TECHNICAL REPORT ◦ JANUARY 2025

Cabin Meadows and Rock Fence Creek Meadows Baseline Conditions Report

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Cover photos, clockwise from top left: Discharge slope meadow, Upper Cabin Meadows; blooming California pitcher plant, Rock Fence Creek; vegetation plot, Cabin Meadows.

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1 EXECUTIVE SUMMARY

The Cabin Meadows and Rock Fence Creek Watershed Planning Project**,** funded by the California Wildlife Conservation Board, seeks to restore 4,190 acres and 19 kilometers of stream systems in Siskiyou County, California. This project employs a low-tech, process-based restoration approach, integrating Indigenous Traditional Ecological Knowledge (ITEK) with modern scientific methods to enhance ecological function, water storage, streamflow, and climate resilience. By addressing hydrological disruptions, sediment transport, and habitat degradation, the project aims to repair the natural processes that sustain these critical ecosystems. Restoration efforts focus on reconnecting floodplains and streams, improving forest health, and restoring degraded wet meadows, while fostering capacity building and stakeholder collaboration.

The project area spans the neighboring sub-watersheds of Cabin Meadow Creek and Rock Fence Creek, located within the Klamath Mountains ecoregion in far northern California. The watersheds, ranging in elevation from 5,120 to 7,680 feet, are characterized by diverse geological features, including ultramafic soils, glacial deposits, and peridotite bedrock. These soils support rare and sensitive plant species, such as the California pitcher plant. Meadows are known to support high levels of biodiversity and the Project area provides habitats critical for aquatic and terrestrial wildlife, including the Cascades frog, a species being considered for listing on the California Endangered Species List. The area's Mediterranean climate, with wet winters and dry summers, underpins its ecological processes, but recent trends show declining snowpack and earlier snowmelt, underscoring the urgency of restoration efforts.

Baseline assessments form the foundation for this work, analyzing current environmental conditions to guide restoration strategies. These assessments encompass seedbanks, vegetation, forestry, hydrology, infrastructure, and channel morphology, as well as the status of aquatic and terrestrial species.

Seedbank analyses revealed the resilience of these ecosystems, with species emerging from soils in potential restoration areas proving similar to those in intact meadows. This indicates a promising capacity for ecological recovery, even in areas where meadows have been heavily degraded or encroached upon by forest. The results suggest that restoration interventions can successfully harness the latent ecological potential within these soils to reestablish diverse plant communities.

Vegetation studies highlight significant deviations from historical conditions due to fire suppression and altered land use practices. Elevated tree densities in upland zones—212 trees per acre in Cabin Meadow Creek and 105 in Rock Fence Creek—reflect a dramatic departure from historical ranges, which averaged as low as 24 trees per acre in similar regions. Smaller tree size classes dominate, with shade-tolerant species like white fir and lodgepole pine increasingly outcompeting native fire-adapted species. Encroachment into meadow zones is pronounced, with transitional areas exhibiting the highest rates of tree regeneration, particularly white fir and lodgepole pine. Snag densities were moderate, with the majority of snags occurring in smaller size classes, further underscoring the impact of disrupted fire regimes on forest structure. These conditions not only reduce biodiversity but also elevate wildfire risk and forest stress due to overcrowding and competition for resources.

Hydrological assessments revealed widespread channel incision and altered flow paths, which have disrupted floodplain connectivity and reduced the capacity of meadows to store groundwater. These meadows historically acted as natural sponges, absorbing water during wet periods and releasing it slowly to sustain streamflows during dry months. Currently, their degraded state limits this function, contributing to reduced ecological resilience and declining habitat quality for aquatic species.

Roads and infrastructure exacerbate these hydrological disruptions. The inventory identified 46.6 kilometers of roads and historical trails, many of which capture and concentrate flow, altering natural pathways. Although the rugged terrain has generally limited sediment delivery, localized areas of concern remain. Stream crossings and road segments were prioritized for intervention, with early work, including the removal of two failed culverts, already completed.

The physical morphology of stream channels reveals degradation, including incision that reduce habitat quality and hydrological connectivity. Restoration plans call for the use of low-tech process-based restoration (LTPBR) approaches where applicable, such as post-assisted log structures (PALS) and beaver dam analogs (BDAs). These interventions are designed to slow streamflow, trap sediment, and raise channel elevations to restore connectivity with surrounding floodplains, improving groundwater recharge, supporting riparian vegetation, and fostering conditions conducive to meadow recovery.

