the Sagehen Field Station (Morrison et al. 1985).
Black swift *Cypseloides niger*	CSSC	Ledges of steep rock faces and canyons, in shallow caves, and behind waterfalls.	**Unlikely to Occur.** Suitable habitat limited in the Watershed and Watershed generally is located outside the species' range (single report from Norden USGS quad only [CNDDB 2020]).
Willow flycatcher *Empidonax traillii*	SE, TNF-S	Medium to large meadows with extensive areas of montane wet meadow, emergent vegetation and large stands of willow or other riparian deciduous shrubs.	**Known to Occur.** This species has been recorded in Lower Carpenter Valley (TNF 2020).
American peregrine falcon *Falco peregrinus anatum*	CFP	Tall vertical cliffs with large potholes or ledges inaccessible to land predators, often near wetlands and riparian corridors which support large bird populations.	**Less likely to Occur.** Suitable nesting habitat is limited in the Watershed, and no observations of species reported on any bird species observation list for the Watershed or adjacent areas (Appendix X).

Species	Status[1]	Habitat	Potential for Occurrence
Greater sandhill crane *Grus canadensis* ssp. *tabida*	ST, CFP, TNF-S	Shallow freshwater wetlands and open grasslands. Nests in montane meadows, open forest, and sagebrush.	**Known to Occur.** This species has been recorded in Lower Carpenter Valley (TNF 2020).
Bald eagle *Haliaeetus leucocephalus*	SE, CFP, TNF-S	Mountainous habitat near reservoirs, lakes, and rivers. Usually nests in mature and old-growth forest within 1 mile of water.	**Known to Occur.** TNF (2020) records near Prosser Creek Reservoir and in Euer Valley.
Yellow-breasted chat *Icteria virens*	CSSC	Riparian habitat and marsh margins, dense willow thickets and other brushy vegetation. On east side of Sierra Nevada, typically found in lower elevation riparian areas in Great Basin scrub.	**Less Likely to Occur.** May occur in lower areas of Watershed closer to Prosser Creek Reservoir, but suitable habitat generally limited.
Yellow warbler *Setophaga petechia*	CSSC	Riparian vegetation along streams and in wet meadows, especially willow and alder thickets.	**Known to Occur.** This species has been observed in North Fork's upper watershed (Dittes & Guardino 2017) and commonly breeds at the Sagehen Field Station (Morrison et al. 1985).
Great gray owl *Strix nebulosa*	SE, TNF-S	Dense coniferous forest adjacent to mountain meadows and forest openings.	**Less Likely to Occur.** No nearby records in CNDDB and no TNF records on the Watershed. Also not reported on any regional bird species lists (Appendix X). Relatively recent sightings have been reported at Perazzo Meadows and around Webber Lake/Lower Lacey Meadow, and suitable habitat exists in the Watershed.
California spotted owl *Strix cccidentalis occidentalis*	CSSC, TNF-S	Coniferous forests that have a complex multi-layered structure, dense canopies, and large diameter trees.	**Known to Occur**. TNF (2020) records reported in Carpenter Valley.
Fish			
Mountain sucker *Catostomus platyrhynchus*	CSSC	Cool, clear mountain streams with hiding cover and a mix of riffles, pools, and runs. Also large rivers, turbid streams, and lakes.	**Could Occur.** This species has been recorded in Lower Prosser Creek, below Prosser Creek Reservoir, and could occur in other reaches of Prosser Creek above the reservoir (CNDDB 2020).
Lahontan cutthroat trout *Oncorhynchus clarkii henshawi*	FT	Cool-water streams with riffle-runs, rocky substrates, and pools with vegetated and stable stream banks.	**Could Occur.** This species is stocked, as a sport fish, in Prosser Creek Reservoir and in Warren Lake. On the basis of these planted fish, the species may occasionally occur in Lower Prosser Creek or in the upper

Species	Status[1]	Habitat	Potential for Occurrence
			reaches of the North Fork below Warren Lake. Stream-resident Lahontan cutthroat are not likely to occur in the Watershed.
Mountain whitefish *Prosopium williamsoni*	CSSC	Clear, cold streams with deeper pools and runs.	**Known to Occur.** This species has been recorded in Lower Prosser Creek below the reservoir, outside the Watershed, and in the upper reaches of the South Fork in Euer Valley (CNDDB 2020). Likely to occur in other reaches of Prosser Creek throughout the Watershed.
Amphibians			
Southern long-toed salamander *Ambystoma macrodactylum*	CSSC	Flooded alpine meadows, permanent and temporary high mountain ponds and lakes up to 10,000 feet.	**Known to Occur.** This species has been recorded in the North Fork upper watershed (CNDDB 2020).
Sierra Nevada yellow-legged frog *Rana sierrae*	FE, ST, TNF-S	Streams, lakes, and ponds in montane riparian, lodgepole pine forest, subalpine conifer, and wet meadow habitats. Elevation range is 2,040–12,070 feet.	**Known to Occur.** This species is known to occur in the upper Watershed, around Warren Lake and in the Coon Creek drainage (CNDDB 2020). Other CNDDB records, located at lower elevations in the Watershed, are questionable.
Mammals			
Pallid bat *Antrozous pallidus*	CSSC TNF-S	Grasslands, shrublands, woodlands, and forests from sea level up through mixed conifer forests. Roosts in tree cavities.	**Could Occur**. Species occurs regionally (D. Johnson pers. obs.) and suitable roosting habitat likely present in the Watershed.
Sierra Nevada mountain beaver *Aplodontia rufa californica*	CSSC	Montane riparian habitat with deep, friable soils.	**Could Occur.** Extensive habitat available in riparian scrub in Euer and Carpenter Valley as well as other meadow habitats in the Watershed. A rare resident at the Saghen Field Station (Morrison et al. 1985), and reported from Hobart Mills and UGSG quad in CNDDB (2020).
Ring-tailed cat *Bassariscus astutu*	CFP	Occurs in various riparian habitats, and in brush stands of most forest and shrub habitats. Nests in rock crevices, tree hollows, woodrat nests, or under cliffs.	**Known to Occur.** Documented around Prosser Creek Reservoir (TNF 2020) and suitable habitat exists elsewhere in lower-elevation, mixed forest-shrub-riparian areas of the Watershed.
Townsend's big-eared bat *Corynorhinus townsendii*	SC, CSSC	Hibernates near entrances of mines and caves. Forages in	**Less Likely to Occur**. Foraging habitat occurs in the

Species	Status[1]	Habitat	Potential for Occurrence
		forested habitats, along open edges.	Watershed, but suitable roosting habitat likely is limited.
Spotted bat *Euderma maculatum*	CSSC	Arid deserts, grasslands, and mixed conifer forests. Roosts in cliffs and rocky outcrops.	**Could Occur**. Suitable foraging and roosting habitat present in the Watershed.
Western mastiff bat *Eumops perotis*	CSSC	Arid to semi-arid habitats including forests, woodlands, grasslands, urban areas. Typically roosts in rock crevices, cliffs or structures.	**Could Occur.** Suitable foraging and roosting habitat present in the Watershed.
Wolverine *Gulo gulo*	FC, ST, CFP, TNF-S	Mountainous regions with mature coniferous forest.	**Less Likely to Occur**. CNDDB records in the Watershed. One nearby occurrence documented with remote sensor camera in 2008, and multiple other sightings have occurred regionally since that time up to 2018; all of these sightings are believed to be of a single male wolverine. Because this individual has not been observed since 2018, he may be deceased (the animal would have minimally been 10 years old as of 2018).
Sierra Nevada snowshoe hare *Lepus americanus tahoensis*	CSSC	Montane riparian scrub, mixed conifer, lodgepole pine forest, aspen, chaparral, montane meadow. Elevation range is 4,850–8,600 feet.	**Could Occur.** Extensive habitat available in aspen stands in mid-Watershed and in riparian scrub in Euer and Carpenter Valley as well as other meadow habitats throughout the Watershed.
Sierra marten *Martes caurina sierra*	TNF-S	Forest/meadow ecotones, rockslides and talus slopes, and riparian zones with thick cover.	**Could Occur**. Reported from Sagehen Field Station (CNDDB 2020), and other observations recorded regionally in CNDDB. Suitable habitat occurs in forested areas surrounding Carpenter and Euer Valley.
Fringed myotis *Myotis thysanodes*	TNF-S	Grasslands, sagebrush steppe, mixed deciduous and mixed conifer forest, and pinyon/juniper. Roosts in rock crevices, cliff edges, caves, mines, and sometimes tree cavities and built structures.	**Could occur.** Suitable foraging and roosting habitat occurs in the Watershed.
Pacific fisher (West Coast DPS) *Pekania pennanti*	FC, SC, CSSC, TNF-S	Large mature trees in closed-canopy coniferous forest and deciduous riparian habitat. Cavities in large trees, snags, logs, and rocky areas.	**Unlikely to Occur**. Multiple CNDDB records from 1970s reported from tracks or hair samples around Webber Lake, and one observation reported from Lake Sterling around this

Species	Status[1]	Habitat	Potential for Occurrence
			same period of time (CNDDB 2020). However, the species generally believed to be extirpated in a region of the Sierra Nevada and Cascade Range between the Pit River and Merced River (which now defines two separate DPS – the West Coast DPS, occurring the in far northern Sierra Nevada, Cascade Range, and Coast Range in California and Oregon, and the Southern Sierra DPS, occurring south of the Merced River in the Sierra Nevada) (CDFW 2010).
American badger *Taxidea taxus*	CSSC	Dry, open areas (i.e., shrub, forest, and herbaceous) with friable soil.	**Less Likely to Occur**. Species likely uncommon regionally but could occur in open, drier, grassy areas with friable soils at the eastern end of the Watershed.
Sierra Nevada red fox *Vulpes vulpes necator*	FC, ST, FSS	Alpine dwarf-shrub, wet meadow, subalpine conifer, lodgepole pine, red fir, aspen, montane chaparral, montane riparian, mixed conifer, ponderosa pine, Jeffrey pine, eastside pine, montane hardwood-conifer. Elevation range is 3,937–12,139 feet.	**Unlikely to Occur**. CNDDB query returned older records in and near the Watershed. However, the species is believed to only occur currently in the Sierra National Forest and near Lassen National Park. Historic CNDDB observations are questionable (i.e., possibly observations of a different species) based on currently available data.

[1] Status Codes

U.S. Fish and Wildlife Service

FE: Federal Endangered

FT: Federal Threatened

FC: Federal Candidate for Listing

California Department of Fish and Wildlife

SE: State Endangered

ST: State Threatened

CFP: California Fully Protected Species

CSSC: California Species of Special Concern

Region 5 United States Forest Service Tahoe National Forest (USFS 2013)

TNF-S = Designated Sensitive Species

APPENDIX E

Invasive Plant Species

Species	Invasive Status[1]	Potential for Occurrence in Watershed	Management Opportunity[2]
Species Present in the Watershed			
Russian knapweed *Acroptilon repens*	Cal-IPC: Moderate CDFA: B NPWMA: 1b	**Present**. This species has been recorded in Euer Valley (Dudek 2016) and Hobart Mills (Calflora 2020).	Containment
Creeping bentgrass *Agrostis stolonifera*	Cal-IPC: Limited CDFA: None NPWMA: None	**Present**. This species has been recorded in Lower Carpenter Valley (Dittes & Guardino 2017).	Containment
Cheatgrass *Bromus tectorum*	Cal-IPC: High CDFA: C NPWMA: None	**Present**. This species has been recorded in Lower Carpenter Valley (Dittes & Guardino 2017).	Containment
Musk thistle *Carduus nutans*	Cal-IPC: Moderate CDFA: A NPWMA: 2	**Present**. This species has been recorded in Hobart Mills and Lower Prosser Creek (USFS), and Euer Valley (Dudek 2016).	Containment
Diffuse knapweed *Centaurea diffusa*	Cal-IPC: Moderate CDFA: A NPWMA: 1b	**Present**. This species has been recorded in Euer Valley (Dudek 2016). There are also multiple records from the Boca vicinity just east of the Watershed (Calflora 2020).	Containment
Yellow starthistle *Centaurea solstitialis*	Cal-IPC: High CDFA: C NPWMA: 1b	**Present**. Recorded in Hobart Mills. There are also several records immediately south of the Watershed in Tahoe Donner (Calflora 2020).	Containment
Spotted knapweed *Centaurea stoebe* ssp. *micranthos*	Cal-IPC: High CDFA: A NPWMA: 1b	**Present**. This species has been recorded in Euer Valley (Dudek 2016). There are also several records in the Tahoe Donner and Truckee area (Calflora 2020).	Containment
Canada thistle *Cirsium arvense*	Cal-IPC: Moderate CDFA: B NPWMA: 1b	**Present**. This species has been recorded in Euer Valley (Dudek 2016). There are also records just outside the Watershed near Hobart Mills (Calflora 2020).	Containment
Bull thistle *Cirsium vulgare*	Cal-IPC: Moderate CDFA: C NPWMA: 2	**Present**. This species has been recorded in Euer Valley (Dudek 2016). There are multiple records within 5 miles to the north and south of the Watershed (Calflora 2020).	Containment
Field bindweed *Convolvulus arvensis*	Cal-IPC: None CDFA: C NPWMA: None	**Present**. This species has been recorded in Euer Valley (Dudek 2016) and Lower Carpenter Valley (Dittes & Guardino 2017).	NA
Scotch broom *Cytisus scoparius*	Cal-IPC: High CDFA: C NPWMA: 1b	**Present**. This species has been recorded in Hobart Mills. There are also several records along the I-80 corridor within the Watershed vicinity (Calflora 2020).	Containment
Klamathweed *Hypericum perforatum*	Cal-IPC: Moderate CDFA: C NPWMA: 2	**Present**. This species has been recorded in Euer Valley (Dudek 2016) and Lower Carpenter Valley (Dittes & Guardino 2017).	Containment

Species	Invasive Status[1]	Potential for Occurrence in Watershed	Management Opportunity[2]
Hairy whitetop *Lepidium appelianum*	Cal-IPC: Limited CDFA: B NPWMA: 1b	**Present**. This species has been recorded in Euer Valley (Dudek 2016). There are also multiple records within 5 miles of the Watershed to the south and east (Calflora 2020).	Containment
Lens-podded hoary cress and whitetop *Lepidium chalepense* and *Lepidium draba*	Cal-IPC: Mod-Alert CDFA: B NPWMA: 1b	**Present**. *Lepidium draba* has been recorded in Euer Valley (Dudek 2016). Both species have also been recorded along the I-80 corridor south of the Watershed (Calflora 2020).	Containment
Perennial pepperweed *Lepidium latifolium*	Cal-IPC: High CDFA: B NPWMA: 2	**Present**. This species has been recorded in Euer Valley (Dudek 2016). There are also several records in Tahoe Donner and along the I-80 corridor (Calflora 2020).	Containment
Scotch thistle *Onopordum acanthium*	Cal-IPC: High CDFA: A NPWMA: 1b	**Present**. This species has been recorded in Euer Valley (Dudek 2016). There are also two records immediately south of the Watershed at Tahoe Donner, and several additional records within 5 miles to the south and east of the Watershed (Calflora 2020).	Containment
Timothy grass *Phleum pratense*	Cal-IPC: None CDFA: None NPWMA: None	**Present**. This species has been recorded in Lower Carpenter Valley (Dittes & Guardino 2017). There are also two records approximately 2 miles north of the Watershed (Calflora 2020).	NA
Kentucky bluegrass *Poa pratensis*	Cal-IPC: Limited CDFA: None NPWMA: None	**Present**. This species has been recorded in Lower Carpenter Valley (Dittes & Guardino 2017). There is also one record approximately 2 miles south of the Watershed in the Norden vicinity (Calflora 2020).	Containment
Sheep sorrel *Rumex acetosella*	Cal-IPC: Moderate CDFA: None NPWMA: None	**Present**. This species has been recorded in Lower Carpenter Valley (Dittes & Guardino 2017). There are also records from within approximately 2 miles north and south of the Watershed (Calflora 2020).	Containment
Russian-thistle *Salsola tragus*	Cal-IPC: Limited CDFA: C NPWMA: 2	**Present**. This species has been recorded in Euer Valley (Dudek 2016). There are also multiple records within 4 miles south of the Watershed in the Truckee vicinity (Calflora 2020).	Containment
Species Likely to Occur in the Watershed			
Houndstongue *Cynoglossum officinale*	Cal-IPC: Moderate CDFA: None NPWMA: None	**Likely.** Recorded approximately 1 mile north of the Watershed in Tahoe National Forest, and approximately 2 miles south of the Watershed near Donner Lake (Calflora 2020). Suitable habitat occurs in the Watershed.	Containment

Species	Invasive Status[1]	Potential for Occurrence in Watershed	Management Opportunity[2]
Orchard grass *Dactylis glomerata*	Cal-IPC: Limited CDFA: None NPWMA: None	**Likely.** Recorded approximately 2 miles south of the Watershed in the Norden vicinity (Calflora 2020). Suitable habitat occurs in the Watershed.	Containment
Redstem filaree *Erodium cicutarium*	Cal-IPC: Limited CDFA: None NPWMA: None	**Likely.** Two records within 5 miles of the Watershed's east side (Calflora 2020). Suitable habitat occurs in the Watershed, and this species is extremely widespread and common.	Containment
Curly dock *Rumex crispus*	Cal-IPC: Limited CDFA: None NPWMA: None	**Likely.** One record approximately 2 miles south of the Watershed in the Norden vicinity (Calflora 2020). This species has also been recorded in the Hobart Mills and Independence Lake 7.5-minute USGS quadrangles (Cal-IPC 2020). Suitable habitat exists in disturbed areas in the Watershed. This species is extremely common and widespread.	Containment
Common mullein *Verbascum thapsus*	Cal-IPC: Limited CDFA: None NPWMA: None	**Likely.** Multiple records approximately 1 mile north and south of the Watershed, in Sagehen Creek and Tahoe Donner, respectively. There are additional records along the I-80 corridor south of the Watershed (Calflora 2020). Suitable habitat exists along roadsides and streambanks, and in disturbed areas in the Watershed. This species is extremely common and widely distributed.	Containment
Species Possibly Occurring in the Watershed			
Black mustard *Brassica nigra*	Cal-IPC: Moderate CDFA: None NPWMA: None	**Possible.** One record from approximately 1.5 miles north of the Watershed, but has not been observed since 1964 (Calflora 2020). Suitable habitat limited to lower elevations in the Watershed.	Surveillance
Ripgut brome *Bromus diandrus*	Cal-IPC: Moderate CDFA: None NPWMA: None	**Possible**. Recorded in the Independence Lake and Hobart Mills 7.5-minute USGS quadrangles (Cal-IPC 2020). Suitable habitat limited to lower elevations in the Watershed.	Containment
Soft brome *Bromus hordeaceus*	Cal-IPC: Limited CDFA: None NPWMA: None	**Possible.** Recorded in the Independence Lake and Hobart Mills 7.5-minute USGS quadrangles (Cal-IPC 2020). Suitable habitat limited to lower elevations in the Watershed.	Containment
Plumeless thistle *Carduus acanthoides*	Cal-IPC: Limited CDFA: A NPWMA: None	**Possible.** Two records from Truckee and Boca vicinities, approximately 3 miles south and east of Watershed (Cal-IPC 2020). Suitable habitat limited to lower elevations in the Watershed.	Eradication

Species	Invasive Status[1]	Potential for Occurrence in Watershed	Management Opportunity[2]
Slenderflower and Italian thistle *Carduus tenuiflorus* and *C. pycnocephalus*	Cal-IPC: Limited CDFA: C NPWMA: None	**Possible.** One record from approximately 3 miles west of Watershed, but has not been observed since 1960 (Calflora 2020).	Surveillance
Purple starthistle *Centaurea calcitrapa*	Cal-IPC: Moderate CDFA: B NPWMA: 1b	**Possible.** Three records along I-80 corridor from approximately 1–5 miles southwest of watershed (Calflora 2020). Suitable habitat in the Watershed limited to lower elevation disturbed areas.	Eradication
Squarrose knapweed *Centaurea virgata* ssp. *squarrosa*	Cal-IPC: Moderate CDFA: A NPWMA: 1b	**Possible.** One record from approximately 4 miles southwest of the Watershed at the I-80 Norden exit (Calflora 2020). Suitable habitat limited to lower elevations in the Watershed.	Surveillance
Rush skeletonweed *Chondrilla juncea*	Cal-IPC: Moderate CDFA: A NPWMA: 1b	**Possible.** Several records approximately 3 miles south of the Watershed in Truckee and Donner Lake (Calflora 2020). Suitable habitat limited to lower elevations in the Watershed.	Containment
Poison-hemlock *Conium maculatum*	Cal-IPC: Moderate CDFA: None NPWMA: None	**Possible.** Several records approximately 3 miles south of the Watershed in Truckee, and east along the I-80 corridor (Calflora 2020). Suitable habitat limited to lower elevations in the Watershed.	Containment
Fuller's teasel *Dipsacus fullonum*	Cal-IPC: Moderate CDFA: None NPWMA: 2	**Possible.** Several records along the Truckee River in the vicinity of the Watershed (Calflora 2020).	Containment
Medusahead *Elymus caput-medusae*	Cal-IPC: High CDFA: C NPWMA: 1b	**Possible.** Three records within 5 miles of the Watershed's east side (Calflora 2020). Suitable habitat is limited to lower elevation disturbed areas in the Watershed.	Containment
Myrtle spurge *Euphorbia myrsinites*	Cal-IPC: None CDFA: None NPWMA: 1b	**Possible.** One record within 5 miles of the Watershed, near Soda Springs (Calflora 2020).	NA
Oblong spurge *Euphorbia oblongata*	Cal-IPC: Limited CDFA: B NPWMA: None	**Possible.** One record within 5 miles of the Watershed, east of Truckee (Calflora 2020).	Surveillance
Halogeton *Halogeton glomeratus*	Cal-IPC: Moderate CDFA: A NPWMA: 1a	**Possible.** One record approximately 5 miles southwest of the Watershed, but has not been observed since 1977 (Calflora 2020). Suitable habitat (i.e., alkali scrub in flats) is limited in lower elevations of the Watershed.	Eradication
Shortpod mustard *Hirschfeldia incana*	Cal-IPC: Moderate CDFA: None NPWMA: None	**Possible.** One record approximately 3 miles south of the Watershed, in Truckee (Calflora 2020). Suitable habitat limited to lower elevations in the Watershed.	Eradication

Species	Invasive Status[1]	Potential for Occurrence in Watershed	Management Opportunity[2]
Mediterranean barley *Hordeum marinum*	Cal-IPC: Moderate CDFA: None NPWMA: None	**Possible.** Recorded in the Independence Lake and Hobart Mills 7.5-minute USGS quadrangles (Cal-IPC 2020). Suitable habitat limited to lower elevations in the Watershed.	Containment
Hare barley *Hordeum murinum*	Cal-IPC: Moderate CDFA: None NPWMA: None	**Possible.** Recorded in the Independence Lake and Hobart Mills 7.5-minute USGS quadrangles (Cal-IPC 2020). Suitable habitat limited to lower elevations in the Watershed.	Containment
Dyer's woad *Isatis tinctoria*	Cal-IPC: Moderate CDFA: B NPWMA: 1b	**Possible.** Two records within 4 miles of the south and east boundaries of the Watershed (Calflora 2020). Suitable habitat occurs in the Watershed.	Surveillance
Everlasting peavine *Lathyrus latifolius*	Cal-IPC: Watch CDFA: None NPWMA: 2	**Possible.** Multiple records approximately 4 miles south of the Watershed, east of Donner Lake (Calflora 2020). Suitable habitat limited to disturbed areas (especially roadsides) in the Watershed.	NA
Ox-eye daisy *Leucanthemum vulgare*	Cal-IPC: Moderate CDFA: None NPWMA: 2	**Possible.** Three records within 5 miles of the Watershed on the south and east sides (Calflora 2020). Suitable habitat (i.e., disturbed areas, meadows, and seeps up to approximately 8,500 feet in elevation) exists in the Watershed.	Containment
Dalmatian toadflax *Linaria dalmatica* ssp. *dalmatica*	Cal-IPC: Moderate CDFA: A NPWMA: 1b	**Possible.** Multiple records within 4 miles of the Watershed in the Truckee vicinity (Calflora 2020). Suitable habitat occurs in the Watershed along roadsides, in fields, or open areas in sagebrush scrub.	Containment
Yellow toadflax *Linaria vulgaris*	Cal-IPC: Moderate CDFA: None NPWMA: 2	**Possible.** Multiple records within 5 miles of the Watershed along the I-80 corridor (Calflora 2020). Suitable habitat occurs in the Watershed in disturbed areas.	Containment
Pennyroyal *Mentha pulegium*	Cal-IPC: Moderate CDFA: None NPWMA: None	**Possible.** One record from Martis Creek Lake approximately 5 miles southwest of the Watershed (Calflora 2020). Suitable habitat is limited to lower elevation moist areas in the Watershed.	Surveillance
Eurasian watermilfoil *Myriophyllum spicatum*	Cal-IPC: High CDFA: C NPWMA: None	**Possible.** Multiple records within 5 miles of the Watershed to the east and southwest (Calflora 2020). Suitable habitat is likely limited to Prosser Creek Reservoir.	Containment
English plantain Plantago lanceolata	Cal-IPC: Limited CDFA: None NPWMA: None	**Possible.** One record approximately 2 miles south of the Watershed in the Norden vicinity (Calflora 2020). Suitable habitat is limited to lower elevation disturbed areas in the Watershed.	Surveillance

Species	Invasive Status[1]	Potential for Occurrence in Watershed	Management Opportunity[2]
Himalayan blackberry *Rubus armeniacus*	Cal-IPC: High CDFA: None NPWMA: 1b	**Possible.** One record from Truckee approximately 5 miles from the Watershed (Calflora 2020). Suitable habitat is limited to lower elevation disturbed areas in the Watershed.	Containment
Bouncingbet *Saponaria officinalis*	Cal-IPC: Limited CDFA: None NPWMA: 1b	**Possible.** Multiple records in Truckee, approximately 3 miles south of the Watershed (Calflora 2020). Suitable habitat exists at lower elevations in the Watershed, including roadsides, streambeds, and disturbed areas.	Containment
Spanish broom *Spartium junceum*	Cal-IPC: High CDFA: C NPWMA: 1b	**Possible.** Recorded in the Truckee 7.5-minute USGS quadrangle (Cal-IPC 2020). Suitable habitat is limited to lower elevation disturbed areas in the Watershed.	Containment
Common tansy *Tanacetum vulgare*	Cal-IPC: Moderate CDFA: None NPWMA: None	**Possible**. One record from approximately 3 miles south of the Watershed, at the east end of Donner Lake (Calflora 2020). Suitable habitat limited to lower elevation disturbed areas in the Watershed. Generally uncommon as an escape from cultivation.	Containment
Species Not Likely to Occur in the Watershed			
Silver wattle *Acacia dealbata*	Cal-IPC: Moderate CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Barb goatgrass *Aegilops triuncialis*	Cal-IPC: High CDFA: B NPWMA: 2	No records in project vicinity (Calflora 2020).	Surveillance
Pacific bentgrass *Agrostis avenacea*	Cal-IPC: Limited CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Tree-of-heaven *Ailanthus altissima*	Cal-IPC: Moderate CDFA: C NPWMA: 1a	No records in project vicinity (Calflora 2020).	Surveillance
Sweet vernalgrass *Anthoxanthum odoratum*	Cal-IPC: Moderate CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Giant reed *Arundo donax*	Cal-IPC: High CDFA: B NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
(Slender) wild oat *Avena barbata* and *A. fatua*	Cal-IPC: Moderate CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance

Species	Invasive Status[1]	Potential for Occurrence in Watershed	Management Opportunity[2]
Fivehook bassia *Bassia hyssopifolia*	Cal-IPC: Limited CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Hoary alyssum *Berteroa incana*	Cal-IPC: Watch CDFA: None NPWMA: 1b	No records in project vicinity (Calflora 2020).	NA
Annual false-brome *Brachypodium distachyon*	Cal-IPC: Moderate CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Field mustard *Brassica rapa*	Cal-IPC: Limited CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Eradication
Rattlesnake grass *Briza maxima*	Cal-IPC: Limited CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Japanese brome *Bromus japonicus*	Cal-IPC: Limited CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Red brome *Bromus madritensis* ssp. *rubens*	Cal-IPC: High CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Woolly distaff thistle *Carthamus lanatus*	Cal-IPC: Mod-Alert CDFA: B NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Tocalote *Centaurea melitensis*	Cal-IPC: Moderate CDFA: C NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Pampasgrass *Cortaderia selloana*	Cal-IPC: High CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Hawthorn *Crataegus monogyna*	Cal-IPC: Limited CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Artichoke thistle *Cynara cardunculus*	Cal-IPC: Moderate CDFA: B NPWMA: 1a	No records in project vicinity (Calflora 2020).	NA
Bermudagrass *Cynodon dactylon*	Cal-IPC: Moderate CDFA: D NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Hedgehog dogtail grass *Cynosurus echinatus*	Cal-IPC: Moderate CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance

Species	Invasive Status[1]	Potential for Occurrence in Watershed	Management Opportunity[2]
Tansy mustard *Descurainia sophia*	Cal-IPC: Limited CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Eradication
Foxglove *Digitalis purpurea*	Cal-IPC: Limited CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Stinkwort *Dittrichia graveolens*	Cal-IPC: Mod-Alert CDFA: B NPWMA: 2	No records in project vicinity (Calflora 2020).	Surveillance
Water hyacinth *Eichhornia crassipes*	Cal-IPC: High-Alert CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Russian-olive *Elaeagnus angustifolia*	Cal-IPC: Moderate CDFA: None NPWMA: 1b	No records in project vicinity (Calflora 2020).	Surveillance
Tasmanian blue gum *Eucalyptus globulus*	Cal-IPC: Moderate CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Leafy spurge *Euphorbia virgata*	Cal-IPC: High-Alert CDFA: A NPWMA: 1a	No records in project vicinity (Calflora 2020).	Surveillance
Japanese knotweed *Fallopia japonica*	Cal-IPC: Mod-Alert CDFA: A NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Tall fescue *Festuca arundinacea*	Cal-IPC: Moderate CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Rattail fescue *Festuca myuros*	Cal-IPC: Moderate CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Italian ryegrass *Festuca perennis*	Cal-IPC: Moderate CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Edible fig *Ficus carica*	Cal-IPC: Moderate CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Fennel *Foeniculum vulgare*	Cal-IPC: Moderate CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
French broom *Genista monspessulana*	Cal-IPC: High CDFA: C NPWMA: 1b	No records in project vicinity (Calflora 2020).	Containment

Species	Invasive Status[1]	Potential for Occurrence in Watershed	Management Opportunity[2]
Cutleaf geranium *Geranium dissectum*	Cal-IPC: Moderate CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Waxy mannagrass *Glyceria declinata*	Cal-IPC: Moderate CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
English ivy, Algerian ivy *Hedera helix* and *H. canariensis*	Cal-IPC: High CDFA: D NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Common velvet grass *Holcus lanatus*	Cal-IPC: Moderate CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Hydrilla *Hydrilla verticillata*	Cal-IPC: High-Alert CDFA: A NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Smooth catsear *Hypochaeris glabra*	Cal-IPC: Limited CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Rough catsear *Hypochaeris radicata*	Cal-IPC: Moderate CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
English holly *Ilex aquifolium*	Cal-IPC: Mod-Alert CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Yellowflag iris *Iris pseudacorus*	Cal-IPC: Limited CDFA: B NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Kochia *Kochia scoparia*	Cal-IPC: Moderate CDFA: None NPWMA: 1a	No records in project vicinity (Calflora 2020).	Surveillance
Glossy privet *Ligustrum lucidum*	Cal-IPC: Limited CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
South American spongeplant *Limnobium spongia*	Cal-IPC: High-Alert CDFA: A NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Uruguay and creeping water-primrose *Ludwigia hexapetala* and *L. peploides*	Cal-IPC: High-Alert CDFA: C NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance

Species	Invasive Status[1]	Potential for Occurrence in Watershed	Management Opportunity[2]
Hyssop loosestrife *Lythrum hyssopifolium*	Cal-IPC: Limited CDFA: None	No records in project vicinity (Calflora 2020).	Surveillance
Purple loosestrife *Lythrum salicaria*	Cal-IPC: High CDFA: B NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
White horehound *Marrubium vulgare*	Cal-IPC: Limited CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
California burclover *Medicago polymorpha*	Cal-IPC: Limited CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Parrotfeather *Myriophyllum aquaticum*	Cal-IPC: High-Alert CDFA: C NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Harding grass *Phalaris aquatica*	Cal-IPC: Moderate CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Common pokeweed *Phytolacca americana*	Cal-IPC: Limited CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Rabbitfoot polypogon *Polypogon monspeliensis*	Cal-IPC: Limited CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Containment
Curlyleaf pondweed *Potamogeton crispus*	Cal-IPC: Moderate CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Sulfur cinquefoil *Potentilla recta*	Cal-IPC: None CDFA: None NPWMA: 1b	No records in project vicinity (Calflora 2020).	NA
Cherry plum *Prunus cerasifera*	Cal-IPC: Limited CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Creeping buttercup *Ranunculus repens*	Cal-IPC: Limited CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Radish *Raphanus sativus*	Cal-IPC: Limited CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Black locust *Robinia pseudoacacia*	Cal-IPC: Limited CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance

Species	Invasive Status[1]	Potential for Occurrence in Watershed	Management Opportunity[2]
Barbwire Russian-thistle *Salsola paulsenii*	Cal-IPC: Limited CDFA: C NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Mediterranean sage *Salvia aethiopis*	Cal-IPC: Limited CDFA: B NPWMA: 1a	No records in project vicinity (Calflora 2020).	Surveillance
Blessed milkthistle *Silybum marianum*	Cal-IPC: Limited CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Tamarisk *Tamarix* spp.	Cal-IPC: High CDFA: B NPWMA: 1a	No records in project vicinity (Calflora 2020).	NA
Hedgeparsley *Torilis arvensis*	Cal-IPC: Moderate CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Puncture vine *Tribulus terrestris*	Cal-IPC: Limited CDFA: C NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Rose clover *Trifolium hirtum*	Cal-IPC: Limited CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Gorse *Ulex europaeus*	Cal-IPC: High CDFA: B NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance
Big periwinkle *Vinca major*	Cal-IPC: Moderate CDFA: None NPWMA: None	No records in project vicinity (Calflora 2020).	Surveillance

Source: Calflora 2020; Cal-IPC 2020a, 2020b; CDFA 2020; Nevada-Placer WMA 2018; USFS 2009.

Notes: Cal-IPC = California Invasive Plant Council; CDFA = California Department of Food and Agriculture; NPWMA = Nevada-Placer Weed Management Area; USGS = U.S. Geological Survey.

[1] Cal-IPC ratings:

High – These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.

Moderate – These species have substantial and apparent—but generally not severe—ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.

Limited – These species may be invasive, but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.

None – Not included on the Cal-IPC Inventory of invasive plants.

CDFA ratings:

A – A pest of known economic or environmental detriment and is either not known to be established in California or it is present in a limited distribution that allows for the possibility of eradication or successful containment. A-rated pests are prohibited from entering the state because, by virtue of their rating, they have been placed on the of Plant Health and

Pest Prevention Services Director's list of organisms "detrimental to agriculture" in accordance with the FAC Sections 5261 and 6461. The only exception is for organisms accompanied by an approved CDFA or USDA live organism permit for contained exhibit or research purposes. If found entering or established in the state, A-rated pests are subject to state (or commissioner when acting as a state agent) enforced action involving eradication, quarantine regulation, containment, rejection, or other holding action.

B – A pest of known economic or environmental detriment and, if present in California, it is of limited distribution. B-rated pests are eligible to enter the state if the receiving county has agreed to accept them. If found in the state, they are subject to state endorsed holding action and eradication only to provide for containment, as when found in a nursery. At the discretion of the individual county agricultural commissioner they are subject to eradication, containment, suppression, control, or other holding action.

C – A pest of known economic or environmental detriment and, if present in California, it is usually widespread. C-rated organisms are eligible to enter the state as long as the commodities with which they are associated conform to pest cleanliness standards when found in nursery stock shipments. If found in the state, they are subject to regulations designed to retard spread or to suppress at the discretion of the individual county agricultural commissioner. There is no state enforced action other than providing for pest cleanliness.

None – Not included on the CDFA list of noxious weeds.

NPWMA categories:

1b – Watch for, report, and eradicate immediately. Present in small populations.

2 – Encourage the management/control of populations to prevent further spread. Isolated populations will be targeted for eradication.

None – Not included in the NPWMA priority invasive plant list.

[2] CalWeedMapper Management Opportunity ratings:

Surveillance – Species not known to exist in the region, but is found within 50 miles of the region.

Eradication – Species exists only in single, isolated quads in the region.

Containment – Species exists in the region at levels higher than surveillance and eradication.

NA – Species was not returned in the Management Opportunities report, indicating it is either not included on the Cal-IPC inventory of invasive plants, or is not known to occur within 50 miles of the region.

CHAPTER 2

TABLES

Table 2-1. Summary of Historical Aerial Photographs Reviewed 1939-2020, Prosser Creek Watershed

Year	Month	Day	Source	color or B/W	Scale	Area Covered	Major Flood Dates	Climate trend	Notes
Aerial Photographs									
1939	June	27	USFS	b/w	1:37,400	90% of watershed	1938	Follows one of the wettest years and a major flood	Quality is fair; all images georectified
1953	June	27	USGS EarthExplorer	b/w	1:37,400	100% of watershed	**1950, 1955**		
1968	June	1	USGS EarthExplorer	b/w	1:142,000	100% of watershed	1963, 1965		Scale too small to evaluate features
1969	Aug	16	USGS EarthExplorer	b/w	1:30,000	50% (lower watershed)	1963, 1965		Post-1960 fire and logging
1970	July	26	USGS EarthExplorer	CIR	1:63,100	100% of watershed	1963, 1965		Post-1960 fire and logging
1974	July	19	USGS EarthExplorer	b/w	1:30,000	60% of watershed			Shows channel instabilities in large meadow systems
1987			USDA	CIR	unknown	60% of watershed	**1982, 1986**		Shows extent of major logging in lower watershed
1992	July	1	USGS EarthExplorer	color	1:24,000	50% of watershed	**1986**	Drought (1987-1994)	Good quality; channel conditions
1993	September	25	Google Earth	b/w	unknown	100% of watershed		Drought (1987-1994)	Good quality; channel conditions
1998	Aug	26	USDA	b/w	unknown	100% of watershed	**1997**		post 1997 landslide, NF Prosser Creek
2005	June	11	Google Earth	color	unknown	100% of watershed			
2009	April	24	Google Earth	color	unknown	100% of watershed	**2005**		
2010	April	24	Google Earth	color	unknown	100% of watershed	**2005**		
2011	June	14	Google Earth	color	unknown	100% of watershed	**2011**	Record snowpack (since 1971)	Aerials show near annual peak flow conditions
2012	Aug	12	Google Earth	color	unknown	100% of watershed	**2011, 2012**		
2015	April	16	Google Earth	color	unknown	100% of watershed		Driest year of drought period	
2018	June	7	Google Earth	color	unknown	100% of watershed	**2017**		Most recent high-resolution aerial available
2020	May	15	Balance UAV	color		Lower Euer Valley		Dry year	Current conditions
2020	May	18	Balance UAV	color		Lower Carpenter Valley		Dry year	Current conditions

Notes

CIR = false-color infrared

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Table 3-3 Stream Reach Designations and Existing Conditions, Prosser Creek Project Watershed

Condition	Reach	Mainstem or Tributary Name	Length[1]	Elevation Range Low	Elevation Range High	Slope[2]	Land Ownership	Geomorphic Setting[3]	Channel Planform[4]	Channel Morphology[5]	Channel Evolution (Cluer & Thorne, 2013)[6]	Remarks
			(miles)	(feet)	(feet)	(ft/ft)					Stage (0 - 8)	
	Prosser Creek Watershed Area: 29.6 sq. miles											
yellow	A1	Prosser Creek (mainstem)	0.64	5741	5768	0.009	USFS	Glacial outwash and alluvium	Single/Braided	Pool-riffle	5	Channel modifications from historical logging/mill;
red	A2	Prosser Creek (mainstem)	0.56	5768	5800	0.01	USFS	Glacial outwash and alluvium	Single/Braided	Pool-riffle	3	State HWY 89 bridge crossing; highly modified, straightened reach; boulder-slope protection on banks; confined floodplain at bridge
green (hatched)	B	Prosser Creek (mainstem)	3.95	5800	6108	0.013	USFS	Glacial outwash, canyon confined	Single meandering channel	Pool-riffle/step-pool	n/a	Canyon confined; inset floodplain/bar development, boulder/cobble armored; willow riparian; high wood load; fully burned over in 1960 wildfire; heavily logged; historical disturbance--recovery
	North Fork Prosser Creek Watershed Area: 13.3 sq. miles											
yellow	C	NF Prosser Creek	1.1	6108	6226	0.019	TDLT	Glacial Till, bedrock, canyon confined	Single meandering channel	Forced pool-riffle, step pool	n/a	High wood load; fine sand substrate; fully burned over in 1960 wildfire; recovery, supports willow riparian
red	D1	NF Prosser Creek	1.62	6226	6245	0.002	TDLT	Alluvium, valley fill	Single meandering channel	Pool-riffle	4	Lower Carpenter Valley; lower reach, incised and widening condition
yellow	D2	NF Prosser Creek	1.42	6245	6263	0.002	TDLT	Alluvium, valley fill	Single meandering channel	Pool-riffle	5	Lower Carpenter Valley; upper reach, incised condition
yellow	D3	NF Prosser Creek	0.25	6263	6269	0.005	TDLT	Moraine	Single meandering channel	Pool-riffle	n/a	Moraine controlled; forested; boulder/cobble riparian; potential restriction of high flows from bridge
white	D4	NF Prosser Creek	1.0	6269	6275	0.004	Private	Alluvium, valley fill	Single meandering channel	Pool-riffle	n/a	Upper Carpenter Valley; immediatley downstream of landslide
white	D5	NF Prosser Creek	0.1	6275	6287	0.022	Private	Toe of landslide	Braided	Forced pool-riffle	n/a	Landslide occurred in 1997 effectively damming channel across meadow; active toe erosion
white	D6	NF Prosser Creek	0.23	6287	6300	0.003	Private	Landslide deposit/depositional	Anastomosing	unknown	n/a	Active deposition at upstream side of landslide toe; active erosion of downstream toe
white	D7	NF Prosser Creek	0.6	6300	6316	0.012	Private	Alluvium, valley fill	Single meandering channel	Pool-riffle	n/a	Active wood loading; active bar movement
	Headwaters: North Fork Prosser Creek; Watershed Area: 7.6 sq. miles											
white	E	NF Prosser Creek	0.2	6316	6324	0.026	Private	Alluvial fan	Single/braided	Pool-riffle	n/a	Active wood loading; active bar movement
white	F	NF Prosser Creek	0.2	6324	6348	0.011	Private	Canyon; bedrock confined	Single meandering channel	Pool-riffle	n/a	Potentially fault-controlled reach; active wood loading; confined
white	G	NF Prosser Creek	1.0	6348	6389	0.012	Private	Older alluvium	Single meandering channel	Forced pool-riffle; pool riffle	n/a	Active wood loading; active bar movement
white	H	NF Prosser Creek-Coon Canyon	1.4	6389	7503	0.15	Private/USFS	Canyon; Bedrock controlled	single straight channel	Step pool	n/a	Also known as "Coon Canyon"
white	I	NF Prosser Creek-Coon Canyon	0.43	7503	7600	0.034	USFS	Alluvium, valley fill	Single meandering channel	Step pool; plane bed	n/a	Isolated meadow system
white	J	NF Prosser Creek-Coon Canyon	0.42	7600	8600	0.23	USFS	Canyon; Bedrock controlled	single straight channel	Step pool-cascade	n/a	Upper "Coon Canyon"
white	K	NF Prosser Creek-Warren Lake	1.3	6434	7200	0.10	USFS	Canyon; Bedrock controlled	single straight channel	Step pool	n/a	Joint-fracture pattern controls channel orientation and form
	South Fork Prosser Creek Watershed Area: 8.4 sq. miles											
white	L	SF Prosser Creek	0.83	6107	6455	0.076	USFS	Glacial outwash; moraines	single straight channel	Step pool	n/a	High wood load
red	M1	SF Prosser Creek	0.85	6455	6504	0.01	TDA	Alluvium, valley fill	Single meandering channel	Pool-riffle	4,5	Incised; includes confluence with Crabtree Canyon (runoff and sediment source). Pools full of fines; remant beaver dams; no macroinvertebrates
yellow	M2	SF Prosser Creek	0.36	6504	6508	0.002	TDA/Private	Alluvium, valley fill	Single meandering channel	Pool-riffle	6	Slightly incised; well-vegetated banks; stable; secondary or remnant channels visible in meadow
green	M3	SF Prosser Creek	0.47	6508	6512	0.002	Private/TDA	Alluvium, valley fill	Single meandering channel	Pool-riffle	0,1	Downstream moraine is a natural grade control; good condition; stable, beaver dams present; good channel-meadow connectivity; some old ditching in meadow; good reference reach
red	M4	SF Prosser Creek	1.38	6512	6530	0.002	TDA	Alluvium, valley fill	Single meandering channel	Pool-riffle	4	Deeply incised; bank failures, runoff and sediment from old ranch and associated roads; cattle impacts; Crossing
white	M5	SF Prosser Creek	1.33	6530	6558	0.004	Private	Alluvium, valley fill	Single meandering channel	Pool-riffle	4,5	Incised; some banks are stable; remnant channels visible in meadow; Coyote Crossing
	Headwaters: South Fork Prosser Creek; Watershed Area: 3.8 sq. miles											
white	N	SF Prosser Creek	0.88	6558	7050	0.11	Private	bedrock confined	single straight channel	Step-pool	n/a	bedrock controlled?
white	O	SF Prosser Creek	0.45	7050	7114	0.02	TDLT/Private	Alluvium, valley fill	Single meandering channel	Pool-riffle	n/a	Small meadow system
white	P	SF Prosser Creek	1.0	7114	7886	0.24	USFS/TDLT	bedrock controlled	single straight channel	Step-pool; cascade	n/a	USFS
white	Q	SF Prosser Creek-Frog Lake	1.3	6544	7600	0.11	Private/TDLT	Bedrock; glacial moraine	single straight channel	Step-pool	n/a	Lower reach private property; alluvial fan feature
	Headwaters: Crabtree Canyon; Watershed Area: 1.5 sq. miles											
yellow	R	SF Prosser Creek-Crabtree Canyon	0.4	6490	6600	0.02	TDA	Alluvial fan	Single/braided	Pool-riffle	5,6	Road crossing impacts
yellow	S	SF Prosser Creek-Crabtree Canyon	1.9	6600	7655	0.11	TDA/USFS/TDLT	Canyon; glacial till and bedrock	single straight channel	Step-pool	5	Road adjacent to channel along segments; natural sediment sources from till
	Hobart Mills Tributary Watershed Area: 4.1 sq. miles											
red	T	Hobart Mills Tributary (mainstem)	1.78	5741	5863	0.02	USFS/Private	Alluvium, valley fill	multiple channels	Pool-riffle	3	Highly modified from previous in-line reservoirs, railroads, disturbance
green	U	Hobart Mills Tributary (East Fork)	1.14	5863	5950	0.015	USFS/Private	Alluvium, valley fill	multiple channels	Pool-riffle	0,1	Fens at head of reach (contact between glacial outwash and Pliocene volcanics); transitions into alluvial fan at head of valley
white	V	Hobart Mills Tributary (East Fork)	1.0	5950	6618	0.12	USFS/Private	Bedrock controlled	Single Channel	Step-pool	n/a	Drains Pliocene volcanics; forested, undeveloped.
yellow	W	Hobart Mills Tributary (West Fork)	0.8	5863	5935	0.015	USFS/Private	Alluvium, valley fill	multiple channels	Pool-riffle	6,7	Supports meadow, formerly ditched, diverted; culverts
yellow	X	Hobart Mills Tributary (West Fork)	0.74	5935	6125	0.05	USFS	Alluvium	Single channel	Pool-riffle	6	Outlet and channel downstream of former Hobart Reservoir; heavily affected by roads and RR grades; receives runoff from SR89
green	Y	Hobart Mills Tributary (West Fork)	0.7	6125	6214	0.02	USFS	Outwash	Single Channel	Pool-riffle	0,1	Possibly fault-controlled; receives runoff from SR89
white	Z	Hobart Mills Tributary (West Fork)	0.8	6214	6593	0.09	USFS	Bedrock controlled	Single Channel	unknown	n/a	Ephemeral, drains Pliocene volcanics

Notes:
(1) Reach lengths were measured from Google Earth
(2) Elevations and slopes were calculated from LiDAR-based topography (USFS, 2014)
(3) Geomorphic setting relates to general landforms or geology
(4) Planform assessed from aerial photographs and field observations
(5) Channel morphology is based on observations in the field or from high-resolution aerial photography
(6) Stage 0 represents a anastomosing grassy or forested wetland; Stage 3-4 is actively incising and widening; Stage 5-6 widening but transitioning to a stable bed from aggradation; Stage 8 is a newly quasi-stable form

Table 4-1. Disturbance Inventory, Prosser Creek Project Watershed, Nevada County, California