Overall, the Project's goals include reconnecting hydrological systems to floodplains and meadows, improving habitat for native species, reducing wildfire risks through forest thinning, and enhancing water quality. Additionally, the project seeks to stabilize soil carbon storage and contribute to regional meadow restoration work. Through the development of cohesive, phased, prioritized restoration plans, the project addresses ecological degradation and also fosters a collaborative and sustainable approach to watershed restoration.

2 INTRODUCTION

2.1 The Project

The Cabin Meadow and Rock Fence Creeks Watershed Planning Project (the Project), funded by California's Wildlife Conservation Board (WCB), will use science-based assessment tools to plan restoration of United States Forest Service (USFS) land in two high value mountain meadow stream and catchment systems in Siskiyou County to improve streamflow, water storage, ecological function, climate change resilience/adaptation, and public use. The Project will restore function by addressing sediment source and transport problems and reconnecting natural hydrologic, geomorphic, and biological processes. It will emphasize Indigenous Traditional Ecological Knowledge (ITEK) and process-based restoration (PBR) design approaches that use natural processes to rebuild healthy and more resilient ecosystems. The Project will produce a comprehensive, phased, and prioritized restoration plan for 4,190 acres and 19 stream kilometers (km), with implementable plans for an initial set of projects that include restoration of eight stream km with instream structures and floodplain reconnection, one bridge design, four culvert repairs, improvement or decommissioning of 16 road km, forest health treatments for 500 acres, and restoration of 100 acres of wet and montane meadows.

The Project will build on initial planning for a portion of the project area already completed by the Klamath National Forest (KNF) (the East Fork Environmental Assessment) (Klamath National Forest 2019). Related implementation work, within the Project footprint, is funded by the North Coast Resource Partnership and California Department of Fish and Wildlife (CDFW), with additional funding in the works through KNF from the Infrastructure Act. The Scott River Watershed Council is also engaging with The Wildlands Conservancy around ways they can support or be involved in restoration; The Wildlands Conservancy holds the grazing allotment in the Project area through the WCB-funded acquisition of the property associated with the East Fork grazing allotment.

The initial phase of the Project entailed collecting background information and current data about conditions in the Project area to develop a comprehensive understanding of existing conditions; those findings are presented in this document. This knowledge will inform the development of the restoration plans.

2.2 The Team

While spear-headed by the Scott River Watershed Council (SRWC), this project has at its heart the integration of the expertise of numerous local and regional collaborators.

SRWC is a place-based organization that develops and implements comprehensive restoration projects spanning those focused on salmonids, instream and riparian restoration, road remediation, fuel reduction, meadow restoration, and prescribed fire. SRWC has a history of bringing diverse stakeholders together to collaboratively seek solutions for complex natural resource issues. SRWC is coordinating all aspects of this project with its project partners.

KNF, the landowner, completed an Environmental Assessment (East Fork Scott Project) in 2019 that includes the Project area. They are the ultimate decision-maker and integrally involved in the Project.

Quartz Valley Indian Reservation (QVIR) is providing ITEK and Indigenous cultural appropriateness oversight, vegetation surveys, photo monitoring, and water quality technical services.

The United States Forest Service (USFS) Pacific Southwest Research Station (PSW) is a world leader in natural resources research through scientific excellence and responsiveness to the needs of current and future generations. They are contributing to data collection and analysis and restoration planning.

The USFS Region 5 Ecology Program uses current ecological science to help develop, implement, and monitor ecological restoration across the region. They are contributing to the development of project specific data collection protocols, as well as data analysis and interpretation and restoration planning.

Stillwater Sciences (Stillwater) is an employee-owned science and engineering firm with specialists in engineering design, engineering geology, hillslope and fluvial geomorphology, hydrology and hydraulics, aquatic and riparian ecology, regulatory compliance, and construction support. Stillwater is providing engineering and geological professional services, focused mainly on roads and stream channels. They are participating in data collection and analysis and restoration planning.

BBW & Associates (BBWA) are consulting forestry and environmental analysis specialists, a forestry company specializing in conservation-based forestry. They are contributing to data collection and analysis, restoration planning, and permitting.

The Northern California Resource Center (NCRC) provides natural resource services to private landowners, public land management organizations and other natural resource-based companies. On this project NCRC is performing botanical, biological, archeological studies, and consultations.

2.3 Purpose and Need

2.3.1 Value of Healthy Meadows

Mountain meadows in the American West are critical ecosystems that provide a range of ecological functions, including biodiversity support, hydrological regulation, fire mitigation, and carbon sequestration. These meadows, situated in montane environments, are particularly valued for their roles as biodiversity hotspots, water storage systems, and refugia from both climate extremes and wildfires. However, human activities such as unmanaged grazing, removal of the largest and high-grade timber, road building and fire suppression have degraded many of these ecosystems, impacting their ability to provide essential services.