Sheet[1]	Disturbance ID[2]	Reach[3]	Mainstem or Tributary Name	Length (miles)	Land Ownership	Disturbance Condition	Source(s) of Disturbance	Remarks
		Prosser Creek Watershed Area: 29.6 sq. miles						
3	D3.1	B	Uplands		USFS	Road runoff and sediment	1960 post-fire erosion control; logging roads; OHV trails	Based on flow accumulation analysis; not all roads/trails assessed.
3	D3.2	A1	Uplands		USFS	Road/trail capture	OHV trails/former logging roads	Prosser Hill, north drainage
4	D4.1	B	Uplands		USFS	Sediment; erosion	Road capture and erosion	FS Road #89-43-10
4	D4.2	B	Uplands		USFS	Runoff concentration; erosion	Road capture and erosion	FS Road #89-33; based on flow accumulation analysis
4	D4.3	A2	Prosser Creek (mainstem)	0.56	USFS	Incising; confined floodplain; engineered-straightened	SR89 Bridge design and construction; channel engineering; conifer encroachment of former floodplain	Conifer encroachment is dense and uniform regrowth from post 1960 wildfire conditions or SR89 bridge construction
4	D4.4	A1	Prosser Creek (mainstem)	0.64	USFS	Aggradation; widening	Reservoir baselevel changes; effects of former channel straightening in Reach A2	A segment of the channel reach is fault-controlled;
5	D5.1	B	Uplands		USFS	Road/ditch capture	1961 post-fire erosion control; logging roads; OHV trails	Northern side of channel; near watershed boundary
5	D5.3	B	Uplands		USFS	Sediment; erosion	Road capture and erosion	FS Road #89-43-10
7	D7.1	B	Meadow		USFS	Wetland soil compaction; runoff concentration; sediment	OHV access; Carpenter Valley Road capture and drainage	Meadow is in fair-good condition
7	D7.2	B	Uplands		USFS	Road runoff and sediment	Road capture and erosion	FS Road #89-33; based on direct observation
7	D7.3	B	Uplands		USFS	Road runoff and sediment	Road capture and erosion	FS Road #89-34-10-10
8	D8.1	B	Uplands		USFS	Road runoff and sediment	Road capture and erosion	FS Road Spur #10-20 and unnumbered roads
8	D8.2	B	Uplands		USFS	Erosion; sediment source	Trail crossing of tributary	Prosser Creek Trail crossing
9	D9.1	B	Uplands		USFS	Road runoff and sediment	Road capture and erosion	Based on flow accumulation analysis
9	D9.2	B	Uplands		USFS	Road runoff and sediment	Road capture and erosion	Based on flow accumulation analysis
		North Fork Prosser Creek Watershed Area: 13.3 sq. miles						
12	D12.1	D1	Uplands		TDLT	Existing road drainage	Old RR grade and drainage alterations	Inspect road drainage in spring or after wet year
12	D12.1	D2	Uplands		TDLT/USFS	Sediment and runoff	Road capture; old logging roads; sensitive geology and soils	Based on flow accumulation analysis; not evaluated in field
12	D12.2	D1	NF Prosser Creek	1.62	TDLT	Incised; widening; sediment	Cumulative effects of catchment-wide disturbances; on-site intensive grazing	
12	D12.2	D2	NF Prosser Creek	1.42	TDLT	Incised; widening; sediment	Cumulative effects of catchment-wide disturbances; on-site intensive grazing	
12	D12.3	D2	Ditch/tributary		TDLT	Ditched and diversion flow from meadow	Ditching in 1960s-1970s	Visible on high-resolution aerial imagery
16	D16.1	D6/F	Uplands		TDLT/USFS	Sediment and runoff	Road capture; old logging roads; sensitive geology and soils	Areas drain to Upper Reach D (private property)
		South Fork Prosser Creek Watershed Area: 8.4 sq. miles						
10	D10.1	M4	Uplands		TDA	South Euer Valley Road/RR grade	Stream crossings; road capture	Both road and old RR grade have altered natural flow pathways; road functionality is limited
10	D10.2	M3/M4	Uplands		TDA	Runoff and sediment	Road capture and drainage	Existing roads used for recreation
10	D10.3	M1	Uplands		TDA	Drainage/sediment	Existing road capture; runoff	North facing slope; S. Euer Valley Road and roads used for recreation
10	D10.3	M1/M2/M3	Uplands		TDA	Runoff and sediment	Road capture and drainage	South Euer Valley Road
10	D10.4	M4	SF Prosser Creek	1.38	TDA	Incised; widening; sediment	Cumulative effects of catchment-wide disturbances; on-site intensive grazing	Subreach near old corral in poor condition
10	D10.5	M4	Uplands		TDA	Road capture: sediment and runoff; gullying	Former ranch and operations; roads/trails	Erosion of alluvial fan deposits; excess runoff and sediment to channel
10	D10.6	M4	S. Euer Valley Road		TDA	Road capture; sediment and runoff	Old RR grade and road	Identified in 5-YR Trail Plan (TDA)
11	D11.4	M2	SF Prosser Creek	0.36	TDA	Former incision	Cumulative effects of catchment-wide disturbances; on-site intensive grazing	Active beaver activity; could augment with other enhancements
11	D11.5	M1	SF Prosser Creek	0.85	TDA	Incised; widening; sediment	Cumulative effects of catchment-wide disturbances; on-site intensive grazing	Subreach downstream of Crabtree Tributary in poor condition
14	D14.1	M5	Uplands		USFS	Runoff and sediment	Road capture and drainage	Above unnamed reservoir; unnamed tributary
14	D14.2	M5	Uplands		USFS	Runoff and sediment	Road capture and drainage	Above unnamed reservoir; unnamed tributary
		Crabtree Canyon; Watershed Area: 1.5 sq. miles						
11	D11.1	S	Uplands		TDA/USFS	Road capture; grading-sediment	Old logging roads and landings	Based on flow accumulation analysis and LiDAR; not evaluated in field
11	D11.2	S	SF Prosser Creek-Crabtree Canyon	1.9	TDA/USFS/TDLT	Bank failure	Road-RR grade related failure	Immediately upstream of confluence of forks
11	D11.3	R/M1	SF Prosser Creek-Crabtree Canyon	0.4	TDA	Sediment source	Historical land-uses; crossing maintenance and use, road capture	Main crossing; temporary high-flow crossing often eroded around; multiple abandoned roads, ditches and crossings.
		Hobart Mills Tributary Watershed Area: 4.1 sq. miles						
2	D2.1	T	Hobart Mills Tributary (mainstem)	1.78	USFS	Incised, widening; meadow desication; active knickpoint at confluence with reservoir (full pool elevation)	Reservoir baseflow changes; intensive grazing; historical land-uses; upstream reservoirs; OHV use	
5	D5.2	X/Y	Uplands		USFS	Road/ditch/RR grade capture	1960 post-fire erosion control; logging roads; OHV trails	Areas not assessed in field; evidence based on flow accumulation analysis
5	D5.3	W	Uplands		USFS	Road/ditch capture	1960 post-fire erosion control; logging roads; OHV trails	FS Road 89-34-10; based on flow accumulation analysis
5	D5.4	X/Y	Hobart Mills Tributary (West Fork)	0.7	USFS	Berming and drainage alterations	Former reservoir construction and operations; 1960 post fire erosion control methods; on-going OHV use and crossings	Former reservoir supports a meadow habitat; condition could be enhanced with berm removal and restoration of flow pathways
5	D5.5	W	Hobart Mills Tributary (West Fork)		USFS	Road capture/ditching	Drainage modifications to/through meadow	Flow capture to east side of meadow, apparently from ditching, and old diversion(s), and old HWY 89 drainage capture.
5	D5.6	U	Uplands		USFS	Road runoff and sediment	Road capture	Flow accumulation analysis
5	D5.7	U	Hobart Mills Tributary (East Fork)	1.14	USFS	Road runoff and sediment	Dirt road maintenance and drainage	Limited to 1, 2 culverts along Hobart Mills Road
6	D6.1	Y	Uplands		USFS	Road runoff and sediment	Road /RR grade capture	FS Road 89-34 and 89-36

Notes:

(1) Sheet refers to page in Map Booklet in Appendix A

(2) Disturbance ID refers to Map Sheet in the Map Booklet in Appendix A (e.g., D3.2 is a disturbance area on Sheet 3)

(3) Reaches were classified using: a) slope; b) channel morphology; c) channel planform; and d) channel condition

Table 5-1 Functional Areas Inventory, Prosser Creek Project Watershed, Nevada County, California

Sheet ID[1]	Protection ID[2]	Reach[3]	Mainstem or Tributary Name	Land Ownership	Conditions	Attributes to Protect	Remarks
			Prosser Creek Watershed Area: 29.6 sq. miles				
4	P4.5	B	Floodplain	USFS	Good condition	Spring pond	Located at base of slope on floodplain terrace
7	P7.4	B	Uplands	USFS	Fair-good mature aspen grove	Avian habitat	May require conifer thinning to enhance grove and habitat
7	P7.5	B	Uplands	USFS	Well-functioning	Springs	Slope-discharge wetland
7	P7.6	B	Uplands	USFS	Good condition	Spring	Provides perennial flow to tributary and Reach B
7	P7.7	B	Meadow	USFS	Good condition	Meadow habitat	See disturbance inventory for impacts; access; road drainage
			North Fork Prosser Creek Watershed Area: 13.3 sq. miles				
12	P12.4	D1/D2	Meadow	TDLT	Well-functioning	Meadow habitat	Exclusive to areas north of the channel
12	P12.5	D2	Uplands	TDLT	Well-functioning	Fens, spring flow;	fault-controlled
12	P12.6	D1	Uplands	TDLT	Well-functioning	Fens, spring flow;	Fault-controlled
12	P12.7	D1	Uplands	TDLT	Well-functioning	Fens, spring flow;	Fault-controlled
13	P13.1	D2	Uplands	TDLT	Well-functioning	Fens, spring flow;	fault-controlled
13	P13.2	D2	Uplands	TDLT	Well-functioning	Fens, spring flow;	fault-controlled
			Headwaters: North Fork Prosser Creek; Watershed Area: 7.6 sq. miles				
16	P16.3	H	Uplands	USFS	Unknown	Unnamed tributary and open water/willow scrub habitats	Remote; inaccessible by road or trail; assessed using CIR and aerial photography; non-roaded area
16	P16.4	H	Uplands	USFS	Unknown	Unnamed tributary and open water/willow scrub habitats	Remote; inaccessible by road or trail; assessed using CIR and aerial photography; non-roaded area
16	P16.5	H	Uplands	USFS	Unknown	Unnamed tributary and open water/willow scrub habitats	Remote; inaccessible by road or trail; assessed using CIR and aerial photography; non-roaded area
16	P16.6	G	UPlands	USFS	Unknown	Unnamed tributary and open water/willow scrub habitats	Remote; inaccessible by road or trail; assessed using CIR and aerial photography; non-roaded area
16	P16.7	G	Uplands	USFS	Unknown	Unnamed tributary and open water/willow scrub habitats	Remote; inaccessible by road or trail; assessed using CIR and aerial photography; non-roaded area
18	P18.1	D7	Uplands	TDLT	Springs		Assessed from CIR and aerial photography
20	P20.1	H	Aquatic habitat	USFS	Exhibits qualities that support SNLYF	Open water habitat; hydrologic sources, wet areas	SNLYF Assessment (HT Harvey & Associates); Appendix E
20	P20.2	H	Aquatic habitat	USFS	Exhibits qualities that support SNLYF	Open water habitat; hydrologic sources, wet areas	SNLYF Assessment (HT Harvey & Associates); Appendix E
20	P20.3	H	Aquatic habitat	USFS	Exhibits qualities that support SNLYF	Open water habitat; hydrologic sources, wet areas	SNLYF Assessment (HT Harvey & Associates); Appendix E
20	P20.4	H	Aquatic habitat	USFS	Exhibits qualities that support SNLYF	Open water habitat; hydrologic sources, wet areas	SNLYF Assessment (HT Harvey & Associates); Appendix E
20	P20.5	H	Aquatic habitat	USFS	Exhibits qualities that support SNLYF	Open water habitat; hydrologic sources, wet areas	SNLYF Assessment (HT Harvey & Associates); Appendix E
21	P21.1	K	Warren Lake	USFS	Exhibits qualities that support SNLYF	Open water habitat; hydrologic sources, wet areas	SNLYF Assessment (HT Harvey & Associates); Appendix E
21	P21.2	K	Devils Oven Lake	USFS	Exhibits qualities that support SNLYF	Open water habitat; hydrologic sources, wet areas	SNLYF Assessment (HT Harvey & Associates); Appendix E
21	P21.3	K	Pond	USFS	Exhibits qualities that support SNLYF	Open water habitat; hydrologic sources, wet areas	SNLYF Assessment (HT Harvey & Associates); Appendix E
21	P21.4	K	Pond	USFS	Exhibits qualities that support SNLYF	Open water habitat; hydrologic sources, wet areas	SNLYF Assessment (HT Harvey & Associates); Appendix E
21	P21.5	K	Pond	USFS	Exhibits qualities that support SNLYF	Open water habitat; hydrologic sources, wet areas	SNLYF Assessment (HT Harvey & Associates); Appendix E
			South Fork Prosser Creek Watershed Area: 8.4 sq. miles				
10	P10.7	M3/M4/M5	Uplands	TDA	Fair-good functioning	Springs; cold clean baseflow support to SF Prosser Creek	Road capture along S. Euer Valley Road and possibly others along the flow pathway; see disturbance inventory
10	P10.8	M2	Uplands	TDA	Fair-good functioning	Springs; cold clean baseflow support to SF Prosser Creek	Road capture along S. Euer Valley Road and possibly others along the flow pathway; see disturbance inventory
11	P11.8	M2	SF Prosser Creek	TDA	Partially functioning	Channel-meadow hydrologic connectivity; meadow condition	Beaver activity; may require other instream enhancements
			Crabtree Canyon; Watershed Area: 1.5 sq. miles				
11	P11.7	R	Uplands	TDA	Fair-good mature aspen grove	avian habitat	May require conifer thinning to enhance grove and habitat
			Headwaters: South Fork Prosser Creek; Watershed Area: 3.8 sq. miles				
14	P14.3	O	Uplands	USFS	Well-functioning	Spring flow	Measured multiple springs with total flow > 0.5 cfs in July 2020
15	P15.1	Q	seasonal pond	TDLT		Seasonal aquatic habitat	Assessed using CIR and aerial photography
15	P15.2	Q	Frog Lake	TDLT	Well-functioning	Montane waters; aquatic habitat; transitional habitats	Additional small open water feature south and above Frog Lake
15	P15.3	Q	Uplands	TDLT	Well-functioning	Discharge slope willow shrub; cold clean baseflow support to SF Prosser Creek	
15	P15.4	Q	Uplands	TDLT		Spring; perennial flow	Assessed using CIR and aerial photography
15	P15.5	Q	Uplands	TDLT/USFS	Well-functioning willow forest trib	Willow shrub riparian habitat; baeflow suport to SF Prosser Creek	Tributary to Reach Q and Euer Valley
16	P16.8	Q	Uplands	TDLT	Good flow	Springs	Supports willow riparian corridor in tributary
16	P16.9	Q	Uplands	TDLT	Good flow	Springs	Supports willow riparian corridor in tributary
16	P16.10	Q	Uplands	TDLT	Good flow	Springs	Supports willow riparian corridor in tributary
			Hobart Mills Tributary Watershed Area: 4.1 sq. miles				
5	P5.9	U	Hobart Mills Tributary (East Fork)	USFS	Well-functioning	Perennial channel and aquatic habitat; meadow	[illegible] Disturbance Inventory
5	P5.10	U	Uplands	USFS	Well-functioning	Springs; fens; baseflow support to downstream meadow	Old pipes and water works suggest this was used as a water source for Hobart Mills area.
5	P5.11	U	Uplands	USFS	Fair-good functioning	Avian habitat; aspen grove	May require conifer thinning to enhance grove and habitat
6	P6.2	Y	Hobart Mills Tributary (West Fork)	USFS	Recovered; healthy linear meadow	Meadow habitat	Fault controlled; sag pond; receives some stormwater runoff from SR89

Notes:

(1) Sheet refers to page in Map Booklet in Appendix B

(2) Protection ID refers to Map Sheet in the Map Booklet in Appendix B (e.g., P13.2 is an area to be protected on Sheet 13)

(3) Reaches were classified using: a) slope; b) channel morphology; c) channel planform; and d) channel condition

CHAPTER 2

FIGURES

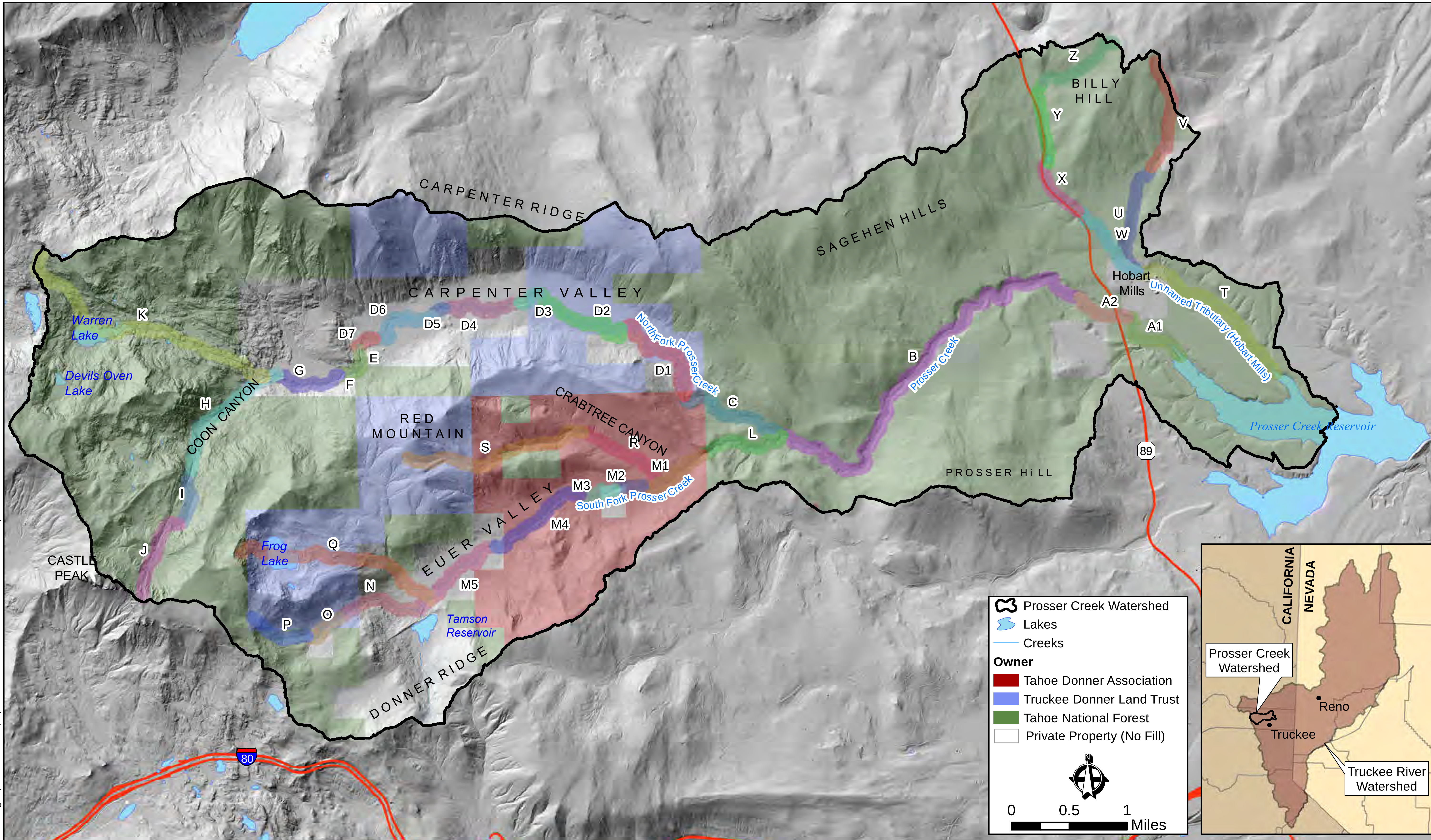

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Figure 3-1. Stream Reach Map, Prosser Creek Watershed, Nevada County, California

Basemap Source: USFS 2014 LiDAR

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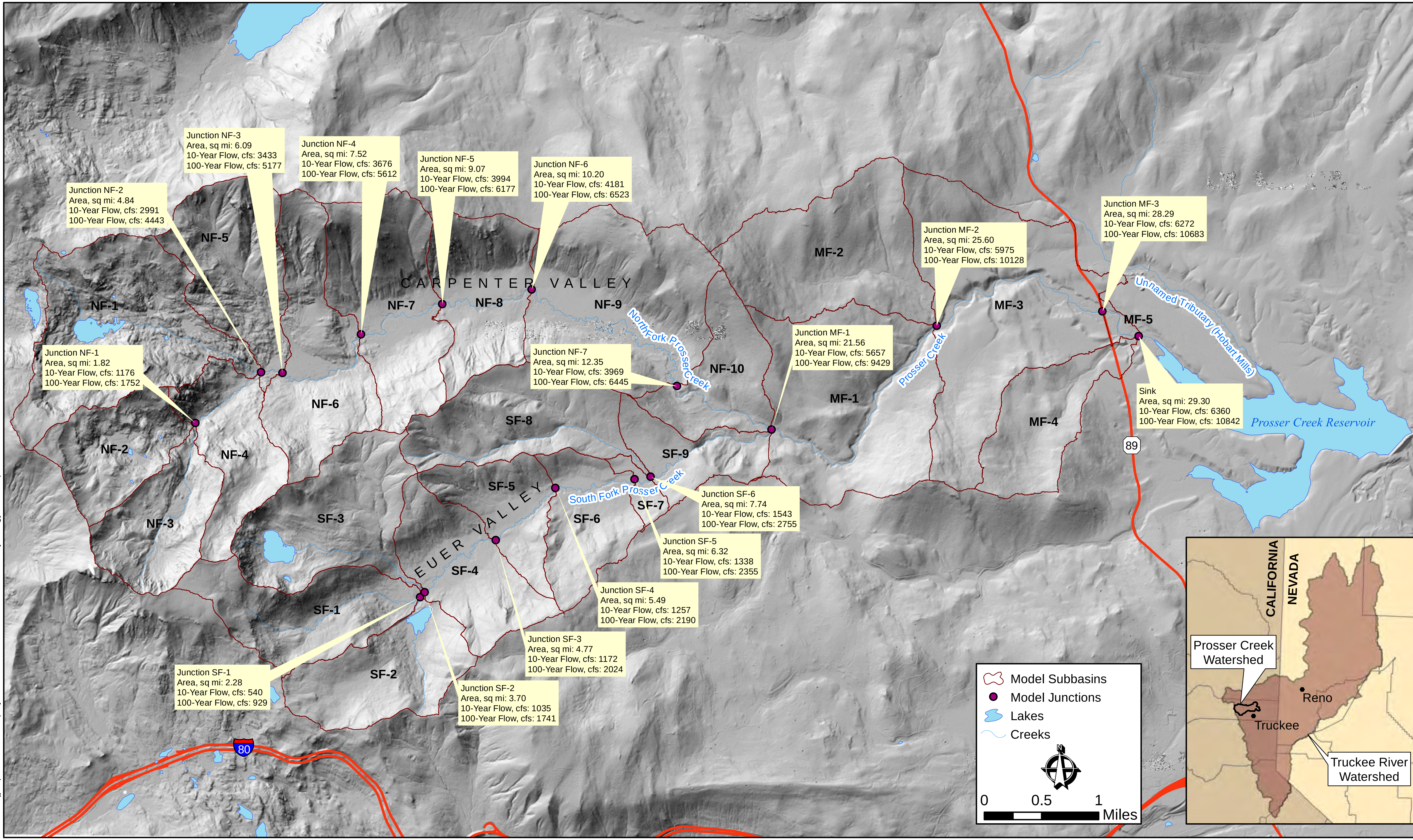

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Figure 3-2. Hydrologic Model Map, Prosser Creek Watershed, Nevada County, California

Basemap Source: USFS 2014 LiDAR

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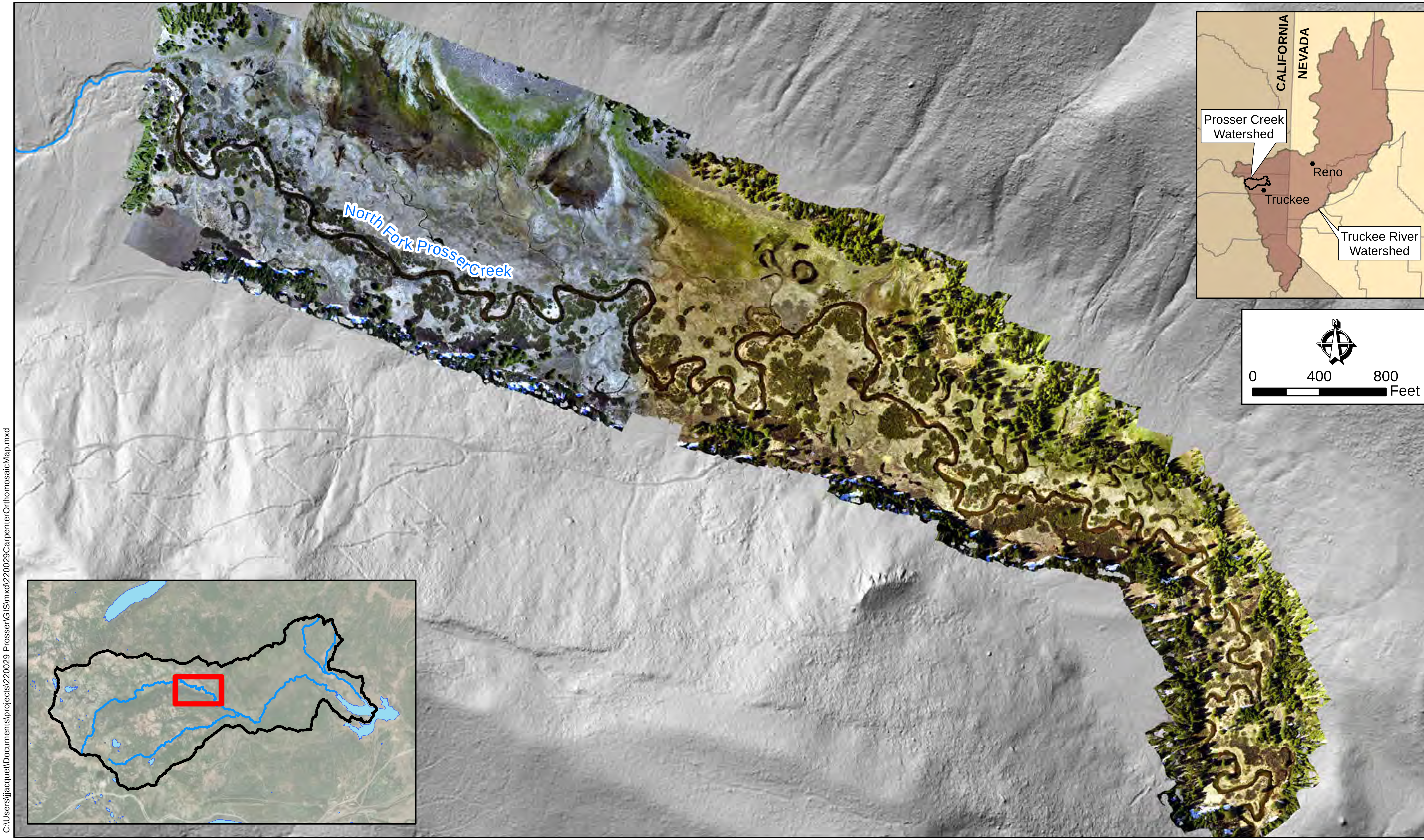

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Figure 3-3. High Resolution Aerial Imagery of Lower Carpenter Valley, Prosser Creek Watershed, Nevada County, California

UAV imagery captured on May 8, 2020 and May 9, 2020
Basemap Source: USFS LiDAR 2014

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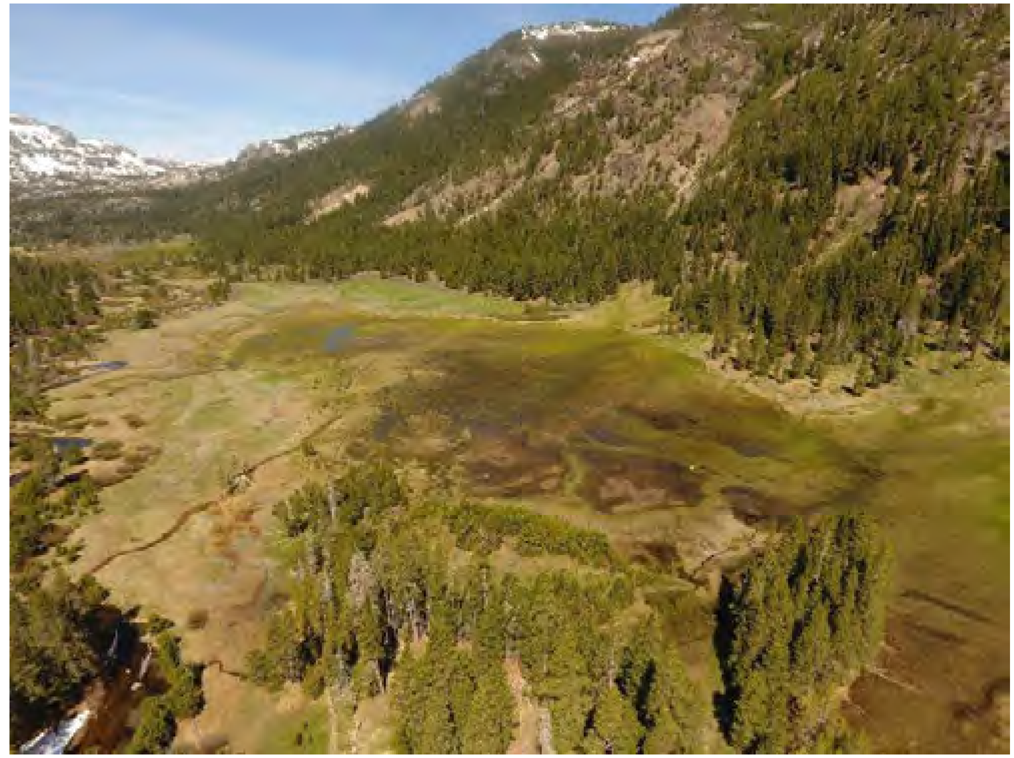

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Figure 3-4. Oblique Aerial Imagery showing Fen Features and Wet Meadow Surface Conditions, Lower Carpenter Valley, Prosser Creek Project Watershed. Photos captured on May 9, 2020

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Figure 3-5. Oblique Aerial Imagery showing Lower Euer Valley, Prosser Creek Project Watershed
Photos captured on May 15, 2020; Coyote Crossing Trail in foreground, looking northeast

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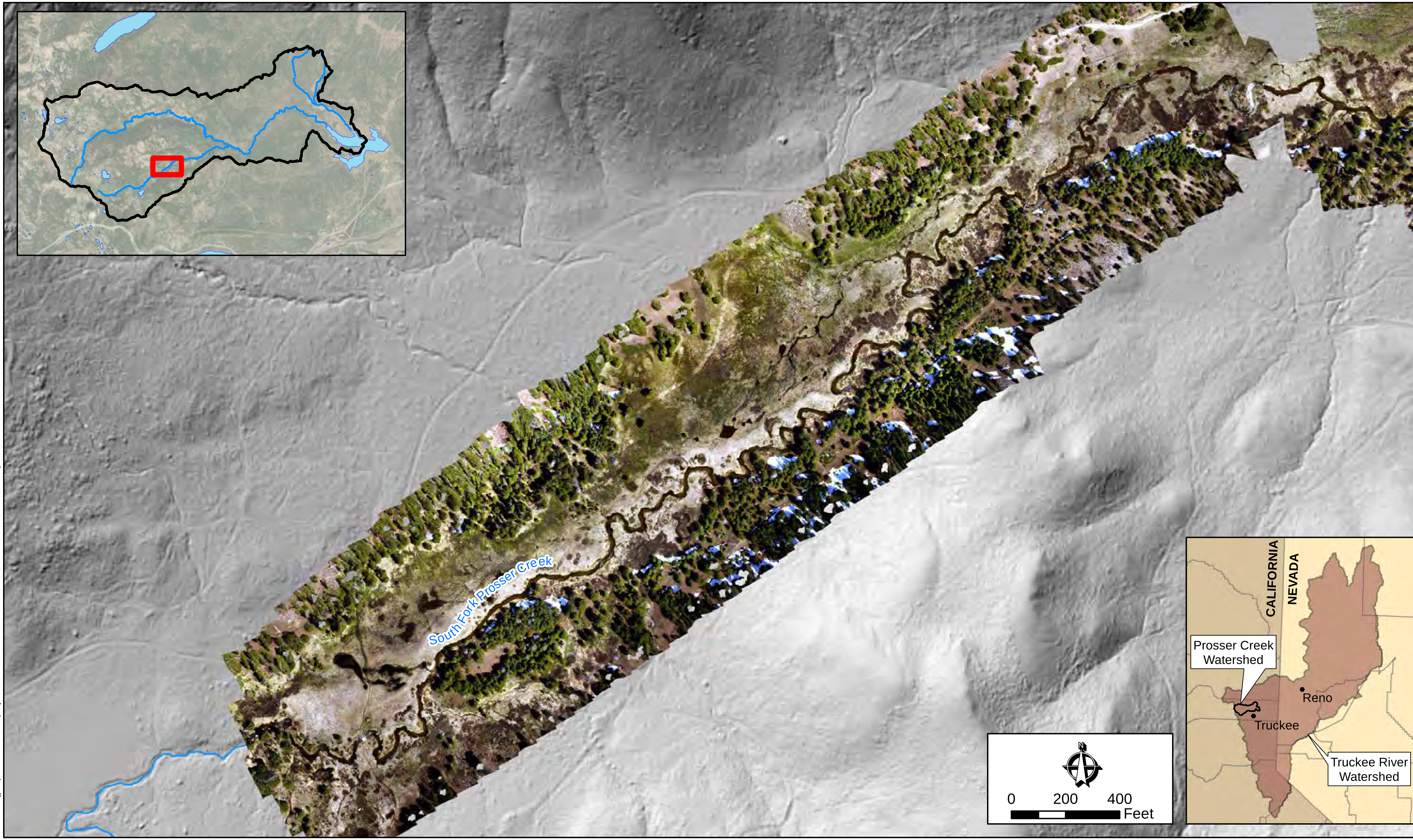

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Figure 3-6a. High-Resolution Aerial Imagery, Lower Euer Valley, Reaches M1-M3, Prosser Creek Project Watershed

UAV imagery captured on May 15, 2020
Basemap Source: USFS LiDAR 2014

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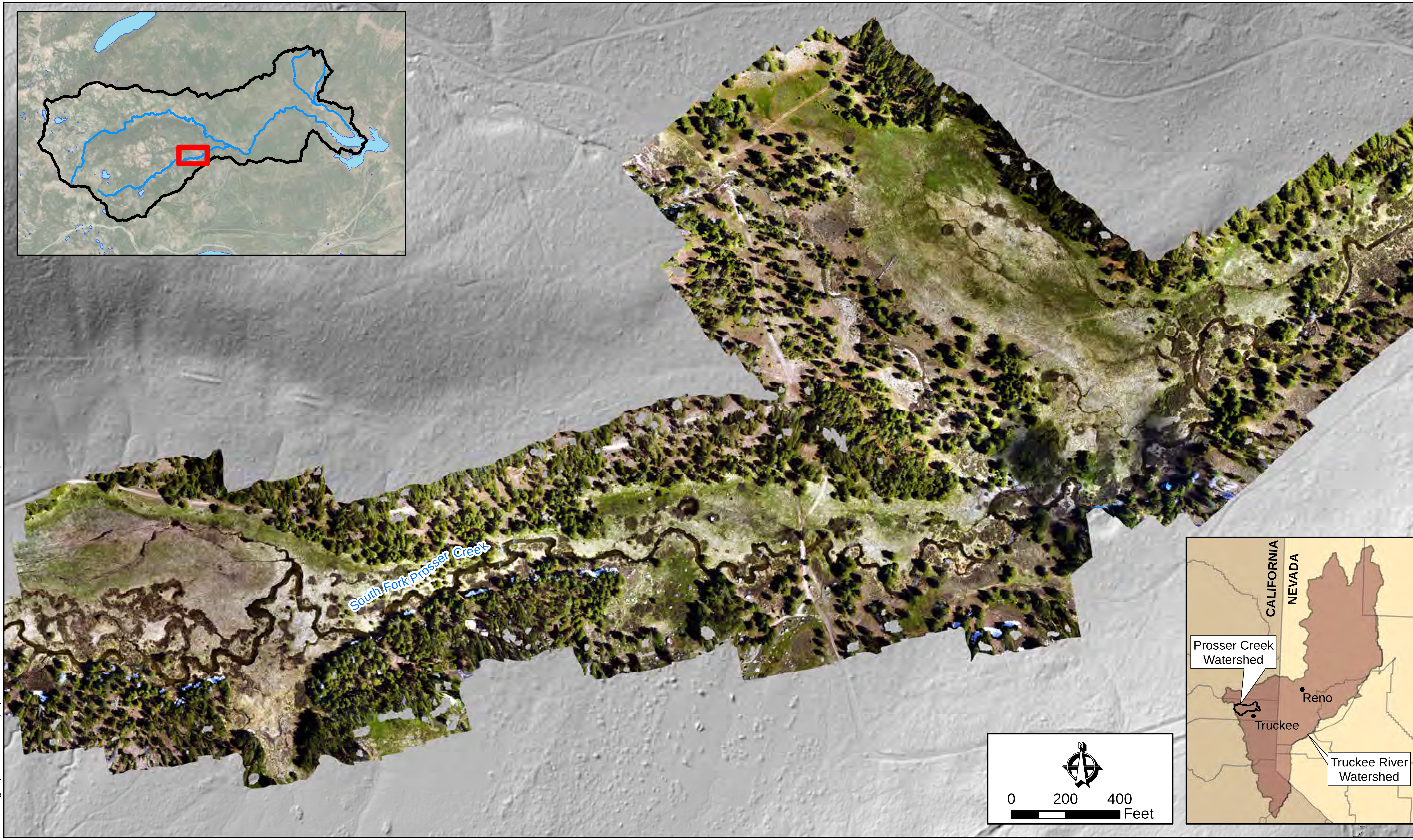

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Figure 3-6b. High-Resolution Aerial Imagery, Lower Euer Valley, Reach M4, Prosser Creek Watershed

UAV imagery captured on May 15, 2020
Basemap Source: USFS LiDAR 2014

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Figure 3-7. Meadow and Reach W, 1910 and 2020 Repeat Photography, Prosser Creek Project Watershed

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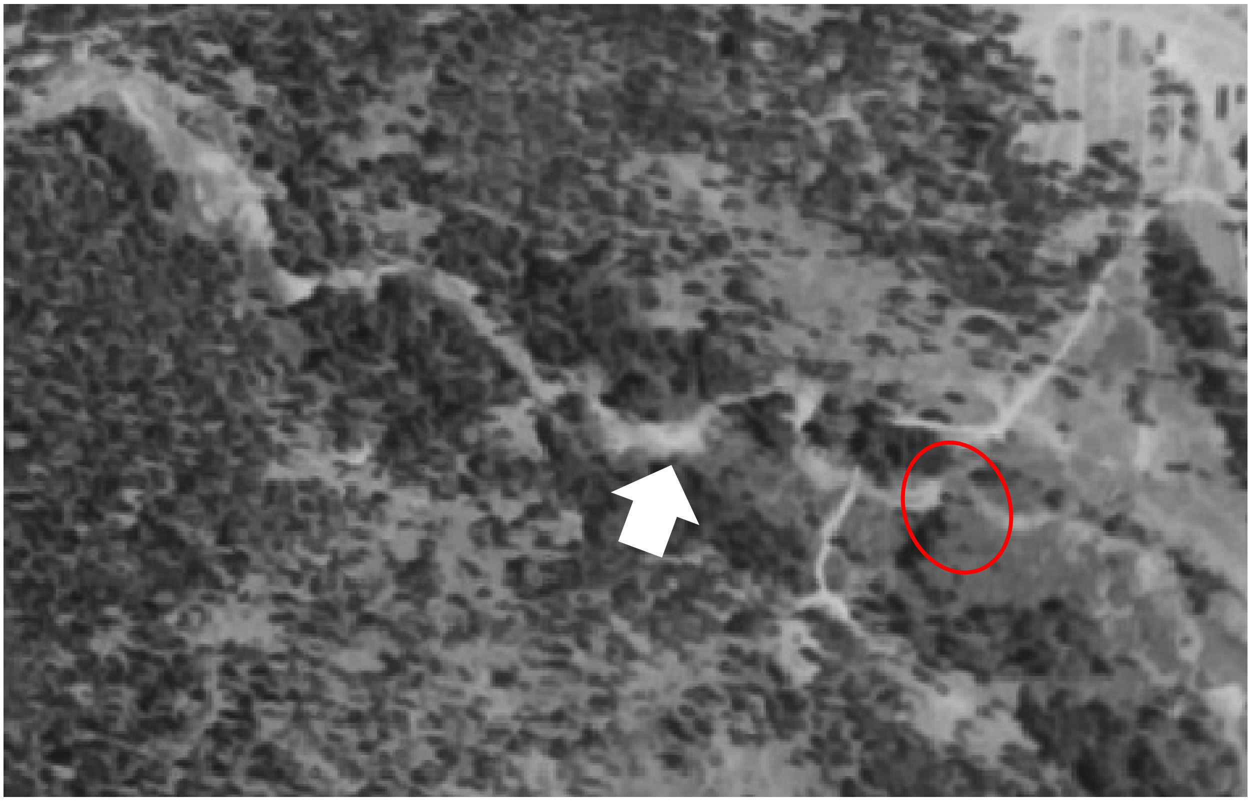

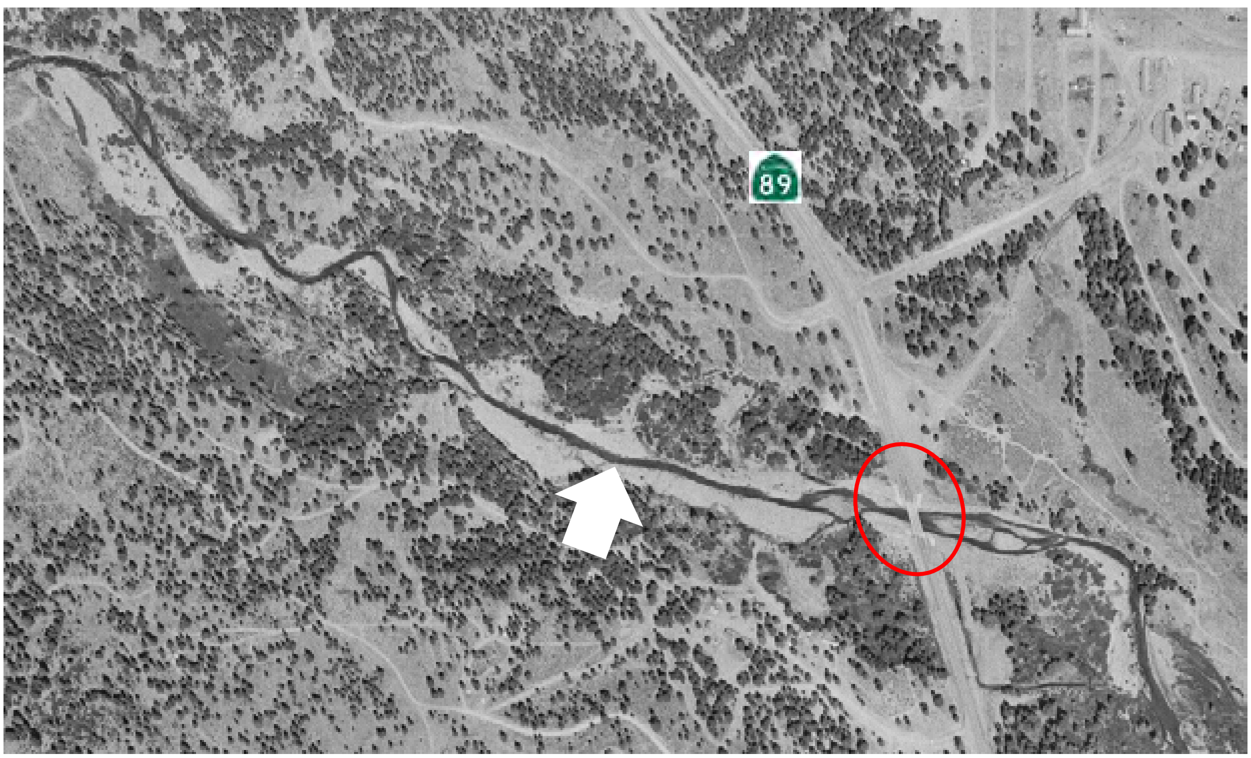

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Figure 4-1. Historical Aerial Imagery 1953 (top) vs. 1968 (bottom), Reach A, Prosser Creek, Nevada County, California. Bridge is identified in the aerial imagery by red circle.

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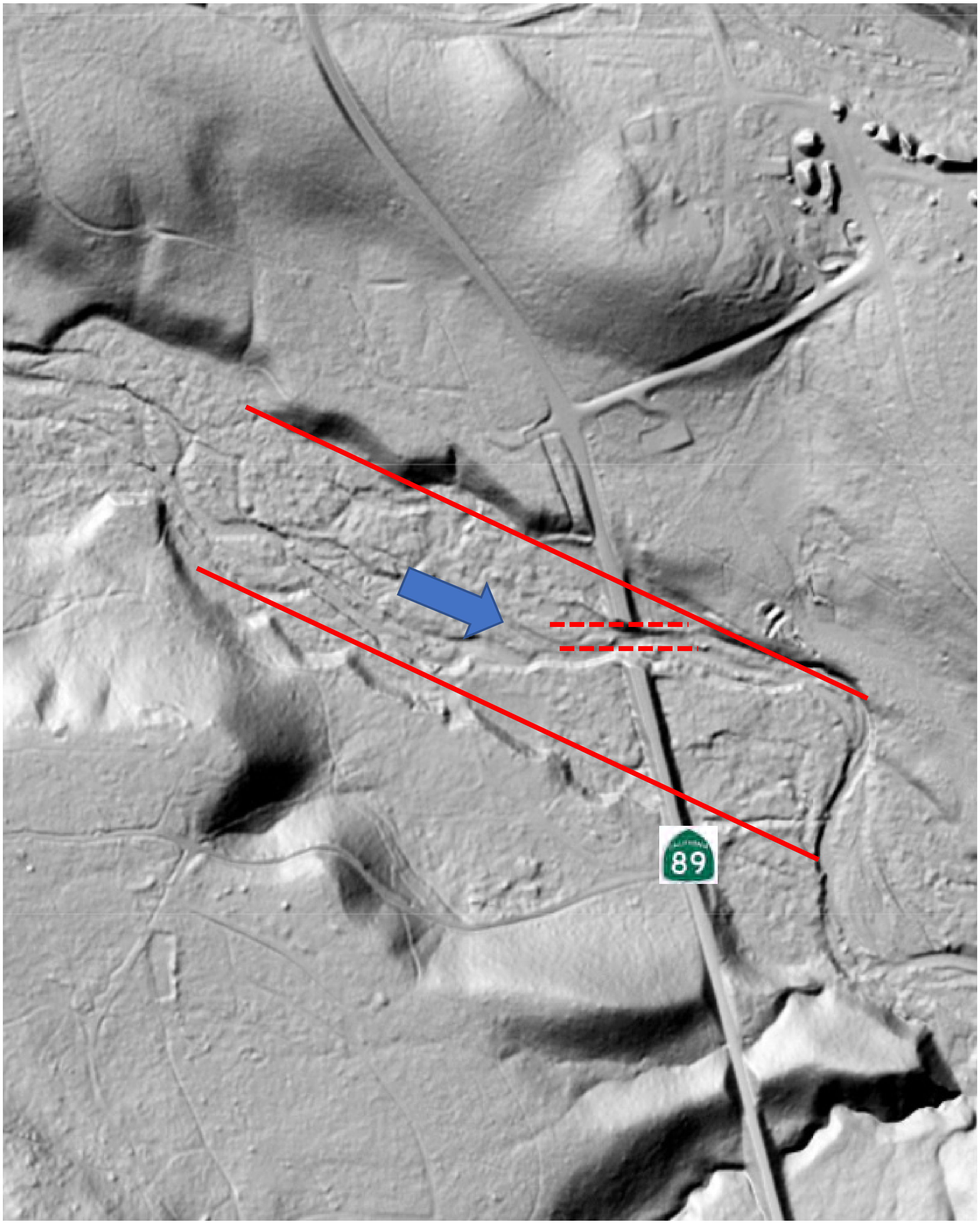

Basemap: USFS, 2014

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Figure 4-2. LiDAR bare earth imagery showing SR89 Prosser Creek crossing, Reach A, Nevada County, California. Red lines depict channel meander corridor and floodplain; dashed red lines depict existing bridge span.

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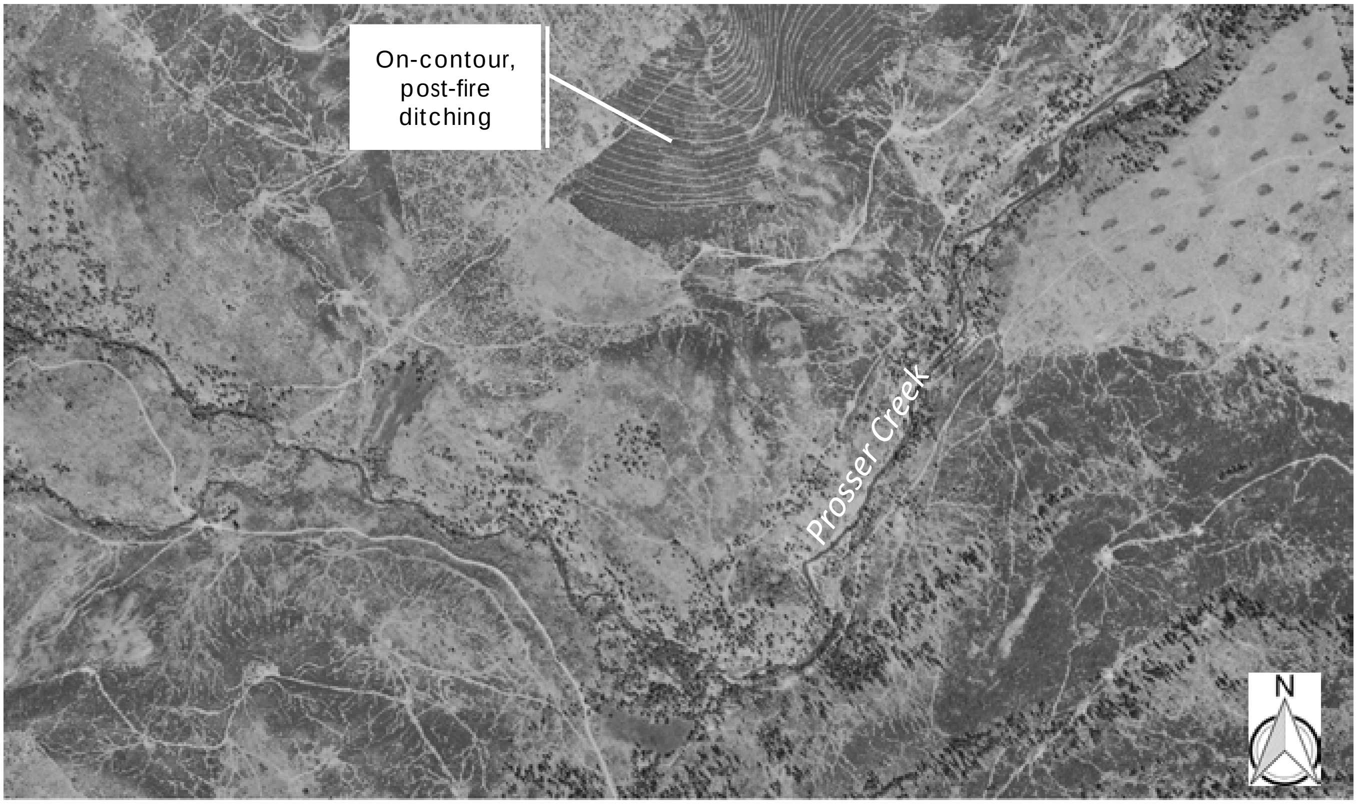

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Figure 4-3. Post-fire road-building, clear-cutting, and on-contour ditching, Sagehen Hills and Prosser Hill, Prosser Creek Watershed, Nevada County, California. Top photo, taken in 1969, shows the extent of on-contour ditching and logging that took place following the 1960 Donner Ridge Fire. Effects of these management strategies are still visible in the 2018 aerial imagery.

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Figure 4-4. Example of road capture, FS Road #89-33, Disturbance ID: D7.2, Prosser Creek Project Watershed, Nevada County, California

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Figure 4-5. Unnamed meadow, Reach B subwatershed, Prosser Creek, Nevada County, California

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Source: USFS, 1974

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Figure 4-6. 1974 Historical Aerial Imagery showing Ditching in Lower Carpenter Valley, Nevada County, California.
Recent aerial imagery suggests this ditch still exists and is causing changes to meadow hydrology.

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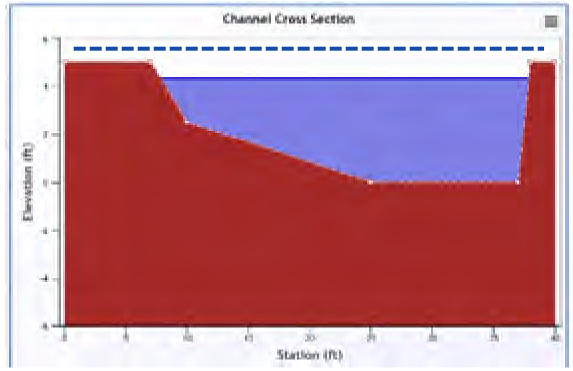
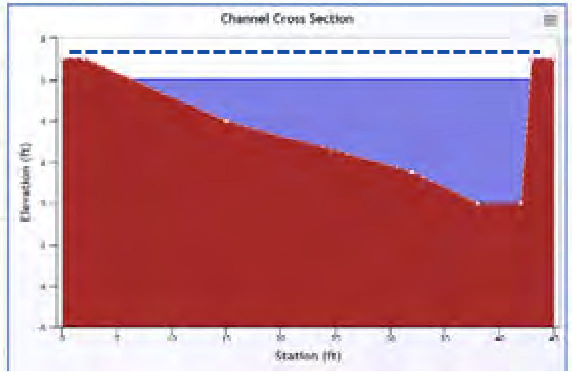
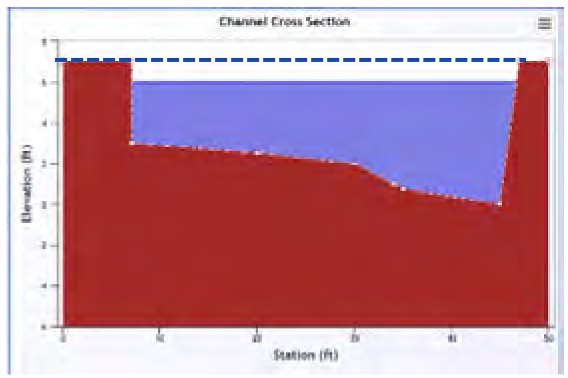


XS: #1
Q10
Flow Range: 505 – 794 cfs
Channel slope: 0.002 ft/ft
Manning's n: 0.028



XS: #3
Q25
Flow Range: 833 – 1,160 cfs
Channel slope: 0.002 ft/ft
Manning's n: 0.021



XS: #4
Q25
Flow Range: 833 – 1,160 cfs
Channel slope: 0.002 ft/ft
Manning's n: 0.028

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Figure 4-7. Normal depth calculations, North Fork Prosser Creek, Reach D1.
Solid blue represents the minimum of range; dashed blue line represents maximum of range.

Source:

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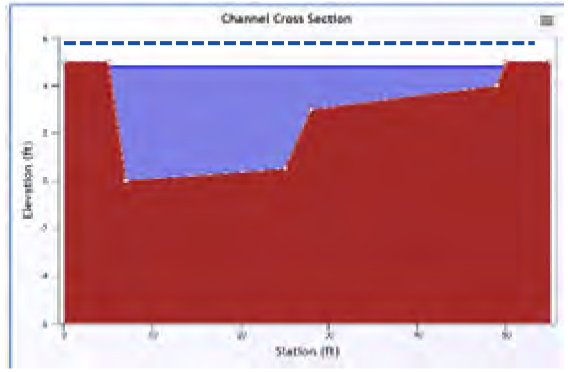
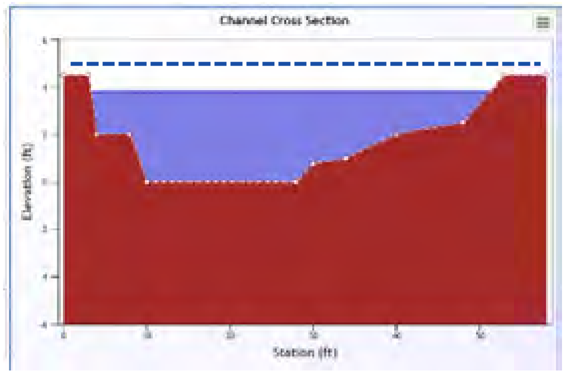


XS: #7
Q10
Flow Range: 505 – 794 cfs
Channel slope: 0.002 ft/ft
Manning's n: 0.030



XS: #9
Q10
Flow Range: 505 – 794 cfs
Channel slope: 0.002 ft/ft
Manning's n: 0.030

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Figure 4-8. Normal depth calculations, North Fork Prosser Creek, Reach D2. Solid blue represents the minimum of range; dashed blue line represents maximum of range.

Source:

© 2020 Balance Hydrologics, Inc.

November 3, 2020

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Figure 4-9. Repeat Photography of NF Prosser Creek (1973 vs. 2020), Reach D1, Prosser Creek Project Watershed

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Figure 4-10. Comparison of Channel Conditions (1939 and 2018), NF Prosser Creek, Reach D1-D2, Lower Carpenter Valley, Nevada County, California.

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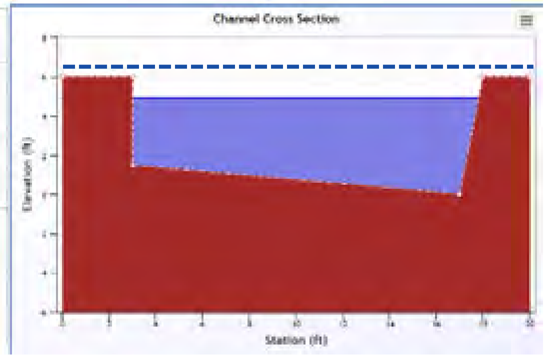
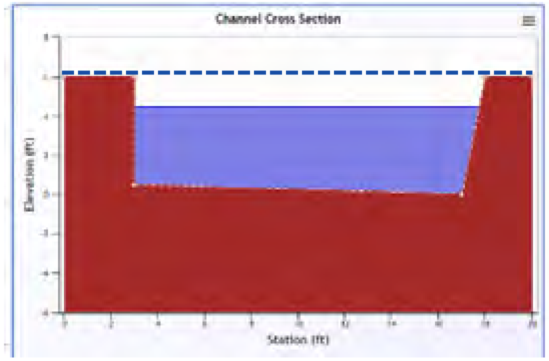
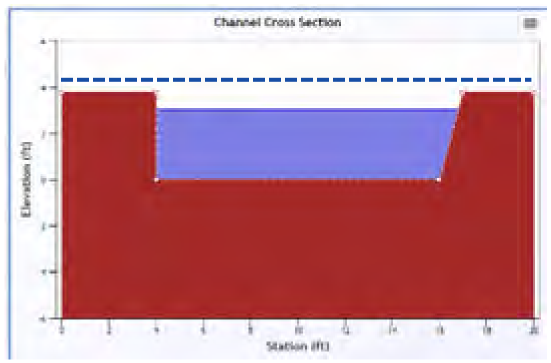


Reach: M1
XS: #1
Q10
Flow Range: 320 – 535 cfs
Channel slope: 0.004 ft/ft
Manning's n: 0.035



Reach: M1
XS: #3
Q10
Flow Range: 320 – 535 cfs
Channel slope: 0.004 ft/ft
Manning's n: 0.035



Reach: M2
XS: #4
Q5
Flow Range: 206 – 360 cfs
Channel slope: 0.004 ft/ft
Manning's n: 0.032

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Figure 4-11. Normal depth calculations for SF Prosser Creek, Reaches M1 and M2, Lower Euer Valley, Prosser Creek Project Watershed
Solid blue represents the minimum of range; dashed blue line represents maximum of range

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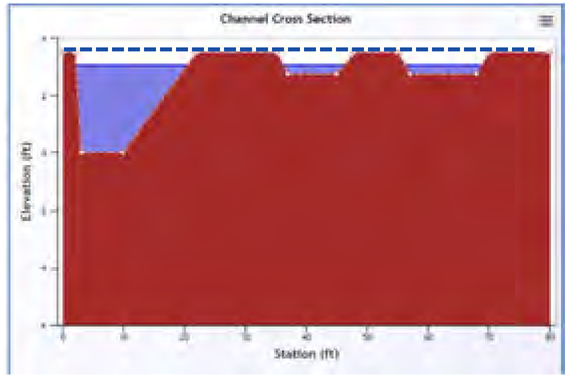
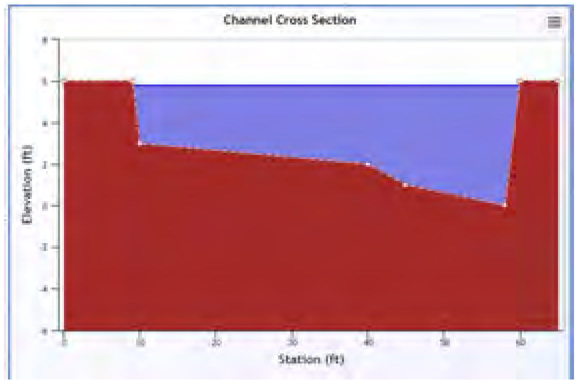
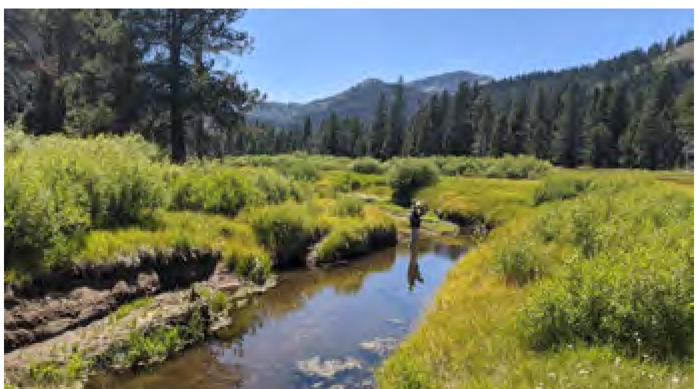
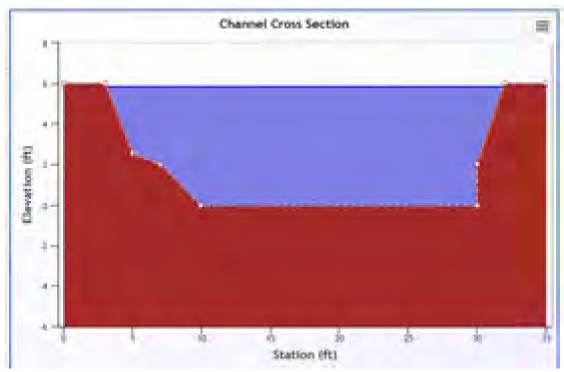


Reach: M3
XS: #5
Q2
Flow Range: 100 – 180 cfs
Channel slope: 0.004 ft/ft
Manning's n: 0.032



Reach: M4
XS: #6
Q100
Flow Range: >1,300 cfs
Channel slope: 0.004 ft/ft
Manning's n: 0.032





Reach: M4
XS: #8
Q100
Flow Range: >1,020 cfs
Channel slope: 0.004 ft/ft
Manning's n: 0.034

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Figure 4-12. Normal Depth Calculations for SF Prosser Creek, Reaches M3 and M4, Lower Euer Valley, Prosser Creek Project Watershed
Solid blue represents the minimum of range; dashed blue line represents maximum of range.

Source:
© 2020 Balance Hydrologics, Inc.

Source: USFS, 1974

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Figure 4-13. 1974 historical aerial photograph showing road and downstream sediment reaching SF Prosser Creek, Reach M4, Nevada County, California.

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Figure 4-14. Tributary headcuting, incision, and erosion associated with old ranch and corral, SF Prosser Creek, Reach M4, Nevada County, California.

© 2020 Balance Hydrologics

July 2, 2020

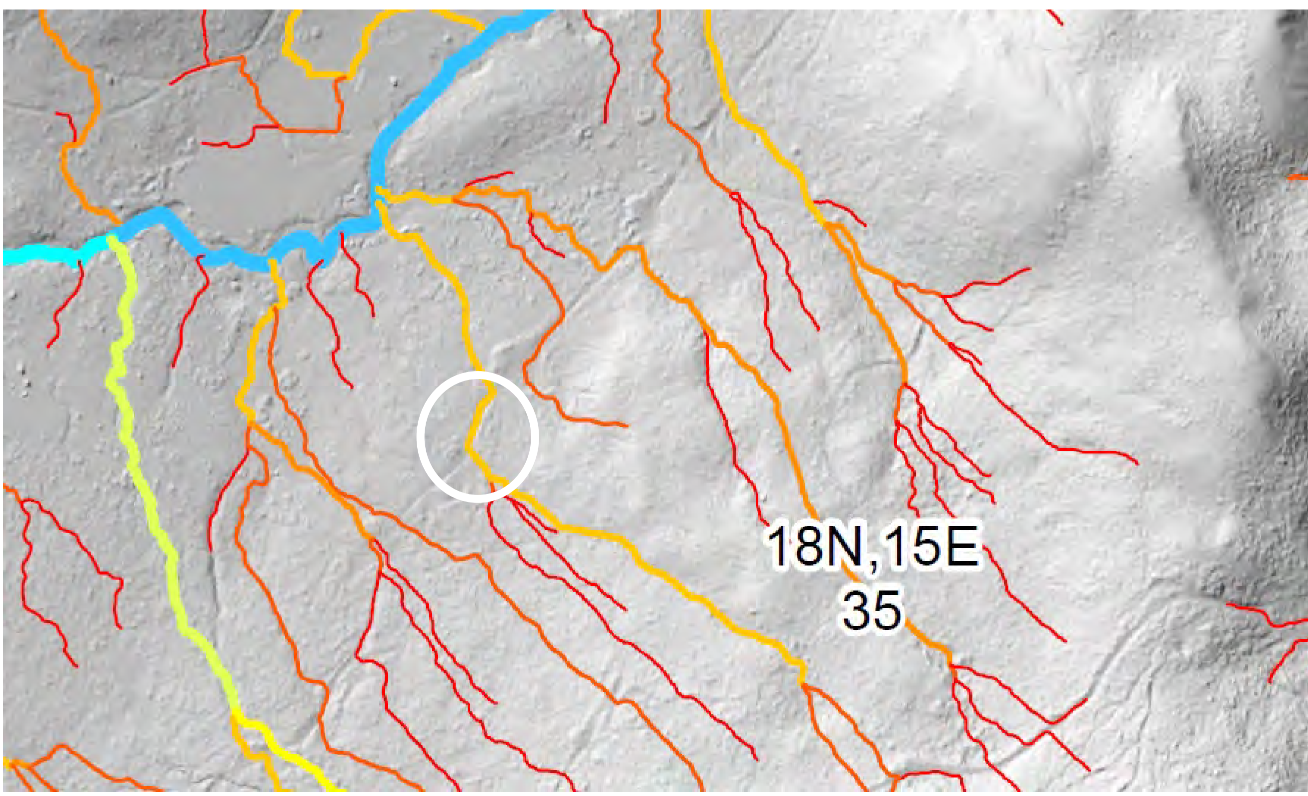

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Figure 4-15. Example of road capture, road/railroad grade, South Euer Valley Road, Nevada County, California. Photo (top) field verifies flow accumulation analysis (bottom)

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CHAPTER 2 APPENDICES

APPENDIX F

Representative Photographs of Stream Reaches, Prosser Creek Project Watershed

April 1, 2020

date unknown

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Appendix A1. **Representative existing conditions, Prosser Creek Reservoir, Nevada County, California**

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Reach A1, April 17, 2020

Reach A2, April 17, 2020

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Appendix A2. **Representative existing conditions, Reach A, Prosser Creek, Nevada County, California**

Reach A1 is downstream of the SR89 bridge; Reach A2 is a straightened, modified reach upstream of and under the SR89 crossing.

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April 28, 2020

April 28, 2020

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Appendix A3. **Representative existing conditions, Reach B, Prosser Creek, Nevada County, California**

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May 8, 2020

Balance Hydrologics™

Appendix A4. Representative existing conditions, Reach C, Prosser Creek, Nevada County, California

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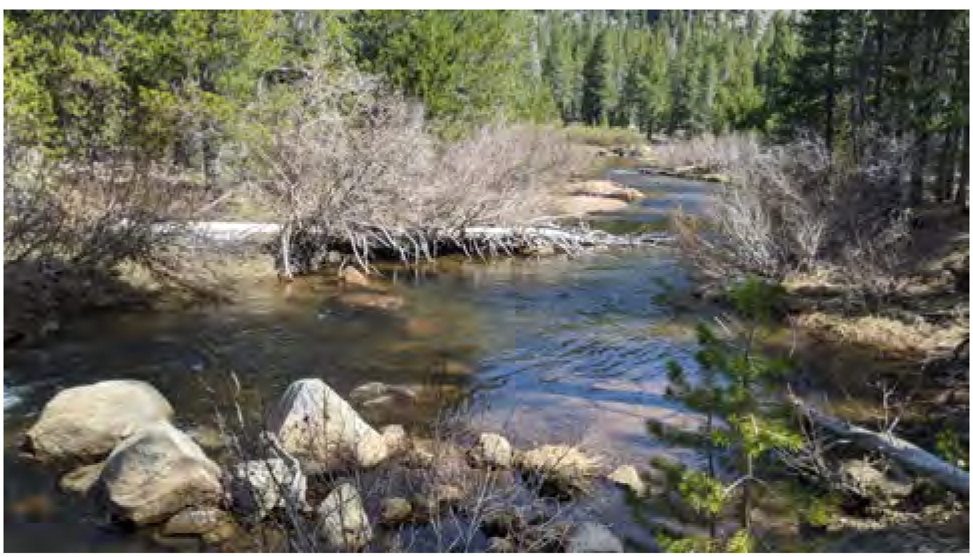
Reach D1
(August 20, 2020)

Reach D2
(May 9, 2020)



Reach D3
(May 9, 2020)

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Appendix A5. Representative existing conditions, Reach D1, D2, and D3, NF Prosser Creek, Lower Carpenter Valley, Nevada County, California

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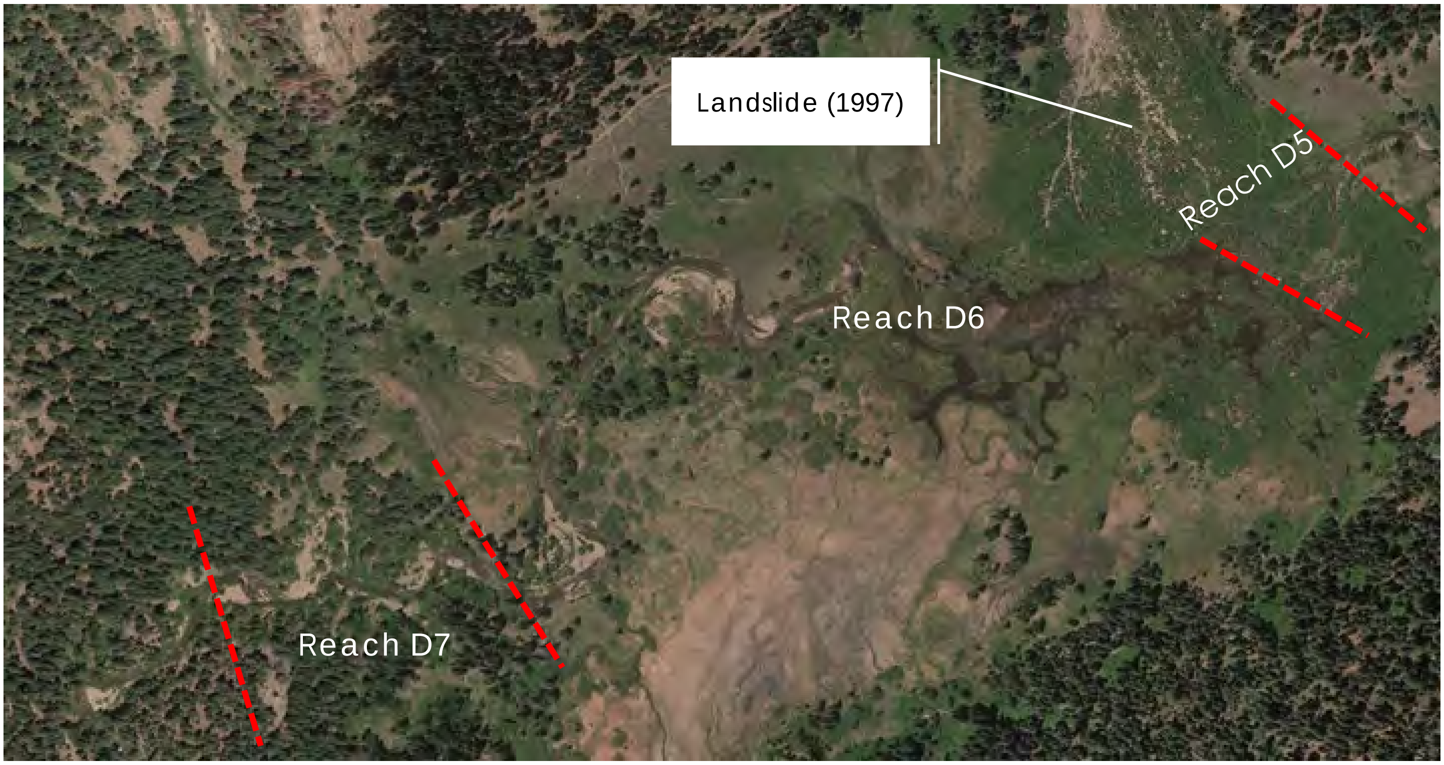
Reach D4 (June 7, 2018)



Reach D5, D6, & D7 (June 7, 2018)

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Appendix A6. Representative existing conditions, Reach D4, D5, D6, & D7, NF Prosser Creek, Upper Carpenter Valley, Nevada County, California

2018 imagery, Google Earth; red-dashed lines separate the subreaches

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Reach E (June 7, 2018)

Reaches F and G (June 7, 2018)

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Appendix A7. **Representative existing conditions, Reach E, F, & G, NF Prosser Creek, Nevada County, California**

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Reaches H, I, and J (June 7, 2018)

Reach K (June 7 and 26, 2018)

Appendix A8. **Representative existing conditions, Reach H, I, J, & K, NF Prosser Creek, Nevada County, California**

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August 9, 2020

August 9, 2020

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Appendix A9. Representative existing conditions, Reach L, SF Prosser Creek, Nevada County, California

Note the landslide along the right bank in the upper photo

© 2020 Balance Hydrologics

July 14, 2020

July 14, 2020

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Appendix A10. Representative existing conditions, Reach M1, SF Prosser Creek, Euer Valley, Nevada County, California

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July 14, 2020

July 14, 2020

Appendix A11. **Representative existing conditions, Reach M2, SF Prosser Creek, Euer Valley, Nevada County, California**

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July 14, 2020

July 14, 2020

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Appendix A12. Representative existing conditions, Reach M3, SF Prosser Creek, Euer Valley, Nevada County, California

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July 14, 2020

July 14, 2020

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Appendix A13. Representative existing conditions, Reach M4, SF Prosser Creek, Euer Valley, Nevada County, California

© 2020 Balance Hydrologics

June 7, 2018

June 7, 2018

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Appendix A14. **Representative existing conditions, Reaches M5, N, O, & P, SF Prosser Creek, Euer Valley, Nevada County, California**

Inset photograph shows a segment of Reach P (USFS)

220029 Reach by Reach (2).ppt

© 2020 Balance Hydrologics

June 7, 2018

Frog Lake, June 11, 2020

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Appendix A15. **Representative existing conditions, Reach Q, SF Prosser Creek, Euer Valley, Nevada County, California**

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Reach R, July 14, 2020

Reach S, July 20, 2020

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Appendix A16. Representative existing conditions, Reach R & S
Crabtree Canyon Tributary, Nevada County, California

© 2020 Balance Hydrologics

October 29, 2020

October 14, 2020

Appendix A17. Representative existing conditions, Reach T, Hobart Mills Tributary, Nevada County, California

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April 1, 2020

April 1, 2020

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Appendix A18. Representative existing conditions, Reach U, Hobart Mills Tributary, Nevada County, California

© 2020 Balance Hydrologics

April 1, 2020

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Appendix A19. Representative existing conditions, Reach V, Hobart Mills Tributary, Nevada County, California

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September 23, 2020

September 23, 2020

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Appendix A20. Representative existing conditions, Reach W, Hobart Mills Tributary, Nevada County, California

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Appendix A21. Representative existing conditions, Reach X, Hobart Mills Tributary, Nevada County, California

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September 1, 2020

September 1, 2020

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Appendix A22. Representative existing conditions, Reach Y, Hobart Mills Tributary and former Hobart Mills Reservoir, Nevada County, California

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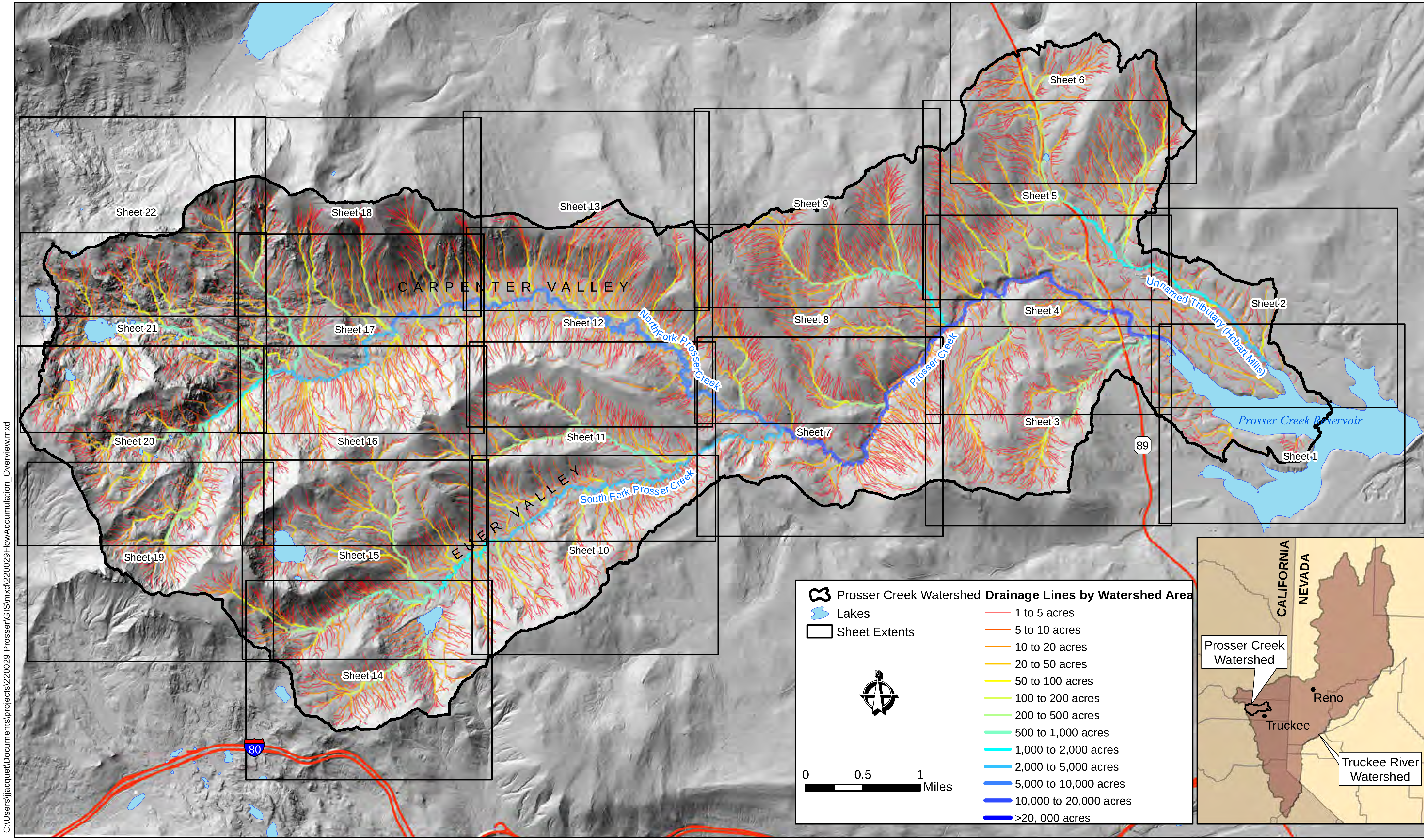
APPENDIX G

Disturbance and Areas for Protection Inventory Map Booklet



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Ecological Consultants

Sheet 0. Flow Accumulation Overview Map, Prosser Creek Watershed, Nevada County, California

Basemap Source: USFS 2014 LiDAR

© 2021 Balance Hydrologics, Inc.

Drainage Lines by Watershed Area
- 1 to 5 acres
- 5 to 10 acres
- 10 to 20 acres
- 20 to 50 acres
- 50 to 100 acres
- 100 to 200 acres
- 200 to 500 acres
- 500 to 1,000 acres
- 1,000 to 2,000 acres
- 2,000 to 5,000 acres
- 5,000 to 10,000 acres
- 10,000 to 20,000 acres
- >20, 000 acres

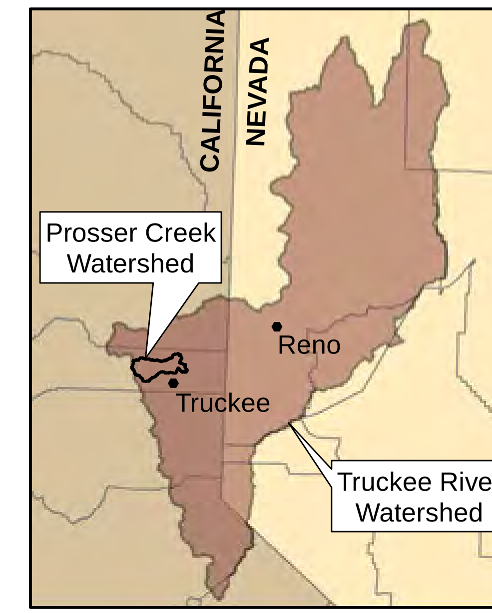
Prosser Creek Watershed

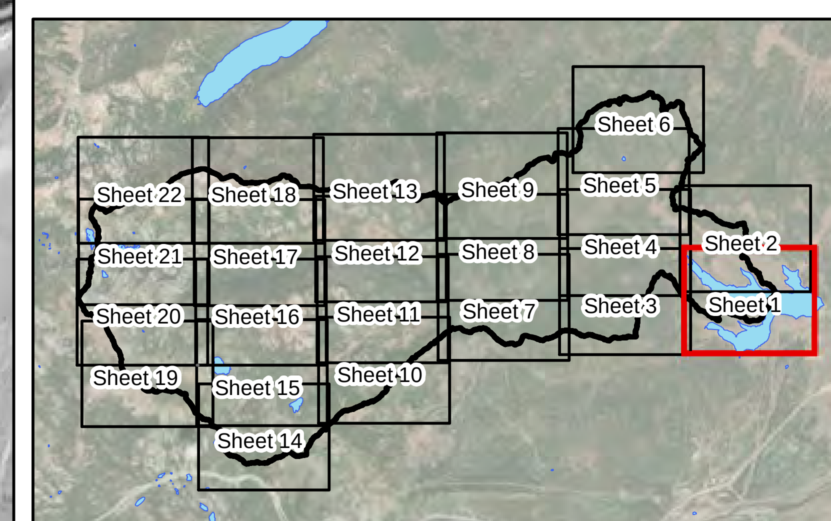
Lakes

Classification
- Disturbed
- Functional

Owner
- Tahoe Donner Association
- Truckee Donner Land Trust
- Tahoe National Forest
- Private Property (No Fill)

0 500 1,000 Feet





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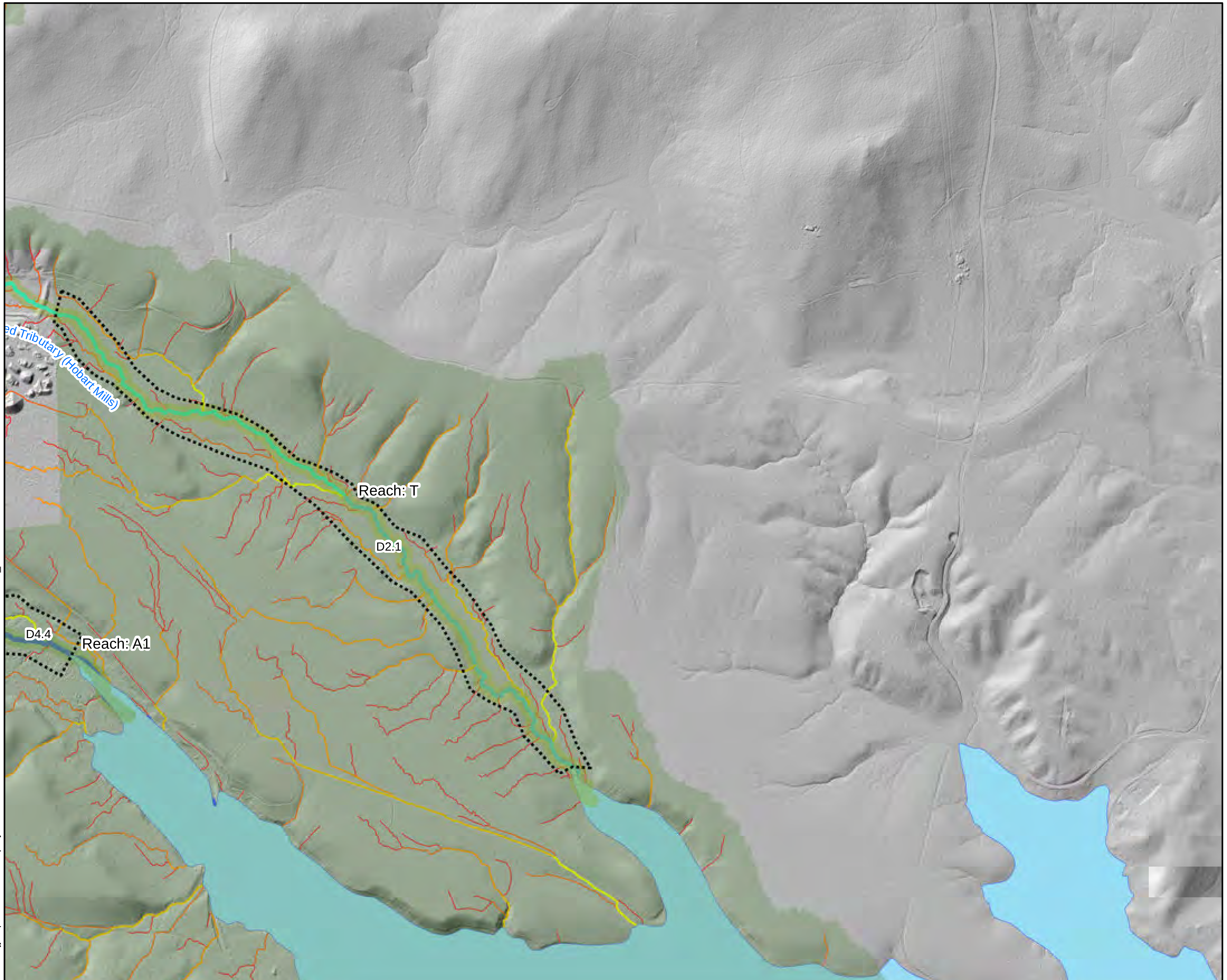
Sheet 1 Flow Accumulation Map Showing Disturbed and Functional Areas, Prosser Creek Watershed, Nevada County, California

Basemap Source: USFS 2014 LiDAR

© 2021 Balance Hydrologics, Inc.



Drainage Lines by Watershed Area

- 1 to 5 acres
- 5 to 10 acres
- 10 to 20 acres
- 20 to 50 acres
- 50 to 100 acres
- 100 to 200 acres
- 200 to 500 acres
- 500 to 1,000 acres
- 1,000 to 2,000 acres
- 2,000 to 5,000 acres
- 5,000 to 10,000 acres
- 10,000 to 20,000 acres
- >20, 000 acres

Prosser Creek Watershed

Lakes

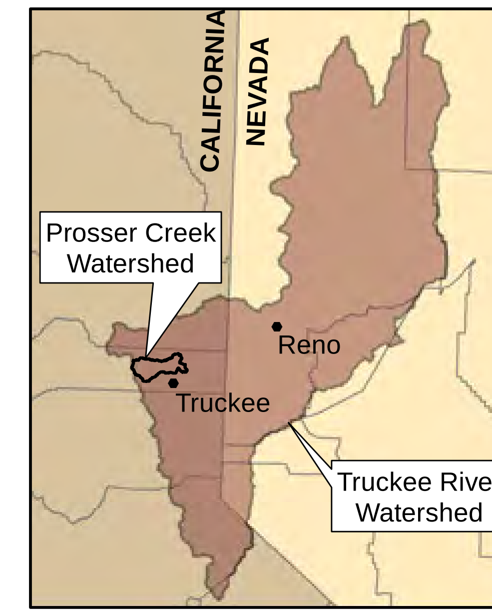
Classification

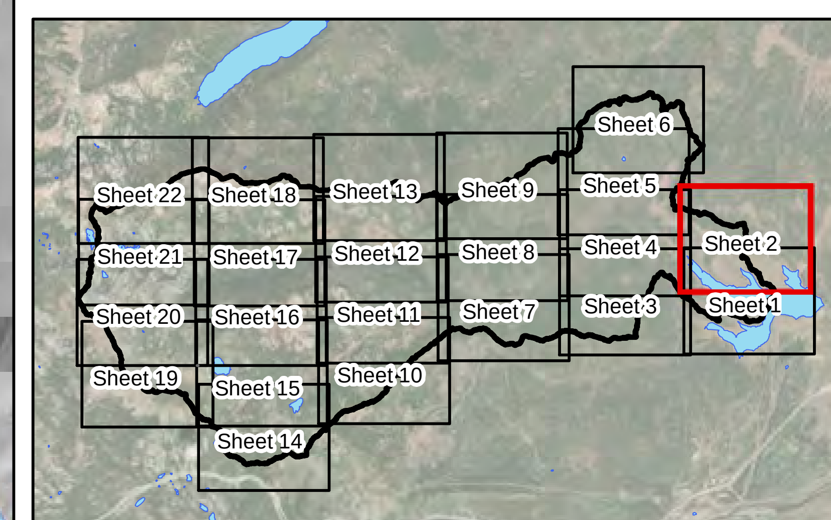
- Disturbed
- Functional

Owner

- Tahoe Donner Association
- Truckee Donner Land Trust
- Tahoe National Forest
- Private Property (No Fill)

0 500 1,000 Feet





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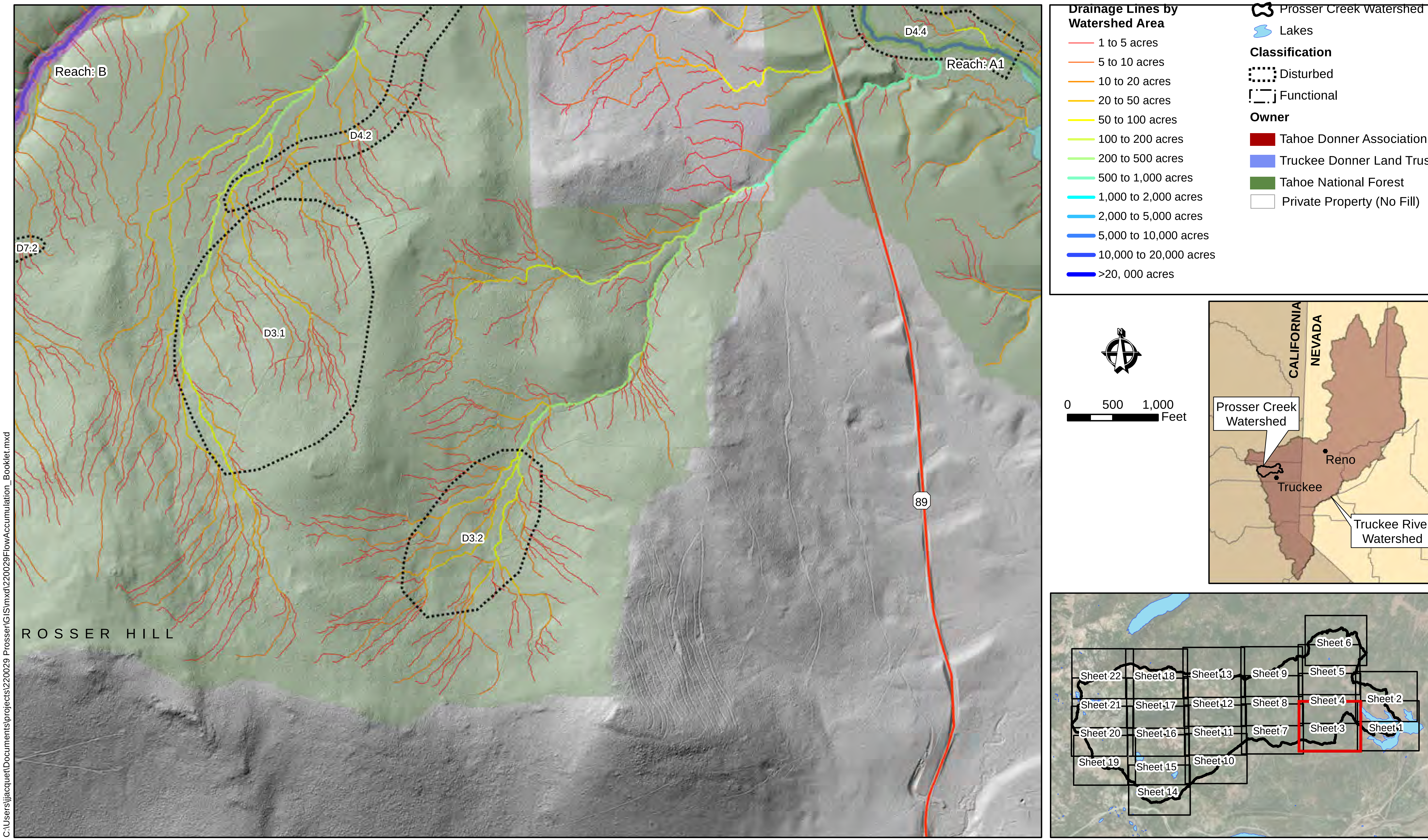
Sheet 2 Flow Accumulation Map Showing Disturbed and Functional Areas, Prosser Creek Watershed, Nevada County, California

Basemap Source: USFS 2014 LiDAR

© 2021 Balance Hydrologics, Inc.



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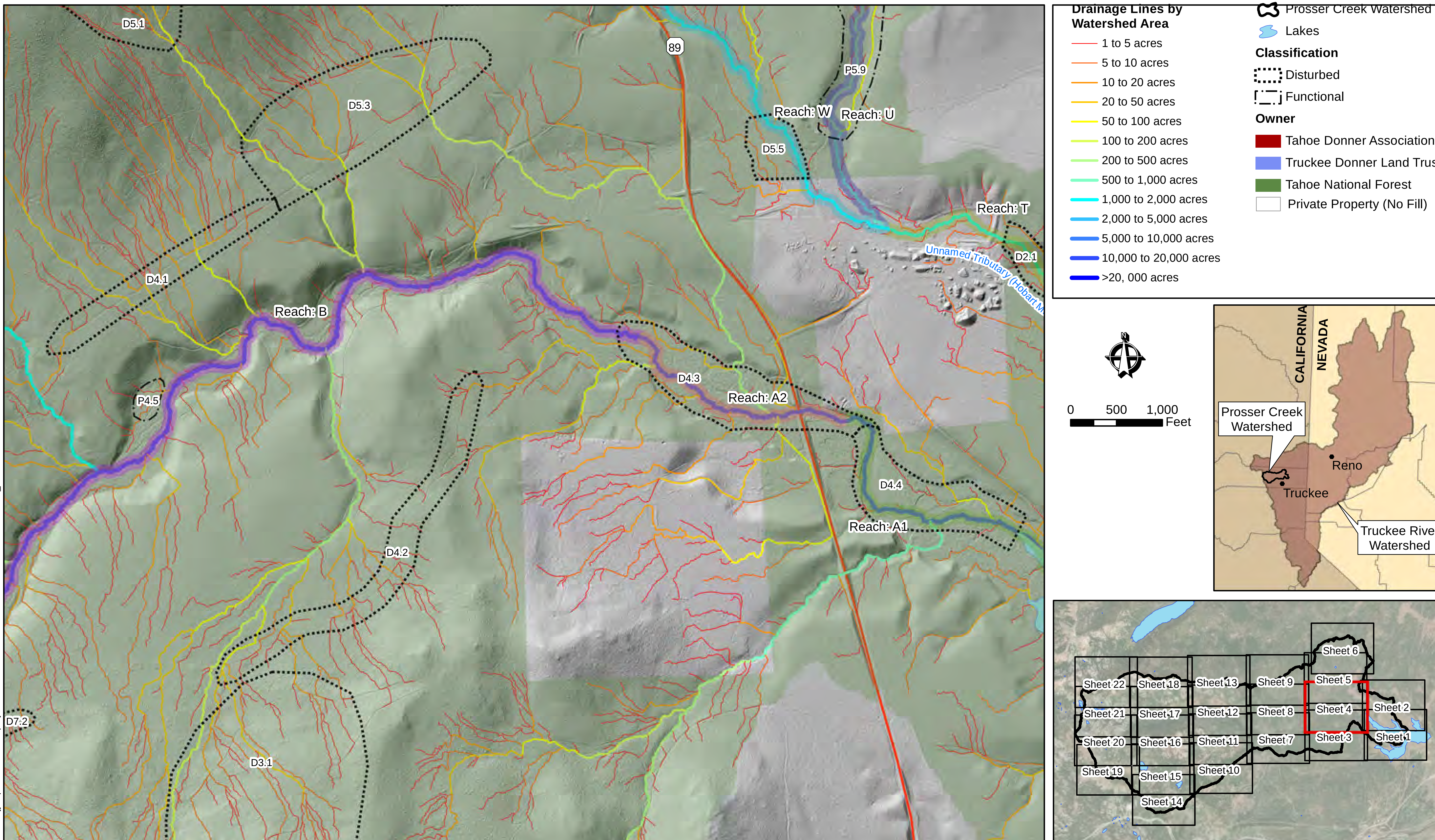
Sheet 3 Flow Accumulation Map Showing Disturbed and Functional Areas, Prosser Creek Watershed, Nevada County, California

Basemap Source: USFS 2014 LiDAR

© 2021 Balance Hydrologics, Inc.



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Sheet 4 **Flow Accumulation Map Showing Disturbed and Functional Areas, Prosser Creek Watershed, Nevada County, California**

Basemap Source: USFS 2014 LiDAR

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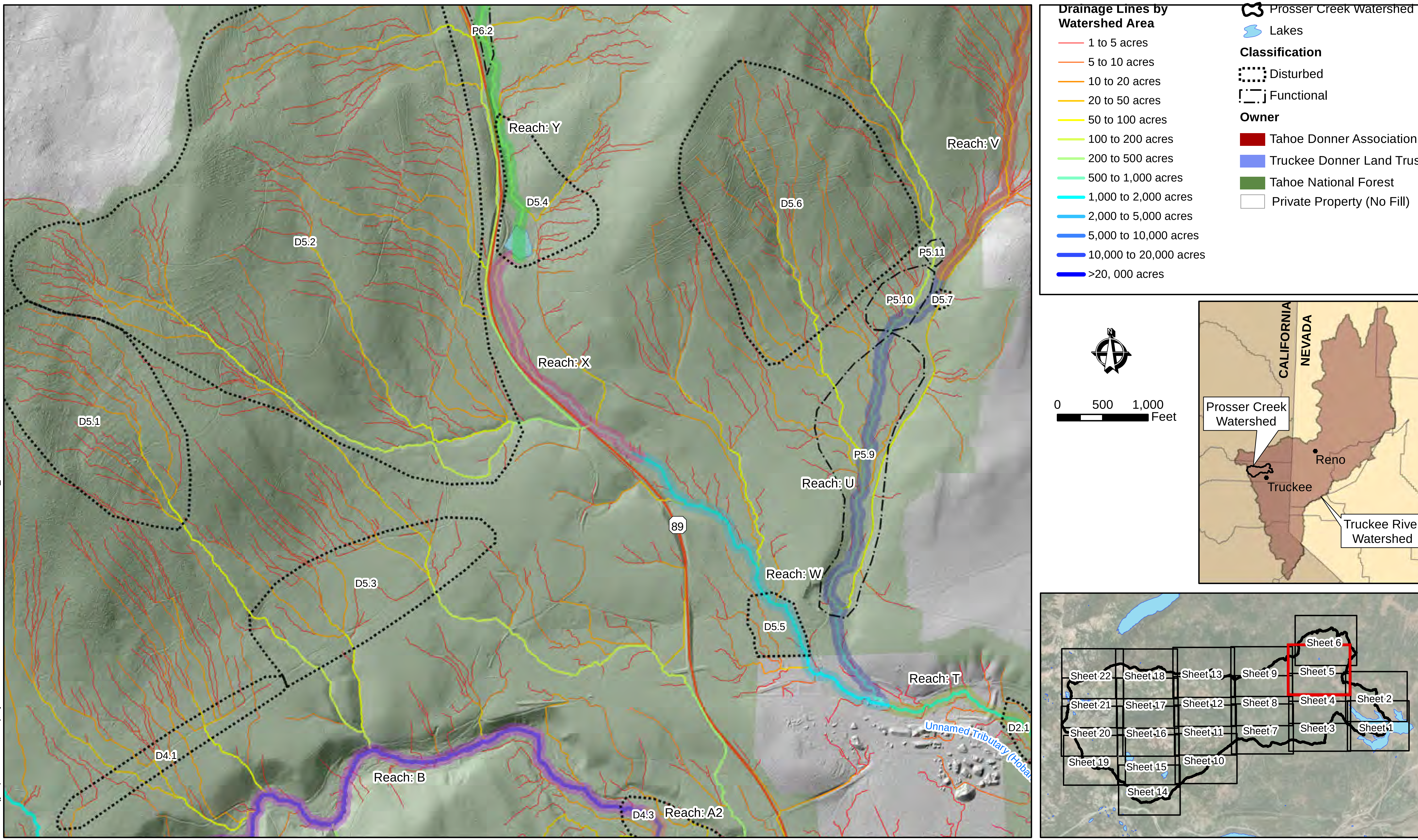

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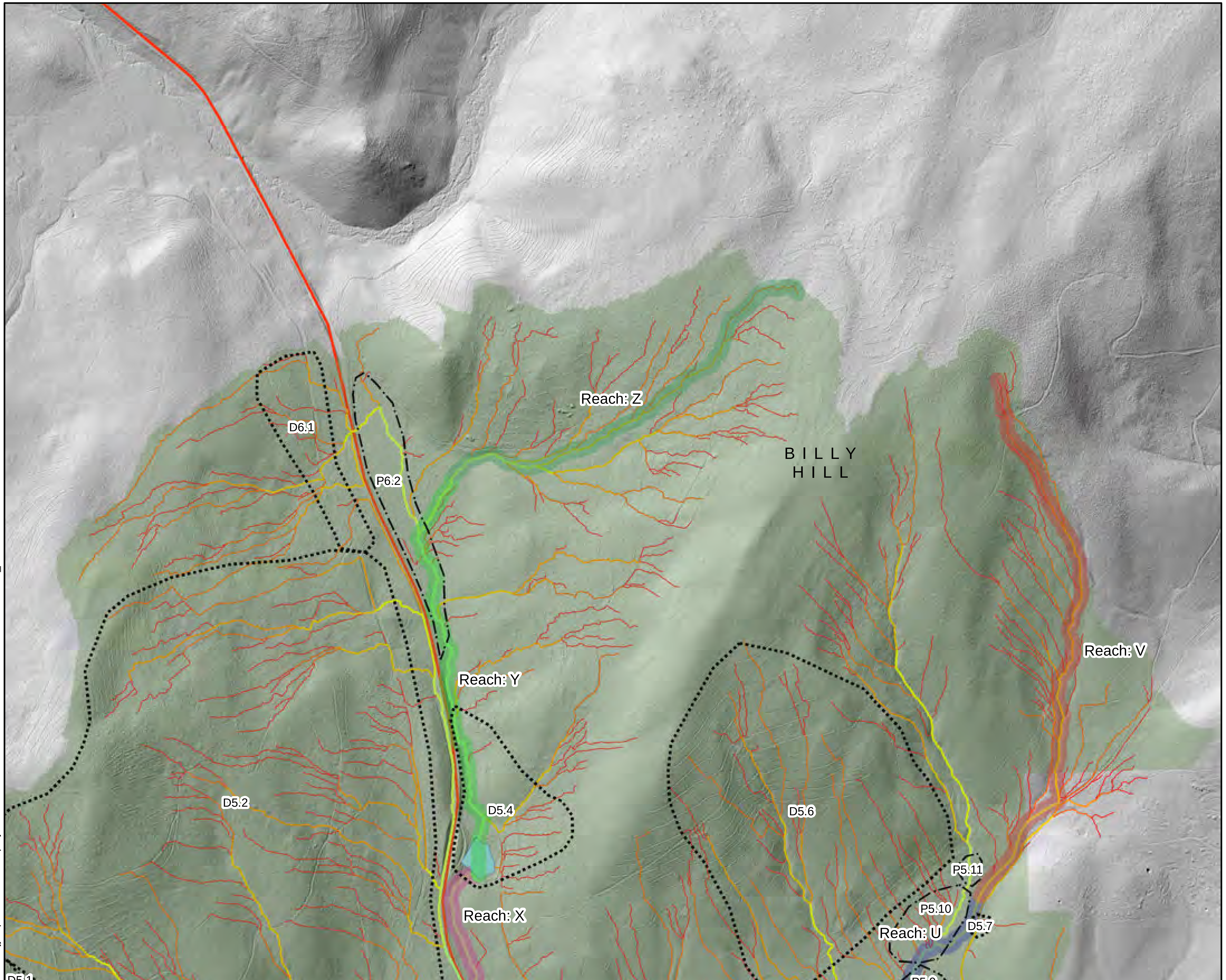
Sheet 5 **Flow Accumulation Map Showing Disturbed and Functional Areas, Prosser Creek Watershed, Nevada County, California**

Basemap Source: USFS 2014 LiDAR

© 2021 Balance Hydrologics, Inc.