Mountain meadows are renowned for their biodiversity, supporting a wide variety of plant species and providing critical habitat for wildlife, including mammals, birds and amphibians. The diversity of meadow plants is essential for sustaining diverse insect and pollinator communities, which in turn contribute to the broader ecological resilience of the region (Jones et al. 2019). Meadows often host endemic and rare species, underscoring their importance as biodiversity hotspots within mountain landscapes (Graber 1996).

The meadow systems in the Cabin Meadow Creek and Rock Fence Creek watersheds have been degraded by anthropogenic impacts leading to significant erosion and hydrological dysfunction. Despite these challenges, remnant fen patches in these areas persist and still support rare species, such as the California pitcher plant (*Darlingtonia californica*), the Cascades frog *(Rana cascadae*), and potential habitat for Pickering's ivesia (*Ivesia pickeringii*). The presence of these species in the Project area highlights the biological importance of even degraded meadow systems, which continue to provide critical habitat for plants and animals.

One of the key functions of mountain meadows is their ability to store water and regulate streamflow. The soils of meadows act like sponges, absorbing water from winter precipitation and slowly releasing it during the dry summer months (Kattleman & Embury 1996). However, in many areas, including Cabin

Meadow Creek and Rock Fence Creek, human impacts have disrupted this natural process. Channel incision and altered flow paths have led to more rapid water conveyance, reduced connection to floodplains, and diminished groundwater recharge (Kattleman & Embury 1996). Despite these impacts, restoration efforts are underway to restore hydrological function in this area identified by KNF as a high priority for restoration.

Mountain meadows also play an important role in regulating downstream water temperatures, which is crucial for maintaining healthy aquatic ecosystems. Cooler water from meadows benefits species like trout and salmon that depend on cold water for survival (Luce et al., 2014). Meadows, with their wet soils and moisture-rich vegetation, function as natural fire breaks. They can help slow or halt the spread of wildfires, making them essential in the context of increasing fire activity in the West (Meddens et al. 2018). While much of the meadow around Cabin Meadow Creek and Rock Fence Creek has been degraded, remnant wetland patches continue to provide these crucial services.

The unique microclimates within mountain meadows make them valuable as climate refugia, offering cooler and wetter conditions for species vulnerable to rising temperatures. As the climate changes, these ecosystems will become increasingly important for providing stable habitats. Additionally, mountain meadows contribute to carbon sequestration through the accumulation of organic material in their soils. However, when meadows are degraded, they can shift from carbon sinks to carbon release sources, exacerbating the effects of climate change (Reed et al. 2021). Restoration efforts focused on reconnecting channels to floodplains and improving hydrological function can help restore their role as carbon sinks (Reed et al. 2022).

Mountain meadows hold deep cultural significance for Indigenous peoples and local communities. For millennia, these meadows have been used for hunting, gathering, and spiritual practices (Turner et al. 2011). Traditional land management practices, such as cultural burning, historically maintained meadow health by reducing tree encroachment and promoting diverse plant communities (Long and Pope 2014). Today, these meadows continue to serve as important cultural and recreational spaces.

2.3.2 Understanding Watershed Degradation

When planning meadow restoration, understanding the mechanisms, forms, and severity of degradation across the watershed is essential for several reasons. Watersheds are interconnected systems where changes in one part can significantly impact other areas (Dellicour et al. 2023). By identifying the specific mechanisms of degradation, such as flow concentration, grazing, conifer encroachment or head-cutting, restoration efforts can be tailored to address these issues at their source (Li et al. 2024). This holistic approach ensures that interventions are not just treating symptoms but are effectively mitigating the root causes of degradation, leading to more sustainable and resilient restoration outcomes (Meng Cui et al. 2024).

Additionally, recognizing the severity of degradation helps prioritize restoration activities. This prioritization will ensure that resources are allocated efficiently, focusing efforts where they are most needed and can have the greatest impact. Understanding the severity of degradation also helps in setting realistic goals and timelines for restoration, ensuring that expectations are aligned with the ecological realities of the watershed.

Finally, a comprehensive understanding of watershed degradation supports adaptive management. As restoration progresses, continuous monitoring and assessment of the watershed’s condition allows for adjustments to be made in response to new challenges or changing conditions. The data collected through long-term monitoring will contribute to the understanding of meadow restoration in a watershed context.