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Drainage Lines by Watershed Area

- 1 to 5 acres
- 5 to 10 acres
- 10 to 20 acres
- 20 to 50 acres
- 50 to 100 acres
- 100 to 200 acres
- 200 to 500 acres
- 500 to 1,000 acres
- 1,000 to 2,000 acres
- 2,000 to 5,000 acres
- 5,000 to 10,000 acres
- 10,000 to 20,000 acres
- >20, 000 acres

Prosser Creek Watershed

Lakes

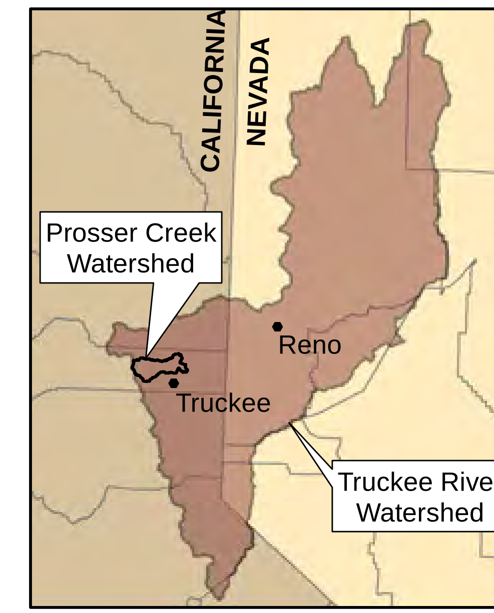
Classification

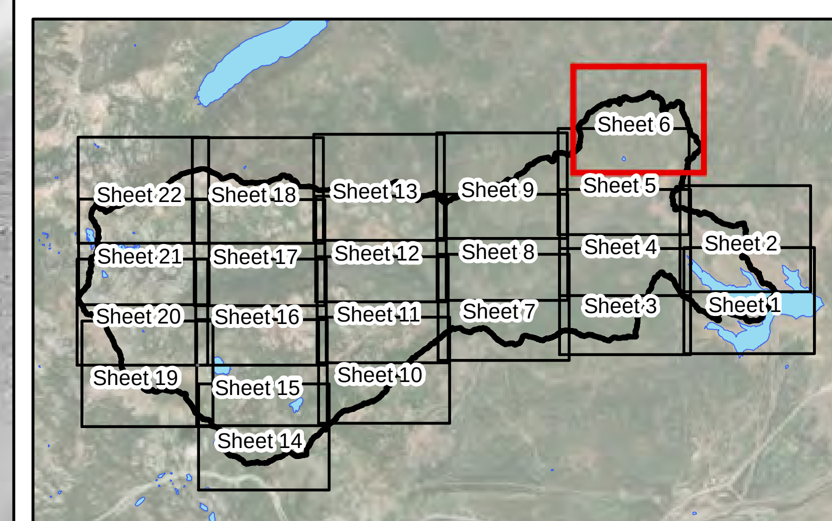
- Disturbed
- Functional

Owner

- Tahoe Donner Association
- Truckee Donner Land Trust
- Tahoe National Forest
- Private Property (No Fill)

0 500 1,000 Feet





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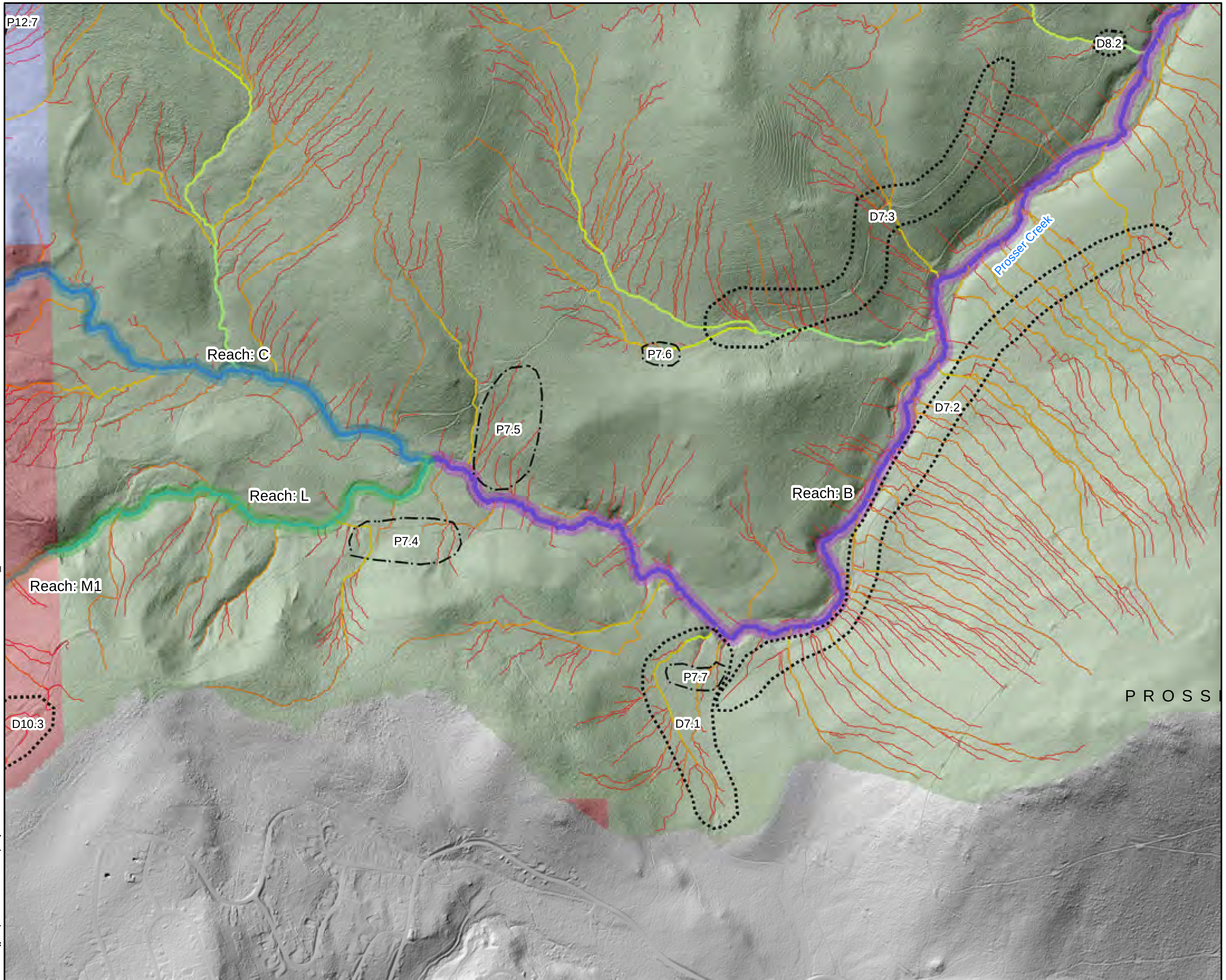
Sheet 6 Flow Accumulation Map Showing Disturbed and Functional Areas, Prosser Creek Watershed, Nevada County, California

Basemap Source: USFS 2014 LiDAR

© 2021 Balance Hydrologics, Inc.



Drainage Lines by Watershed Area

- 1 to 5 acres
- 5 to 10 acres
- 10 to 20 acres
- 20 to 50 acres
- 50 to 100 acres
- 100 to 200 acres
- 200 to 500 acres
- 500 to 1,000 acres
- 1,000 to 2,000 acres
- 2,000 to 5,000 acres
- 5,000 to 10,000 acres
- 10,000 to 20,000 acres
- >20, 000 acres

Prosser Creek Watershed

Lakes

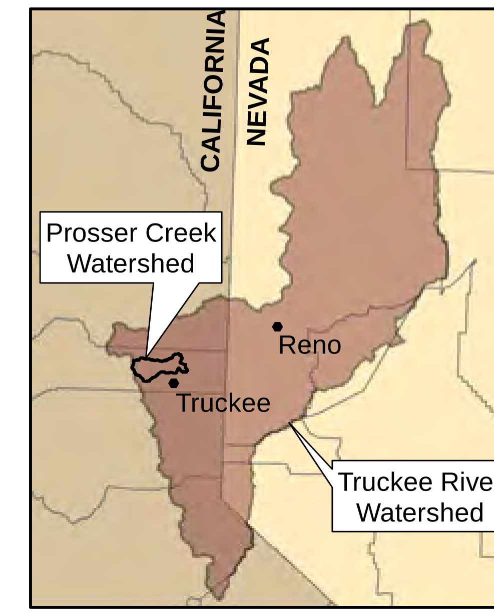
Classification

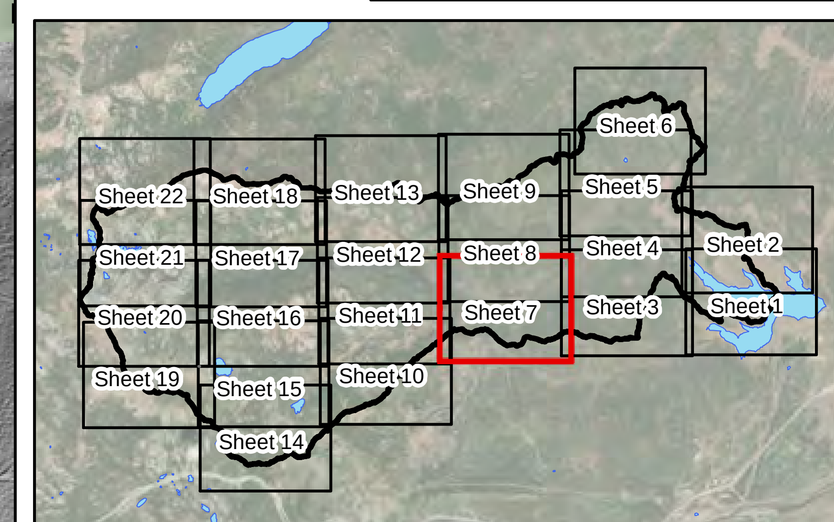
- Disturbed
- Functional

Owner

- Tahoe Donner Association
- Truckee Donner Land Trust
- Tahoe National Forest
- Private Property (No Fill)

0 500 1,000 Feet





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Sheet 7 Flow Accumulation Map Showing Disturbed and Functional Areas, Prosser Creek Watershed, Nevada County, California

Basemap Source: USFS 2014 LiDAR

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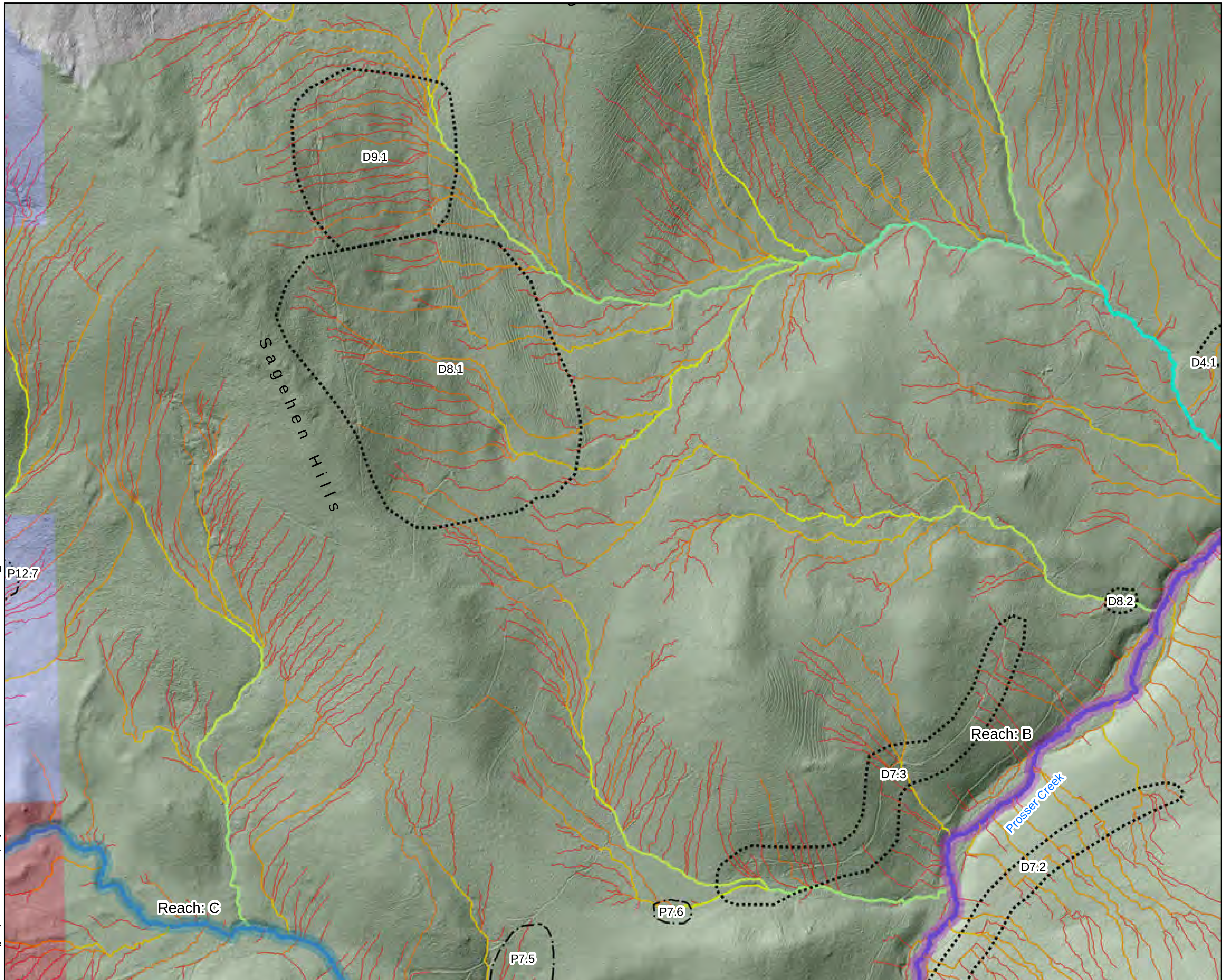


Drainage Lines by Watershed Area

- 1 to 5 acres
- 5 to 10 acres
- 10 to 20 acres
- 20 to 50 acres
- 50 to 100 acres
- 100 to 200 acres
- 200 to 500 acres
- 500 to 1,000 acres
- 1,000 to 2,000 acres
- 2,000 to 5,000 acres
- 5,000 to 10,000 acres
- 10,000 to 20,000 acres
- >20, 000 acres

Prosser Creek Watershed

Lakes

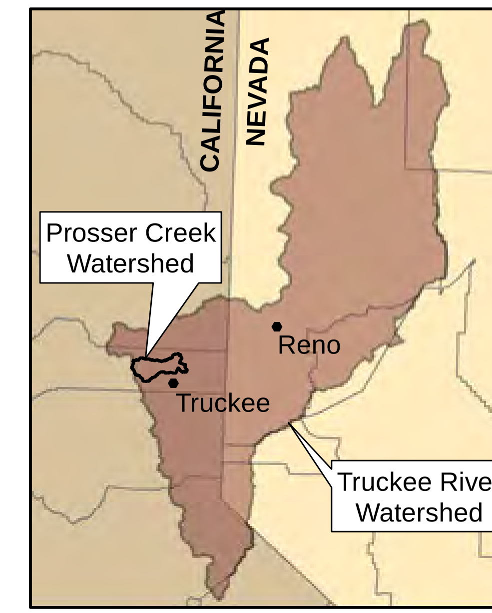
Classification

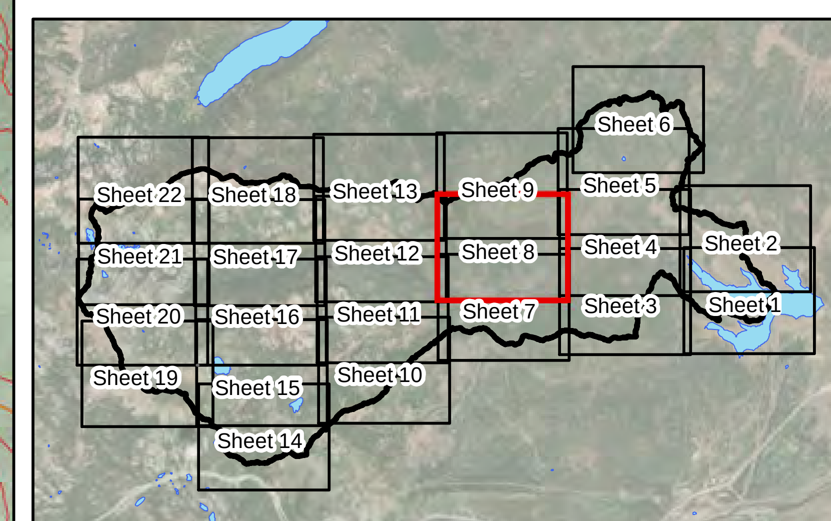
- Disturbed
- Functional

Owner

- Tahoe Donner Association
- Truckee Donner Land Trust
- Tahoe National Forest
- Private Property (No Fill)

0 500 1,000 Feet





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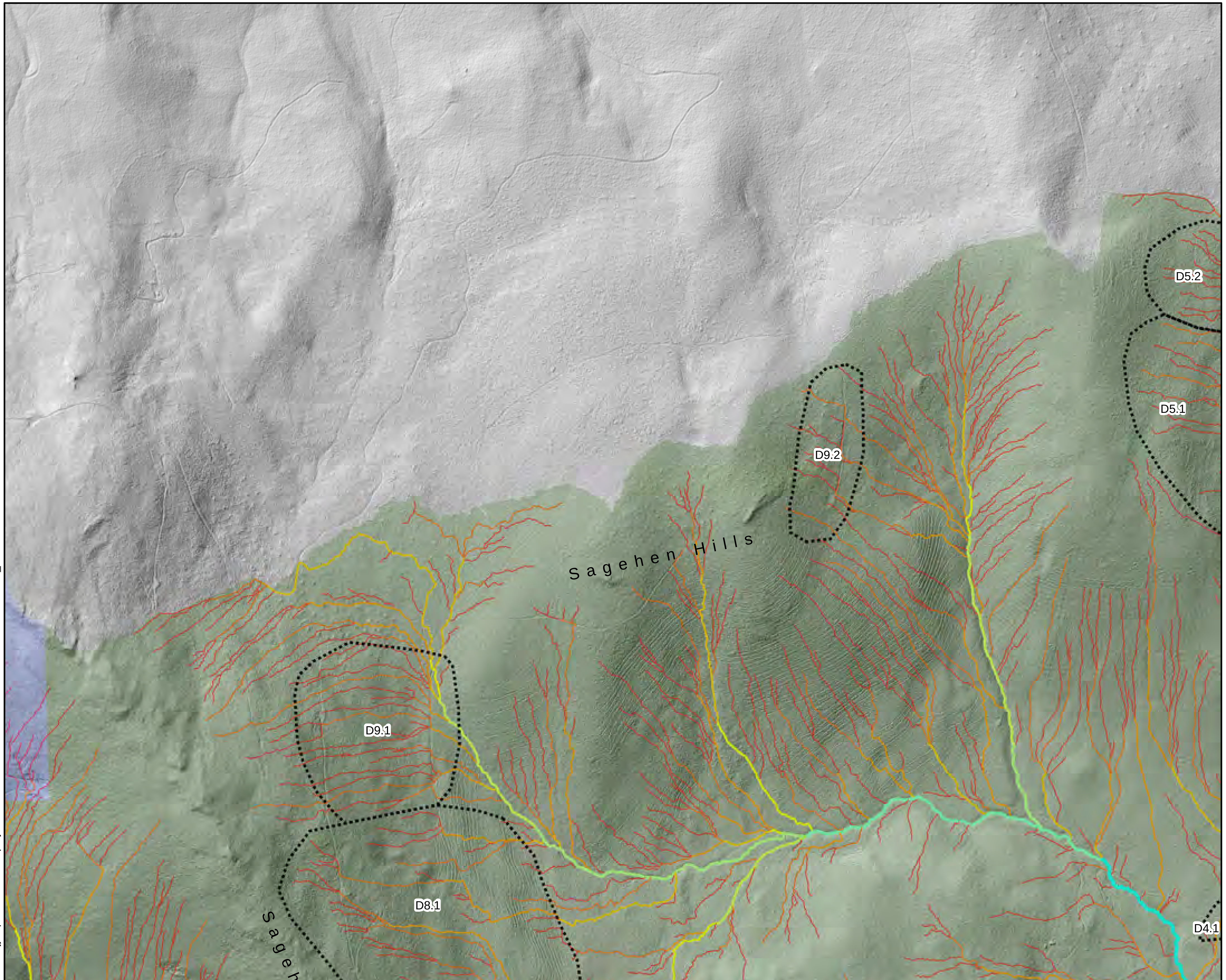
Sheet 8 **Flow Accumulation Map Showing Disturbed and Functional Areas, Prosser Creek Watershed, Nevada County, California**

Basemap Source: USFS 2014 LiDAR

© 2021 Balance Hydrologics, Inc.



Drainage Lines by Watershed Area

- 1 to 5 acres
- 5 to 10 acres
- 10 to 20 acres
- 20 to 50 acres
- 50 to 100 acres
- 100 to 200 acres
- 200 to 500 acres
- 500 to 1,000 acres
- 1,000 to 2,000 acres
- 2,000 to 5,000 acres
- 5,000 to 10,000 acres
- 10,000 to 20,000 acres
- >20, 000 acres

Prosser Creek Watershed

Lakes

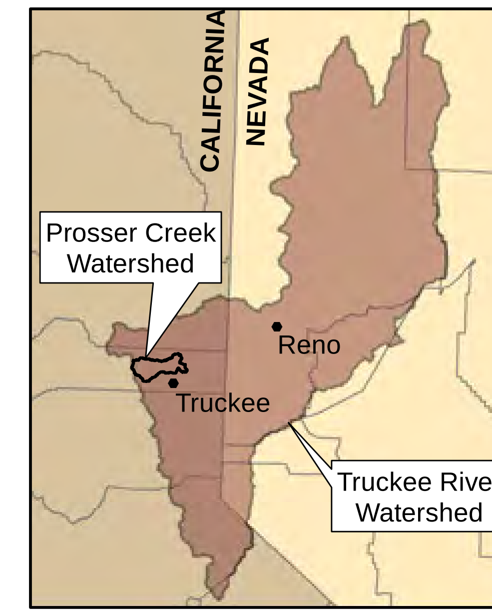
Classification

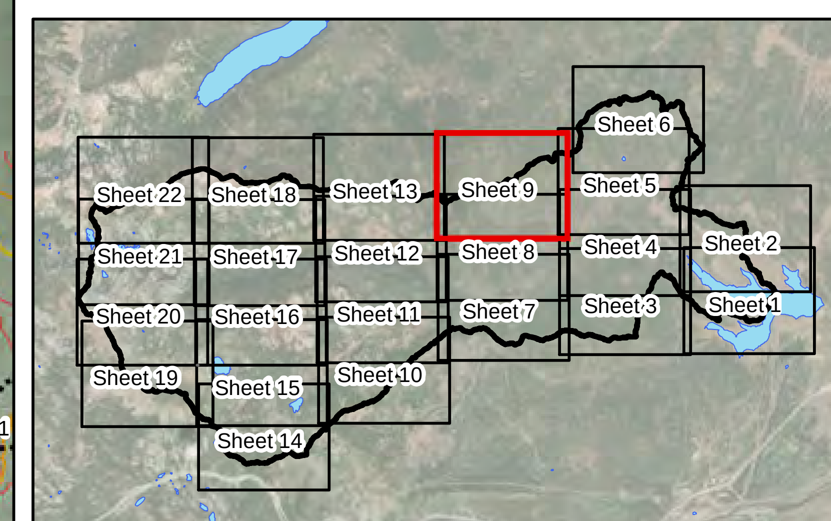
- Disturbed
- Functional

Owner

- Tahoe Donner Association
- Truckee Donner Land Trust
- Tahoe National Forest
- Private Property (No Fill)

0 500 1,000 Feet





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Sheet 9 Flow Accumulation Map Showing Disturbed and Functional Areas, Prosser Creek Watershed, Nevada County, California

Basemap Source: USFS 2014 LiDAR

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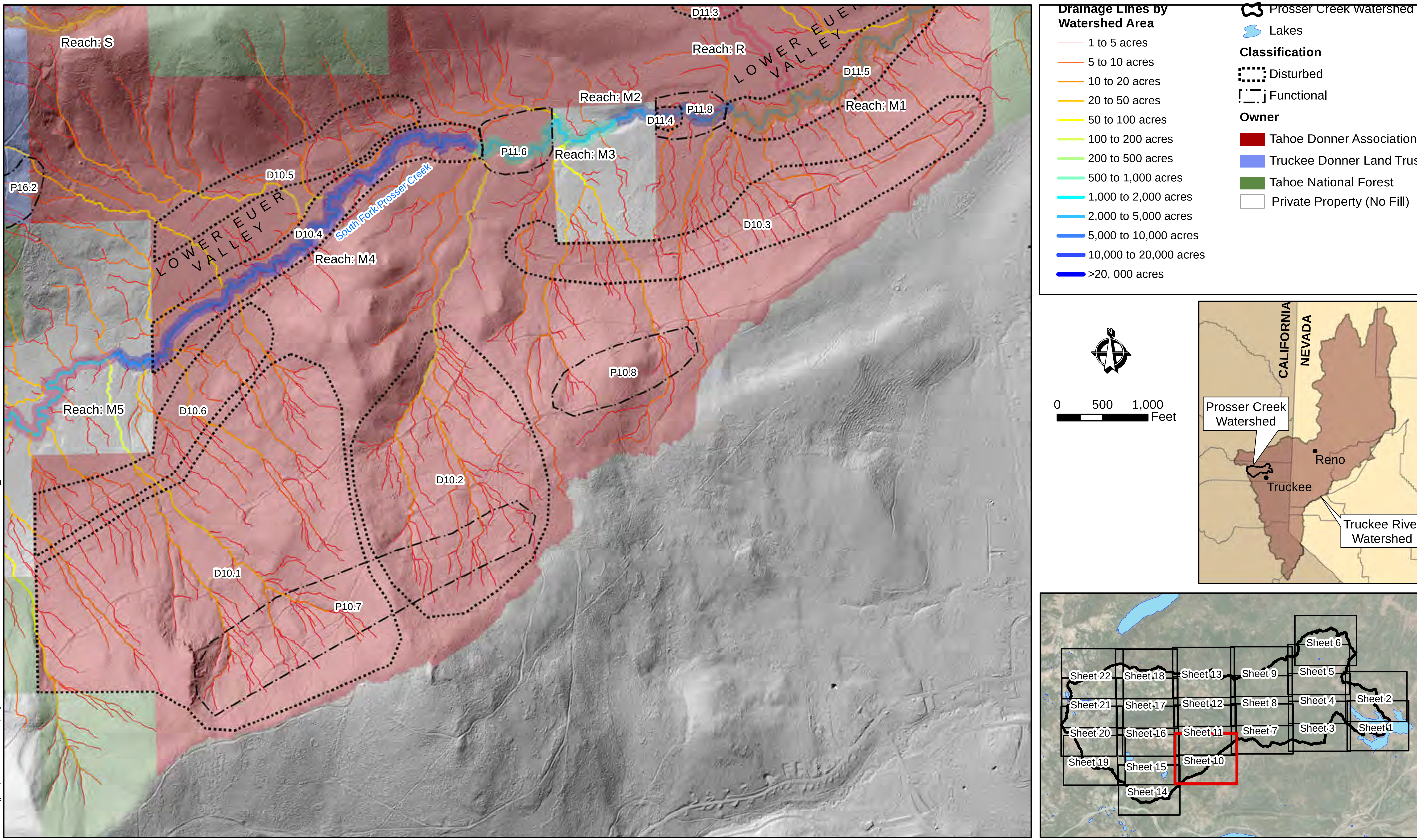

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Sheet 10 Flow Accumulation Map Showing Disturbed and Functional Areas, Prosser Creek Watershed, Nevada County, California

Basemap Source: USFS 2014 LiDAR

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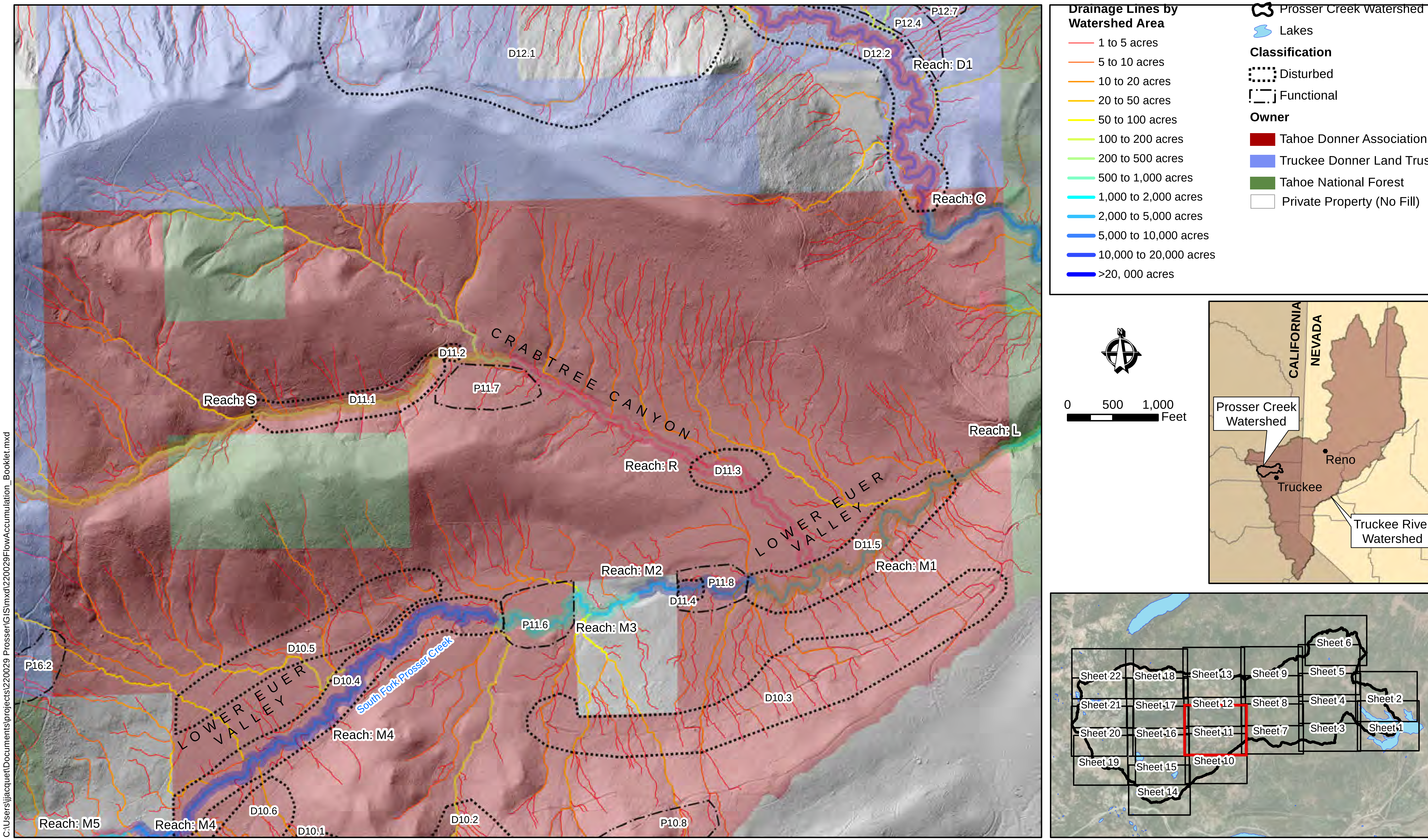

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Sheet 11 Flow Accumulation Map Showing Disturbed and Functional Areas, Prosser Creek Watershed, Nevada County, California

Basemap Source: USFS 2014 LiDAR

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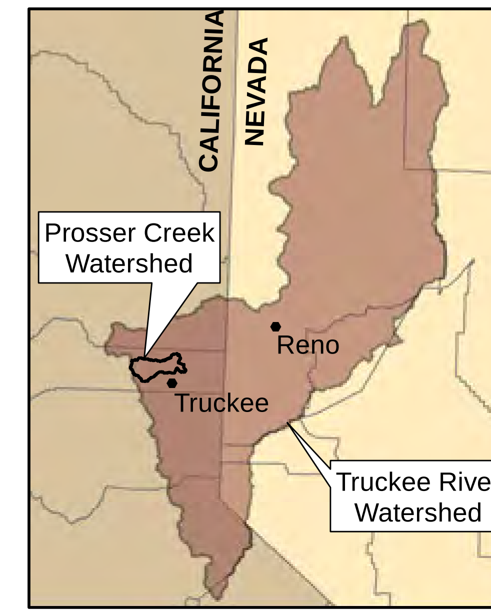
Drainage Lines by Watershed Area
- 1 to 5 acres
- 5 to 10 acres
- 10 to 20 acres
- 20 to 50 acres
- 50 to 100 acres
- 100 to 200 acres
- 200 to 500 acres
- 500 to 1,000 acres
- 1,000 to 2,000 acres
- 2,000 to 5,000 acres
- 5,000 to 10,000 acres
- 10,000 to 20,000 acres
- >20, 000 acres

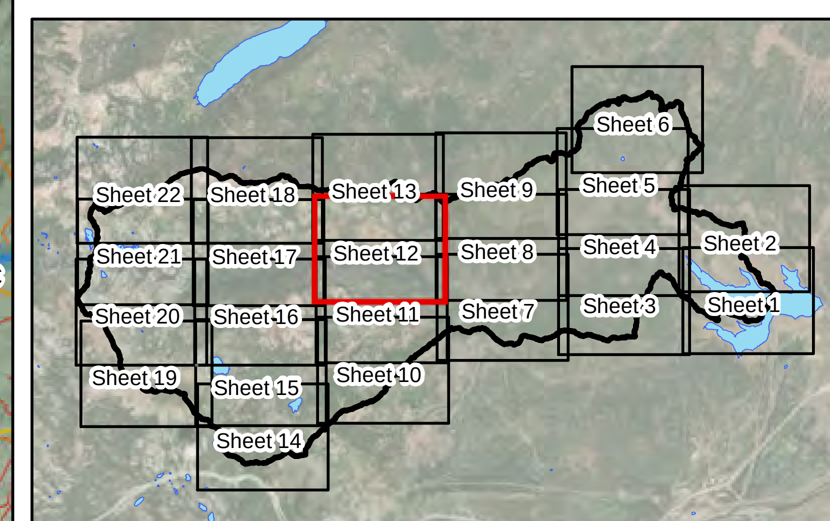
Prosser Creek Watershed
Lakes

Classification
- Disturbed
- Functional

Owner
- Tahoe Donner Association
- Truckee Donner Land Trust
- Tahoe National Forest
- Private Property (No Fill)

0 500 1,000 Feet





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Sheet 12 Flow Accumulation Map Showing Disturbed and Functional Areas, Prosser Creek Watershed, Nevada County, California

Basemap Source: USFS 2014 LiDAR

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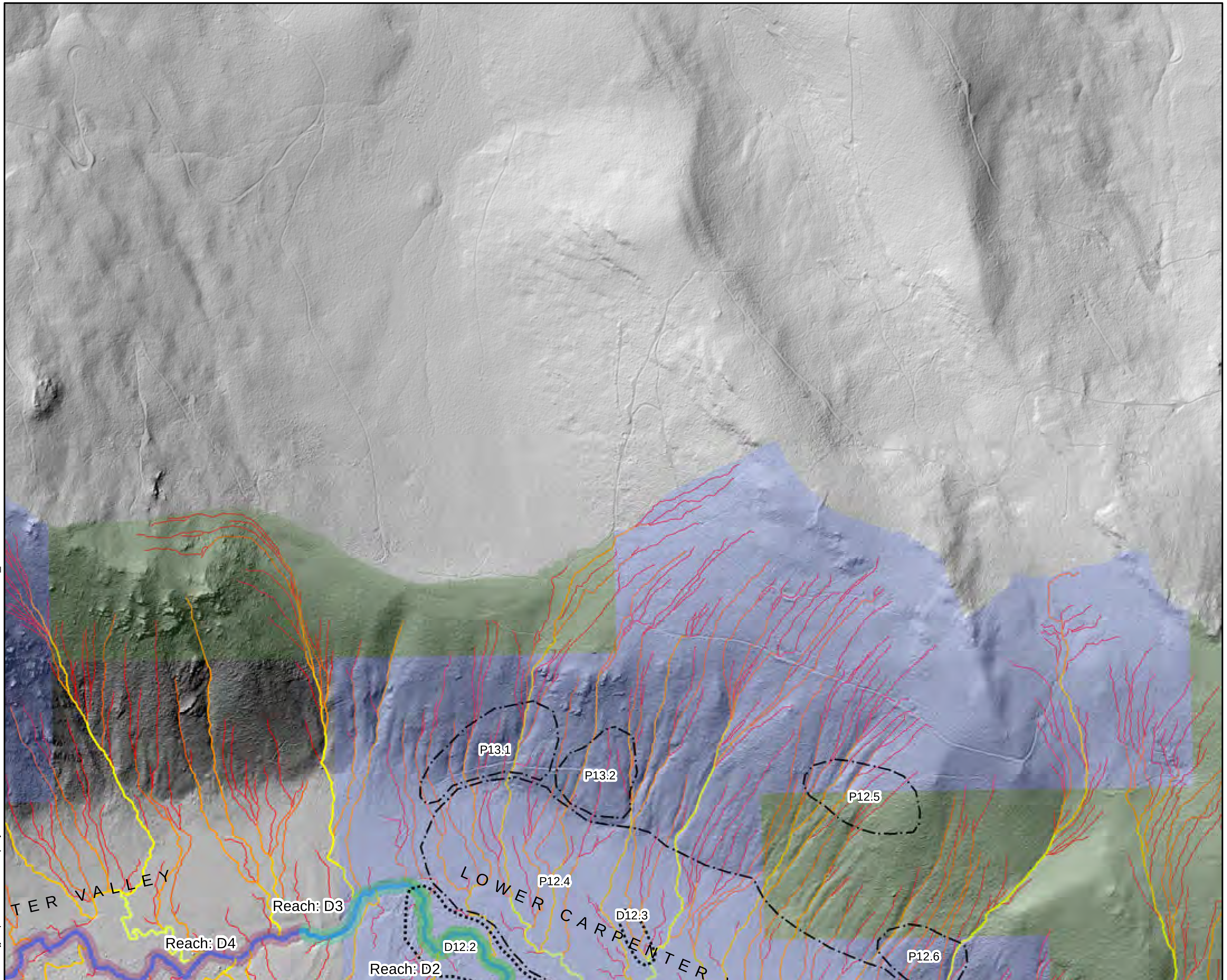


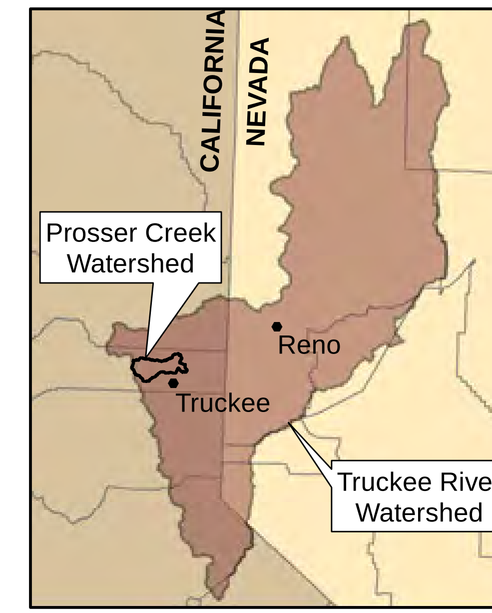
Drainage Lines by Watershed Area
- 1 to 5 acres
- 5 to 10 acres
- 10 to 20 acres
- 20 to 50 acres
- 50 to 100 acres
- 100 to 200 acres
- 200 to 500 acres
- 500 to 1,000 acres
- 1,000 to 2,000 acres
- 2,000 to 5,000 acres
- 5,000 to 10,000 acres
- 10,000 to 20,000 acres
- >20, 000 acres

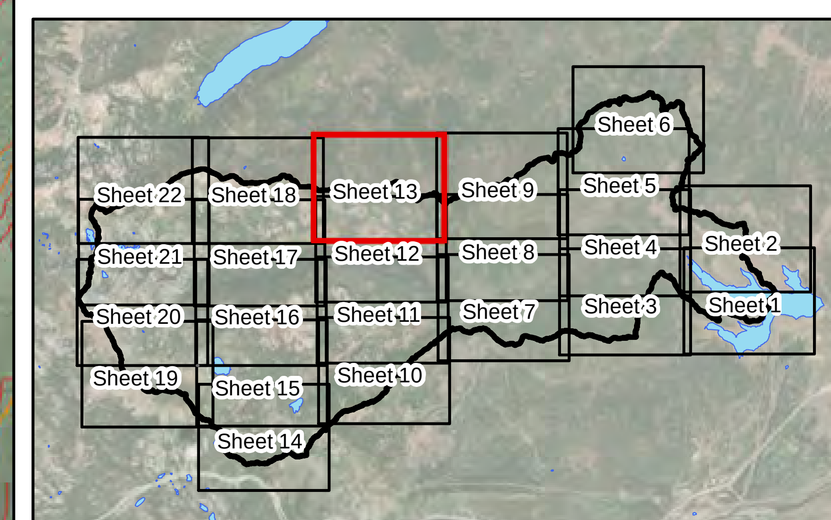
Prosser Creek Watershed
Lakes

Classification
- Disturbed
- Functional

Owner
- Tahoe Donner Association
- Truckee Donner Land Trust
- Tahoe National Forest
- Private Property (No Fill)

0 500 1,000 Feet





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Ecological Consultants

Sheet 13 Flow Accumulation Map Showing Disturbed and Functional Areas, Prosser Creek Watershed, Nevada County, California

Basemap Source: USFS 2014 LiDAR

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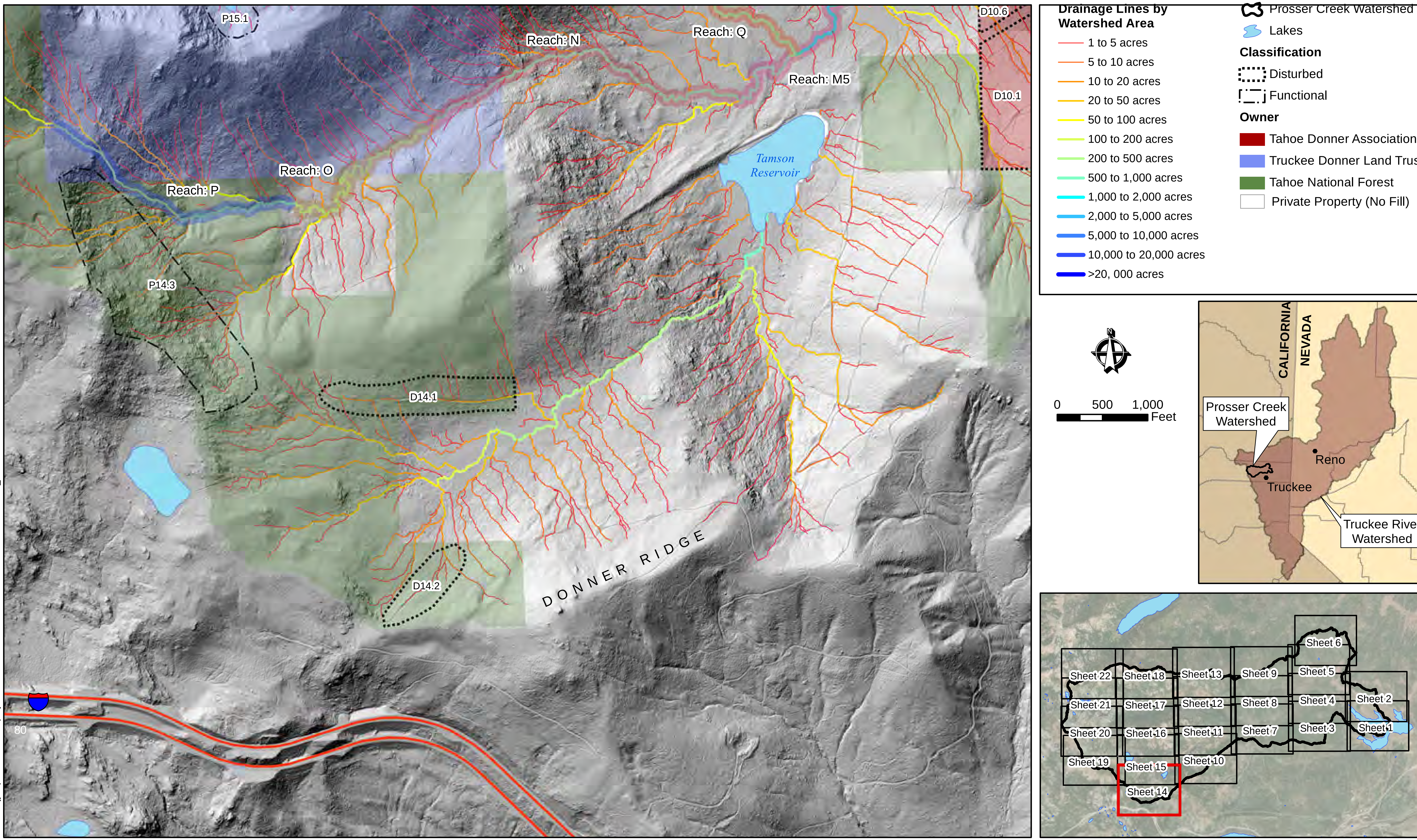

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Sheet 14 Flow Accumulation Map Showing Disturbed and Functional Areas, Prosser Creek Watershed, Nevada County, California

Basemap Source: USFS 2014 LiDAR

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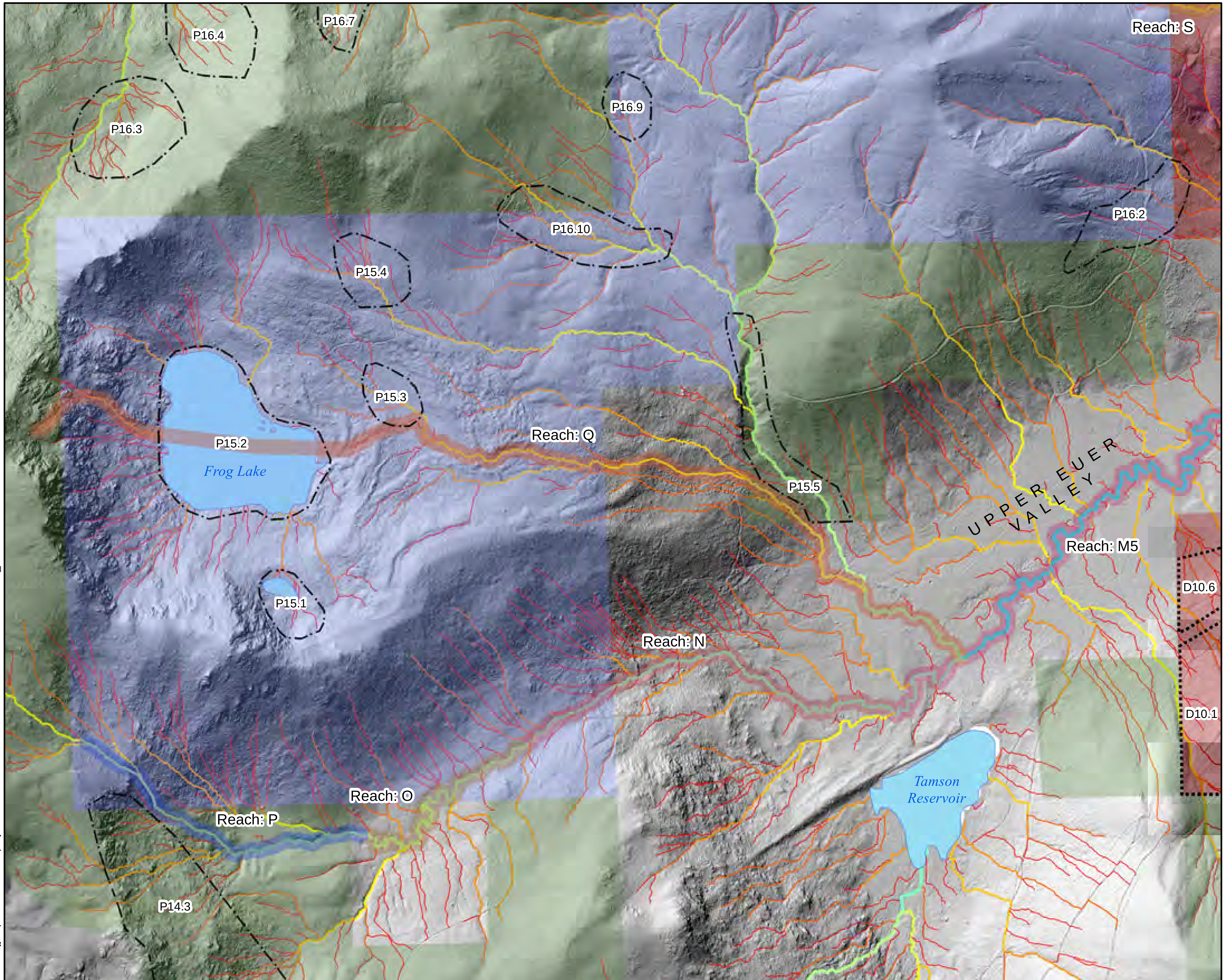


Drainage Lines by Watershed Area

- 1 to 5 acres
- 5 to 10 acres
- 10 to 20 acres
- 20 to 50 acres
- 50 to 100 acres
- 100 to 200 acres
- 200 to 500 acres
- 500 to 1,000 acres
- 1,000 to 2,000 acres
- 2,000 to 5,000 acres
- 5,000 to 10,000 acres
- 10,000 to 20,000 acres
- >20, 000 acres

Prosser Creek Watershed

Lakes

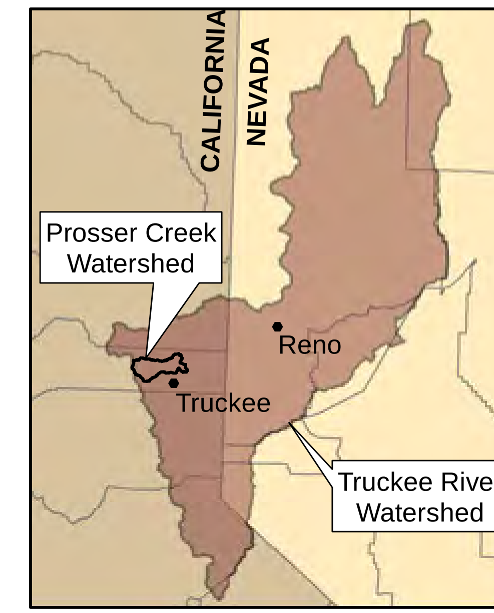
Classification

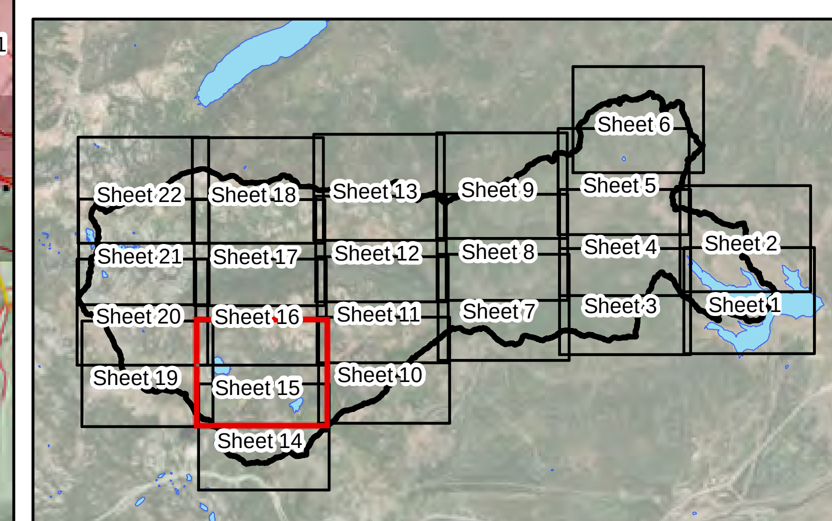
- Disturbed
- Functional

Owner

- Tahoe Donner Association
- Truckee Donner Land Trust
- Tahoe National Forest
- Private Property (No Fill)

0 500 1,000 Feet





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Sheet 15 Flow Accumulation Map Showing Disturbed and Functional Areas, Prosser Creek Watershed, Nevada County, California

Basemap Source: USFS 2014 LiDAR

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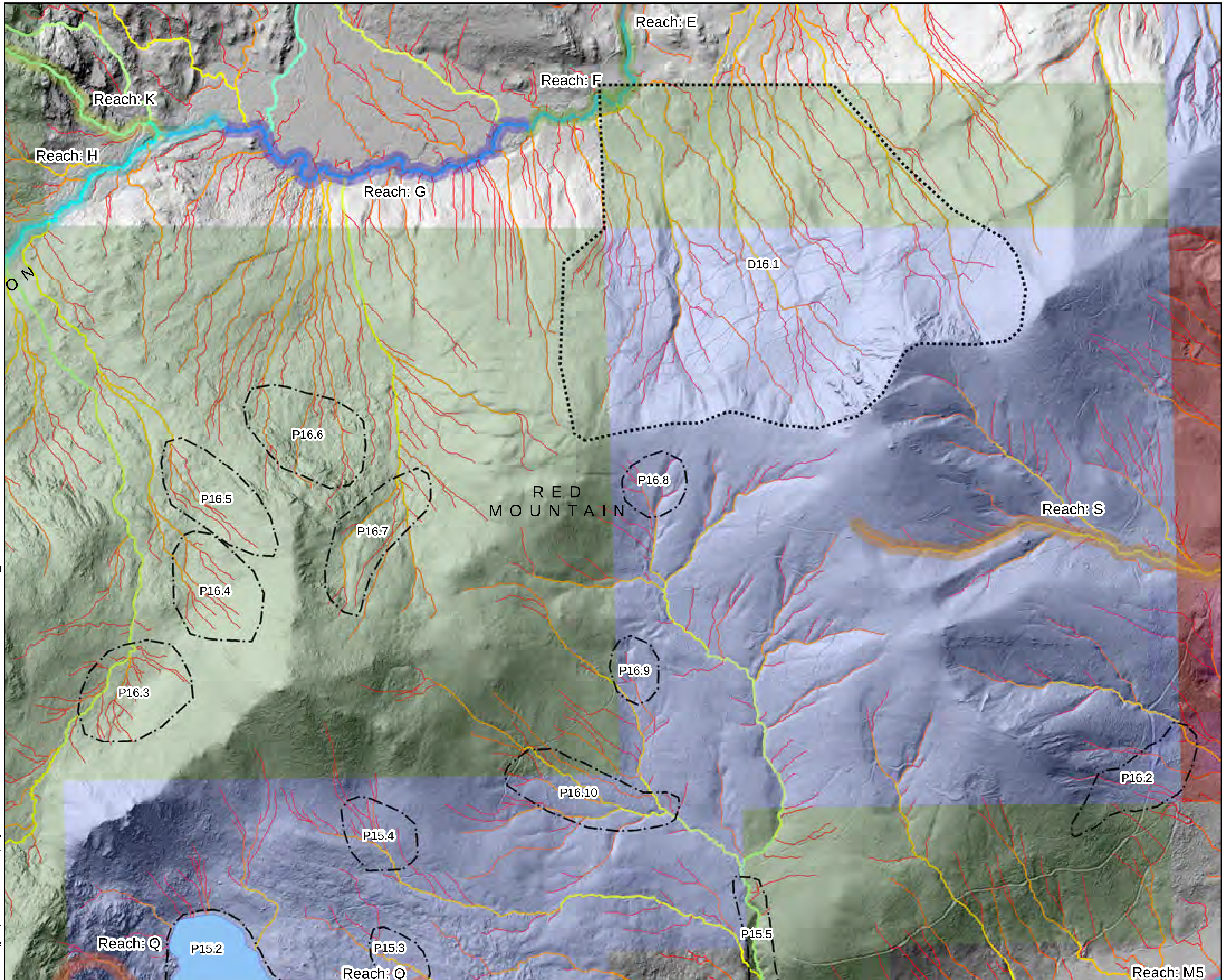

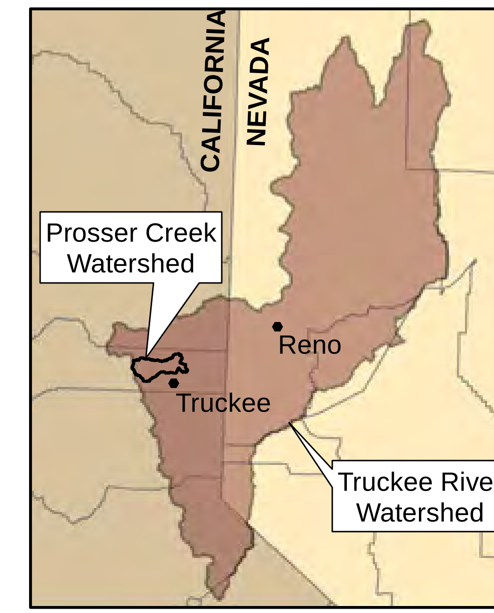

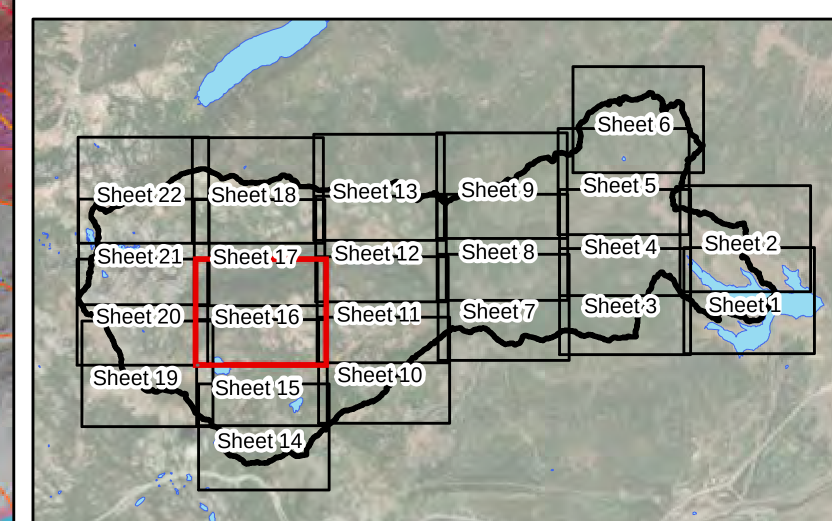

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Sheet 16 Flow Accumulation Map Showing Disturbed and Functional Areas, Prosser Creek Watershed, Nevada County, California

Basemap Source: USFS 2014 LiDAR

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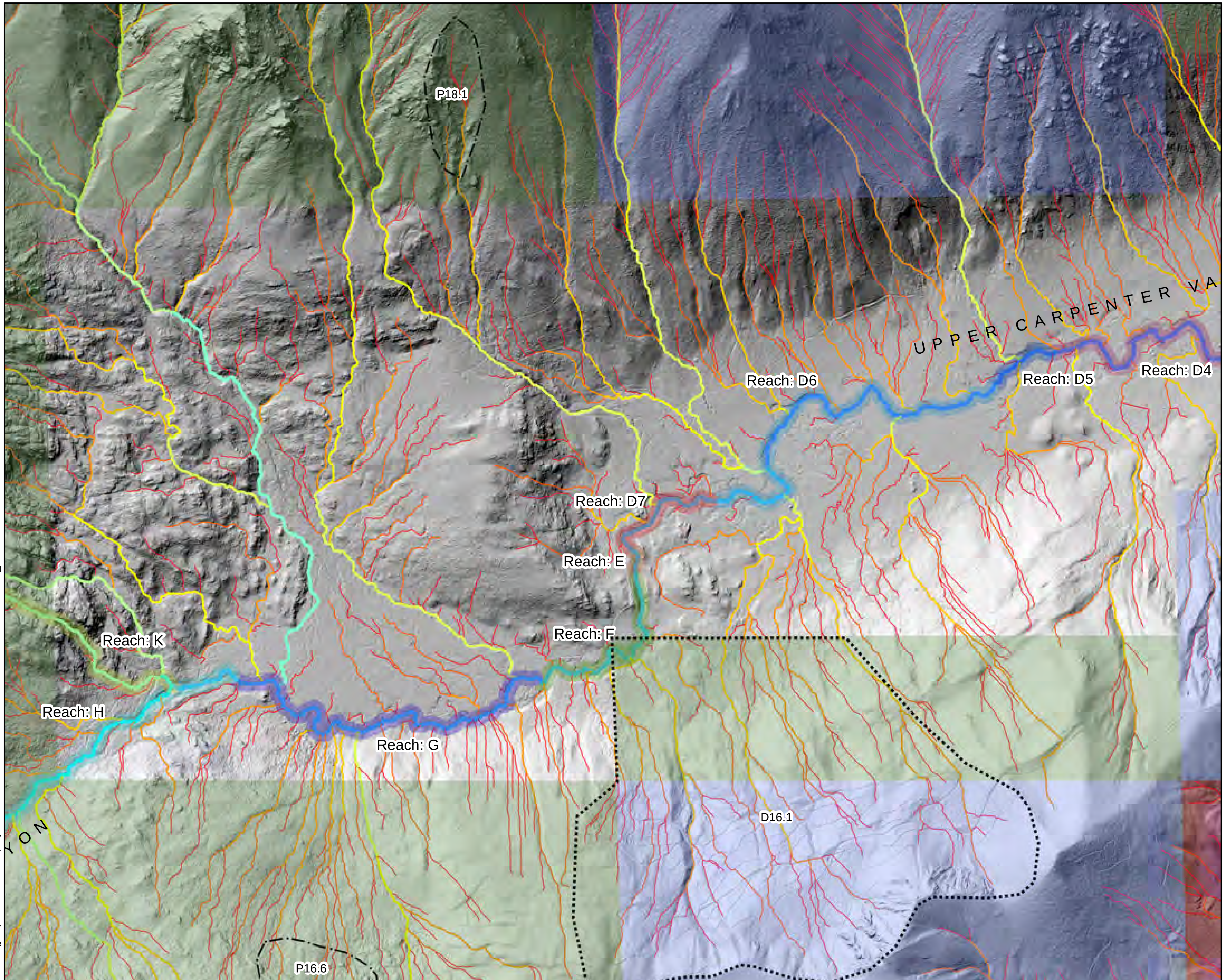

Drainage Lines by Watershed Area
- 1 to 5 acres
- 5 to 10 acres
- 10 to 20 acres
- 20 to 50 acres
- 50 to 100 acres
- 100 to 200 acres
- 200 to 500 acres
- 500 to 1,000 acres
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- 2,000 to 5,000 acres
- 5,000 to 10,000 acres
- 10,000 to 20,000 acres
- >20, 000 acres

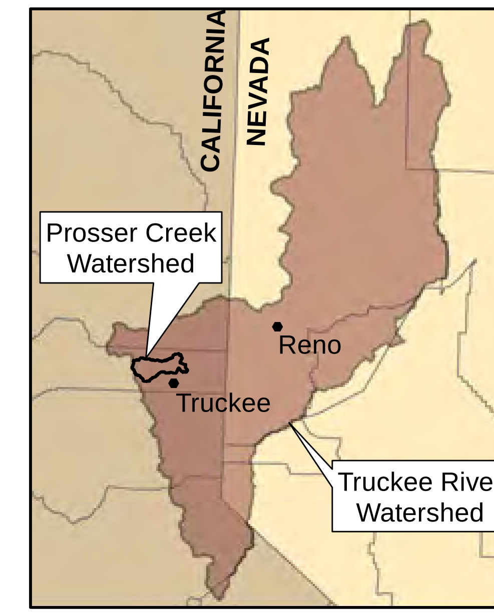
Prosser Creek Watershed

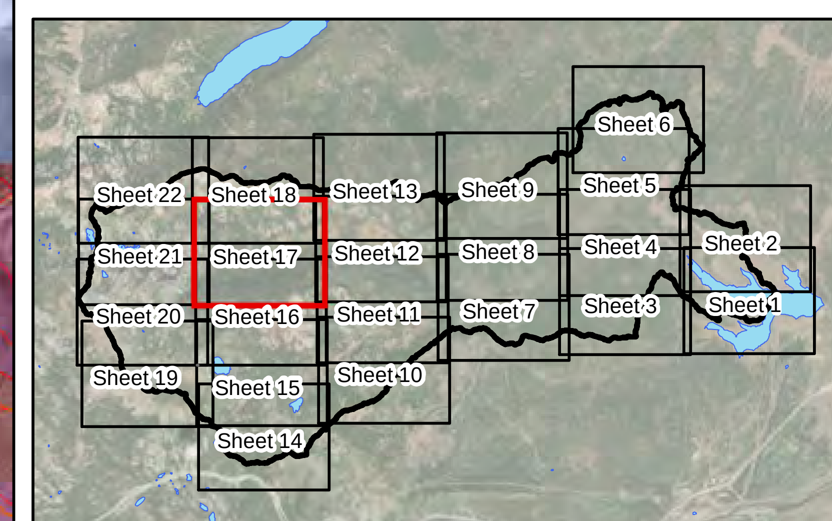
Lakes

Classification
- Disturbed
- Functional

Owner
- Tahoe Donner Association
- Truckee Donner Land Trust
- Tahoe National Forest
- Private Property (No Fill)

0 500 1,000 Feet





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Sheet 17 Flow Accumulation Map Showing Disturbed and Functional Areas, Prosser Creek Watershed, Nevada County, California

Basemap Source: USFS 2014 LiDAR

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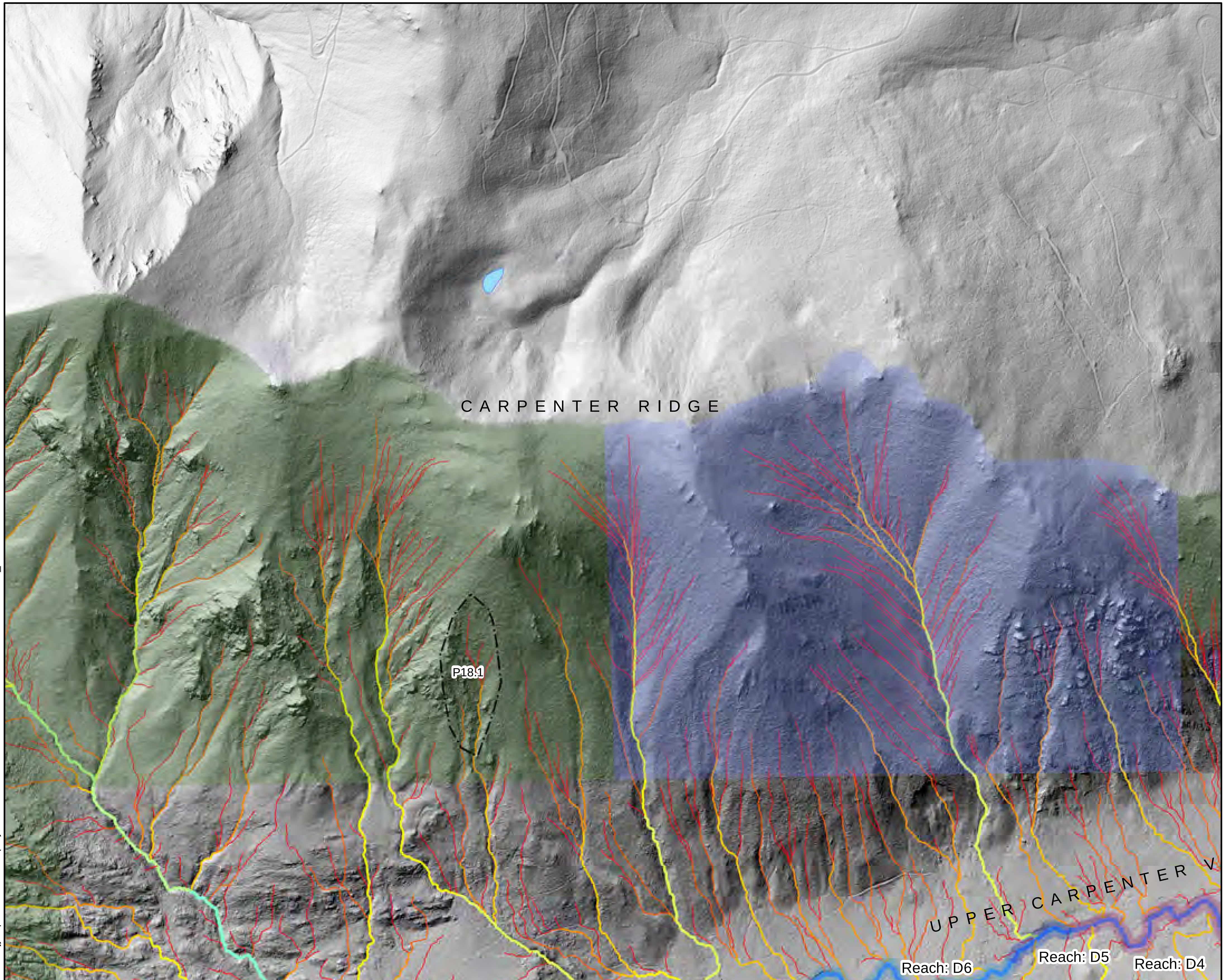

Drainage Lines by Watershed Area

- 1 to 5 acres
- 5 to 10 acres
- 10 to 20 acres
- 20 to 50 acres
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- 10,000 to 20,000 acres
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Prosser Creek Watershed

Lakes

Classification

- Disturbed
- Functional

Owner

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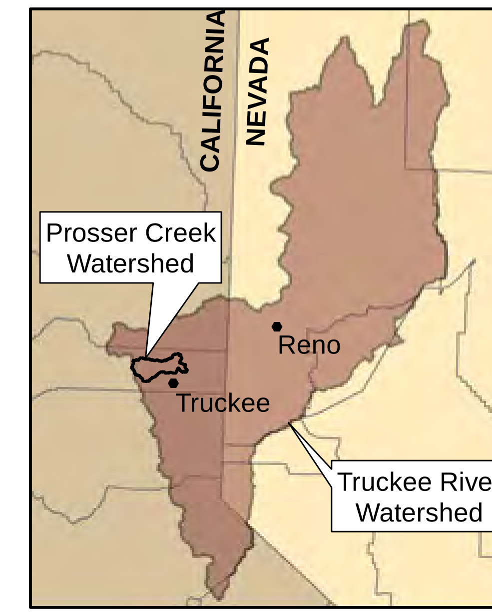
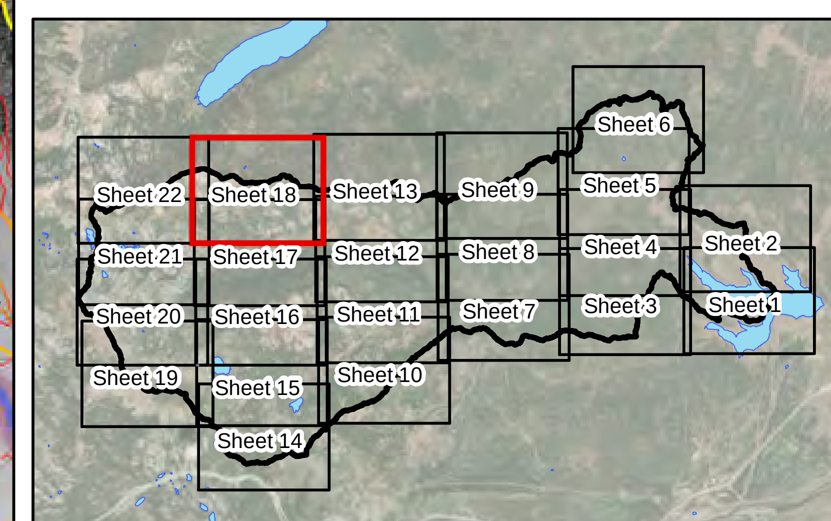
- Tahoe National Forest
- Private Property (No Fill)

0 500 1,000 Feet





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Sheet 18 Flow Accumulation Map Showing Disturbed and Functional Areas, Prosser Creek Watershed, Nevada County, California

Basemap Source: USFS 2014 LiDAR

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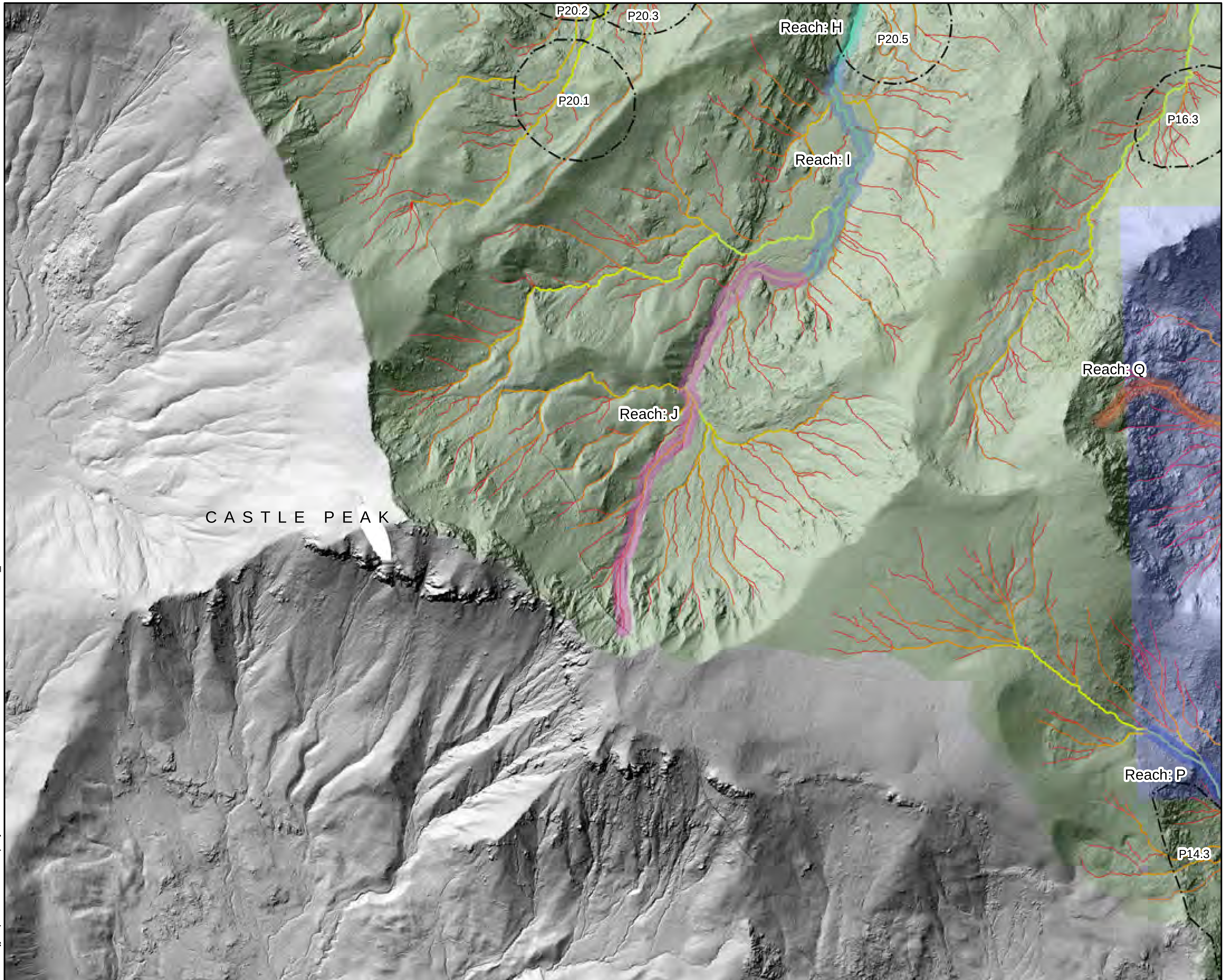

Drainage Lines by Watershed Area

- 1 to 5 acres
- 5 to 10 acres
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Prosser Creek Watershed
Lakes

Classification

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Owner

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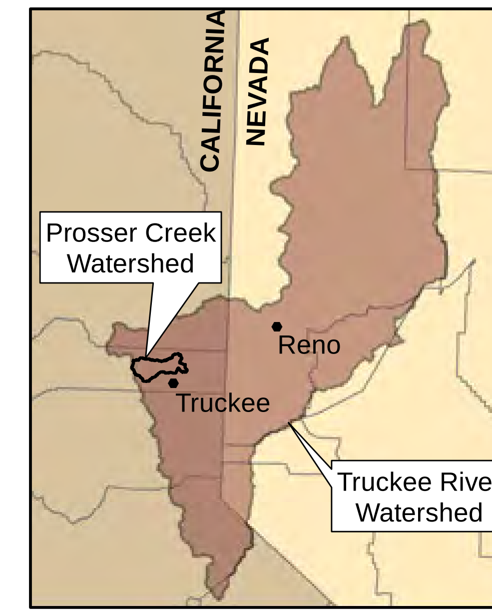
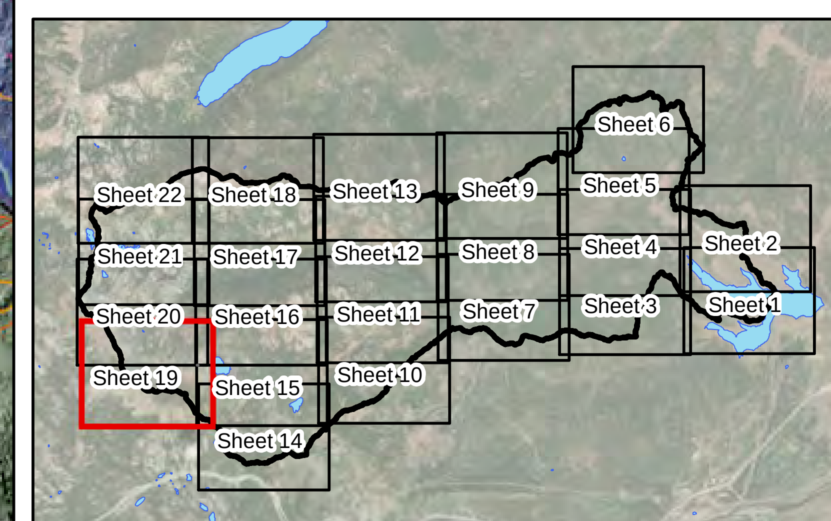
- Private Property (No Fill)

0 500 1,000 Feet





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Sheet 19 Flow Accumulation Map Showing Disturbed and Functional Areas, Prosser Creek Watershed, Nevada County, California

Basemap Source: USFS 2014 LiDAR

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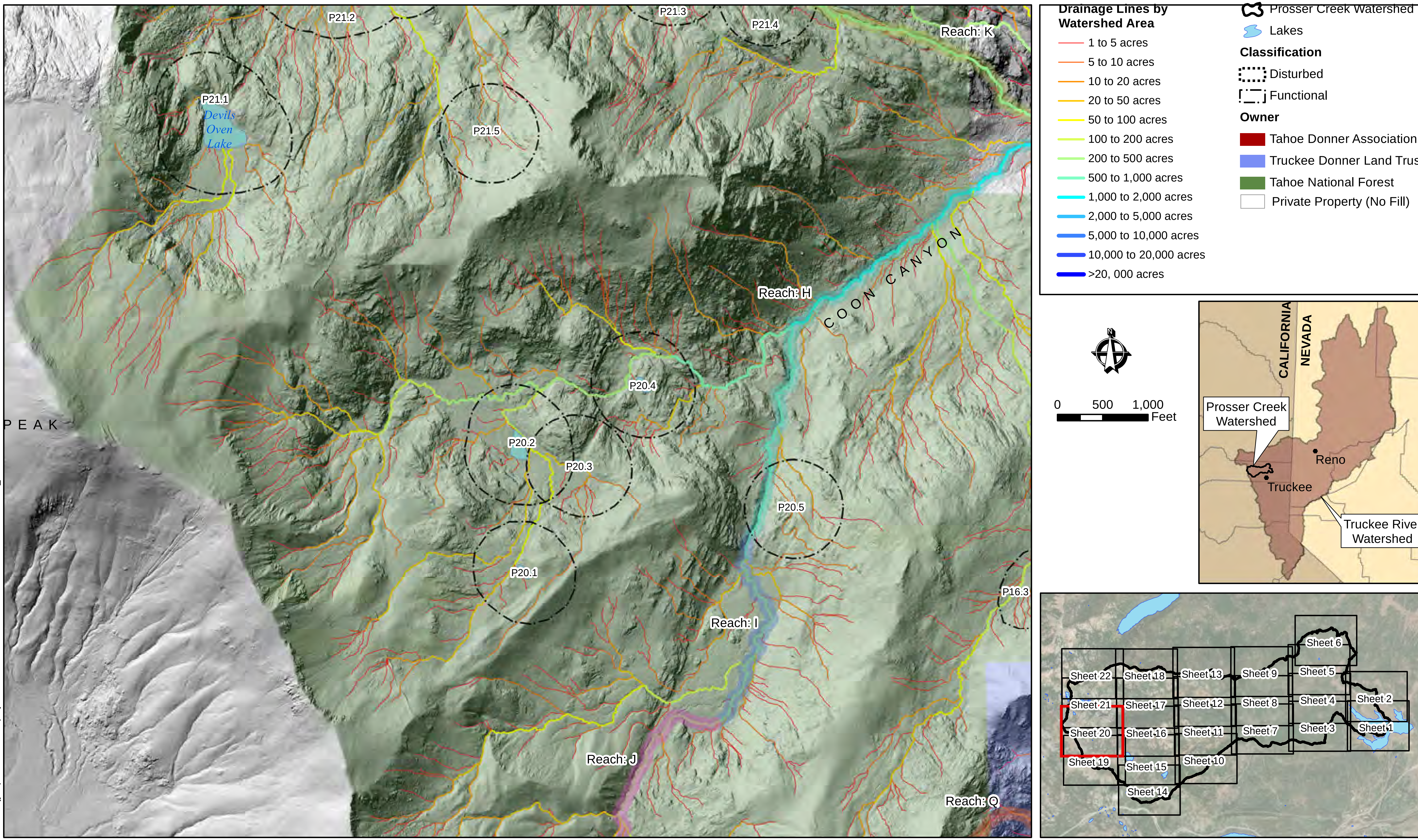

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Sheet 20 **Flow Accumulation Map Showing Disturbed and Functional Areas, Prosser Creek Watershed, Nevada County, California**

Basemap Source: USFS 2014 LiDAR

© 2021 Balance Hydrologics, Inc.

Drainage Lines by Watershed Area
- 1 to 5 acres
- 5 to 10 acres
- 10 to 20 acres
- 20 to 50 acres
- 50 to 100 acres
- 100 to 200 acres
- 200 to 500 acres
- 500 to 1,000 acres
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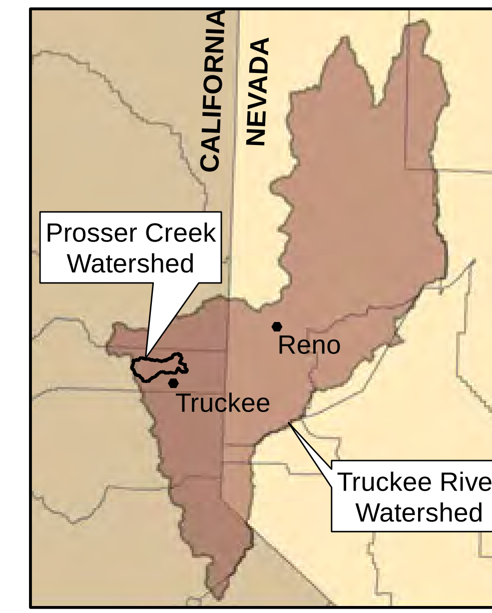
- 2,000 to 5,000 acres
- 5,000 to 10,000 acres
- 10,000 to 20,000 acres
- >20, 000 acres

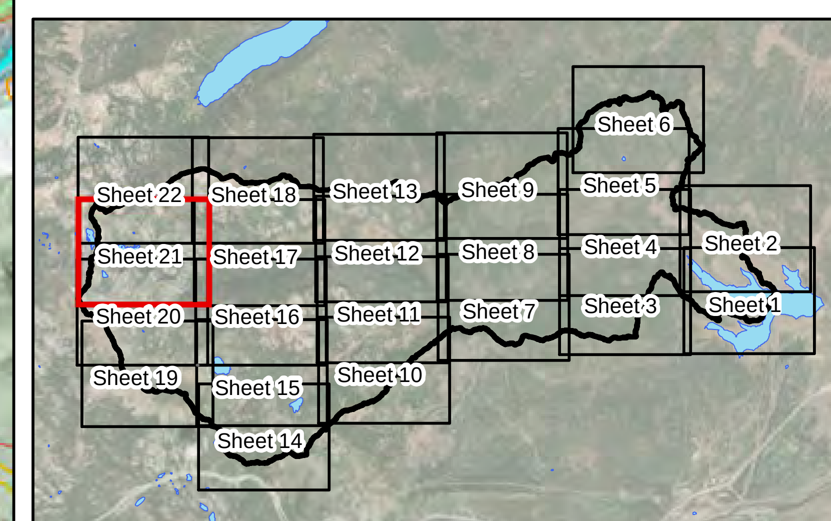
Prosser Creek Watershed
Lakes

Classification
- Disturbed
- Functional

Owner
- Tahoe Donner Association
- Truckee Donner Land Trust
- Tahoe National Forest
- Private Property (No Fill)

0 500 1,000 Feet





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Sheet 21 Flow Accumulation Map Showing Disturbed and Functional Areas, Prosser Creek Watershed, Nevada County, California

Basemap Source: USFS 2014 LiDAR

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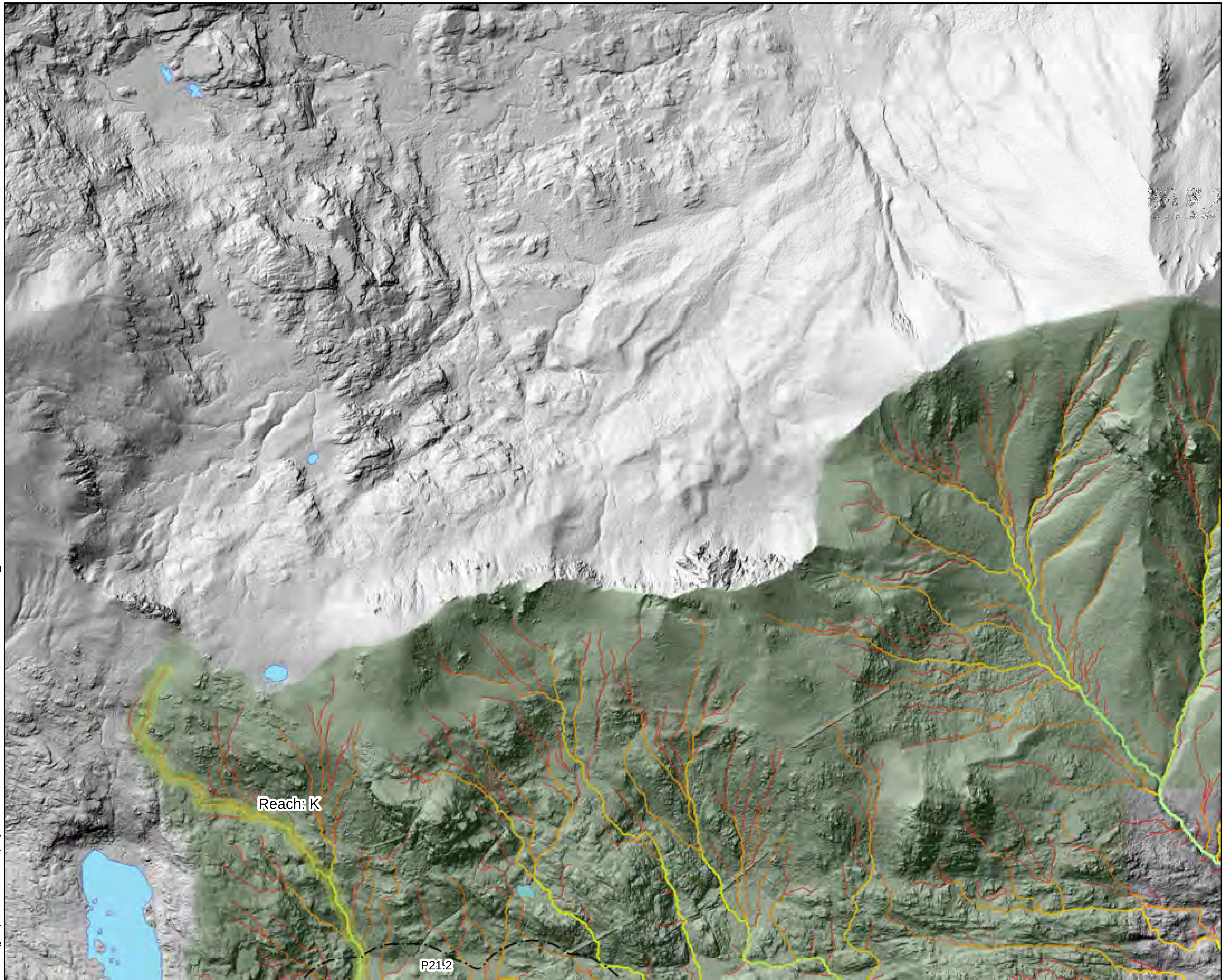

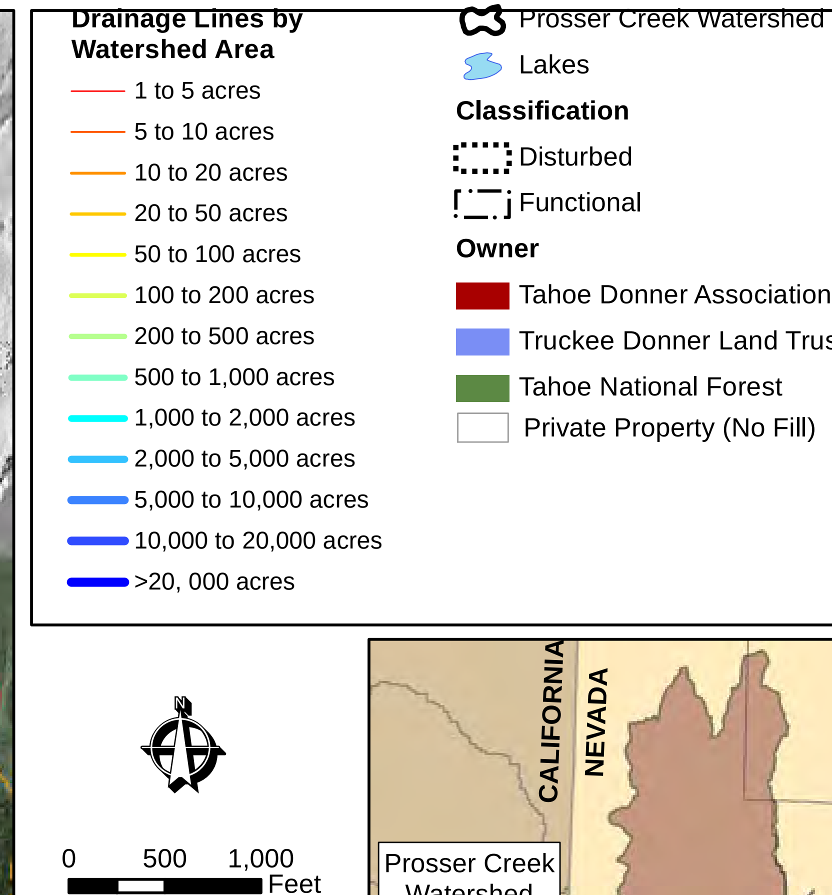

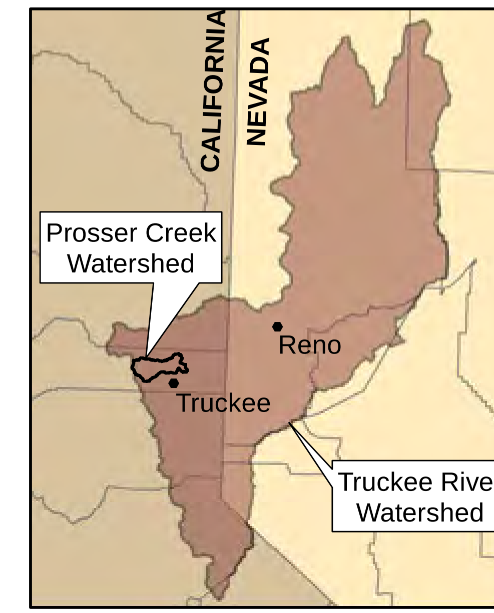

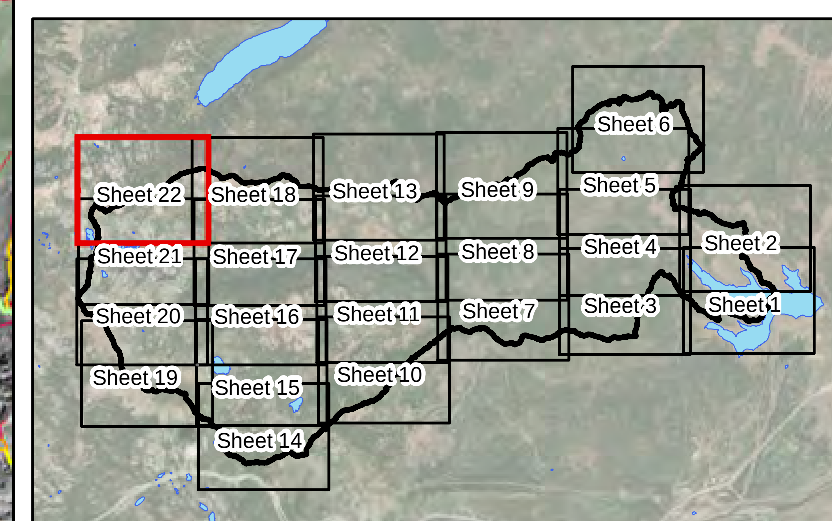

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Sheet 22 Flow Accumulation Map Showing Disturbed and Functional Areas, Prosser Creek Watershed, Nevada County, California

Basemap Source: USFS 2014 LiDAR

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APPENDIX H

Lahontan Cutthroat Trout Assessment

H. T. HARVEY & ASSOCIATES
Ecological Consultants
50 years of field notes, exploration, and excellence

Memorandum

Project# 4425-01

January 8, 2021

To: **Beth Christman, Truckee River Watershed Council**

From: **Matt Wacker, H. T. Harvey & Associates**

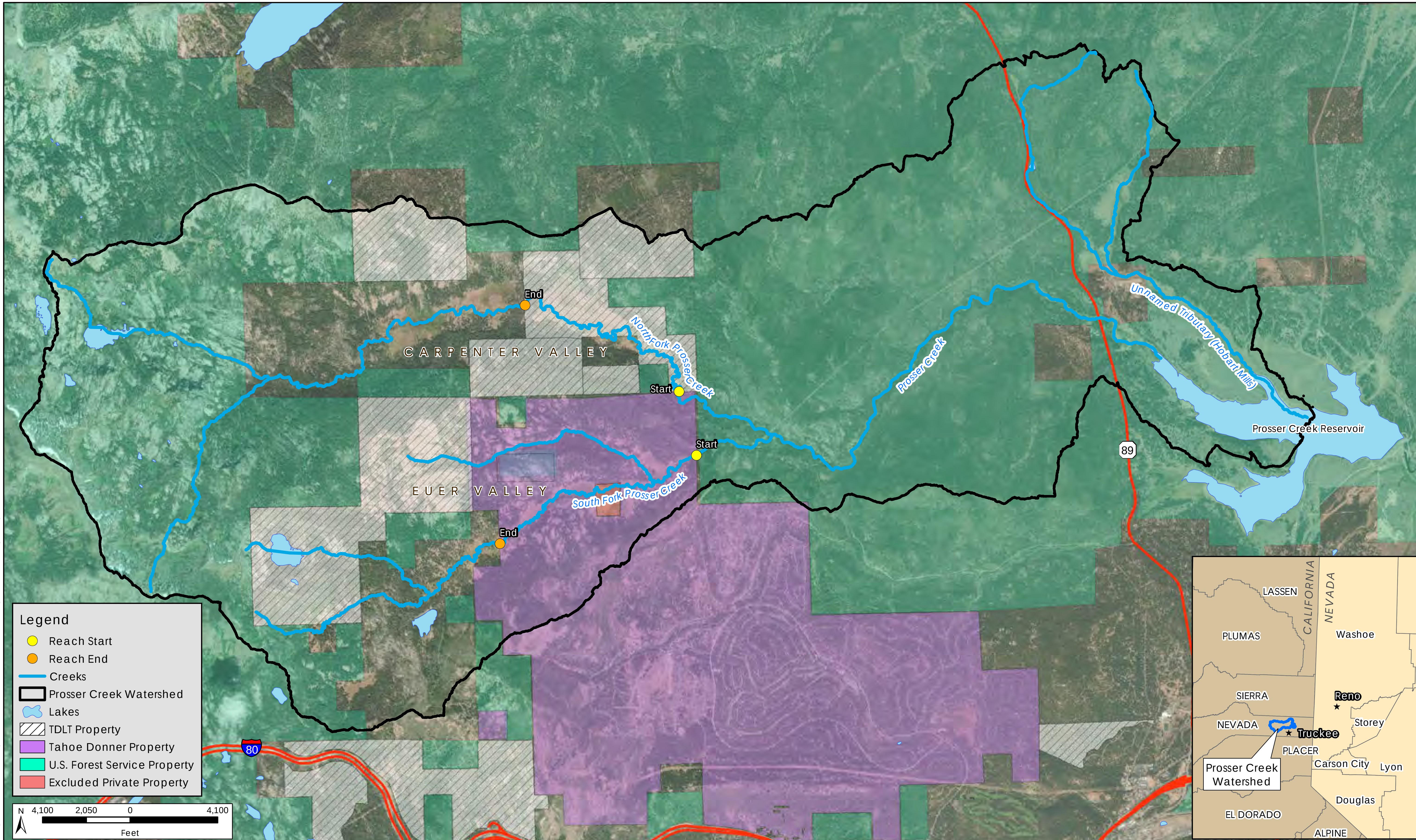
Subject: **Lahontan Cutthroat Trout (*Oncorhynchus clarkii henshawi)* Prosser Creek Watershed Reintroduction Assessment**

Introduction

The following summarizes Lahontan cutthroat trout (*Oncorhynchus clarkii henshawi*, LCT) reintroduction potential in the Prosser Creek Watershed (Figure 1). The assessment was completed by H. T. Harvey & Associates as a component of the larger Prosser Creek Watershed Assessment being developed on behalf of the Truckee River Watershed Council by Balance Hydrologics (Balance), H. T. Harvey & Associates, and Dr. Susan Lindstrom. Dr. Sharon Kramer, H. T. Harvey & Associates principal fisheries ecologist, together with Matt Wacker, senior associate ecologist, and Dr. Kristina Wolf, rangeland ecosystem ecologist, developed this assessment. This assessment represents a reconnaissance-level assessment of LCT reintroduction potential and is limited by field conditions observed in 2020, a dry year with roughly 67% of the 30-year average annual precipitation (NRCS 2020), and a limited field data collected over 2 days in July and September 2020.

Background

Moyle et al. (1996) identified four zoogeographic regions (drainages) in the Sierra Nevada, each defined by distinctive native fish communities sharing few species in common. The Lahontan Basin, consisting of the Susan, Truckee, Carson, and Walker River drainages, is characterized by ten native fish species, including LCT, which historically were distributed widely throughout the drainage from lowlands to elevations above 2000 m (6560 ft). Historically, LCT were abundant and occurred in Lake Tahoe, Pyramid Lake, Winnemucca Lake, the Truckee River, and tributaries to these waterbodies (Sigler et al. 1983). Extensive logging, water diversions, poorly managed grazing, overfishing for commercial harvest, road construction, and the introduction of



N:\Projects4400\4425-01\Reports\Lahontan Cutthroat Trout Feasibility Assessment\Fig 1 Project Location.mxd

H. T. HARVEY & ASSOCIATES
Ecological Consultants

Figure 1. Project Location
Prosser Creek Lahontan Cutthroat Trout Reintroduction Feasibility Assessment (4425-01)
January 2021

nonnative fishes and other aquatic organisms have contributed to the elimination of LCT from most of the species' historic range in the Lahontan Basin, with significant populations of LCT remaining in only Pyramid Lake (Murphy and Knopp 2000). Within the Truckee River drainage small populations occur in Independence Lake, Independence Creek, and in several other, smaller, isolated populations, mostly in lakes (e.g., Warren Lake, Prosser Creek Reservoir, Webber Lake), all of which originated from introductions of hatchery-reared fish.