2.3.3 Advance the Science of Meadow Restoration within a Watershed Context

This planning Project is paired with an implementation project funded by the North Coast Regional Partnership for the implementation of instream structures and conifer removal on a small portion of the Project area. These early interventions are being used in an iterative plan-do-study-act (adaptive management) methodology to inform and accelerate the planning and design process proposed in this application. Small in-stream structures are informing the design team about "what the water wants to do" in real time, so that larger scale interventions like road remediation can be based on lessons learned from early interventions.

The project is showing that moving from studying and planning to implementation can be accomplished in 1 to 4 years, rather than the 5 to10-year time frame current practice typically requires. In addition to the site-specific goals, the Project is also collaborating with other landscape scale meadow restoration and planning efforts, such as the Klamath Meadows Partnership (KMP), with the goal of streamlining and disseminating landscape scale restoration planning and design methodologies.

The Lost Meadows Model, developed by Karen Pope and Adam Cummings (Pope and Cummings 2023; Cummings et al. 2023) using meadow data from the Sierra Nevada Mountains, identified approximately 60 acres of potentially recoverable wet meadow habitat in the project area. One aspect of the Project is to contribute to the calibration of the Lost Meadows Model to the Klamath Mountains.

Lessons learned from the assessment and planning tasks in this Project will be utilized to inform and calibrate the assessment and planning tools being developed in the larger KMP planning process. The two efforts are synergistic and are consciously being planned to integrate and support each project's specific goals and objectives, as well as an integrated end result.

2.3.4 Low-Tech, Process-Based Restoration and Opportunities for Capacity Building

As part of this project, the team is committed to implementing low-tech, process-based restoration (LTPBR) practices wherever feasible. These restoration actions will prioritize natural ecological, geomorphic and hydrological processes and minimal technological intervention to achieve sustainable and resilient ecosystems.

To ensure that the broader restoration community benefits from the Project's efforts, SRWC and project partners will actively share their successes and lessons learned through both formal and informal channels. This includes presenting at conferences and sharing insights more informally with partner organizations. By doing so, they aim to foster a deeper understanding and appreciation of LTPBR among restoration practitioners and stakeholders.

Additionally, SRWC will offer hands-on training sessions for restoration practitioners who are eager to gain practical experience in LTPBR techniques. These training sessions will not only enhance the skills and knowledge of participants but also build capacity within the organization and the larger community. By empowering individuals with the tools and expertise needed for effective restoration, they hope to create a ripple effect that extends the impact of the project far beyond its initial scope.

2.3.5 Indigenous Traditional Ecological Knowledge

Indigenous Traditional Ecological Knowledge (ITEK) is an oral wisdom of place-based knowledge passed down through generations. This method of land management strategies has been developed and refined for centuries, allowing these communities to sustainably steward their local ecosystems. The practices involve a deep understanding of biodiversity, seasonal changes, migration patterns, and river systems, enabling Indigenous people to cultivate, harvest and conserve natural resources efficiently. By integrating cultural values and spiritual beliefs into land stewardship, ITEK not only encourages and emphasizes the importance of maintaining ecological balance but fosters a profound connection to tribal ancestral territory and history.

Incorporating ITEK into meadow restoration efforts is crucial for fostering both ecological and cultural resilience. ITEK offers invaluable insights into sustainable land management. By integrating ITEK into planning, implementation, and monitoring phases, restoration projects can benefit from time-tested techniques that promote biodiversity, soil health, and water management. This holistic approach not only enhances the ecological outcomes but also ensures that the cultural heritage and traditional practices of Indigenous communities are respected and preserved.

The Quartz Valley Indian Reservation is an integral partner in this project, involved in initial and ongoing monitoring, restoration plans, and ITEK specifically. Thus far, they have been directly involved in vegetation plots, water quality monitoring, and photo monitoring. They will continue to influence the project through input on restoration plans.

2.4 Goals and Objectives

2.4.1 Goals

This Project will produce a comprehensive, holistic, prioritized restoration plan for the mountain meadow systems and surrounding forest, streams and roads in the Cabin Meadow and Rock Fence Creeks watersheds. The ultimate goals of this project are to (1) regain the historical scale and quality of wet meadow, riparian, and fen habitats, (2) increase the capacity of the watersheds to serve as fuel breaks in future wildfires, and (3) improve hydrological conditions for native amphibians and downstream fisheries including coho salmon (*Onchorhynchus kisutch*). To meet the goals, the plan will address hydrologic degradation, water quality, fuels and forest health, and aquatic habitat for native species.

When implemented, these plans will result in the achievement of the following objectives.