Life History

Stream-resident LCT are opportunistic feeders, with diets consisting of drift organisms, typically aquatic insects (Moyle 2002, Dunham et al. 2000, Baxter et al. 2005) such as chironomids (midges), hemipterans (true bugs – e.g., caddisflies, mayflies, stoneflies, mosquito larvae), odonates (damselflies and dragonfly larvae), coleopterans (beetles), and hydracarinads (back-swimmers and water boatmen) as well as aquatic zooplankton (e.g., copepods), terrestrial insects, amphipods (e.g., scuds), algae, and aquatic vascular plants (Sigler et al. 1983). Larger LCT (>300 mm [11.8 inches] total length [TL]) are mostly piscivorous; although, even these larger fish may feed opportunistically on aquatic insects and zooplankton, with the volume of invertebrates eaten decreasing with increasing LCT size. Females mature at three or four years (352–484 mm [13.8–17.8 inches] TL), and males mature at two or three years (299–445 mm [11.7–17.5 inches] TL), with most body growth occurring in the spring (Sigler et al. 1983). Growth rates are faster in the larger, warmer waters of lakes where fish are a large portion of the diet, as compared to LCT in streams, which have a relatively slower growth rate, are smaller, and generally become sexually mature around year three (Ray et al. 2007).

Lake-resident female LCT generally do not spawn in consecutive years, but rather, every other year or even every three years, and depending on the age at maturity, females may only spawn once or twice in their lifetime (Sigler et al. 1983). Although little is known about the spawning habits of stream-adapted LCT (USFWS 2009), the timing of spawning typically occurs between April and July but can vary annually based on stream flow, elevation, and water temperature (McAfee 1966, Lea 1968, Moyle 2002, Rissler et al. 2006). In lake environments, LCT may live 5–9 years (Lea 1968, Rankel 1976, Rissler et al. 2006), while stream-dwelling LCT generally live to be less than 6 years of age (Ray et al. 2007).

Eggs are deposited in clean, small gravels, generally between 6.4–12.7 mm (0.24–0.5 inch) in size, that are well oxygenated and relatively silt-free for good egg survival. LCT eggs generally hatch in 4–6 weeks, depending on water temperature, and fry emerge from the redd 13–23 days later (Lea 1968, Rankel 1976). Emergent fry remain in shallow shoreline areas with small gravel/cobble for hiding cover. By early fall the fry have developed into small (40–80 mm [1.5–3.1 inches] TL) fingerlings which may school together in shallow pools (USFWS 2009).

Habitat and Ecology

Like most salmonids, LCT require relatively clear, cold waters to maintain viable populations (USFWS 2009). Stream-resident LCT generally prefer rocky areas, riffles, deep pools, and habitats near overhanging logs, shrubs, or banks (McAfee 1966; Sigler and Sigler 1987). They generally do not inhabit waters colder than 7°C

(45°F), or do so only rarely (Sigler et al. 1983). As with other stream-resident salmonids, they prefer relatively stable water temperatures averaging around 13°C (55°F) and ranging between approximately 9°C (48°F) and 17°C (63°F) (Hickman and Raleigh 1982). Higher temperatures, up to 22°C (72°F) (Hickman and Raleigh 1982), or potentially greater, can be tolerated for short durations as can wide diurnal fluctuations in stream temperature (USFWS 1995). Lower-gradient streams are preferred, and reaches above 4% average slope generally are less suitable for the species (Li et al. 1984)

Physical habitat requirements vary by life stage. Spawning occurs in silt-free, well-oxygenated gravels generally between 6.4–12.7 mm (0.25–0.5 inch) in size with suitable patch sizes between 0.3–1.3 m^2 (3.2–14 ft^2) in area with minimum width of 0.9 m (3 ft) (Al-Chokhachy et al. 2020). These areas typically are located along stream margins and around flow obstructions where suitably sized gravel has been deposited. In general, the lack of suitable spawning habitat is likely the most limiting physical habitat parameter affecting the reproduction and sustainability of LCT populations (Al-Chokhachy et al. 2020). Juvenile rearing habitat may be found extending across stream channels at lower flows, or may be concentrated along margins at higher flows. Suitable habitats include pools, runs, and glides at least 0.5 m^2 (5.4 ft2) in size that are located in close proximity to undercut banks, in-stream woody debris, aquatic vegetation, and similar habitat elements that provide for cover, predator avoidance, and current refugia (Al-Chokhachy et al. 2020). Adults tend to prefer deep pools, and flows are generally not as limiting in defining habitat suitability (Stillwater Sciences 2006). Overall, the top three stream attributes that characterize areas of higher-quality LCT habitat are: 1) pool habitat contributes 35–60% of the total stream habitat area; 2) streambank stability is greater than 90%; and 3) streambank cover is greater than 25% (May and Albeke 2008).

Threats

Nonnative rainbow trout (*Oncorhynchus mykiss*) readily hybridize with native cutthroat trout and produce fertile offspring. Extensive genetic mixing of natives, nonnatives, and hybrids contribute to the loss of locally adapted genotypes and can lead to the extinction of a population or an entire species (Rhymer and Simberloff 1996). Moreover, nonnative fish, especially other trout species, are currently the greatest threat to LCT rangewide, resulting in loss of available habitat and range constrictions primarily through competition and hybridization (USFWS 2009). There is a greater likelihood of finding nonnative fish in larger streams (Whittier and Peck 2008). Over half of stream lengths in the western U.S. contain nonnative fish, with larger streams having comparatively higher occupancy of nonnative trout, primarily brook trout (17% of streams studied), brown trout (*Salmo trutta*) (16% of streams studied), and rainbow trout (14% of streams studied) (Lomnicky et al. 2007). The majority of LCT population extirpations since the mid 1990's have been caused by nonnative trout (USFWS 2009). Nonnative trout co-occur with LCT in approximately 36.3% of currently occupied stream habitat and all historically-occupied lake habitats (except for Walker Lake), and most LCT populations that co-occur with nonnative trout are decreasing in both range and abundance (USFWS 2009). Several studies have documented cutthroat trout populations increasing after brook trout removal (Shepard et al. 2002, Peterson et al. 2004). Brown trout also have been shown to displace native cutthroat trout populations through competitive advantages (Wang and White 1994, de la Hoz Franco and Budy 2005, McHugh and Budy 2005, 2006, Budy et al. 2007, Shemai et al. 2007). Other invasive aquatic species, such as Mysis shrimp (Order: Mysida) also may have deleterious effects on LCT recovery, as they have the potential to disrupt aquatic food webs upon which LCT depend as apex predators in these stream ecosystems (USFWS 2009).

Aside from competition with nonnative trout and other nonnative aquatic species, climate change presents a significant threat to LCT, particularly to stream resident fish. Increasing aridity and more frequent droughts can negatively impact aquatic ecosystems, including causing decreases in fish numbers at the population and community level, loss of habitat, poor water quality (i.e., hypoxia and increased water temperatures), decreased ability for fish movement, fish crowding, and stream desiccation (Matthews and Marsh-Matthews 2003). Small streams (width of 1.5 m [5 ft] or less) are generally more susceptible to drying, high stream temperatures in summer, and freezing in winter (Lake 2003), and are thus more likely to be lose suitable habitat; although; functioning small streams with good quality habitat (e.g., deep pools, groundwater spring-dominated flows) and limited anthropogenic influences can sustain salmonids during drought (White and Rahel 2008).

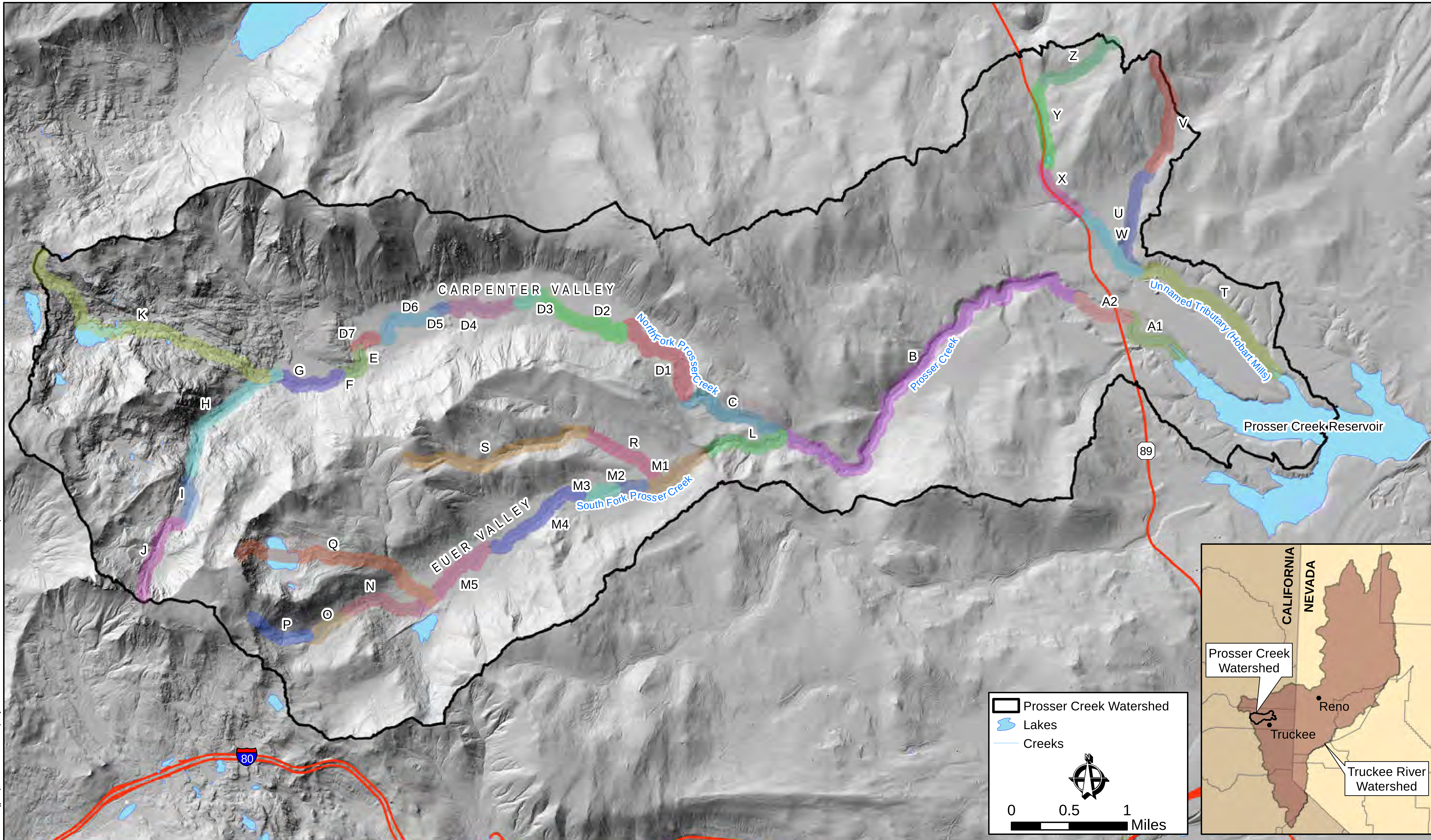
Climate change also is expected to result in a longer wildfire season. The increasing frequency of larger, more severe wildfires (McKenzie et al. 2004, Westerling et al. 2006), and post-fire large storm events (e.g., rain on snow events or monsoonal storms) can severely reduce or extirpate local fish populations through reduced water quality, siltation, and similar impacts (Novak and White 1990, Propst et al. 1992, Bozek and Young 1994, Rinne 1996, Rieman et al. 1997). Fires can affect ecosystem processes for years or even decades, causing elevated stream temperatures due to reduced stream shading, and recovery to postfire temperatures may take longer if streams encounter debris flows and flooding which alter the stream channel (Dunham et al. 2007). Post-fire mortalities, reductions in population size, and poor recruitment have been documented in some remnant LCT populations (Humboldt-Toiyabe National Forest 2004, Neville and DeGraaf 2006).

Methods

As part of the watershed assessment, Balance mapped and identified stream reaches throughout the Prosser Creek watershed. Based on Balance's reach designation, and coordination with the Watershed Council, LCT habitat assessment reaches were selected in lower Carpenter Valley and lower Euer Valley (Figure 2). Reaches include D1, D2, and D3 (Lower Carpenter Valley), and M1, M2, M3 and M4 (Lower Euer Valley). These study reaches were selected for several reasons, including:

1) **Slope and length**: the study reaches were selected because they are characterized by relatively long, continuously flat, gentle gradients that are more likely to provide LCT in-stream habitat elements. Other reaches upstream and downstream of Carpenter Valley and Euer Valley were excluded either owing to steeper slopes—stream gradients greater than 4% average slope are less often used by LCT (Li et al. 1984)—and/or relatively short reach lengths.

2) **Ownership**: for practical reasons, the study reaches were selected because ownership by potential project partners, specifically the Tahoe Donner Association (lower Euer Valley) and Truckee Donner Land Trust (lower Carpenter Valley), facilitated site access for field assessments. Additionally, future LCT reintroductions or habitat enhancements are more likely to be feasible in these reaches owned by



C:\Users\jjacquet\Documents\projects\220029 Prosser\GIS\mxd\220029ReachMap.mxd

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Figure 2. Stream Reach Map, Prosser Creek Watershed, Nevada County, California

Basemap Source: USFS 2014 LiDAR

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potential project partners. Upstream reaches in Euer Valley and Carpenter Valley owned by private parties, that also might provide suitable LCT habitat, were not included in the analysis.

4) **Hydrology**: Lower Carpenter Valley and lower Euer Valley were selected because springs, fens, and other sources of perennial, cold water provide base flows potentially suitable for supporting the temperature and water quality (e.g., pH, DO) requirements of LCT. The presence of localized, perennial groundwater inputs in these reaches also, potentially, provides some measure of protection against future changes in stream temperature and hydrology (i.e., as a result of climate change) relative to reaches that rely only on upstream flows and seasonal runoff.

The study reaches were evaluated based on their potential to support LCT reintroduction. The general strategy for evaluating LCT reintroduction potential emphasized field identification, at a reconnaissance level, of highly-suitable habitat for critical life stages, specifically adult spawning habitat and rearing habitat for juvenile LCT. Fry habitat was not mapped to simplify field mapping and because fry habitat is unlikely to be a limiting factor on LCT population sustainability (i.e., spawning [Al-Chokhachy et al. 2020] and juvenile rearing habitat are more likely to be limited in extent and therefore more limiting on LCT reintroduction potential).

Within each study reach, representative 100-m (330 ft) stream segments were selected randomly such that approximately 20% of each study reach was surveyed in the field. During the field survey, the surveyor walked each segment within the stream channel, wearing polarized sunglasses and progressing from the downstream end to upstream end of each segment and mapped patches of LCT spawning and juvenile rearing habitat. Highly-suitable habitats were defined as follows:

- Spawning habitat was defined as relatively silt-free gravel patches with average gravel sizes between approximately 6.4–12.7 mm (0.25–0.5 inch) that were at least 0.3–1.3 m^2 (3.2–14 ft^2) in area with minimum width of 0.9 m (3 ft). Gravel patches meeting these criteria were mapped within the stream's ordinary high water mark (i.e., patches that likely would be inundated during spawning when higher flows occur), even if the patch was above the active stream channel observed during the field survey (which occurred during assumed base flow conditions in a year with below average precipitation).
- Juvenile rearing habitat was mapped in pools, glides, and runs in areas that were at least 0.3 m (1 ft) in depth and were located within 0.6 m (2 ft) of suitable in-stream cover such as large woody debris, undercut banks, large rocks and boulders, or overhanging woody riparian vegetation.

A total of eight approximately 100-m (330 ft) segments were mapped in Euer Valley, and 10 segments were mapped in Carpenter Valley (Figures 3a–3i). Representative photographs were taken to visually document conditions present during the field survey (Appendix A).

In addition to mapping the amount and location of LCT spawning and juvenile rearing habitats, data provided by Purdy (2017, 2020), which was compiled following standard U.S. Forest Service steam assessment methods (USFS 2012) under separate contract to the Watershed Council, were used to derive measures of the abundance of pool habitat, streambank stability, and woody riparian streambank cover in an effort to further characterize the LCT habitat suitability in each segment (May and Albeke 2008). Last, approximations of nonnative trout abundance were recorded (i.e., 10s, 100s) during field mapping of spawning and juvenile rearing habitat to provide an additional metric for use in evaluating LCT reintroduction potential.

Results

Results of the field habitat assessment are summarized in Table 1 and Table 2 as well as depicted graphically in Figures 3a to 3i. Representative photos from each surveyed segment are provided in Appendix A. There are no standards against which to determine whether or not the amount of spawning and juvenile rearing habitat, measured as a percentage of the total area of each survey segment, represents "good" habitat conditions for LCT. However, a comparison of Table 1 and Table 2 reveals some noteworthy contrasts between the two survey reaches. For example, there is a pronounced difference in spawning and rearing habitat availability between the two survey areas, specifically extensive spawning habitat and relatively little rearing habitat was mapped in lower Carpenter Valley relative to lower Euer Valley. There also is substantial among-segment variability in spawning habitat availability in lower Carpenter Valley (e.g., only 3.7% of segment CV-9 versus 38.6% of segment CV-6) while the magnitude of among-segment variability in both spawning and rearing habitat is notably less throughout lower Euer Valley. Pool habitats were abundant in all reaches, with minor exceptions (e.g., segment CV-10), particularly in lower Euer Valley where abundant beaver dams were present throughout the South Fork of Prosser Creek (e.g., segment EV-3 occurred entirely above an active beaver dam).

Nearly all survey segments in lower Carpenter Valley were characterized by unstable banks in excess of 20% of the surveyed stream segment, on average, while bank instability was generally lower in lower Euer Valley, particularly in segments downstream and immediately upstream of Euer Valley Road (segments EV-4, EV-3, and EV-1). Riparian shrub cover generally ranging from about 25% to 45% absolute cover, on average, was present in both survey reaches, with some variation in cover among segments ranging from up to 70% cover in segments CV-1 and CV-3 and as little as 6%–8% cover in segment EV-3. Overall, shrub cover was more constant with less variability in lower Carpenter Valley relative to lower Euer Valley. Nonnative fishes were nearly absent in lower Carpenter Valley and only scattered, occasional trout up to approximately 150mm (6 inches) TL were observed; conversely, nonnative trout were abundant in lower Euer Valley with at least 100 fish ranging in length from 25mm (1 inch) TL up to roughly 250mm (10 inches) TL consistently observed in each 100-m (330 ft) survey segment.

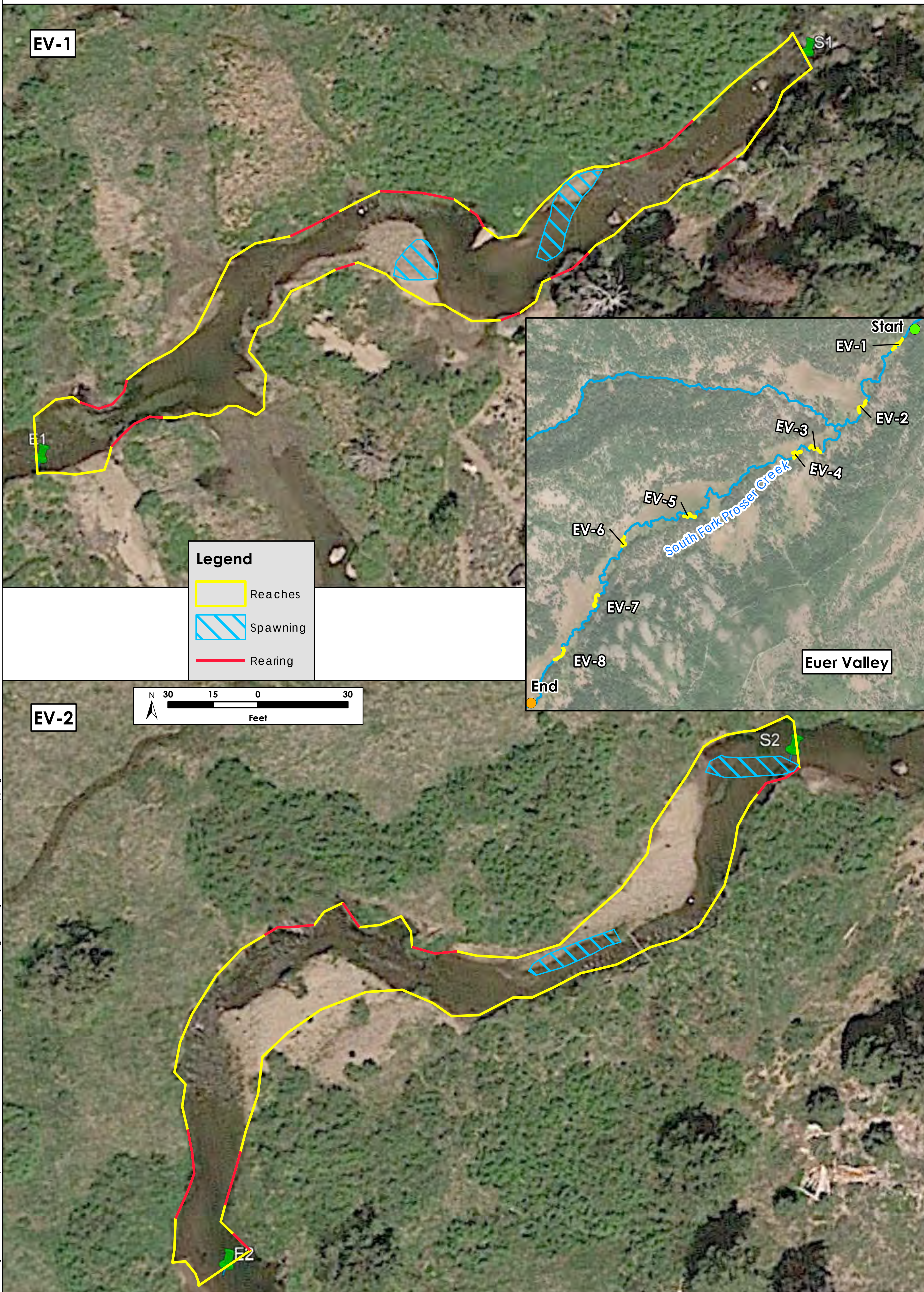
Table 1. Lower Carpenter Valley LCT Assessment Summary

Segment Id	% Spawning Habitat	% Rearing Habitat	% Pool Habitat	% Unstable Banks	% Shrub Cover (Left)	% Shrub Cover (Right)	Nonnative Trout Abundance
CV-1	8.1%	1.1%	47.6%	23.8%	30.0%	70.0%	<10
CV-2	13.0%	1.1%	61.6%	30.8%	56.9%	57.4%	<10
CV-3	30.6%	0.9%	59.4%	29.7%	50.0%	70.0%	<10
CV-4	25.0%	1.8%	70.0%	35.0%	30.7%	44.7%	<10
CV-5	8.7%	0.3%	39.6%	19.8%	14.4%	45.1%	<10
CV-6	38.6%	1.5%	56.0%	28.0%	9.8%	29.0%	<10
CV-7	9.6%	1.7%	59.8%	29.9%	18.5%	26.6%	<10
CV-8	29.3%	0.9%	54.6%	27.3%	12.2%	34.5%	10s
CV-9	3.7%	1.8%	46.8%	23.4%	22.7%	34.8%	10s
CV-10	30.2%	0.7%	26.4%	13.2%	39.5%	49.4%	10s
Average	**19.7%**	**1.2%**	**52.2%**	**26.1%**	**28.5%**	**46.1%**	**<10**

Table 2. Lower Euer Valley LCT Assessment Summary

Segment Id	% Spawning Habitat	% Rearing Habitat	% Pool Habitat	% Unstable Banks	% Shrub Cover (Left	% Shrub Cover (Right)	Nonnative Trout Abundance
EV-1	5.8%	4.7%	100.0%	7.1%	61.2%	30.6%	100s
EV-2	4.8%	3.4%	55.9%	23.8%	52.9%	41.1%	100s
EV-3	0.0%	5.6%	100.0%	1.6%	6.0%	8.0%	100s
EV-4	10.8%	6.6%	100.0%	4.1%	32.1%	32.3%	100s
EV-5[1]	8.6%	7.0%	ND	ND	ND	ND	100s
EV-6	10.7%	2.0%	63.6%	29.6%	17.2%	49.4%	100s
EV-7	1.0%	1.8%	73.2%	19.1%	14.5%	52.1%	100s
EV-8	5.8%	1.4%	84.6%	26.0%	9.8%	19.4%	100s
Average	**5.9%**	**4.1%**	**82.5%**	**15.9%**	**27.7%**	**33.3%**	**100s**

[1] Purdy’s 2020 Lower Euer Valley assessment did not include survey segment EV-5



Imagery: Google Earth 2019

N:\Projects4400\4425-01\Reports\Lahontan Cutthroat Trout Feasibility Assessment\Fig 3a Study Reaches and Habitat Mapping.mxd

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Figure 3a. Study Reaches and Habitat Mapping (EV-1 – EV-2)
Prosser Creek Lahontan Cutthroat Trout Reintroduction Feasibility Assessment (4425-01)
January 2021

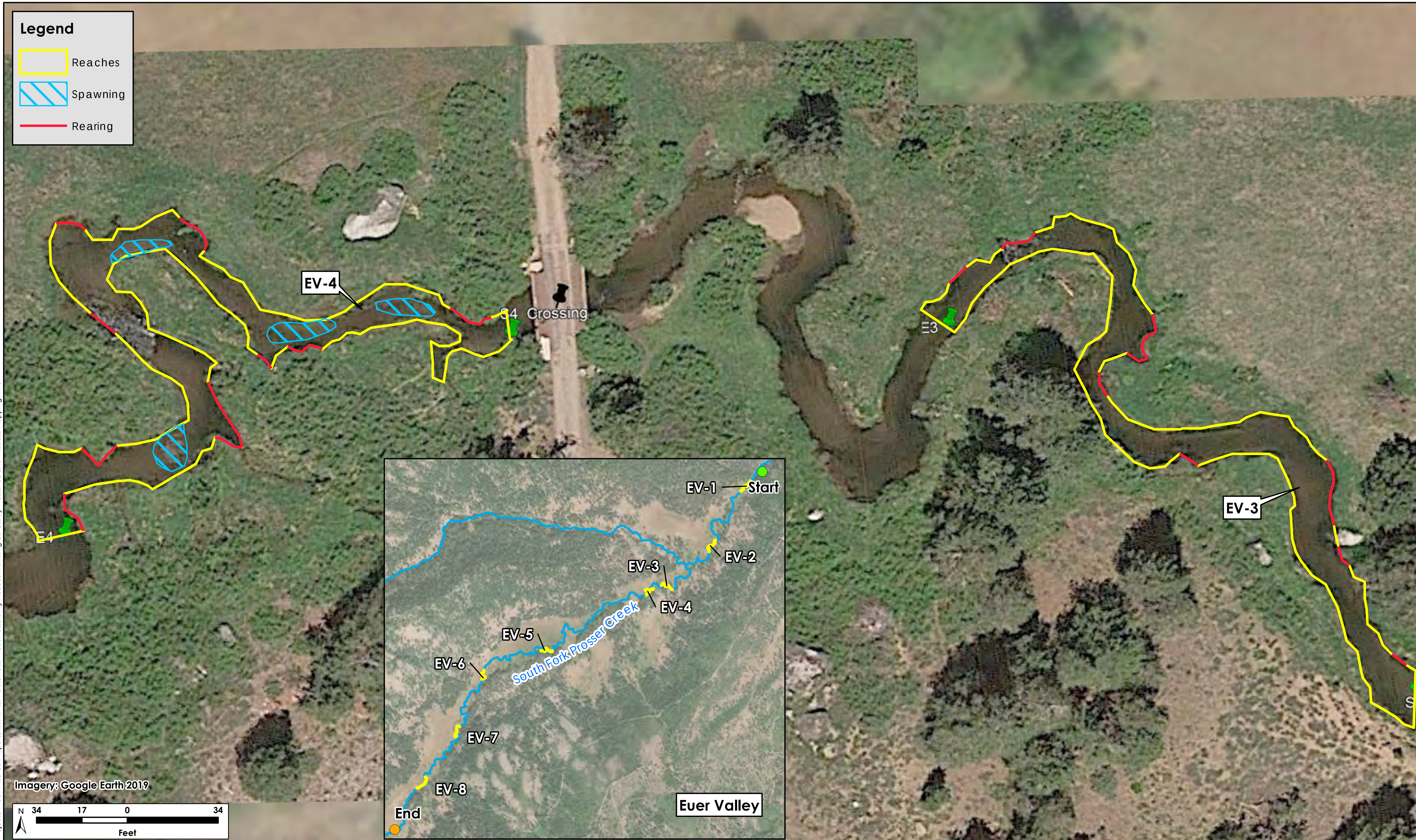

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Figure 3b. Study Reaches and Habitat Mapping (EV-3 – EV-4)
Prosser Creek Lahontan Cutthroat Trout Reintroduction Feasibility Assessment (4425-01)
January 2021

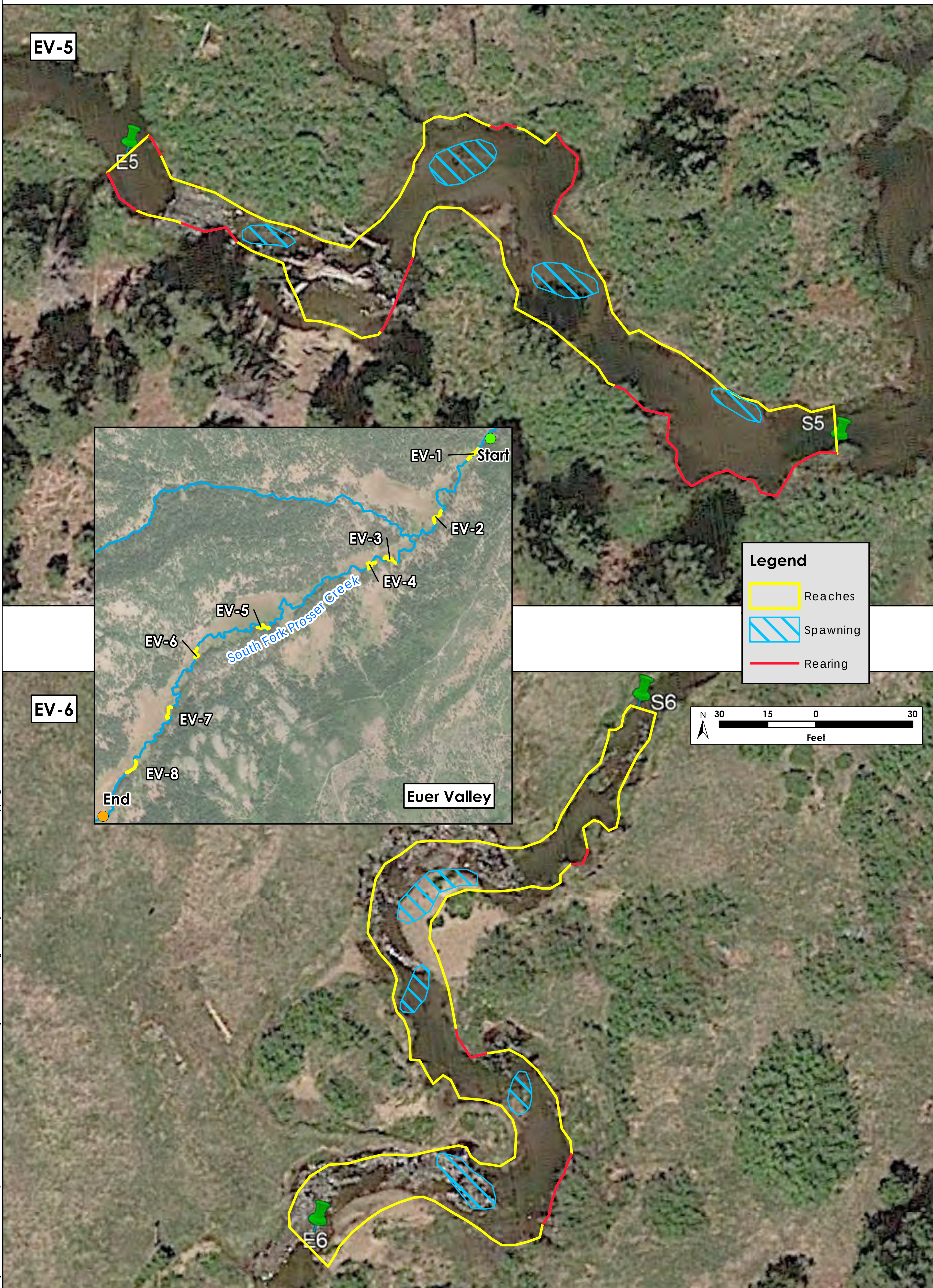

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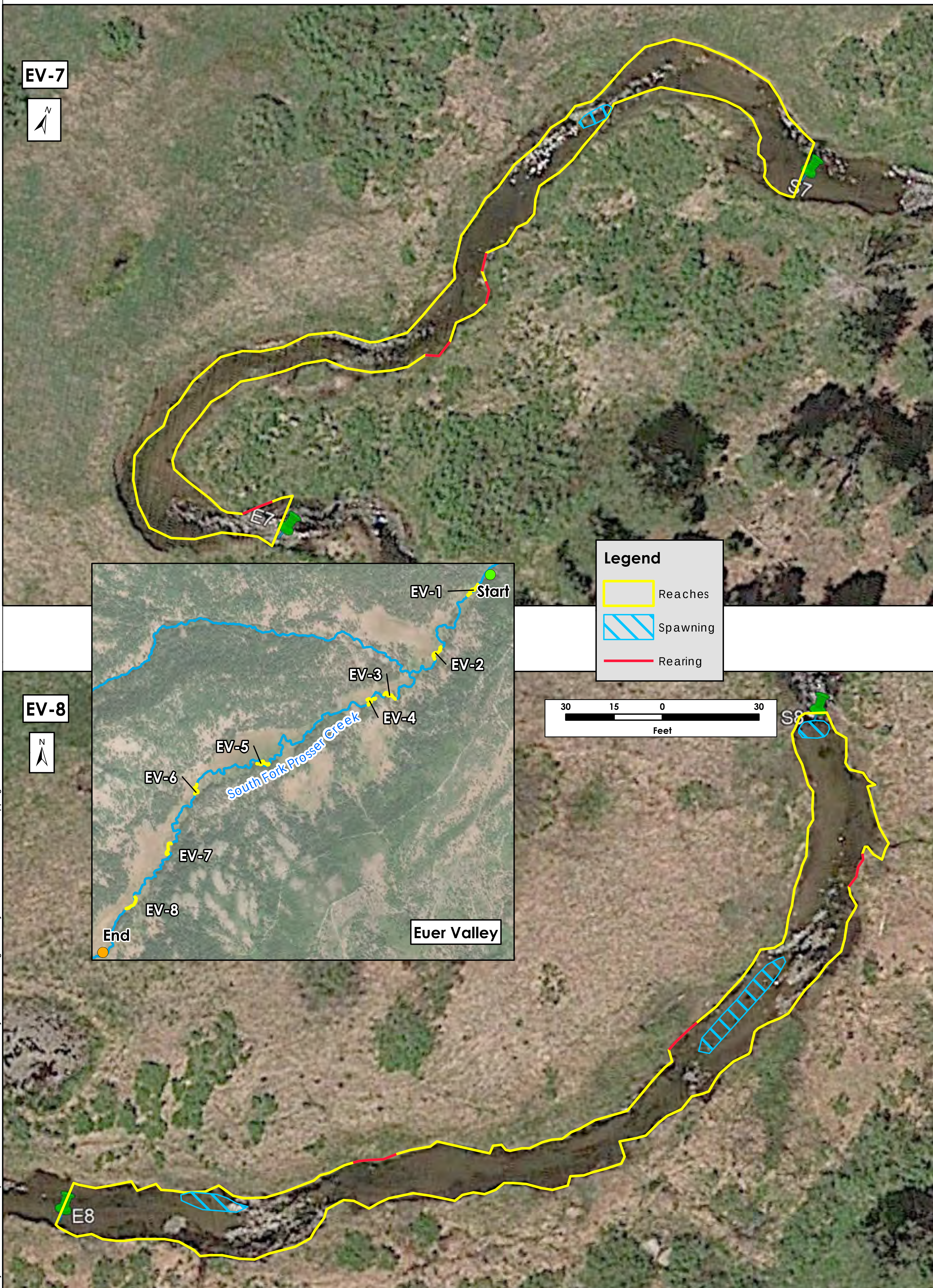
Figure 3c. Study Reaches and Habitat Mapping (EV-5 – EV-6)
Prosser Creek Lahontan Cutthroat Trout Reintroduction Feasibility Assessment (4425-01)
January 2021



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Imagery: Google Earth 2019

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Figure 3d. Study Reaches and Habitat Mapping (EV-7 – EV-8)

Prosser Creek Lahontan Cutthroat Trout Reintroduction Feasibility Assessment (4425-01)

January 2021

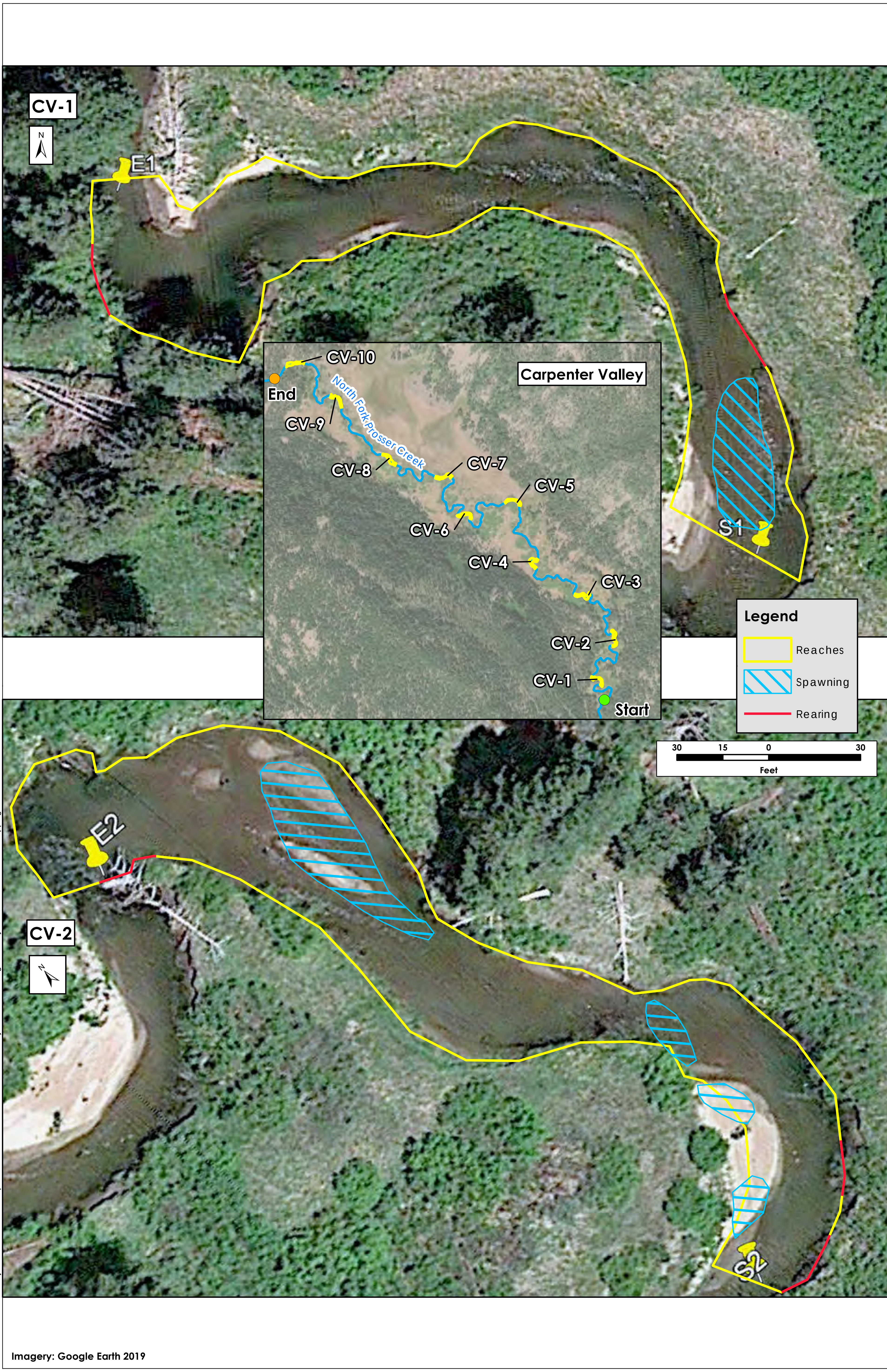

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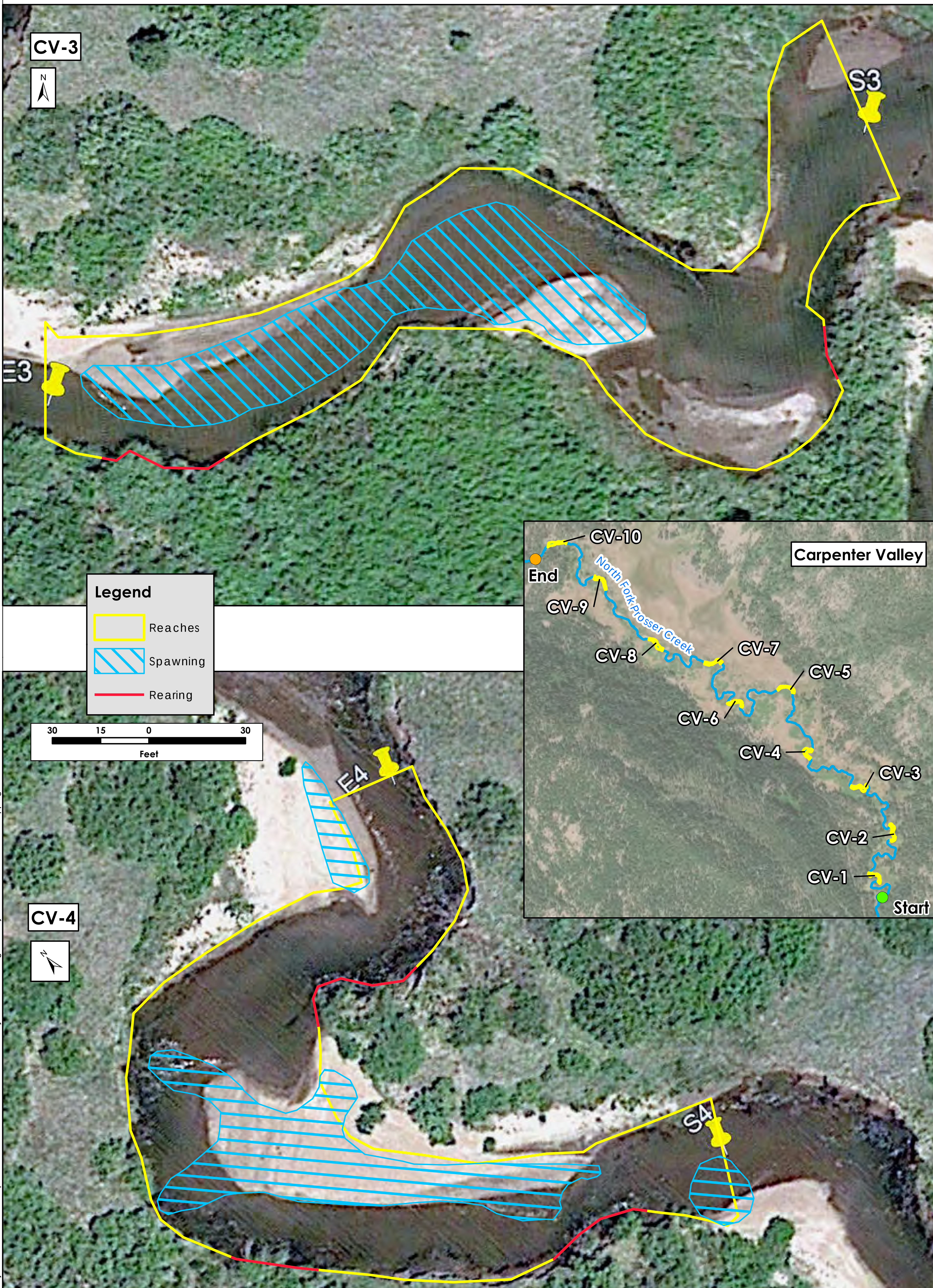
Figure 3e. Study Reaches and Habitat Mapping (CV-1 – CV-2)

Prosser Creek Lahontan Cutthroat Trout Reintroduction Feasibility Assessment (4425-01)

January 2021



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Imagery: Google Earth 2019

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Figure 3f. Study Reaches and Habitat Mapping (CV-3 – CV-4)
Prosser Creek Lahontan Cutthroat Trout Reintroduction Feasibility Assessment (4425-01)
January 2021

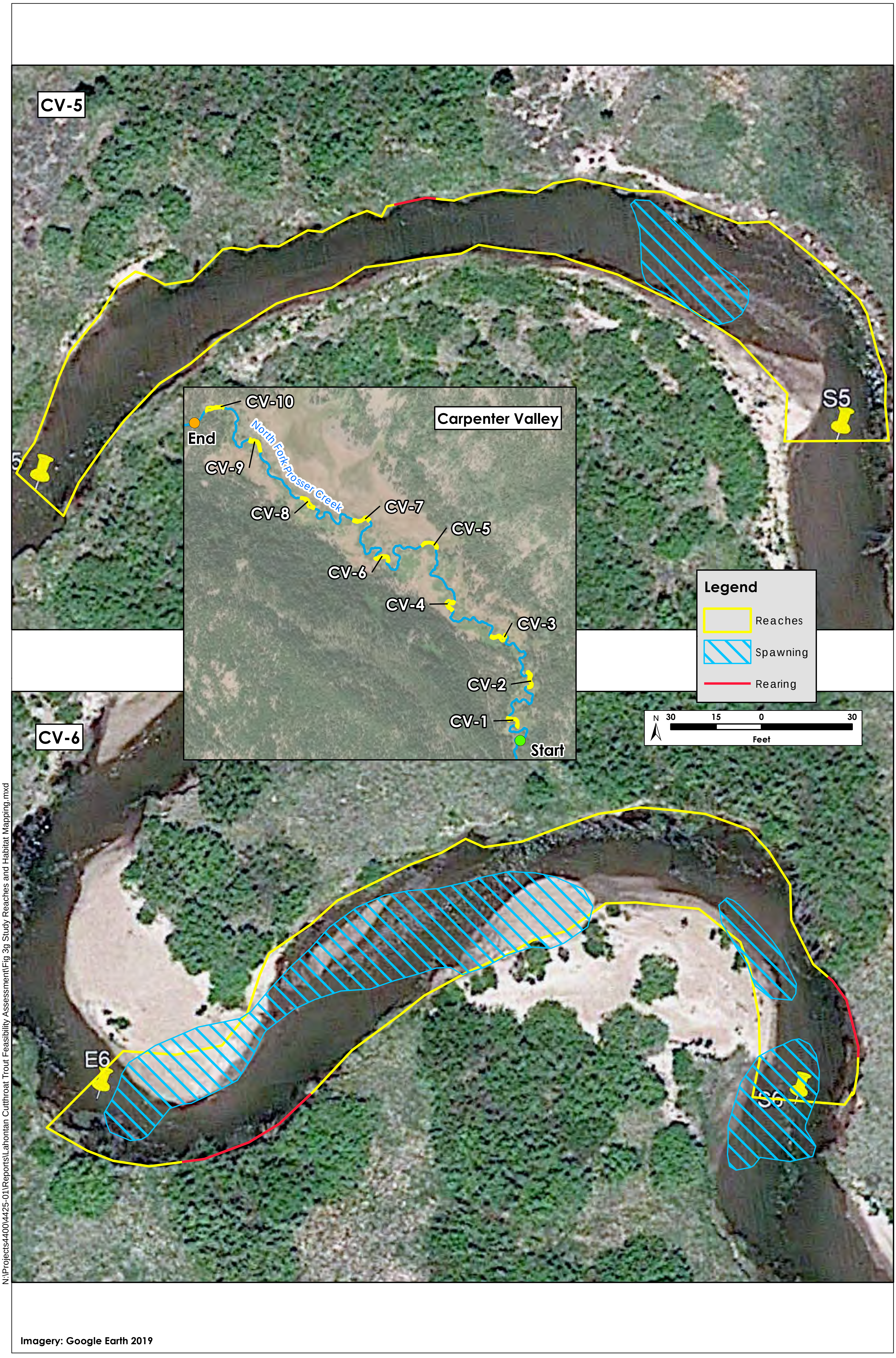

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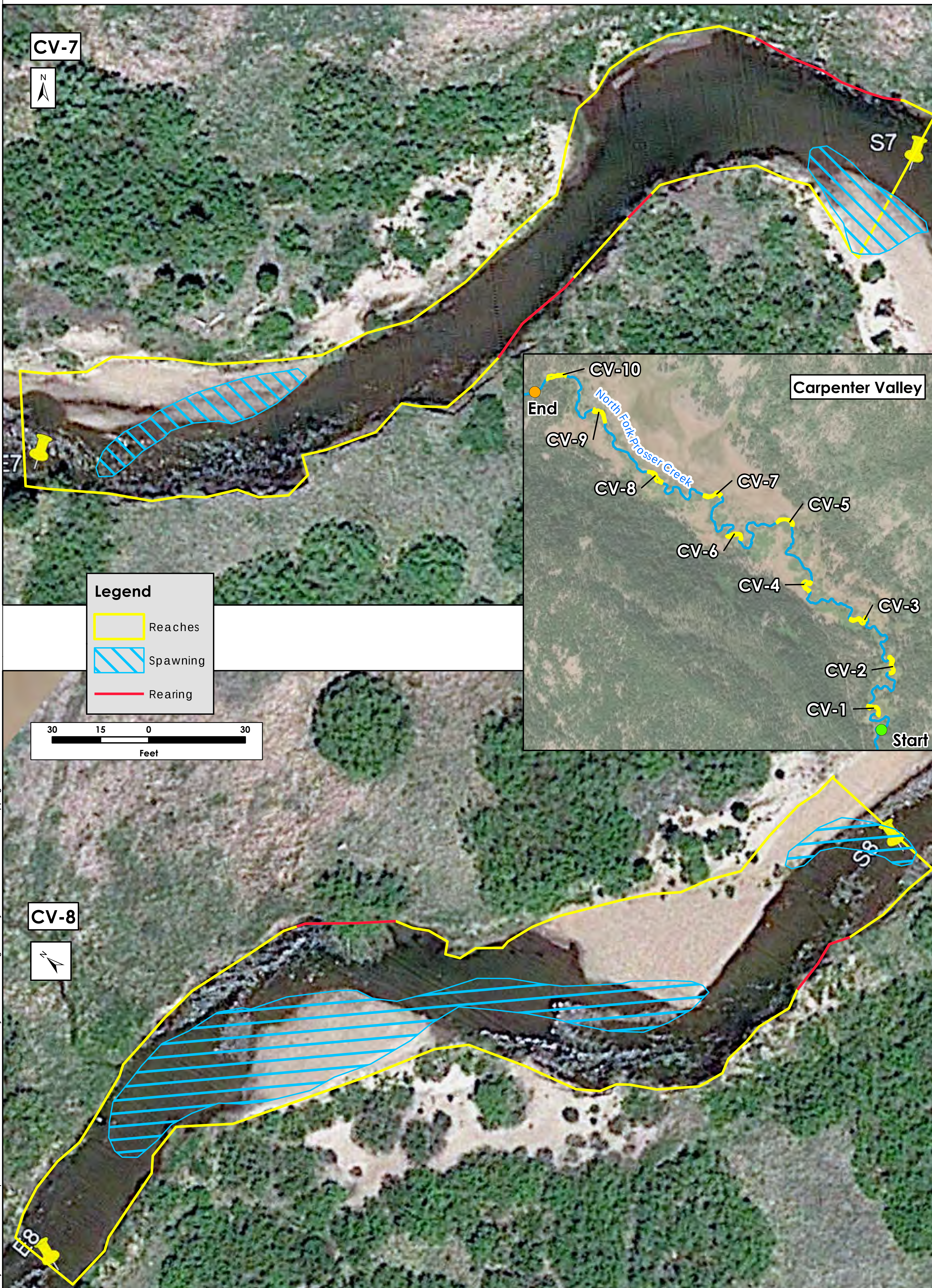
Figure 3g. Study Reaches and Habitat Mapping (CV-5 – CV-6)

Prosser Creek Lahontan Cutthroat Trout Reintroduction Feasibility Assessment (4425-01)

January 2021



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Imagery: Google Earth 2019

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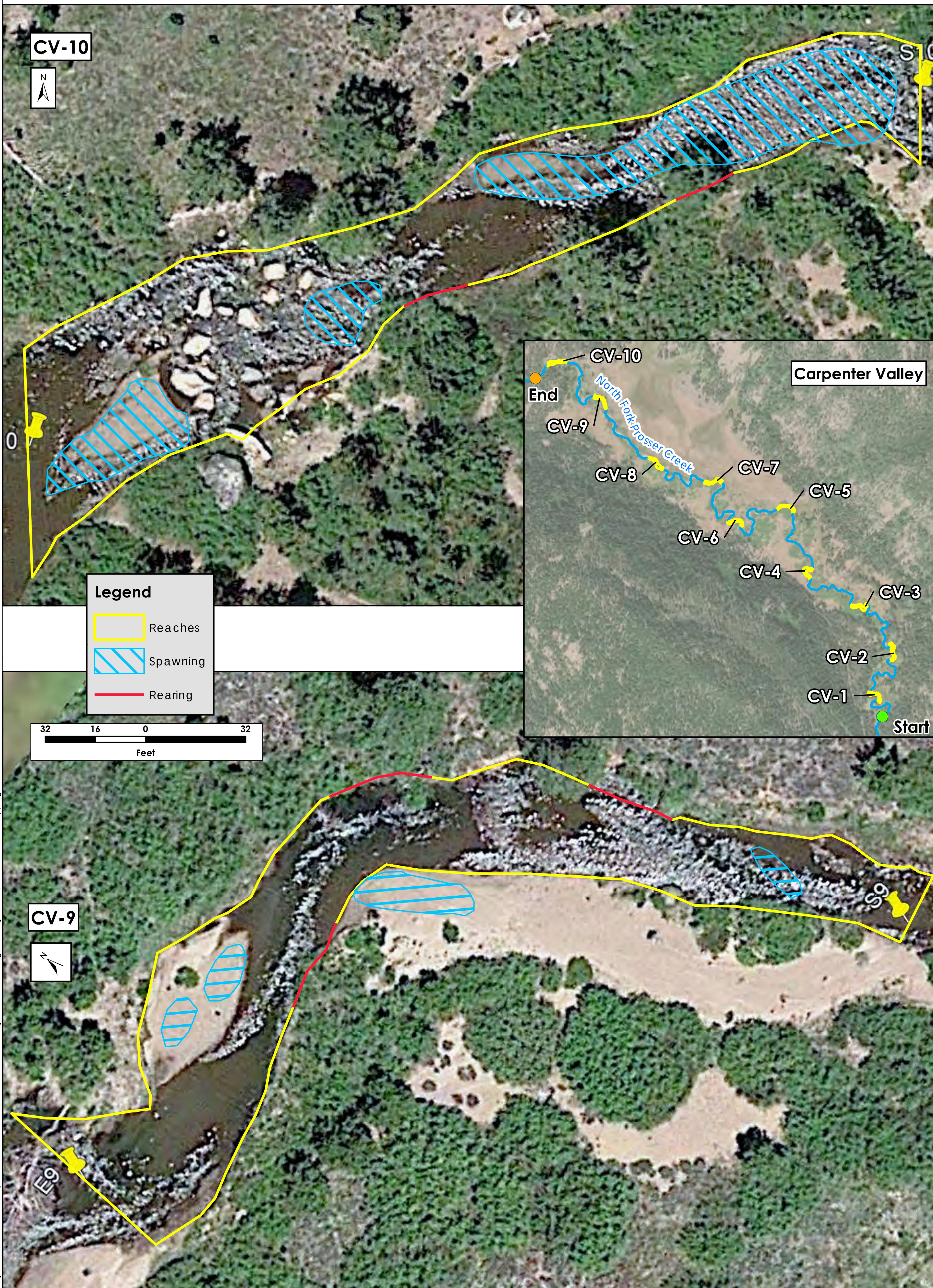
Figure 3h. Study Reaches and Habitat Mapping (CV-7 – CV-8)

Prosser Creek Lahontan Cutthroat Trout Reintroduction Feasibility Assessment (4425-01)

January 2021



N:\Projects4400\4425-01\Reports\Lahontan Cutthroat Trout Feasibility Assessment\Fig 3i Study Reaches and Habitat Mapping.mxd

Imagery: Google Earth 2019

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Figure 3i. Study Reaches and Habitat Mapping (CV-9 – CV-10)

Prosser Creek Lahontan Cutthroat Trout Reintroduction Feasibility Assessment (4425-01)

January 2021

Discussion

Results indicate that, in general, there appears to be sufficient spawning, rearing, and pool habitat to support LCT within both surveyed reaches of Prosser Creek, with some potential caveats. Specifically, the amount of highly-suitable rearing habitat in lower Carpenter Valley is much less relative to lower Euer Valley. In large part, this lack of rearing habitat is due to ongoing stream degradation and widening, which has resulted in elements of bank cover (e.g., undercut banks, root wads) not occurring in close proximity to deeper pools during baseflow conditions. As mentioned above, there is no empirical basis for determining whether or not the relative lack of rearing habitat in lower Carpenter Valley would be limiting factor for LCT reintroduction in any way; however, potential restoration actions to increase rearing habitat availability in lower Carpenter Valley (e.g., by encouraging bed aggradation or rising the water surface elevation during baseflow conditions) likely would benefit LCT. Additionally, the estimated percentage of pool habitat in lower Euer Valley was above the range thought to characterize highly-suitable LCT habitat (i.e., greater than 60% of the stream area on average), largely due to the presence of abundant beaver dams throughout lower Euer Valley. Although extensive pool habitat was observed, with three surveyed reaches consisting of pool habitat only, the abundance of other salmonids with habitat requirements similar to LCT implies that the physical habitat characteristics of the South Fork in lower Euer Valley also likely provide a suitable juxtaposition and abundance of spawning, rearing, and pool habitats to support LCT reintroduction.

Similarly bank cover, in the form of woody riparian vegetation (i.e., willow, in the case of the study reaches primarily *Salix lemonii*), appears to be sufficiently abundant, on average, to support LCT reintroduction, albeit approaching the lower end of the range (25% cover) reported to characterize higher quality LCT habitat. However, a closer inspection of the data for individual reaches shows that several reaches, approximately 50% of the surveyed reaches in Euer Valley and Carpenter Valley combined, supported less than 25% willow cover on at least one side of the stream channel through the reach; in other words, willow cover is generally discontinuous along the stream channel with some areas of dense, nearly continuous woody riparian cover along the stream bank and other areas that lack woody riparian cover and are primarily characterized by sedges (*Carex* spp.) and grasses along the stream bank. The relative lack of willow cover was particularly evident in the upstream halves of both study reaches. Furthermore, and as described above, even stream segments with abundant willow cover frequently are not providing shade, root wads, and other in-stream habitat elements that contribute to bank cover and LCT habitat suitability because of channel degradation and widening. Channel degradation and widening similarly has resulted in undercut banks, which provide an alternative source of bank cover in reaches dominated by sedges and grasses rather than willows along the bank, being located well above the low flow channel where undercut banks do not benefit fish.

Unstable banks were common in both study reaches and generally well above the range thought to characterize higher quality LCT habitat (i.e., 90% stable banks or less than 10% bank instability). Only 3 study segments, all in lower reaches of the South Fork from the Euer Valley Road crossing downstream (EV-4, EV-3, and EV-1), were characterized by relatively stable banks. Stream banks in all other Euer Valley segments, and all Carpenter Valley segments, were actively eroding with stream bank instability approaching or exceeding 30% of the total bank length in many stream segments. As already described, ongoing bank erosion has led to, and continues to result in, channel widening and the loss of habitat elements that improve LCT habitat quality (i.e., undercut banks and woody riparian cover). Erosion may also directly, or in indirectly, degrade LCT habitat in other ways, such as increased water temperatures owing to a lack of riparian cover that creates shade, or sedimentation that potentially degrades water quality and reduces spawning gravel quality. The relationship between ongoing bank erosion and other forms of LCT habitat degradation require further investigation in Carpenter Valley and Euer Valley as both water quality (in terms of temperature and turbidity) and spawning gravel quality superficially appeared potentially suitable for LCT during the reconnaissance investigation, despite widespread active bank erosion.

Last, the abundance of nonnative trout were remarkably different in Carpenter Valley relative to Euer Valley. Few to no nonnative trout were observed in Carpenter Valley, while abundant nonnative trout, primarily brook trout, were noted throughout Euer Valley. The reason for this obvious difference is not immediately apparent as both reaches are equally connected to downstream reaches of Prosser Creek that should allow for equal colonization of both reaches from downstream trout populations. Identifying the underlying causes for this difference between the two reaches would require more study and investigation. However, this observed difference in nonnative trout abundance may be related to the combined effects of 3 factors: the January 1997 landslide on private property in Upper Carpenter Valley, the presence of upstream brook trout populations on the South Fork, and limited recolonization of nonnative trout from downstream populations. It is plausible that the 1997 landslide in Upper Carpenter Valley resulted in a large, episodic discharge of sediment into the North Fork, which may have been of a magnitude sufficient to eliminate many fishes from adjacent reaches of the creek (i.e., in lower Carpenter Valley). Following this event, recolonization of this reach has been low due to limited upstream trout population sources (brook trout exist in Devil's Oven and Walker Lakes, but both lakes are well upstream of lower Carpenter Valley) and, potentially, limited colonization from downstream trout populations. Limited downstream colonization is hypothesized based on few observations of brown and rainbow trout in both study reaches, as described further below for Euer Valley.

Conversely, the lower Euer Valley study reach is located downstream from a reservoir on adjacent private property that, potentially, provides a source of brook trout to supplement and sustain existing South Fork trout populations. Although details on the fish stocking history and management of this reservoir are unknown, it is plausible that the reservoir supports a population of brook trout as this species routinely was stocked into high elevation lakes throughout the Sierra Nevada (Knapp 1996). A spillway is evident on this reservoir (based on aerial photography), and brook trout, if they were to occur in this reservoir, doubtlessly would be carried into the South Fork from the reservoir when it periodically overflows down its spillway and into the South Fork. Thus, the brook trout observed throughout lower Prosser Creek likely represent a stable local population, occasionally supplemented by fish washed into the South Fork from the adjacent reservoir.

Reaches of Prosser Creek downstream of Euer Valley are more likely to support rainbow and brown trout, rather than brook trout, as rainbow and brown trout are abundant in Prosser Creek Reservoir and both species, but not brook trout, are routinely stocked for recreational sport fishing in lower-elevation streams and lakes regionally. The relative lack of brown trout and rainbow trout, compared to brook trout, in lower Euer Valley (no fish surveys were completed as part of this assessment, but observations during the reconnaissance survey suggest that many of the larger fish are brook trout) implies that colonization of other nonnative trout from downstream populations is limited; the relative lack of rainbow and brown trout in Carpenter Valley also supports this inference. Were colonization of rainbow and brown trout from downstream populations a more common occurrence, both species potentially would be more frequently observed in lower Carpenter Valley as well as in Euer Valley, even with abundant brook trout in Euer Valley because both rainbow and brown trout tend to outcompete brook trout where these species co-occur (Lennon 1967, Fausch and White 1981, Whitworth and Strange 1983, Larson and Moore 1985).

Again, all of the inferences above regarding fish populations in lower Carpenter Valley and lower Euer Valley are largely conjecture and supported by only limited field study. However, if accurate, the lack of competitive interference from nonnative trout in lower Carpenter Valley implies a possible LCT reintroduction opportunity, assuming that other elements of habitat suitability discussed above are addressed. In Euer Valley, more extensive nonnative trout eradication, likely combined with an upstream fish barrier to prevent future colonization from reservoir populations of nonnative trout, would be required to successfully reintroduce LCT to the South Fork, notwithstanding the presence or absence of other habitat factors required by LCT.

In addition to all the factors discussed above, issues related to population isolation and habitat patch size are important to consider when evaluating LCT reintroduction opportunities. Most historical LCT habitat is now fragmented and/or isolated at stream, watershed, and basin scales. Moreover, short length of stream segments and small population sizes that they support are of concern for the long-term population viability of LCT (USFWS 2009). Population viability of cutthroat trout is correlated with stream length or habitat size (Hilderbrand and Kershner 2000, Harig and Fausch 2002, Young et al. 2005). Trout move throughout stream networks searching for the various habitat types needed to complete their life cycle (i.e., spawning, rearing, migration, cover) (Baltz et al. 1991, Fausch and Young 1995, Muhlfeld et al. 2001, Schmetterling 2001, Hilderbrand and Kershner 2004, Schrank and Rahel 2004, Colyer et al. 2005, Neville et al. 2006, Umek 2007). The shorter the stream reach, the more likely it is that one or more of LCT's required habitats is either missing or inadequate for completion of the species' life cycle (USFWS 2009). Thus, in choosing reintroduction locations, priority should be given to longer stream reaches, connected stream networks, and areas with a variety of habitats that support different life stages.

Some recommendations have been made in regards to stream length and number of individuals needed for successful reestablishment of LCT populations. To maintain population viability, sufficient individuals must be present to prevent serious inbreeding and loss of genetic variation. The effective population size (number of individuals that contribute to recruitment) is generally a small proportion of the total population size (Williams et al. 1988). Allendorf and Ryman (1987) suggest that an effective population size for sustaining hatchery stocks of salmonids is 200, while a later investigation recommended 500 (Rieman and Allendorf 2001). Thus, a much larger census population would be needed to compensate for unbalanced sex ratios, age structure, and mortality due to flood, drought, or other stochastic events. Therefore, habitat to support many thousands of individuals could be required to maintain an effective breeding population.

For example, to ensure long-term persistence, Hilderbrand and Kershner (2000) and Allendorf et al. (1997) estimated a minimum of 2,500 cutthroat trout would be required (but see Wainwright and Waples 1998 for a discussion of the large variation in factors and impacts to maintenance of individual populations). There are few LCT populations of this size anywhere, and none in the Truckee River basin (Stead 2007). At least 8.2 km (5.1 mi) of stream habitat would be required to maintain a population of that size when fish density is high (300 fish/km [484 fish/mi]). However, accounting for mortality, emigration, and other factors, adding a 10% loss rate of individuals increases the required length to 9.3 km (5.8 mi) in order to maintain the same number (i.e., 2,500) of fish. If population densities are lower (e.g., 200 fish/km [320 fish/mi] and 100 fish/km [160 fish/mi]), stream length increases to 12.5 km (7.8 mi) and 25 km (15.5 mi), respectively, to maintain the same size population (Hilderbrand and Kershner 2000) (Table 3). Similarly, Young et al. (2005) found that to maintain a population of 2,500 cutthroat trout, 8.8 km (5.5 mi) of stream were needed, while Ray et al. (2007) found a positive relationship between stream length and population size for 13 different LCT streams. See Table 3 for a summary of these hypothesized relationships between LCT population sizes, fish density, and stream length. For reference, the TDA-owned reach of the South Fork in Euer Valley is roughly 4 km long, and the TDLT-owned reach of the North Fork in Carpenter Valley is roughly 5 km long, thus collaboration among adjacent private landowners, who control the upper reaches of Euer Valley and Carpenter Valley, and the Tahoe National Forest, which manages areas in the upper Prosser Creek Watershed, together with the TDA and TDLT will be required to support LCT reintroductions under nearly all reasonable estimates of effective population size and fish densities (Table 3).

Table 3. Minimum stream length to support different fish populations

	Census Population Size		
Fish Density	**1,000**	**2,500 (N_e = 500)**	**5,000**
High 482 fish/mi (300 fish/km)	2.3 mi (3.7 km)	5.7 mi (9.3 km)	11.5 mi (18.5 km)
Moderate 322 fish/mi (200 fish/km)	3.5 mi (5.6 km)	8.6 mi (13.9 km)	17.3 mi (27.8 km)
Low 161 fish/mi (100 fish/km)	6.9 mi (11.1 km)	17.3 mi (27.8 km)	34.5 mi (55.6 km)

Source: Hilderbrand and Kersher 2000
Notes:; N_e = effective population size.
Applies to streams less than 23 ft (7 m) wide, incorporating 10% losses.

Conclusion

Based on this initial assessment, a successful reintroduction plan for LCT in the Prosser Creek Watershed will likely require concurrent and complementary stream and watershed restoration actions that support at least good habitat suitability of sufficient size and connectivity; cooperation among multiple landowners and stakeholders; an eradication/control program for removal and long-term exclusion of nonnative trout, particularly within the South Fork; and a monitoring and maintenance program to track actions and results to inform adaptive management and decision-making. In terms of improving physical habitat conditions, the most critical needs are actions that address watershed-wide sources of degradation (e.g., sedimentation resulting from legacy forest road networks) as well as localized bank erosion, stream incision, and channel widening in an effort to encourage bed aggradation, improve floodplain connectivity, and increase water surface elevations, particularly during baseflow conditions.

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Appendix A. Representative Photos

Photo 1. Reach CV-1 showing bank erosion, undercut banks and in-stream woody debris; fine sediment common in this reach.

Photo 2. Reach CV-2 showing pea-sized gravel bars with limited woody riparian cover.

Photo 3. Reach CV-3 showing long glide with pea-sized gravels; woody riparian vegetation present but well above channel at baseflow conditions due to overwidened channel.

Photo 4. Reach CV-4 showing beaver dam at downstream end of surveyed reach; note increased water surface elevation above dam and good availability of undercut banks and pool habitat at baseflow conditions.

Photo 5. Reach CV-5 showing significant channel degradation and an overwidened channel with poor bank stability; abundant gravel (generally 5–15 mm) present, similar to most other surveyed reaches in Carpenter Valley.

Photo 6. Reach CV-6 showing continuous riparian cover over a long, deep pool along left bank; some signs of bank erosion and fine sediment becoming more common on stream bed.

Photo 7. Reach CV-7 at upstream end showing signs of bank erosion on right bank; increasing fine sediment with embedded gravels on stream bed and limited in-stream cover.

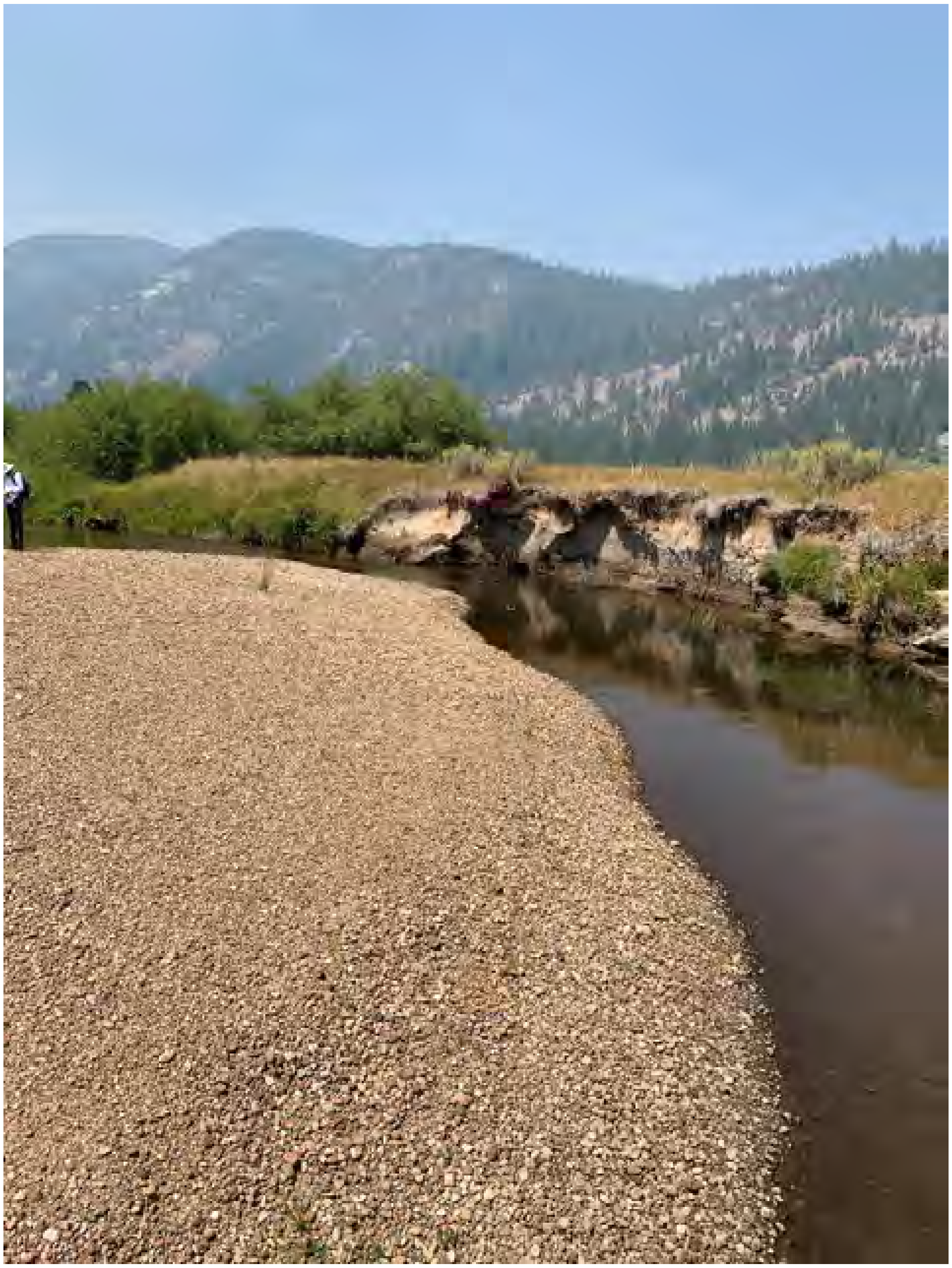


Photo 8. Reach CV-8 showing signs of bank erosion on outside bend (left bank) and large gravel bar on inside bend with limited in-stream cover for fish.

Photo 9. Reach CV-9 showing continuous willow cover over shallow pool along left bank and abundant gravel (generally 5–20 mm) on exposed bar.

Photo 10. Reach CV-10 North Fork Prosser Creek beginning to enter moraine separating Upper and Lower Carpenter Valleys; gravel sizes approaching 70–100mm with in-stream boulders becoming common.

Photo 11. Reach EV-1 South Fork Prosser Creek beginning to enter lower Euer Valley; good stream cover from adjacent forest with bed characterized by larger, angular gravels 10mm–50mm in size; abundant willow cover along banks.

Photo 12. Reach EV-2 showing bank failure and small amounts of in-stream cover; larger (50–100mm) angular cobbles likely coming from Crabtree Canyon tributary, which enters the South Fork near this location.

Photo 13. Reach EV-3 showing beaver dam at downstream end of survey reach; line along streamside vegetation implies a recent water surface elevation drop of 10–15cm but continuous bank cover remains through grasses, sedges and undercut banks; little willow cover in this reach.

Photo 14. Reach EV-4 showing smaller gravels 5–20mm (well above Crabtree Canyon confluence), little or no stream incision, and good bank cover; beaver dam present at the upstream end of this reach.

Photo 15. Reach EV-5 showing beaver dam at bottom of photo; good riparian cover but filamentous algae becoming more common; debris pile in stream from failed TDA trail system crossing.

Photo 16. Reach EV-6 showing significant channel incision, sod clumps collapsing into the stream, and overwidened channel with limited in-stream cover and habitat complexity; suitable spawning habitat (gravels at the larger end of sizes reported more suitable for LCT) present on exposed gravel bar. A historic livestock corral and barns occur just downstream from this location.

Photo 17. Reach EV-7 showing significant channel incision with limited in-stream cover and habitat complexity; willows and undercut banks are present but not available to fish during baseflow conditions.

Photo 18. Reach EV-8 showing slight channel incision; undercut banks and riparian vegetation are present and provide some fish habitat benefits at baseflow conditions; fine sediment becoming more common on stream bed.

APPENDIX I

Sierra Nevada Yellow-Legged Frog Reintroduction Feasibility Assessment

Memorandum

Project# 4425-01

January 8, 2021

To: **Beth Christman, Truckee River Watershed Council**

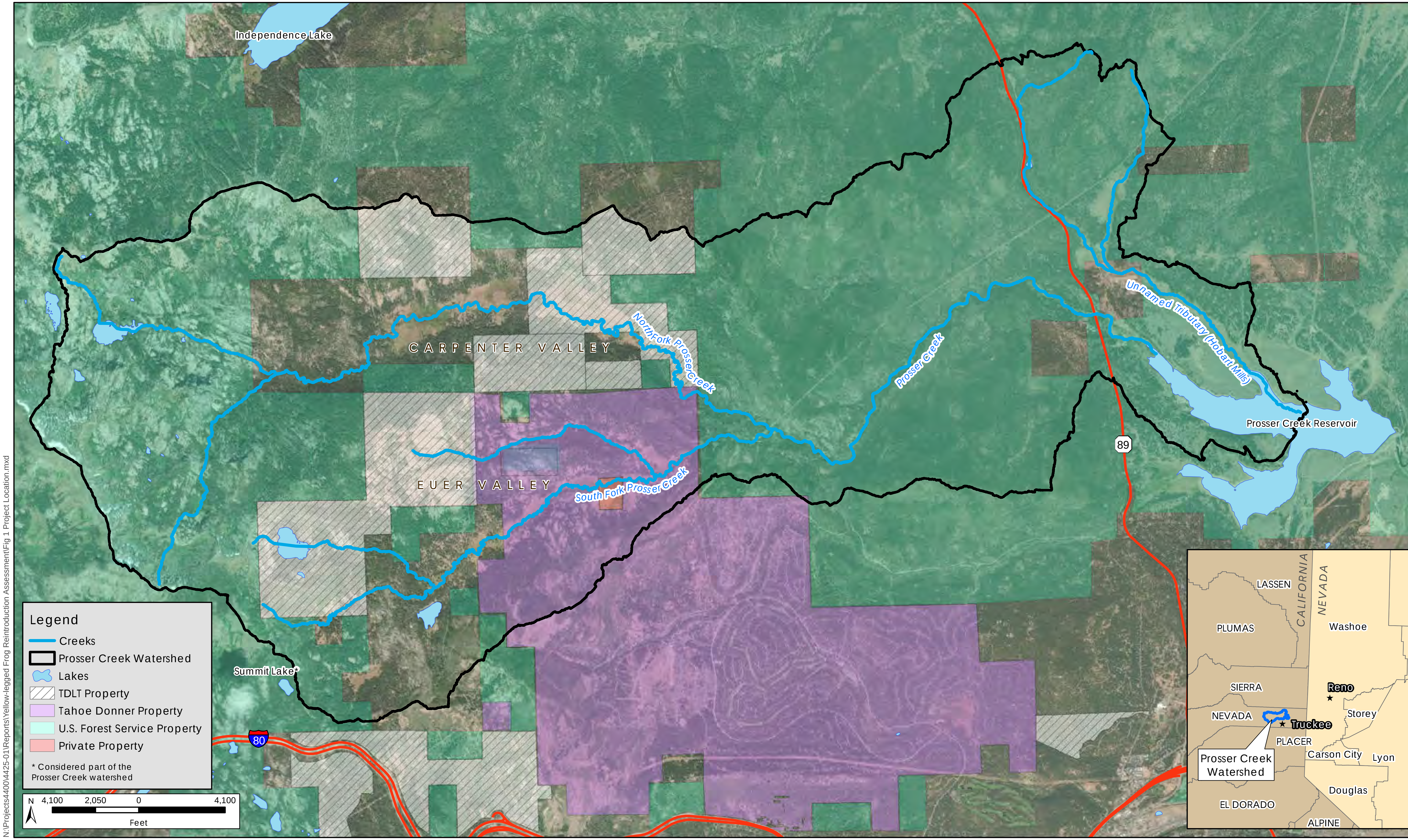
From: **Matt Wacker, H. T. Harvey & Associates**

Subject: **Sierra Nevada Yellow-Legged Frog (*Rana sierrae*) Prosser Creek Watershed Assessment**

Introduction

The following report summarizes an analysis of the hydrology and connectivity of lentic habitats (e.g., lakes and ponds) in the Prosser Creek Watershed (watershed) (Figure 1). The analysis was completed to determine, at a reconnaissance level, the potential for the watershed to support breeding of Sierra Nevada yellow-legged frogs (*Rana sierrae*, SNYLF). Populations of this native frog species are declining rangewide, and the species is under threat of extinction from the combined effects of infectious disease, predatory nonnative trout, and climate change (Ryan et al. 2014; CDFW et al. 2018). The assessment was prepared by Dr. John Romansic, herpetologist, with assistance from Matt Wacker, senior associate ecologist, both of H. T. Harvey & Associates. The assessment represents a planning or concept level analysis of the potential for maintaining, or expanding, the species' range within the watershed and identifies management activities that could be undertaken to benefit the species. This analysis is part of the larger Prosser Creek Watershed Assessment being developed on behalf of the Truckee River Watershed Council by Balance Hydrologics, H. T. Harvey & Associates, and Dr. Susan Lindstrom.

Originally, we planned a field-based, multifaceted assessment of habitat conditions in the upper watershed, where SNYLF are known to occur, and the potential of these habitats, and other potentially-suitable lentic habitats, to support the life-history of SNYLF, including reproduction, feeding, thermoregulation, refuge use, overwintering, and dispersal. This field-based assessment was scheduled for late summer of 2020, but was unable to be completed due to hazardous wildfire smoke conditions and the wildfire-related closure of the Tahoe National Forest, where fieldwork was planned to occur.



H. T. HARVEY & ASSOCIATES

Ecological Consultants

Figure 1. Project Location

Prosser Creek Sierra Nevada Yellow-legged Frog Reintroduction Feasibility Assessment (4425-01)

January 2021

Thus, we conducted an alternate, desktop analysis focusing on three topics crucial for evaluating and planning potential management actions that may improve conditions for SNYLF populations in the watershed: (1) hydrology of potential SNYLF breeding sites; (2) connectivity between potential breeding sites; and (3) potential immigration from neighboring watersheds. To evaluate the watershed's ability to support hydrological conditions suitable for SNYLF breeding under current conditions and drier conditions predicted under climate change (Topic 1), we assessed the capacity of habitats with suitable flow regimes to sustain year-round surface water, a prerequisite for successful SNYLF reproduction. We also evaluated the landscape's ability to maintain a connected SNYLF metapopulation (Topic 2) by assessing the spatial arrangement of aquatic habitats (including lotic habitats, wet meadows, and similar aquatic habitats that can support SNYLF movement and migration, even if not otherwise suitable for breeding) and the potential for SNYLF dispersal among them. Our investigation of potential immigration into the Prosser Creek watershed (Topic 3) focused on the proximity of potential breeding sites in adjacent watersheds.

Background

A robust analysis of SNYLF in the watershed requires a nuanced understanding of the habitat requirements of the species, its predator-prey relationship with trout, including nonnative species, and the influence of environmental factors including waterbody characteristics and climate change on these relationships. SNYLF have an extensive historic range in California and the western edge of Nevada that stretches from the southern end of the Cascade Mountains, through the northern and central Sierra Nevada Mountains, and down to Kings Canyon National Park and the Inyo National Forest in the southern Sierra Nevada (CDFW et al. 2018). Prior to discovery of species-level genetic differences between SNYLF and southern mountain yellow legged frogs (*R. muscosa*), which inhabit the southern Sierra Nevada south of the range of SNYLF (Macey et al. 2001; Vredenburg et al. 2007), the two species were considered a single species known as the mountain yellow-legged frog (*R. muscosa*).

In the central and southern Sierra Nevada, SNYLF primarily use abundant lake and pond habitats for reproduction, foraging, growth and development, and overwintering (CDFW et al. 2018; Brown et al. 2019). The ecology of SNYLF in lakes and ponds of this regions is relatively well understood (Pope and Matthews 2001; Knapp 2005; Knapp et al. 2016). The northern Sierra Nevada is different in its geomorphology; most of its watersheds, including the Prosser Creek watershed, contain relatively little lake and pond habitat compared to the central and southern Sierra Nevada. Consequently, SNYLF are associated primarily with creeks and streams (i.e., lotic habitats) in the northern Sierra Nevada; although, they will also use suitable lakes and ponds (Brown et al. 2019, 2020; Yarnell et al. 2019). Relatively little is known about the ecology of SNYLF in streams (USFWS 2014), and consequently our understanding of the species in the lotic-dominated northern Sierra Nevada is limited, leading to some uncertainty in how the species should be managed in this part of its range.

Despite geographic differences in the relative use of lotic versus lentic habitats, SNYLF throughout their range use still or slow-moving water for reproduction (USFWS 2014). Thus, in stream habitats, low-flow pools are targeted. Yarnell et al. (2019) found that rearing sites used by SNYLF larvae in streams of the northern Sierra Nevada averaged a flow rate of 0.1 m/sec (3.3 ft/sec), and 98% of rearing sites had a flow rate less than 2 m/sec (6.6 ft/sec). We know of no confirmation of SNYLF eggs or larvae in swift-flowing water. Thus, we consider still or slow-moving water to be a habitat requirement for reproduction in this species. Furthermore, the still or slow-moving water must last year-round without freezing all the way to the bottom in the winter (USFWS 2014). Most SNYLF populations occur at elevations above 1,219 m (> 4,000 ft) (USFWS 2014). The relatively short length of the ice-free season in high-elevation aquatic habitats prevents SNYLF larvae from completing metamorphosis in the same year that they hatch. Consequently, larvae require 1–4 years to develop, depending on the elevation, with longer larval developmental times at higher elevations (AmphibiaWeb 2020).

Nonnative trout introduced to lakes and ponds in the range of SNYLF have caused or contributed to numerous population declines and extensive range contraction in SNYLF by preying upon larvae and preventing successful reproduction (Knapp and Matthews 2000; Knapp 2005). The presence of nonnative trout effectively excludes SNYLF from breeding in otherwise suitable breeding habitat, with the exception of some streams in the northern Sierra Nevada. For reasons that are not well understood, the northern Sierra Nevada support several persistent populations of SNYLF that reproduce in trout-occupied streams (Brown et al. 2019, 2020; Yarnell et al. 2019). Most of these SNYLF populations are small (Brown et al. 2019, 2020; Yarnell et al. 2019), and thus so their long-term viability is uncertain. Nevertheless, trout-occupied streams might be a crucial component of SNYLF recovery, and some such streams have recently received captive-reared SNYLF to augment existing populations (Brown et al. 2020).

Coexistence of SNYLF and salmonids in northern Sierra streams might be influenced by physical stream characteristics. In particular, smaller streams that contain dry sections during the summer might be particularly likely to support coexistence. Dry sections of stream appear to act as seasonal barriers that might allow successful SNYLF reproduction in isolated, ponded stream reaches supporting fewer, or no, fish (Brown et al. 2020). The unique evolutionary history of SNYLF the northern Sierras, relative to other parts of the species' range, might also play a role. Various species of salmonids, including Lahontan cutthroat trout (*Oncorhynchus clarkii henshawi*), steelhead/rainbow trout (*Oncorhynchus mykiss*), spring-run Chinook salmon (*Oncorhynchus tshawytscha*), and mountain whitefish (*Prosopium williamsoni*), are native to watersheds that likely supported SNYLF populations in the northern Sierras, but these fishes typically are not native to the regions of the central and southern Sierra where SNYLF occur. It is possible that SNYLF in the northern Sierras evolved microhabitat selection and antipredator behaviors, owing to a shared recent evolutionary history with salmonids, which allow SNYLF larvae to avoid predation well enough to allow population persistence. However, stocking nonnative salmonids at high densities for recreational sport fishing, a common practice throughout all Sierra Watersheds over the last 100–150 years, might cause an unnatural level of predation risk relative to the conditions under which SNYLF evolved, even for populations that co-evolved with salmonids, and thereby reduce the density and the long-term viability of these SNYLF populations.

The negative effects of trout on SNYLF are likely to be exacerbated by climate change-related drying of aquatic systems. In the mountains of western North America, including the Sierra Nevada, increases in winter temperatures will cause less precipitation to fall as snow and cause the snowpack to melt faster, which will intensify summer drawdown of surface waters and drying of streams, ponds, wetlands, and riparian zones (Elsner et al. 2010; Hamlet et al. 2013; Dickerson-Lange and Mitchell 2014; Leibowitz et al. 2014; Lee et al.

2015). Increased summer air temperatures will add an additional drying effect on waterbodies (Cooper et al. 2018). Hydroperiod (i.e., the length of time that a waterbody holds surface water) will shorten in many cases; some currently permanent or perennial streams and ponds will become seasonal or intermittent; some currently seasonal ponds will become ephemeral; and some wetlands and riparian areas will shrink in size (Lee et al. 2015).

The resulting loss of SNYLF breeding habitat will be particularly problematic because it will be combined with habitat losses already incurred due to the presence of nonnative trout. Ryan et al. (2014) use the term "climate vice" to describe the combined effects of climate change and nonnative trout on SNYLF and other amphibian species that are sensitive to predation by trout. These amphibian species are excluded from reproducing in many of the larger, deeper lakes and ponds that are resistant to climate change-induced drying because of the presence of nonnative trout. Currently, many populations of SNYLF depend heavily on marginal, shallow ponds and wetlands for reproduction, especially in the central and southern Sierras, where the species primarily breeds in lentic habitats. But it is precisely the shallow habitats that will experience shortened hydroperiods in the future. Under climate change, many of these ponds and wetlands will no longer hold water long enough to allow successful metamorphosis of amphibians (Ryan et al. 2014). It is unclear how the climate vice will affect SNYLF in the northern Sierras, where the species is primarily associated with streams, because little information exists on fine-scale habitat use. Specifically, it is unknown to what degree northern SNYLF populations use shallow, marginal habitats for reproduction. In the watershed, the climate vice could reduce the amount of fish-free breeding habitat available to SNYLF (which is now, most likely, confined to relatively smaller tarns and other glacial lakes in the upper watershed that were never stocked with nonnative trout and are hydrologically disconnected from extant trout populations), increasing the importance of reproduction in trout-occupied creeks and streams, as well as the potential conservation benefits of management actions that create trout-free conditions in deeper lakes and ponds that more likely to remain perennial even with climate change.

Methods

Waterbody Permanence

We identified waterbodies that might have flow regimes suitable for SNYLF breeding and examined their permanence across the watershed employing a time series of aerial imagery. Fifteen time points spanning from 2010 to 2018 were used: 24 April 2010, September 2010 (exact date unspecified), 10 July 2010, 14 June 2011, 29 August 2011, 28 August 2012, 16 June 2013, 29 April 2014, 25 July 2014, 15 April 2015, 23 June 2016, 13 July 2016, 29 June 2017, 11 August 2017, and 7 June 2018. All imagery was sourced from Google Earth (2020) and viewed on the Google Earth platform, except that imagery for 25 July 2014 came from the National Agriculture Imagery Program (USDA 2014) and was viewed on CalTopo (2020). Each image covered the entire watershed, except those from 29 August 2011, 15 April 2015, and 29 June 2017, which were essentially limited to the area extending west of a line running north-south through the watershed and intersecting the eastern tip of Warren Lake. Additionally, for the purpose of this analysis Summit Lake and its immediate vicinity, including a pond 24 m to the southwest, were considered part of the watershed even though there is some uncertainty as to whether Summit Lake lies in the watershed or flows west to the South Yuba River watershed.

Extant waterbodies were identified using primarily aerial imagery taken on 29 April 2014 and 15 April 2015, the dates upon which the most unfrozen surface water was visible throughout the watershed, in combination with a 7.5 minute topographic map tool (USGS 2020). Where the presence of water or its likely flow regime was ambiguous because images lacked sufficient resolution or contained obscuring shadows, conclusions were inferred using the full time series of images as opposed to only the two images from April 2014/2015. All aquatic habitat types potentially containing still or slow-moving water were considered, including lakes, reservoirs, ponds, tarns, meadow pools, oxbows, beaver-constructed canals, side channels and backwaters of streams and creeks, and stream pools, except that pools in the main channel of streams and creeks were not considered due to the difficulty of identifying them in narrow, high-gradient headwater streams. Also, the likely presence of trout in main-channel pools makes them somewhat less likely to support SNYLF reproduction in comparison to marginal waterbodies such as oxbows, side channels, backwaters, and ponds in the floodplain that are hydrologically connected to the main channel (i.e., through shallow groundwater) but lack a surface water connection.

Several meadows along Prosser Creek, including its north and south forks in Carpenter and Euer Valley (respectively), contained a complex stream network, but in each meadow only one channel was designated as the main channel. A complex of numerous pools, which likely includes beaver dams, is located at the site of a 1997 landslide in upper Carpenter Valley, along the North Fork Prosser Creek (Figure 2). This complex includes numerous off-channel pools connected by surface water. It was treated as one site because of uncertainty over the boundaries of the particular waterbodies and the high propensity for them to change rapidly from beaver dam-building activities and dam blowouts during high water flows (personal observations by John Romansic, ecologist, H. T. Harvey & Associates, 2015-2019). Any other waterbody outside of a main channel was scored as a "site" if it held water at least once during the 2010-2018 time series and the observer (John Romansic) judged that it might contain still or slow-moving water during times of year that SNYLF embryos are present or larvae are active (roughly snowmelt to October) in at least some years. Although it is likely that some of sites contained stream flow too rapid for SNYLF embryos or larvae, our inclusive approach minimized the possibility of missing waterbodies with hydrological characteristics suitable for SNYLF reproduction.

Site permanence was assessed using two focal, late-summer time points, 28 August 2012 and 11 August 2017. At the closest snow telemetry (SNOTEL) station, located at Independence Lake, 2.1 mi. (4.7 km) to north of the watershed (NRCS 2020), water year-to-date precipitation (inches of rain plus inches of snow water equivalent since 1 October of the previous year) on 28 August 2012 was 34.7 in (88.1 cm), which is 73% of the 1991-2020 water year-to-date precipitation average of 47.5 in. (120.5 cm). Over the 1991-2020 time period, this station recorded 17 dry years (years in which year-to-date precipitation was below the 1991-2020 average). Across these 17 dry years, average year-to-date precipitation at the station on 28 August was 35.5 in (14.0 cm; range: 24.7-47.4 in.; standard deviation: 6.6 in.), within 0.8 in. (2.0 cm) of the 2012 level, indicating that the 34.7 in. recorded in 2012 represents a typical dry year for the 30-year span. In contrast, water year-to-date precipitation at this station on 11 August 2017 was 88.7 in. (225.3 cm), which is 188% of the 1991-2020 average of 47.2 in. (119.9 cm). Indeed, at Independence Lake, 2016-2017 was the wettest water year during the 30-year period (NRCS 2020). In 2017, the snowpack at Independence Lake lasted until 25 July but lasted until only 19 June in 2012. Thus, our 2012 and 2017 time points represent late summer in a typical dry year and an extremely

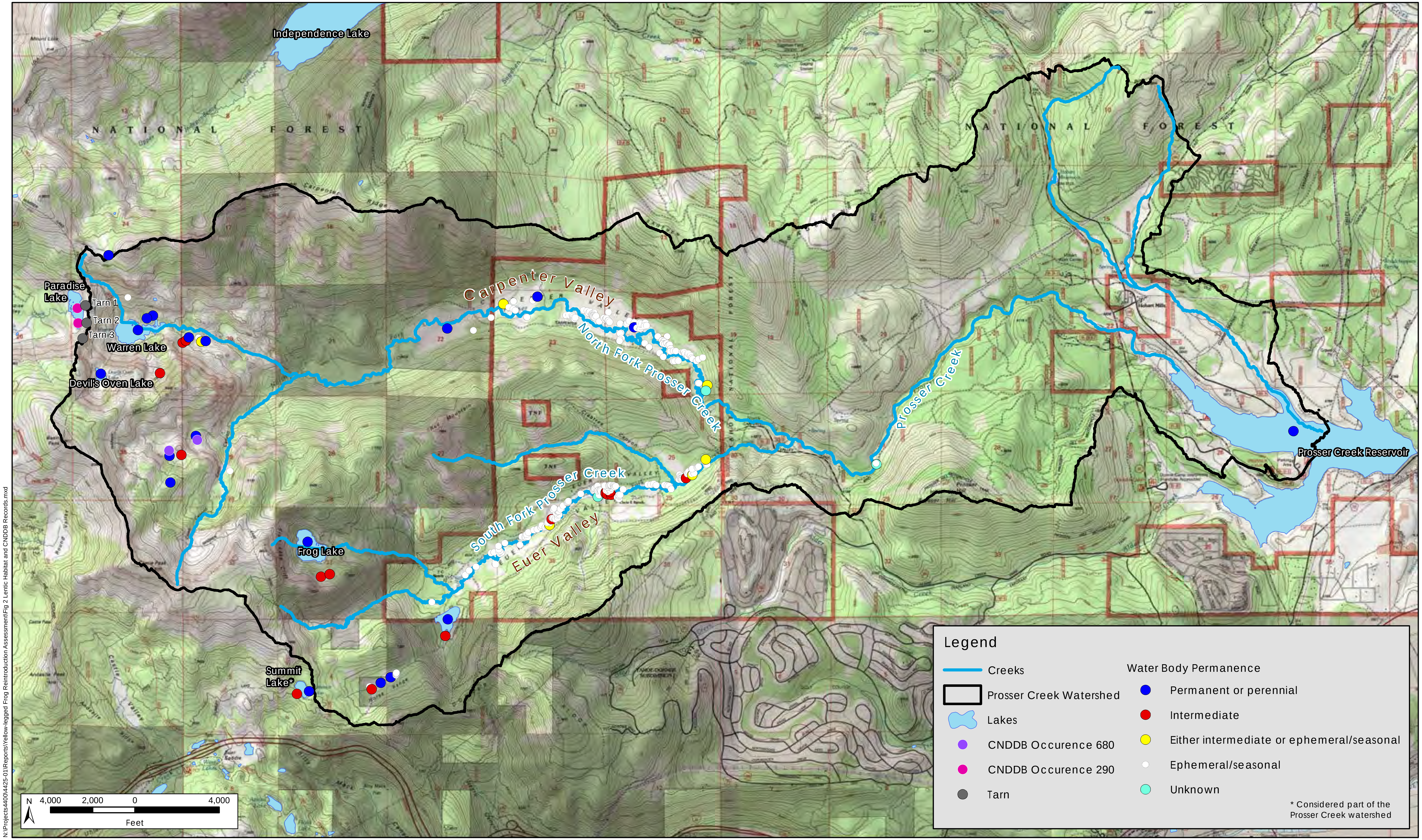


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Figure 2. Lentic Habitat and CNDDB Records

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wet, "best-case scenario" year, respectively, under current climatic conditions (defined as conditions over the 30 years spanning 1991 and 2020).

Presence or absence of surface water was scored by the observer for each site at each focal time point. If the presence or absence of water at a particular location could not be determined (e.g. because of shadows or insufficient image clarity), its permanence was scored as "unknown". Site permanence under current climatic conditions was characterized for waterbodies according to the pattern of surface water presence or absence observed across the focal time points (Table 1).

Table 1. Classification of Site Permanence under Current Climatic Conditions According to Surface Water Presence and Absence at Focal Time Points

Surface water present?		
Late Summer 2012 (Wet Year)	**Late Summer 2017 (Wet Year)**	**Classification Under Current Conditions**
No	No	Ephemeral/seasonal (dries every year)
Unknown	No	Ephemeral/seasonal (dries every year)
No	Unknown	Uncertain; either ephemeral/seasonal (dries every year) or intermediate (dries in some years)
No	Yes	Intermediate (dries in some years)
Yes	Yes	Perennial or permanent (dries rarely, if ever)
Unknown	Unknown	Undetermined (drying regime unknown)

To examine how well hydrological conditions on 28 August 2012 reflect a typical dry year under current climatic issues, we checked the identified lentic waterbodies for differences in surface water presence/absence between 28 August 2012 and 25 July 2014. 2014 was chosen for comparison to 2012 because both years had similarly dry weather conditions; on 25 July 2014, water year-to-date precipitation at the Independence Lake SNOTEL station was 57% of the station's 1991-2020 average, and the 2014 snowpack lasted until 5 June at this location (NRCS 2020). Areas below approximately 1951 m (6400 ft) along the main stem of Prosser Creek and in Carpenter Valley along North Fork Prosser Creek and areas below approximately 2012 m (6600 ft) in Euer Valley along South Fork Prosser Creek, were excluded from the comparison between two dry years because the July 2014 imagery lacked sufficient clarity to judge water presence/absence in these locations.

Connectivity

To evaluate whether the spatial arrangement of the watershed's aquatic sites is favorable for long-term maintenance of a SNYLF metapopulation, we assessed the likelihood of SNYLF dispersal between potential breeding sites using our waterbody permanence analysis, topographical maps depicting the locations of marsh and wetland habitat, and published estimates of SNYLF dispersal capabilities. To estimate maximum dispersal capabilities of SNYLF, we reviewed all published mark-recapture and radiotelemetry studies of SNYLF and reported in the literature (Matthews and Pope 1999; Pope and Matthews 2001; Matthews 2003; Matthews and Preisler 2010; Fellers et al. 2013; Brown et al. 2019). Among these six studies, the greatest straight-line distance between any two detections of a single SNYLF individual was 1365 m (Fellers et al. 2013). We used this distance as the maximum dispersal distance. We also assumed that no SNYLF can travel farther than 420 m (1378 ft.) of straight-line distance without encountering aquatic habitat (i.e., lake, pond, tarn, creek, stream, marsh, wetland, or spring) based on the greatest reported overland movement distance (420 m; Pope & Matthews 2001). Adult SNYLF have sometimes been observed traveling on snow (V. Vredenburg, pers. comm.), but we assumed conservatively that neither snow, ice, nor puddles of water over ice or snow can substitute for aquatic habitat during dispersal.

We defined dispersal as movement of an individual SNYLF from its natal waterbody to a different waterbody, followed by reproduction of this individual in the latter. For the purposes of this connectivity analysis, we assumed that SNYLF are capable of breeding in all sites characterized as perennial or permanent in the waterbody permanence analysis. We further assumed that SNYLF are capable of breeding throughout the entire extent of permanent creek and permanent stream habitat (all solid blue-line streams mapped by USGS [2020]). This is unrealistic, but useful for the connectivity analysis. As discussed previously, several SNYLF populations in the northern Sierra Nevada persist in trout occupied creeks and streams (Brown et al. 2019; Yarnell et al. 2019), either by reproducing in main-channel pools, off-channel, peripheral waterbodies, or both. Sites suitable for SNYLF reproduction likely occur in spaces throughout the watershed's stream network, with no gaps exceeding 1365 m, which would effectively make the entire stream network a conduit for dispersal.