2.4.2 Objectives

- Reduce accelerated/concentrated runoff and erosion from roads and other disturbed areas.
- Restore and enhance hydrologic connectivity between channels, floodplains, and wetlands/meadows.
- Increase valley bottom groundwater storage that will help moderate peak flows, increase base flows and support wet meadows/fens.
- Reduce the potential for atypical high severity wildfire by improving forest health and reducing dry wood and tree densities.
- Restore and enhance habitat for native plants, wildlife, fish and amphibians.
- Improve water quality.
- Increase soil carbon storage in meadows and fens.
- Contribute to refining and calibrating the Lost Meadow Model for the Klamath region.

2.5 Approach

2.5.1 Understand Existing Conditions

Existing conditions analysis includes data on terrain; stream channel morphology and condition; roads and water crossings; vegetation, groundwater, discharge, water quality, aquatic species and habitats. Combining these different layers of data over the landscape of the two sub-basins will allow the development of prioritized restoration plans that fully take into consideration all the interrelated components affecting the health of the ecosystem. The plans will guide restoration over the following five to ten years, addressing road and water crossings; forest health and fuels; stream channelization and disconnection; and the health of wet and seasonally wet meadows.

2.5.2 Design Principles

When planning and conducting a restoration project, planners and practitioners tend to focus on areas and levels of degradation. It is also important to acknowledge the value of the habitat that does remain comparatively intact. For example, oftentimes the incised channel provides the only remaining riparian and wetland habitat to support a broad assemblage of invertebrates, amphibians, fish, birds, and mammals. The restoration approach for this Project attempts to minimize harm to existing riparian, meadow, and fen habitats while also increasing their area and improving their condition. Process-based design principles (Ciotti et al. 2021) will work with the natural hydrological and biological processes occurring onsite to create a positive feedback loop in which regeneration occurs over time. This approach highlights the importance of place-based stewardship and the application of ITEK.

In general, the approach: (1) views forest meadow and fen ecosystems as three-dimensional landforms that have developed over long time spans through interactions between physical and biological processes, and (2) asserts that the main purpose of restoration is to reinvigorate and revitalize these processes. The underlying principles of the approach are to: (1) use the intrinsic energy of a site (e.g. the potential energy of streams and the solar energy captured by plants) to do the work of restoration where possible; (2) begin with minimally invasive procedures before attempting more heavily engineered and largely irreversible approaches; and (3) address the root causes of degradation and remove or modify human infrastructure that constrains fluvial processes, if possible (Ciotti et al. 2021).

2.5.3 Building with Low-Tech Process-Based Restoration (LTPBR)

To restore the Project's floodplain and meadow ecosystems, work will occur within low gradient reaches of stream channels to increase complexity by adding wood and rock structures that slow and spread flows and capture sediment to raise streambed elevation (Hammersmark et al. 2009, Lindquist and Wilcox 2000, Pope et al. 2015). Process-based restoration accomplishes these goals by trapping sediment through direct reductions in stream power at key locations, distributing stream power by restoring historical flow paths and/or mitigating or removing human barriers to flow (e.g., road networks), encouraging multi-threaded channel formation, and creating conditions favoring the growth of emergent and riparian vegetation (e.g., targeted livestock management) that can resist erosive flows (Wheaton et al. 2019). The techniques reduce and distribute stream power through strategic placement of post-assisted log structures (PALS) and beaver dam analogs (BDAs) using on site natural materials including wood, sod, rock, and soil. Locations of structures are determined by the existing arrangement of valley bottom landforms, as well as stream energy and sediment sources (Beechie et al. 2010, Pollock et al. 2014, Wheaton et al. 2019). BDAs, for example, have been shown to halt and reverse incision, raise groundwater tables, improve water quality, attenuate flood flows, and re-invigorate desiccated riparian and wetland areas (Pollock et al. 2014, Bouwes et al. 2016, Weber et al. 2017). These structures also help to create conditions that favor passive colonization and persistence of beaver (*Castor canadensis*).

2.5.4 A Phased Approach

The KNF completed some conifer removal and legacy channel treatment in Cabin Meadows in 2021 and 2022.

As mentioned above, in conjunction with this Project, the CDFW and the North Coast Regional Partnership provided funding for some early implementation actions, namely construction of in-stream structures and removal of encroaching conifers. Instream structure construction in the Rock Fence sub-watershed began in fall of 2023 and will be largely completed by fall 2025. More instream work in Cabin Meadows will occur in 2025 and will be largely completed by that fall. Additional conifer removal, in both sub-basins, will happen in 2026.

The restoration plans developed through this Project will take into account the short-term impacts of these initial actions, so that the longer term and larger scale interventions are informed by real-world results specific to the site. As the effects of the initial restoration actions become apparent, the restoration plans will be adjusted appropriately for future scaled up efforts.

3 ENVIRONMENTAL SETTING

3.1 Location

The Project is in Siskiyou County, in far northern California, approximately 16 miles southeast of the City of Etna and approximately 12 miles west southwest of Weed. The Project area consists of the United States Forest Service land within the two neighboring sub-watersheds of Rock Fence Creek and Cabin Meadow Creek (Figure 3-1). While they share similar histories and species, Cabin Meadow Creek's catchment area is approximately 2.5 times the size of Rock Fence Creek's catchment area. The Project watersheds range in elevation from 5,120 to 7,680 feet.

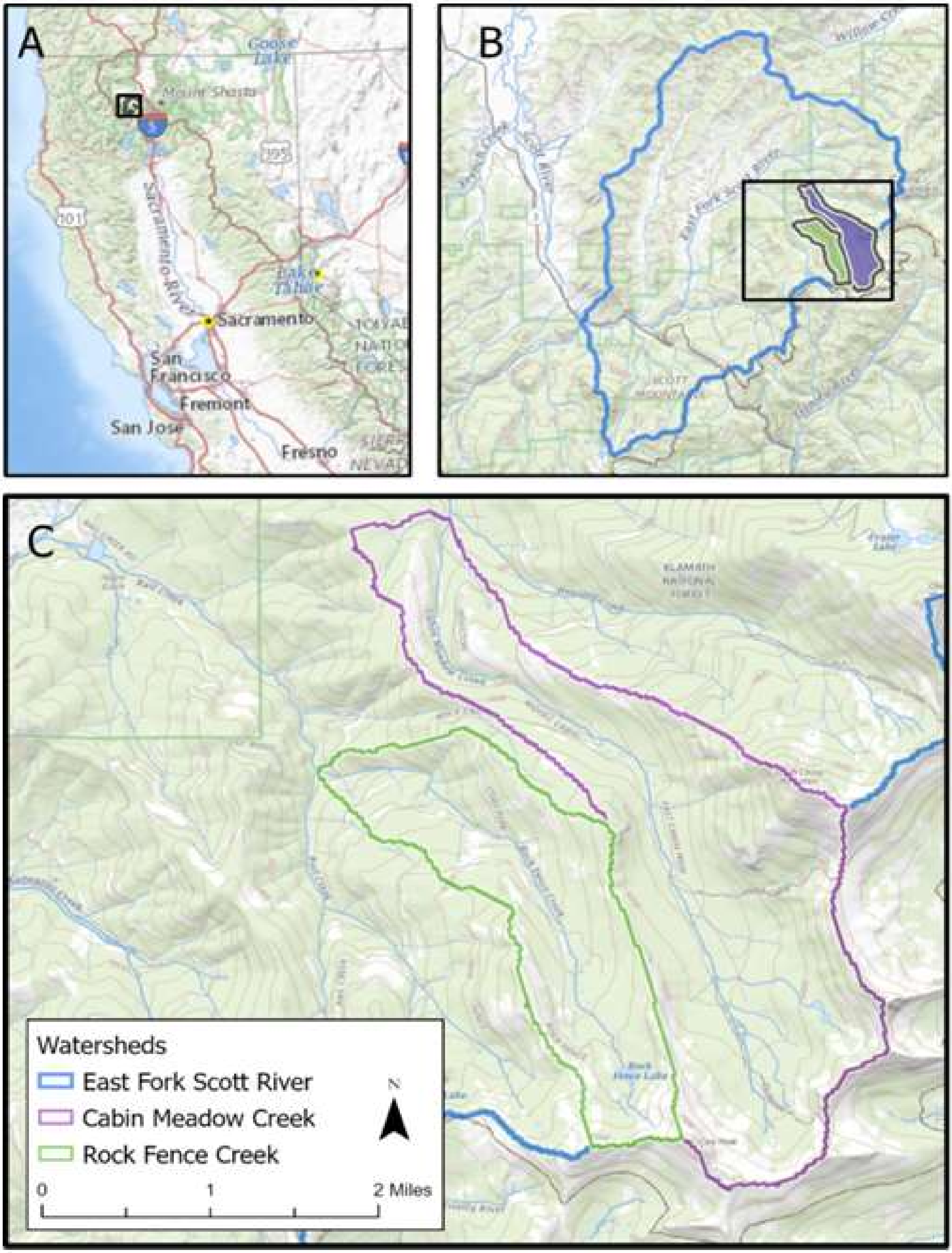


Figure 3-1. Location of project in California (A) and within the East Fork Scott River Watershed (B). The project includes both Cabin Meadow Creek and Rock Fence Creek (C).