Immigration

The potential for immigration of SNYLF from neighboring watersheds was evaluated using estimates of the maximum dispersal abilities of the species; the location of waterbodies, including extant breeding sites in neighboring watersheds; and the location of waterbodies with permanence and flow regimes potentially suitable for SNYLF. This was loosely defined to include pools in the main stem of creeks and streams. Thus, for this analysis, we assumed that the entire extent of permanent creek and stream habitat (all solid blue-line streams mapped by USGS [2020]) was suitable for movement during immigration. Because most creek and stream habitat in the watershed is separated from any waterbody in a neighboring watershed by more than 420 m (straight-line distance) of terrestrial habitat; choosing the alternative option of excluding of creeks and streams made no difference in our results. Extant breeding sites were identified using species occurrence records in the California Natural Diversity Database (CNDDB 2020).

Results

Waterbody Permanence

We identified a total of 271 sites that might have still and slow-moving water suitable for SNYLF breeding (Figure 2). Nineteen were characterized as perennial or permanent; these consisted of Warren Lake, Devil's Oven Lake, Frog Lake, Summit Lake, and 15 unnamed waterbodies comprised of lakes, ponds, tarns, pools at the margins of streams or creeks (marginal pools), and the pool complex along the North Fork on Prosser Creek in upper Carpenter Valley. As expected, the two extant SNYLF breeding sites in the watershed (CNDDB [2020] occurrence number 680), located between Devil's Oven Lake and Frog Lake, were included among the sites found to be perennial or permanent. Sites assigned to the perennial/permanent category were concentrated in the upper elevations in the western and southwestern portions of the watershed. We identified only four perennial or permanent sites along Prosser Creek, including its north and south forks. However, it should be emphasized that our analysis of waterbody permanence did not include the main channel of Prosser Creek or its forks. These main channels likely contain some permanent pools that are potentially suitable SNYLF.

Sixteen sites (eight ponds and eight marginal pools) were classified as intermediate, and 230 sites, including small ponds in the upper elevations in the western and southwestern parts of the watershed and many marginal pools along the creeks, were classified as ephemeral. Six sites were placed in the uncertain category because it could not be determined whether they were ephemeral or intermediate, and three sites could not be assessed at all because of shadows and insufficient image clarity. Results from the 2014 imagery matched those from the 2012 imagery exactly, with one exception. One small pond located 345 m southwest of the eastern tip of Warren Lake, and designated as permanent or perennial based on the imagery from 2012 and 2017, could not be discerned in the 2014 imagery.

Connectivity

Our connectivity analysis found that none of the potential breeding sites in the watershed were isolated. Instead, we found that the potential breeding sites formed an extensive network. Potential breeding sites within the network were connected by creeks, streams, short stretches of terrestrial habitat (≤420 m), intermediate and ephemeral waterbodies identified in the analysis of waterbody permanence, and additional marsh habitat mapped in by USGS (2020). The spatial arrangement of waterbodies created many potential routes for SNYLF to disperse from one potential breeding site to another without having to traverse any stretches of dry land greater than 420 m.

Immigration

A tarn located approximately 40 m southeast of Paradise Lake (Tarn 2, Figure 2) was identified as a potential source of SNYLF immigrating into the watershed. It is located approximately 413 m west-northwest of Warren Lake. Since 2008, SNYLF larvae have been detected in both Tarn 2 and Paradise Lake (CNDDB [2020] occurrence number 290). Thus, Tarn 2 is currently a potential source of SNYLF traveling to Warren Lake. Our analysis of potential immigration found no other potential breeding sites close enough to the waterbodies in the Prosser Creek watershed to serve as a source of SNYLF immigration into the watershed. Besides Tarn 2, all waterbodies in neighboring watersheds are located beyond 420 m of uninterrupted terrestrial habitat.

Discussion

Our assessment of waterbody permanence identified 19 waterbodies within the watershed (excluding the main channel of creeks and streams) that are permanent or perennial under current climate conditions. Eight of these are particularly interesting because they are relatively small ponds, none being larger than about 0.25 ha, and are located in the upper elevations of the watershed. It is possible that these ponds were never stocked with trout and are protected from trout invasion by natural fish barriers in streams or because they are not connected to the larger stream network. If these ponds lack trout, they might be highly suitable for reintroduction of SNYLF. Based on the most recent surveys conducted 2012, two of these 8 ponds currently support a small breeding population of SNYLF (CNDDB 2020). We suggest that surveys be conducted in the other 6 permanent or perennial to determine which, if any, contain trout and identify which, if any, support SNYLF breeding or foraging, sunning, and overwintering behaviors of juveniles and adults.

The 19 waterbodies classified as permanent or perennial because they appeared hold year-round surface water might be suitable for SNYLF breeding if their flow levels are appropriately low. However, it is possible that some of these waterbodies that were small in size dried after aerial photographs were taken in 2012 (the dry year) or in 2012 and 2017 (the dry and the wet year). Furthermore, some of the waterbodies, in particular the smaller ponds, might dry down far enough in the summer and early fall to freeze solid in the winter, which would likely kill any SNYLF larvae present. Thus, our analysis should be interpreted as a first step in investigating the suitability of hydrological conditions for SNYLF. We eliminated many waterbodies as potential breeding sites for SNYLF because they did not support any surface water in the dry year or even in the wet year. However, these waterbodies might contribute to SNYLF conservation by facilitating foraging and sunning behaviors of juveniles and adults. Further work is necessary to better ascertain which of the remaining waterbodies are best suited for SNYLF reproduction and which waterbodies are the best candidates for management actions such as fish removal and SNYLF reintroduction

Another limitation of our assessment of waterbody permanence is that it reflects only current conditions. We identified waterbodies that are permanent or perennial even in a dry year (2012) representative of the dry years that frequently occur under current climatic conditions. Unfortunately, we were unable to assess how waterbodies will respond to year-to-year variation in precipitation and temperature conditions in future decades. The "wet" and "dry" years used in our assessment (2017 and 2012, respectively) likely do not match the conditions of "wet" and "dry" years expected in the future under the continued drying influence of climate change. We propose that the pattern of surface water presence and absence observed in the 2012 "dry" year be used as a gauge of future "average" conditions (i.e., drier conditions relative to current) in the future. The water patterns observed in the 2017 "wet" year are likely to be irrelevant in the future because the amount of precipitation that falls as snow, and the duration of the future snow pack, are anticipated to rarely, if ever, reach levels observed in 2017 or similarly "wet" years under recent climate conditions. In addition, future "dry" years will likely be drier than the "dry" year in our analysis (i.e., 2012). Further investigation, including on-the-ground habitat surveys, are necessary to assess which of these will hold year-round water through the year-to-year increases and decreases in snow levels in the drier climate of the coming decades.

As, expected, all lakes in the watershed greater than 3 ha in size (Warren Lake, Devil's Oven Lake, Frog Lake, Summit Lake, and an unnamed reservoir 1.8 km southeast of Frog Lake) held surface water in all aerial images examined. At least four of these (Warren Lake, Devil's Oven Lake, Frog Lake, and the unnamed reservoir) contain nonnative trout (CDFW 2019a, 2019b; USFS 2020) and are thus less suitable for SNYLF reproduction. Although northern SNYLF populations can reproduce in trout-occupied streams, there is no evidence that they can do so in trout-occupied lakes. Warren Lake contains stocked Lahontan cutthroat trout, which are native to the region but might not be native to Warren Lake per se. Because of the uncertainty over whether or not the smaller, shallower ponds that are currently permanent or perennial will hold year-round water in the future, trout removal in one or more of the deep lakes combined with reintroduction of SNYLF may be necessary to prevent extirpation of SNYLF from the watershed. Currently, the only known SNYLF breeding sites in the watershed consist of two small ponds, the largest of which is 0.34 ha in size. These ponds are located 1.3-1.4 km (0.8 to 0.9 mi) southeast of Devil's Oven Lake (CNDDB occurrences 290 and 680, Figure 2),. There is no evidence that SNYLF is currently reproducing in any other waterbody in the watershed, including creeks and streams. Furthermore, the size of the watershed's known SNYLF population is small. Thus, an increase in mortality due to infection, disease, predation, extreme drought, or other stochastic events might cause this population to die out, even without the added threat of climate change, highlighting the key importance of establishing additional breeding populations in the watershed.

The connectivity analysis suggested that the current spatial arrangement of aquatic habitat in the watershed is conducive to establishment of a SNYLF population in which breeding sites throughout the watershed are connected via dispersal. This analysis was somewhat idealized because it ignored the presence of predatory trout in lakes and ponds and used current hydrological conditions instead of future conditions under which the extent of surface water on the landscape will be lower and more fragmented, especially in late summer and early fall. We suggest that managers carefully examine the trout distribution, estimate future hydrological conditions, and carefully consider the spatial arrangement of sites fully suitable for SNYLF reproduction when planning SNYLF-related conservation actions.

The analysis of immigration identified one waterbody, Tarn 2 next to Paradise Lake, as being located close enough to Warren Lake to serve as a source of SNYLF dispersing into the Prosser Creek watershed. Particular obstacles along the route might prove too difficult for SNYLF to surmount, but genetic evidence shows that SNYLF have surmounted formidable watershed barriers over their evolutionary history, including the steep mountain pass between the San Joaquin River and the Middle Fork Kings River (Rothstein et al. 2020). Warren Lake is currently occupied by trout and thus is likely not suitable breeding habitat, but incoming SNYLF could, theoretically, rest and hydrate at the lake before moving on to other nearby sites in the watershed that could be suitable for breeding. Paradise Lake and Tarn 2 currently support a small population of SNYLF. However, the current size of the breeding population in the vicinity of Paradise Lake is too low to be a realistic source of immigration. The highest number of individuals ever recorded for this population, including larvae and adults, is 12 (CNDDB 2020). With so few candidate sites for immigration, the chances that any individuals will end up dispersing to the watershed, let alone successfully reproducing there, is extremely low. Thus, active reintroduction of SNYLF is the only realistic potential outside source of SNYLF individuals to use for conservation of the species in the watershed, unless the population in the vicinity of Paradise Lake increases in the future. Some recent research suggests that reintroduction efforts, if attempted, should emphasize captive rearing and release of adult frogs due to high mortality of other frog life stages following reintroduction (Brown et al. 2020).

The watershed contains additional ecological features that warrant consideration during formulation of SNYLF conservation strategies. Firstly, the pathogenic fungus *Batrachochytrium dendrobatidis* (Bd) which contributes to population declines in SNYLF (Briggs et al. 2005; Vredenburg et al. 2010) and many other amphibian species

(Fisher and Garner 2020) was detected in the existing watershed SNYLF population in 2011 (CNDDB 2020). Bd might be exerting a negative effect on this population; the highest number of individuals ever recorded between the two ponds used by this population is 17, including larvae and adults (CNDDB 2020). SNYLF in the central Sierra Nevada appear to be recovering after being reduced by Bd (Knapp et al. 2016), but it is unknown whether or not this rebound effect is occurring in the northern Sierra Nevada. The most recent interagency recommendations for SNYLF conservation highlight the importance of considering Bd when designing reintroduction efforts (CDFW et al. 2018). Although techniques for helping SNYLF and other amphibians persist in the presence of Bd are still being developed, managers might increase their likelihood of successful reintroduction and re-establishment through new advances in captive rearing techniques that increase resistance and newly developed field applications of antifungal chemical or probiotics treatments that reduce Bd infection loads (CDFW et al., 2018).

Finally, the beaver population in the watershed can potentially be leveraged to aid SNYLF. Although there is currently little information on the relationship between SNYLF and beavers, a recent study in trout-occupied stream systems in the Washington Cascade Range found that slow-developing amphibian species with hydroperiod requirements similar to SNYLF are strongly associated with beaver dams (Romansic et al. 2020). Complex aquatic habitats created by beavers in the north and south forks of Prosser Creek might provide SNYLF larvae with an abundance of off-stream refugia that allows them to better avoid predatory trout. Beaver dams might also create peripheral ponds in the floodplain that are hydrologically suitable for SNYLF reproduction but lack trout because they have no surface water connection with the main stream channel. Notably, the largest SNYLF population in the northern Sierra Nevada occurs in an extensive beaver dam complex near Independence Creek (Brown et al. 2019). Investigation of habitat characteristics in the vicinity of beaver dams in Prosser Creek combined with research on extant SNYLF populations in beaver-influenced habitats would help elucidate the potential role of beavers in supporting SNYLF conservation in the watershed.

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APPENDIX J

Project Sheets

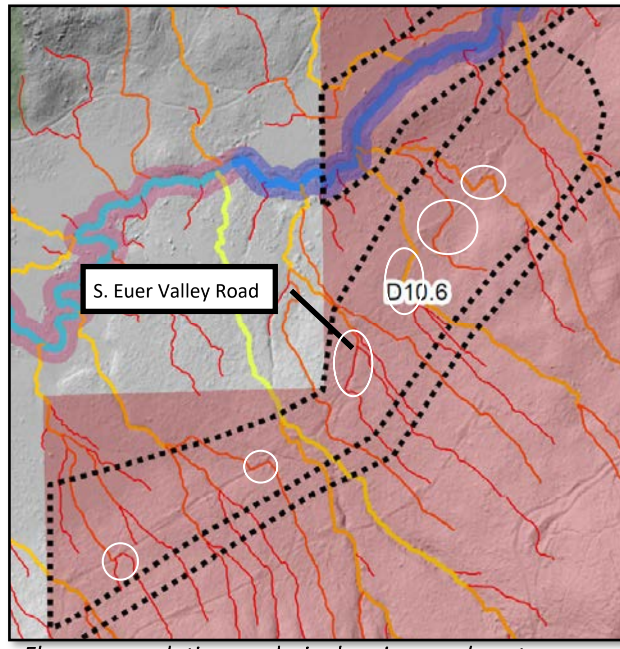
Project 5: South Euer Valley Road Improvements

Problem: Road capture of tributary flow, erosion, increase in runoff and sediment to Prosser Creek
Project: Restore hydrologic connectivity and improve crossings
Location: Tahoe Donner Association, Reach M4, Disturbance ID: D10.6

General description of problem:

Euer Valley includes an approximately 200-acre meadow that exhibits evidence of channel incision, groundwater lowering, and meadow conversion in places. Legacy land-uses and associated roads are likely sources of degradation. Roads in the watershed are likely a source of excess runoff and sediment to degraded channel reaches. South Euer Valley Road is one such road that exhibits road capture at multiple perennial and ephemeral stream crossings. South Euer Valley Road is maintained for recreational use by Tahoe Donner Association, but a long-term solution is needed to improve the recreational experience and address runoff and sediment impacts.

Example of road capture of a perennial tributary along South Euer Road



Flow accumulation analysis showing road capture (white circles)

Goal(s)	Sources of degradation	Objectives to achieve goal(s)
• Restore hydrologic connectivity • Improve aquatic and riparian habitat • Improve recreation	• Road capture of streams	• Remove plugged or crushed culverts • Recontour road at crossings • Install ford crossings or new culverts • Improve road drainage • Restore natural flow pathways

Management and Restoration Approach:

The initial approach would consist of: (1) Using the existing flow accumulation analysis, field verify each location where road capture occurs; (2) Evaluating contributing area, range of flows, and channel geometry; (3) Identifying a crossing design appropriate for channel size and recreational use; (4) Restoring road surface and implement best management practices for improved road drainage.

*Cost Estimate:
Less than $10K
$10K-$100K
$100K-$500K
$500K-$2M
$2M +

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Project 5: South Euer Valley Road Improvements

Target Conditions/Success Criteria:

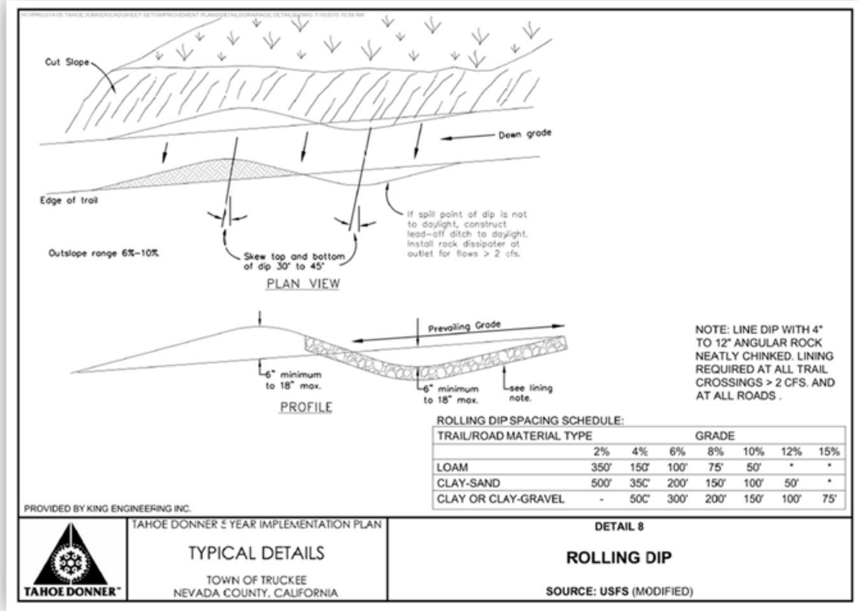
- Reduced runoff and sediment to SF Prosser Creek
- Eliminated road capture of streams
- Reduced trail degradation and maintenance

Implementation Timeframe

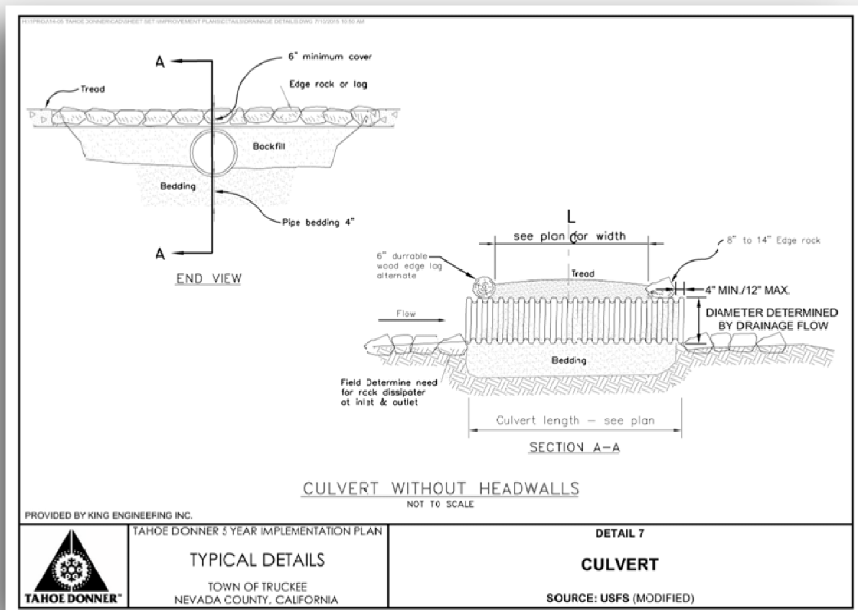
- Field verification and data gathering (1 week)
- Design (2-4 months)
- Permitting (6-12 months)
- Implementation (2-6 weeks)

Project monitoring recommendations:

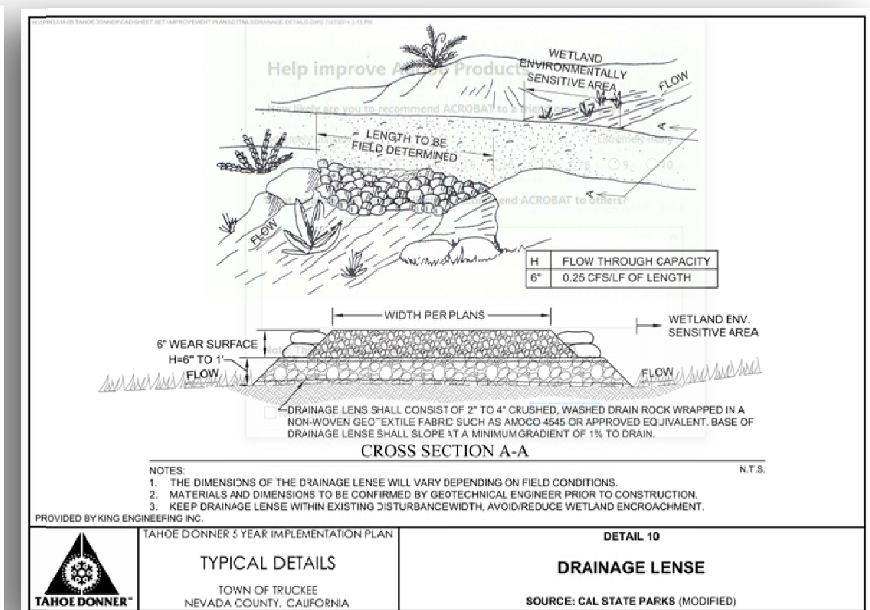
- Observation of flow and road conditions during snowmelt runoff or rainfall-runoff events
- Repeat aerial imagery using a drone



Typical of a 'Rolling Dip' at a stream crossing (TDA, 5 YIP, 2016)



Typical of a 'Culvert' at a stream crossing (TDA, 5 YIP, 2016)



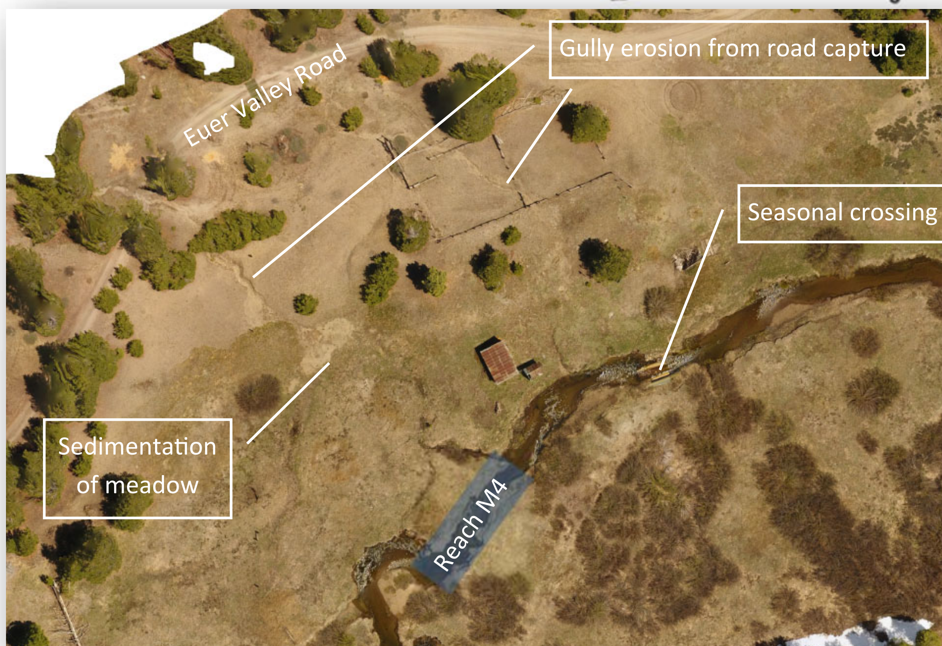
Typical of a 'Drainage Lense' at a stream crossing (TDA, 5 YIP, 2016)

Project 6: South Fork Prosser Creek Meadow and Stream Restoration (Cowboy Crossing and Corral Area)

Problem: Undersized crossing, channel/bank scour, impaired road drainage, excess runoff and sediment
Project: Improve crossing, road drainage improvements, sediment load reductions
Location: Tahoe Donner, Reach M4, Disturbance ID: D10.4 and D11.5

General description of problem:

Reach M4 of South Fork Prosser Creek exhibits measurable incision and active channel widening. Upland sources of excess runoff and sediment continue to impact channel conditions. Former ranch and logging roads have concentrated runoff and resulted in gully erosion. Sediment fills meadow and channel habitats and has converted some areas to upland. Separately, a seasonal (winter) recreational crossing may exacerbate channel scour and bank erosion. The Cowboy Crossing project is an opportunity to address some of the upland disturbances and reduce runoff and sediment loads to the creek and improve a winter crossing with reduced impacts to the channel.



Aerial photograph of 'Cowboy Crossing' (2020)

Goal(s)	Sources of degradation	Objectives to achieve goal(s)
• Reduce excess runoff and sediment to Reach M4	• Historical ranching/grazing	• Improve seasonal crossing
• Protect and enhance meadow habitat	• Road construction and use	• Identify and address sediment sources
• Improve channel conditions and habitat	• Disturbance to sensitive soils	• Improve road drainage
	• Seasonal crossing structures	• Improve recreational trails

Management and Restoration Approach:

Road and trail drainage will be evaluated and improvements prioritized to reduce runoff and sediment to the meadow and creek at this location while maintaining access and recreational use. Upland erosion could be addressed through gully repair, revegetation and slope stability measures. Meadow habitats could be restored by removing sediment/debris flow deposits and artificial fill. Finally, temporary crossing designs could be evaluated to identify an appropriate crossing that meets recreational needs while minimizes impacts on the channel (see Project 3). As part of this project, existing recreational use in the area of the former ranch/corral and access for private property upstream will be maintained and improved.

Project 6: Cowboy Crossing and Coral Area

Target Conditions/Success Criteria:

- Reduced sediment loads to meadow and creek
- Reduced bed and bank scour at crossing
- Increased wet meadow habitat

Implementation Timeframe

- Field surveys and data gathering (2 week)
- Design (4-6 months)
- Permitting (6-12 months)
- Implementation (4-8 weeks)

Project monitoring recommendations:

- Repeat photopoints
- Vegetation transects
- Channel condition assessments
- Streamflow/sediment gaging

Cost Estimate:

*Cost Estimate:
Less than $10K
$10K-$100K
$100K-$500K
$500K-$2M
$2M +

Constraints

- Upland geology and soils are sensitive to disturbance, legacy impacts pervasive and challenging to reverse
- Temporary crossings require regular management

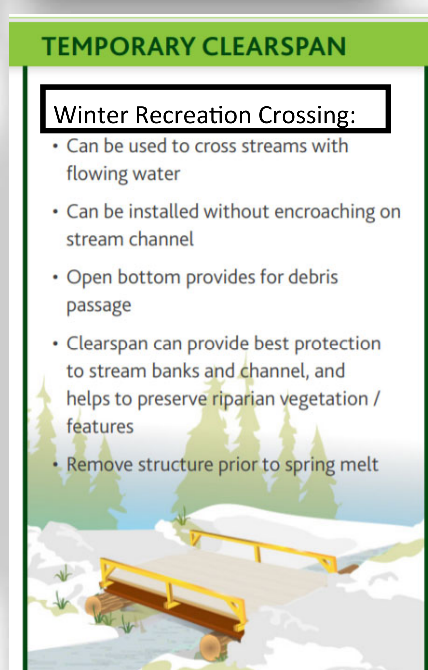
Opportunities

- Improvements to upland disturbance areas can also benefit efforts downstream and instream habitat in South Fork Prosser Creek
- Improvements to recreational experience

Road capture and gully erosion, former road and existing trail above corral

Active headcutting and gully formation above meadow

Temporary infrastructure used for winter crossing of SF Prosser Creek



Alternative temporary winter crossing structure, Source: BC Minitry of Water, Lands and Air Protection, 2004

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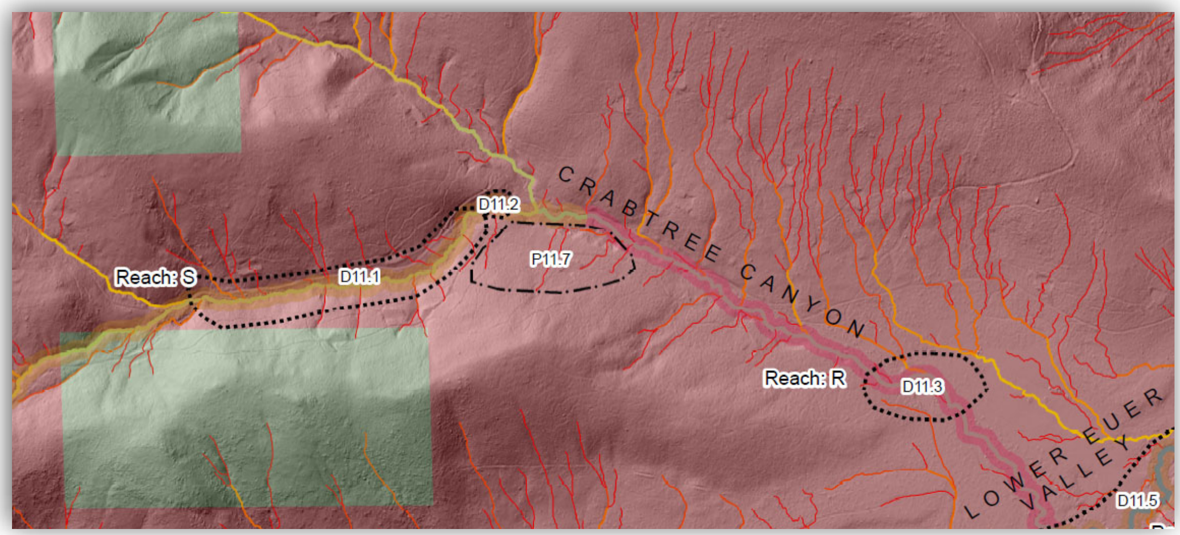
Project 7: Crabtree Canyon Tributary Road and Trail Improvements

Problem: Channelization, road drainage, increase in runoff and sediment to South Fork Prosser Creek
Project: Identify and address upland stressors, improve road drainage, remove sediment sources
Location: Tahoe Donner, Reaches R and S,
Disturbance ID: D11.1, D11.2, and D11.3

General description of problem:

Conditions in the lower reach of South Fork Prosser Creek are degraded and likely the result of legacy land-uses in Crabtree Canyon including road and railroad building for logging. Roads and railroad grades were constructed parallel to Crabtree Creek and impinge on the channel in many locations; multiple channel crossings still exist today. Disturbances to steep terrain underlain by erodible geology and soils are likely major sources of excess runoff and sediment. Addressing legacy impacts would improve the recreational experience and reduce impacts to downstream habitat in South Fork Prosser Creek.



Flow accumulation analysis showing Crabtree Canyon Tributary reaches and disturbance areas

***Cost Estimate:**

Less than $10K
$10K-$100K
$100K-$500K
$500K-$2M
$2M +

Goal(s)	Sources of degradation	Objectives to achieve goal(s)
• Reduce excess runoff and sediment from Crabtree Canyon	• Logging roads and railroad grades	• Decommission old roads/trails
• Improve downstream habitat	• Stream crossings	• Improve road drainage
• Improve recreation	• Channel modifications	• Improve stream crossings
	• Disturbance to sensitive soils	• Restore channel geometry and riparian vegetation

Management and Restoration Approach:

The initial approach would consist of: (1) Using LiDAR imagery and flow accumulation analysis to highlight key disturbance areas then field verifying to quantify degree of disturbance and drainage alteration; (2) Working with TDA to: a) identify roads/trails to improve for access/recreation and drainage; and b) identify roads that can be decommissioned; and (3) restoring modified channel segments.

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Project 7: Crabtree Canyon Tributary Road and Trail Improvements

Target Conditions/Success Criteria:

- Reduced runoff and sediment to SF Prosser Creek
- Eliminated road capture of streams
- Improved stream crossings
- Reduced trail degradation and maintenance

Implementation Timeframe

- Field verification and data gathering (2 week)
- Design (4-6 months)
- Permitting (6-12 months)
- Implementation (4-10 weeks)

Project monitoring recommendations:

- Evaluate sediment reductions using flow/sediment gaging
- Channel geometry cross-section monitoring at crossings

Constraints

- Existing road needs to be maintained to provide access to Frog Lake, wildfire and forest fuels management, and winter recreation.
- Steep and erodible terrain may limit scale and scope of restoration;

Opportunities

- Crabtree Canyon includes several seasonal and perennial springs that help maintain down-stream meadow habitat and baseflow in most years
- Crabtree Canyon includes large aspen groves that could be enhanced as part of this project

Alternative temporary winter crossing structure, Source: BC Ministry of Water, Lands and Air Protection, 2004

Existing temporary crossing structure, Crabtree Canyon Tributary

Project 8: South Fork Prosser Creek Meadow and Stream Restoration (Euer Valley Main Crossing)

Problem: **Undersized crossing, channel scour, road drainage, meadow dissection by road**

Project: **Improve crossing, reach-wide beaver dam analog construction, road drainage improvements**

Location: **Tahoe Donner Association, Reach M1-M2; Disturbance ID: D11.4, and D11.5**

General description of problem:

Reaches M1 and M2 of South Fork Prosser Creek are bisected by the main Euer Valley Crossing. Both reaches exhibit historical incision and on-going channel widening. Reach M1 (downstream) exhibits a greater degree of degradation, likely associated with the existing undersized crossing. Constriction of peak flows has exacerbated bank instabilities and channel widening. Historical incision has resulted in decreased channel-floodplain connectivity. Furthermore, the road has incised into the meadow surface, north of the crossing, disrupting meadow hydrology. Finally, roads south of the crossing capture snowmelt runoff and concentrate discharge into a single ditch. The drainage is a source of excess runoff and sediment to Reach M1.

Aerial photograph of Euer Valley Crossing (2020)

Goal(s)	Sources of degradation	Objectives to achieve goal(s)
• Improve crossing to convey high flows	• Historical road construction/use	• Replace or modify crossing
• Restore channel-floodplain connectivity	• Undersized crossing	• Construct multiple beaver dam analogs (BDAs), reach-wide
• Improve road drainage and meadow hydrology	• Disturbance to sensitive soils	• Improve road drainage
	• Excess runoff and sediment	

Management and Restoration Approach:

Euer Valley Road and crossing at SF Prosser Creek provides access to multiple landowners. Instream restoration elements will encourage channel aggradation and increase bed elevations over time resulting in increases in water surface elevations and meadow flooding from improved channel-floodplain connectivity will require design of the road across the meadow (north of crossing) such that road capture and erosion is minimized, seasonal access is feasible, and recreational uses are maintained.

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Project 8: Euer Valley Main Crossing

Constraints

- Construction will require temporary access closures for landowners and recreationists.

Target Conditions/Success Criteria:

- Reduced high-flow constrictions; reduced channel scour
- Conveyance of frequent floods
- Improved channel-floodplain connectivity
- Restored channel geometry

Implementation Timeframe

- Field surveys and data gathering (4 week)
- Design (4-6 months)
- Permitting (6-12 months)
- Implementation (4-6 weeks)

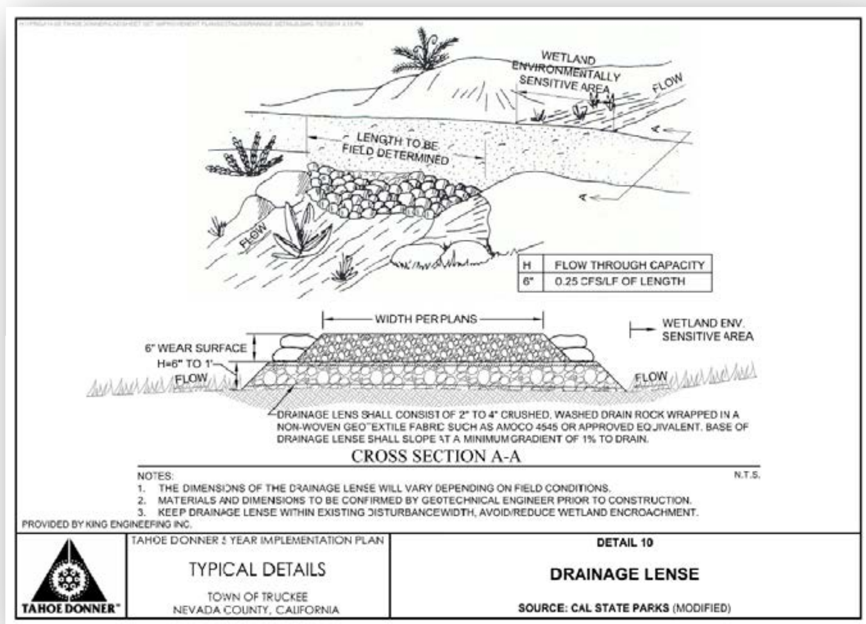
Opportunities

- Beaver activity in this reach could be leveraged to help restore instream conditions and channel-meadow or floodplain connectivity.
- High visibility reach due to its location as a year-round recreation access across Euer Valley; public education opportunities exist.

Project monitoring recommendations:

- Geomorphic cross-section surveys
- Shallow groundwater monitoring
- Channel condition assessments

Example of ''beaver dam analog' or BDA, Upper Truckee Marsh, South Lake Tahoe, CA, Balance Hydrologics, 2021



Typical of a 'Drainage Lense", TDA, 5YIP, 2016)

***Cost Estimate:**

Less than $10K
$10K-$100K
$100K-$500K
$500K-$2M
$2M +

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Project 9: South Fork Prosser Creek Meadow and Stream Restoration (Quickdraw Crossing)

Problem: **Informal summer trail crossing has generated bank erosion and ditching in meadow-riparian**

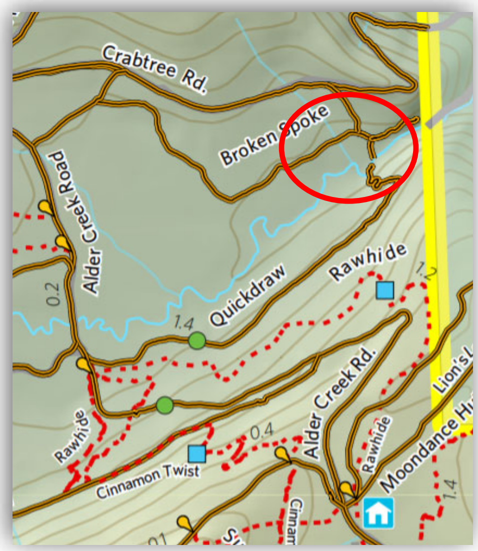
Project: **Relocate trail and construct formal crossing**

Location: **Tahoe Donner Association, Reach M1, Disturbance ID: D11.5**

General description of problem:

A multi-use trail (Quickdraw) includes an informal crossing of SF Prosser Creek at the downstream end of the Euer Valley meadow. Crossing locations vary based on user and streamflow conditions and have resulted in bank erosion, sensitive soil compaction and ditching, and impacts to riparian habitat. Similarly, the connecting trail (Broken Spoke) follows a former ranching or logging road which also impacts meadow soils and natural drainage. Opportunities exist to relocate the crossing and trail segments to offset historical impacts and enhance meadow, riparian and stream habitats.

Aerial photograph showing crossing area (2020)



(Trail map showing Quickdraw crossing (red circle); Tahoe Donner Association, 2021.

Goal(s)	Sources of degradation	Objectives to achieve goal(s)
• Offset historical impacts • Enhance meadow, riparian, stream habitat	• Informal trail crossing • Legacy road construction and use • Disturbance to sensitive soils	• Relocate trail segments and crossing • Uncompact soils and revegetate

Management and Restoration Approach:

These trails are part of the larger Tahoe Donner Trails and Recreational Program. Trail relocation and crossings should follow best management practices and guidance established in the Tahoe Donner Trails 5-Year Implementation Plan (2016). Sensitive soils and meadow habitats should be delineated to highlight avoidance areas. Relocated trail segments and a new crossing should be selected based on topography, soils, hydrology, and feasibility for construction. Uplands formed by a glacial moraine located immediately downstream provide an opportunity to establish a formal crossing and develop a crossing structure that utilizes natural channel stability in boulder-restricted channel.

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Project 9: Quickdraw Crossing

Target Conditions/Success Criteria:

- Reduced bank erosion and meadow compaction
- Improved meadow condition

Implementation Timeframe

- Field surveys and data gathering (1 week)
- Design (1-2 months)
- Permitting (4-8 months)
- Implementation (2-3 weeks)

Project monitoring recommendations:

- Repeat ground and aerial imagery
- Vegetation transects

Constraints

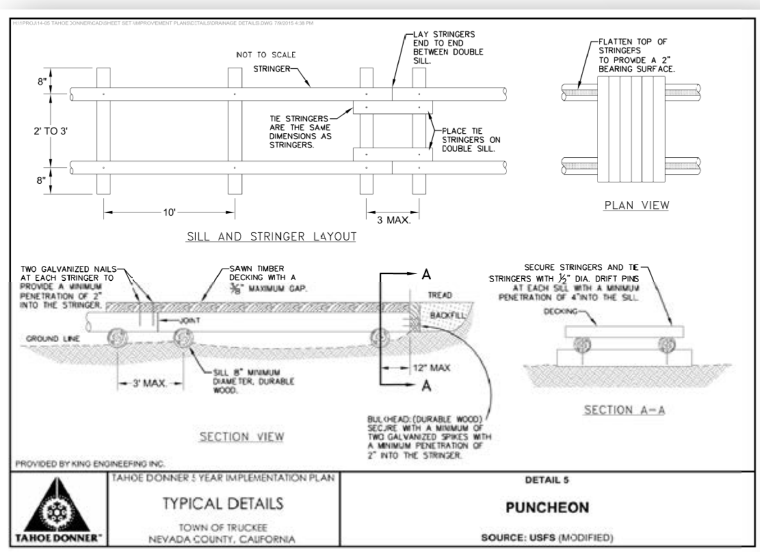
- Trail construction through glacial moraine may require small heavy equipment and access

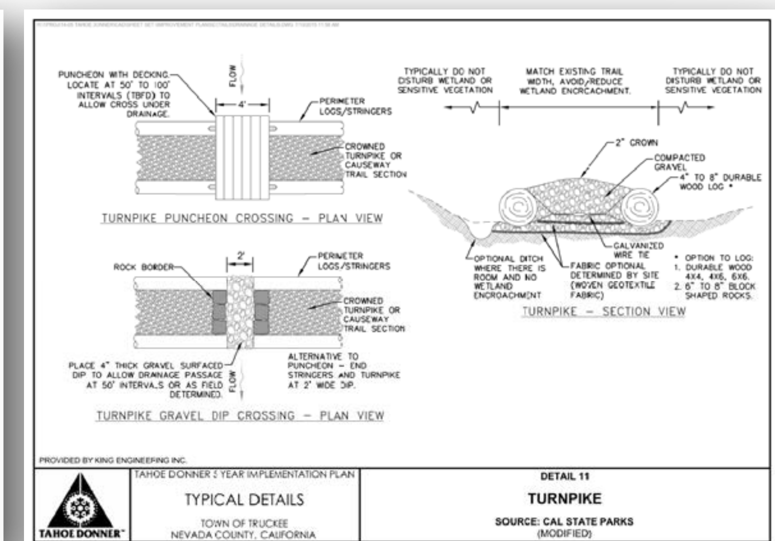
Opportunities

- Improvements to recreational experience
- Glacial moraine offers natural channel stability

*Cost Estimate:
Less than $10K
$10K-$100K
$100K-$500K
$500K-$2M
$2M +

SF Prosser Creek looking downstream at moraine; potential formal crossing





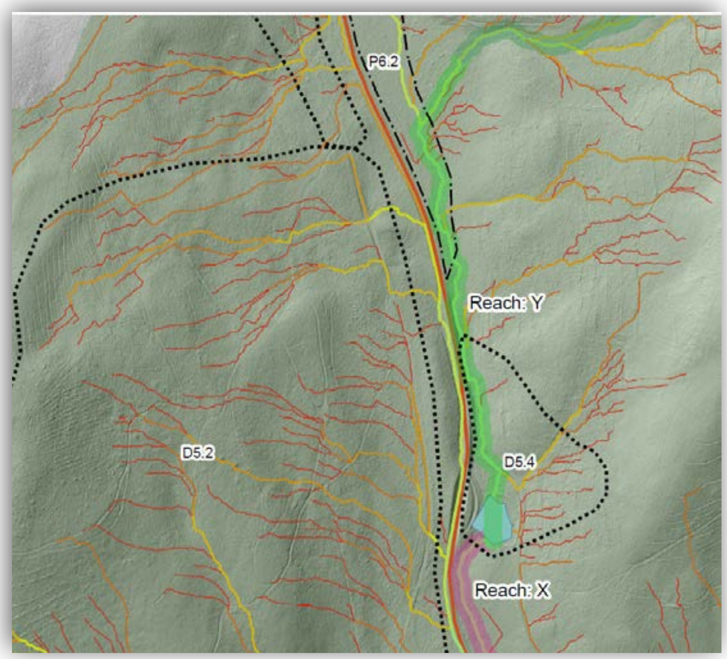
Typical of a 'Puncheon' to improve recreational experience and minimize impacts to sensitive soils (left); Typical of a 'Turnpike' an alternative for crossing seasonally wet areas (right), TDA, 5YIP, 2016.

Project 13: Hobart Mills Reservoir Wetland Enhancement

Problem: **Former reservoir disrupted stream and meadow processes**
Project: **Remove earthen dams, restore stream-meadow habitats**
Location: **Tahoe National Forest, Hobart Mills Tributary, West Fork, Reach Y, Disturbance ID: D5.4**

General description of problem:

Hobart Reservoir was constructed sometime between 1920 and 1930 for potable water supply to the town of Hobart Mills. Water was diverted/imported from Sagehen Creek to increase storage volumes. Two earthen dams constructed for the reservoir filled meadow habitat and altered upstream and downstream channel processes. Adjacent abandoned roads also show evidence of altered natural flow pathways above the reservoir. State Route 89 also contributes stormwater runoff to the channel adjacent to the channel. Approximately 6 acres of meadow habitat exist within Reach Y. Opportunities exist to remove many legacy impacts and increase meadow acreage and enhance habitat.



Flow accumulation analysis showing Reach Y and former Hobart Reservoir

Goal(s)	Sources of degradation	Objectives to achieve goal(s)
• Restore or enhance meadow condition and habitat	• Reservoir construction and operation • Roads, road capture • Stormwater runoff	• Remove former earthen dam and reservoir infrastructure • Decommission roads, restore natural flow pathways • Install stormwater best management practices

Management and Restoration Approach:

The initial approach would consist of: (1) Subsurface exploration to identify former meadow surface and soils and remove sediment accumulation; (2) Identifying footprint of earthen dam and remove fill; (3) Implementing a revegetation plan; (4) Mapping and identifying adjacent roads for decommissioning and restoring natural drainages; (5) Installing stormwater sediment basins at existing SR89 outfalls to aggrade incised channel.

Project 13: Hobart Mills Reservoir Wetland Enhancement

Target Conditions/Success Criteria:

- Increase meadow acreage
- Reduce erosion
- Reduce stormwater impacts to meadow/channel

Implementation Timeframe

- Field data collection, surveys (4 weeks)
- Design (3-4 months)
- Permitting (6-12 months)
- Implementation (4-6 weeks)

Project monitoring recommendations:

- Vegetation surveys
- Wetland delineations before/after

Cost Estimate:

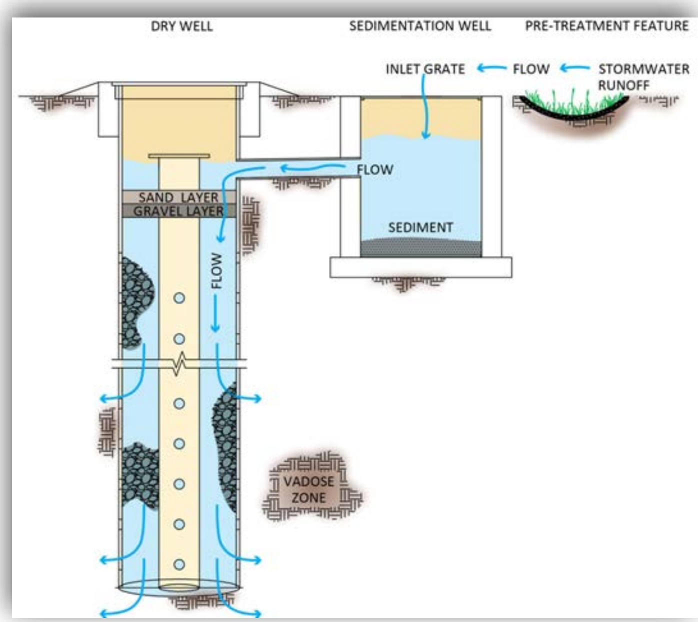
Less than $10K
$10K-$100K
$100K-$500K
$500K-$2M
$2M +

Constraints

- SR89 stormwater management will require coordination with CalTrans
- Historical/cultural resource evaluation may be required

Opportunities

- Completion of a full Prosser Watershed Roads Inventory and Assessment may benefit this project; helping to identify other road/drainage impacts upstream
- Prioritization of this project may benefit Project #7: Hobart Mills Tributary Restoration
- Accessible location for implementing restoration and habitat improvements



Schematic of a stormwater management practice using sedimentation trap and dry well to reduce stormwater runoff impacts to sensitive environments. Investigation of site soils and depth to bedrock will be required before selecting stormwater BMP (Source: OEHHA, 2021)

Historical photograph (1930s) of Hobart Reservoir (top; Truckee-Donner Historical Society) and existing conditions today (bottom)

Balance Hydrologics

foriver TRUCKEE RIVER WATERSHED COUNCIL

Project 14: Hobart Mills Tributary Restoration

Problem: Incising and widening channel, meadow desiccation, habitat degradation,
Project: Identify and treat watershed stressors, channel restoration, grazing management, knickpoint mitigation
Location: Tahoe National Forest, Reach T, Disturbance ID: D2.1

General description of problem:

Reach T once supported a healthy 20-acre meadow; however legacy land and water uses, unmitigated knickpoint erosion from changing reservoir base levels, and on-going grazing practices have generated cumulative disturbances. The stream and meadow is located immediately downstream of the former Hobart Mill. The area endured logging operations, reservoir operations, roads and railroads. More recently, this area shows evidence of bank trampling and complete vegetation removal from sheep. Opportunities exist to address legacy impacts and enhance a moderate-sized Sierra meadow and associated habitat.

***Cost Estimate:**

Less than $10K
$10K-$100K
$100K-$500K
$500K-$2M
$2M +

Recent photo showing active knickpoint erosion in Reach T

Flow accumulation analysis showing Reach T

Goal(s)	Sources of degradation	Objectives to achieve goal(s)
• Enhance meadow condition and habitat	• Mill/reservoir operations • Roads and railroads • Reservoir water levels • Grazing	• Identify and address watershed stressors • Remove instream/meadow disturbances • Arrest knickpoint erosion; grade control • Develop grazing plan

Management and Restoration Approach:

The initial approach would consist of: (1) Identifying if roads or other drainage disturbances in tributary watershed can be addressed through management actions; (2) Restoring modified channel segments; (3) Installing buried grade control features to arrest knickpoint erosion and headcut migration from reservoir; (4) Installing bioengineered check dams to aggrade incised channel; (5) Working with USFS on a temporary grazing exclosure and long-term grazing plan; and (6) Managing recreational access.

Balance Hydrologics | H. T. Harvey & Associates Ecological Consultants | foriver Truckee River Watershed Council

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Target Conditions/Success Criteria:

- Reverse habitat loss
- Increase shallow groundwater levels
- Reduce erosion
- Restore meadow habitat and function

Implementation Timeframe

- Design (4-6 months)
- Permitting (6-12 months)
- Implementation (4-6 weeks)

Project monitoring recommendations:

- Vegetation surveys
- Stream gaging
- Shallow groundwater piezometers
- Channel geometry cross-sections
- Repeat aerial drone imagery

Constraints

- Upstream disturbances or stressors may include private property
- Reservoir operations will continue indefinitely

Opportunities

- USFS manages majority of lands within the watershed
- Local and accessible meadow for implementing restoration and habitat improvements and conducting ongoing stewardship and adaptive management

Oblique aerial image, looking downstream at Reach T and meadow, Balance Hydrologics, 2020