The project includes portions of Sections 7, 8,17, 18 T40N, R06W Mount Diablo Meridian (MDM), Sections 1,12,13, T40N, R07W, MDM, Sections 22, 23, 25, 26, 34, 35, 36, T41N, R07W MDM. The Project area includes the South China Mtn, Scott Mtn and Gazelle Mtn USGS 7.5' Quadrangles. The Rock Fence Creek and Cabin Meadow Creek watersheds are part of the Cal Watershed Units 1105.4201016 (Cabin Meadow Creek and 1105.420102 (Rail Creek). These watersheds drain to the East Fork Scott River which is listed as a 303(d) impaired (sediment, siltation, temperature) waterbody by the EPA and California Waterboard Regional Board 1 North Coast Region.

The project is located within the Klamath Mountains ecoregion. The ecoregion, also known as a geomorphic province, was unglaciated during the Pleistocene epoch, when it served as a refuge for northern plant species.

Special areas within or adjacent to the project watersheds include:

- Cory Peak Botanical and Geological Area:
    - 400 acres
    - Serpentine crest zone sensitive species
- China Mountain Botanical and Geological Area
    - 900 acres
    - Hemlock, whitebark pine, foxtail pine community
    - High elevation
    - Ultramafic soils.
- Rock Fence Creek Botanical Area
    - 100 acres
    - Serpentine riparian plant community

3.2 Geology and Geomorphology

The Cabin Meadow Creek and Rock Fence Creek watersheds are located within the Klamath Mountains geomorphic province, which is underlain by a series of geologic terranes comprised of accreted oceanic lithosphere, volcanic arcs, and mélange (Irwin 1994). The Project area is located in the Eastern Klamath terrane. The oldest rocks in the Eastern Klamath terrane within the East Fork Scott River area are the Salmon and Abrams schists, recrystallized sedimentary and volcanic rocks of early Paleozoic or late Precambrian age. Unconformably overlying these rocks are more than 5,000 feet of slightly metamorphosed, strongly folded sedimentary rocks (e.g., sandstone, chert, slate, and limestone) of Silurian-Ordovician age correlated with the Duzel, Moffett Creek, and Gazelle formations (Holtz 1977). During the Mesozoic, these bedrock units were intruded and deformed, leading to the formation of granitic and ultramafic rocks ranging in composition from peridotite to granodiorite (Mack 1958). The peridotites are typically highly sheared and serpentinized. The granodiorites are also commonly highly weathered and erosive where jointed and sheared, often producing a large supply of sand (Sommarstrom et al. 1990).

Bedrock geologic units underlying the Project area predominantly consist of peridotite (Op) and gabbro (Ogb) of the Trinity Ophioite (Figure 3-2) (Wagner and Saucedo 1987, Irwin 1994). Minor exposures of dioritic and granitic plutonic rocks (Mzd and Mzg) occur north and west of the Project area; and a relatively small area of sedimentary rocks (marine sandstone, shale, chert, and limestone) of the Gazelle Formation (DSg) occurs in the central eastern portion of the Rock Fence Creek watershed.

Bedrock geology across much of the Project area is overlain by glacial and alluvial deposits. Glacial deposits are derived from Quaternary alpine glacial advance and retreat during and following the Last Glacial Maximum (~18,000 ybp) (Sharp 1960, Howat et al 2007). This Project did not involve detailed mapping of glacial landforms, relative or absolute dating of landform ages, or correlation of landforms to glacial chronology. Glacial deposition features occur in the Project area as end and lateral moraines, less distinct recessional moraines forming inset benches on canyon walls and valley slopes, and as extensive till filling the valley floor within each basin. Excellent examples of moraines occur in the drainage on the south slope of South China Mountain west of High Camp Pass and on the north and west sides of Cabin Meadow Lake. Glacial deposits also occur as narrow, elongate hills (similar to drumlins or flutes) in the upper elevations of the Cabin Meadow Creek valley below Chilcoot Pass, the result of streamlining of material beneath the glacier. These subparallel elongate hills may be comprised of bedrock and/or unconsolidated deposits. The alpine glaciers responsible for these deposits originated from the high elevation southern divide between Cabin Meadow Creek and High Camp Creek in the upper Trinity River basin. Successive sheets of glacial till extensively fill the Cabin Meadow Creek valley floor. The terminus of these sheets is indicated by several prominent slope breaks in the valley profile and visible in slope maps (Figure 3-3, Figure 3-4). The till deposits contain a wide range of poorly sorted and non-stratified particle sizes from boulder to sand. Better sorted and stratified glacial outwash deposits are also apparent in some streambank exposures.

The area surrounding Rock Fence Lake within private property was not included in the roads assessment and has not yet been investigated as part of this work, so the origin of the lake and landforms surrounding it are not well understood. However, the rough texture and disorganized topography visible in LiDAR for this area suggests that the lake and landforms were formed by a large landslide emanating from near the northwest slope of Cory Peak rather than from glacial processes.

Alluvial deposits occur throughout both the Cabin Meadow Creek and Rock Fence Creek Project areas as rockfall, landslide deposits, debris flows, alluvial fans, Quaternary and Holocene river terraces, and floodplain deposits. These deposits may be derived in some cases from glacial deposits and/or intercalate to form complex depositional environments within the valley toe slopes and valley floor.

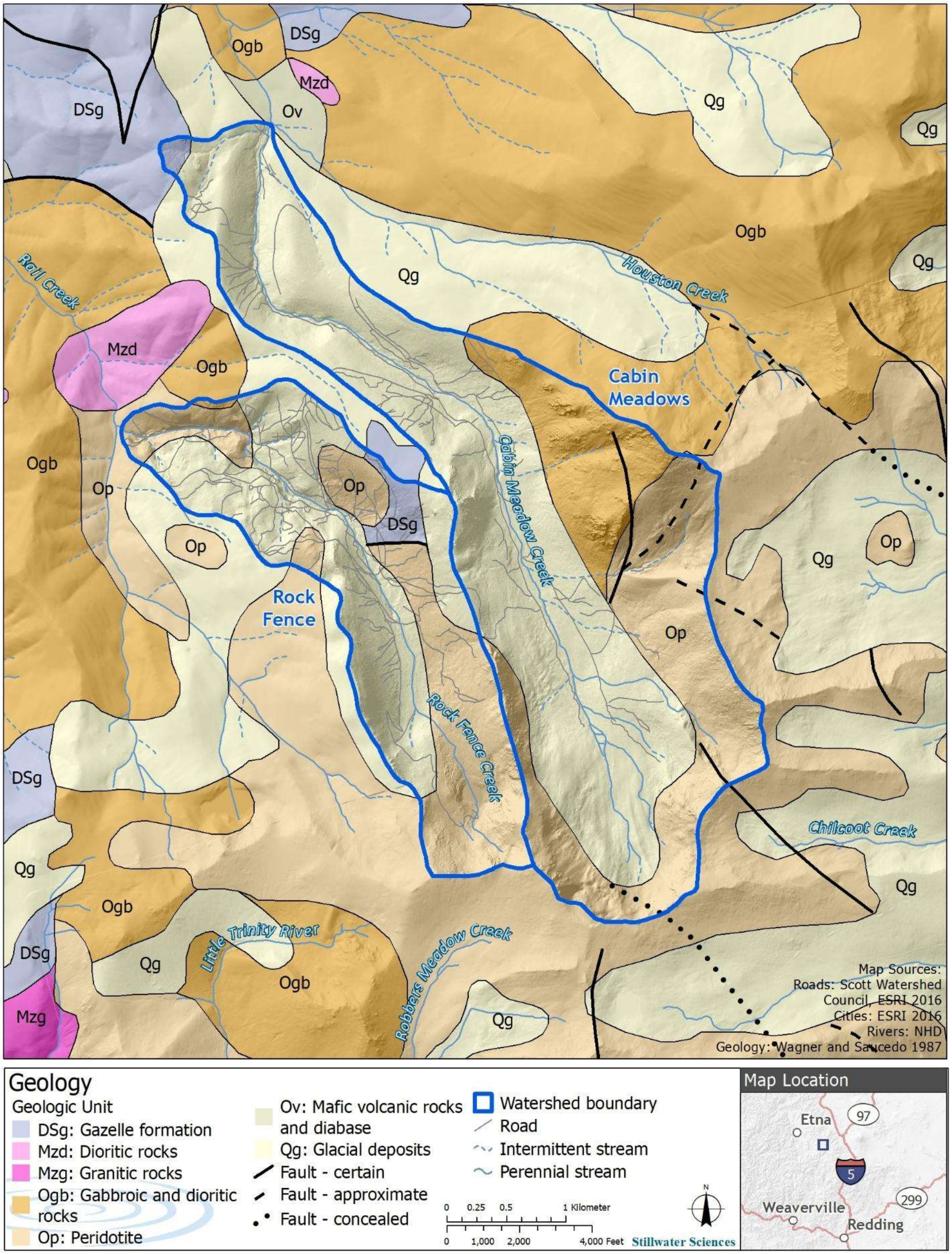


Figure 3-2. Geologic map of the Cabin Meadow Creek and Rock Fence Creek watersheds.

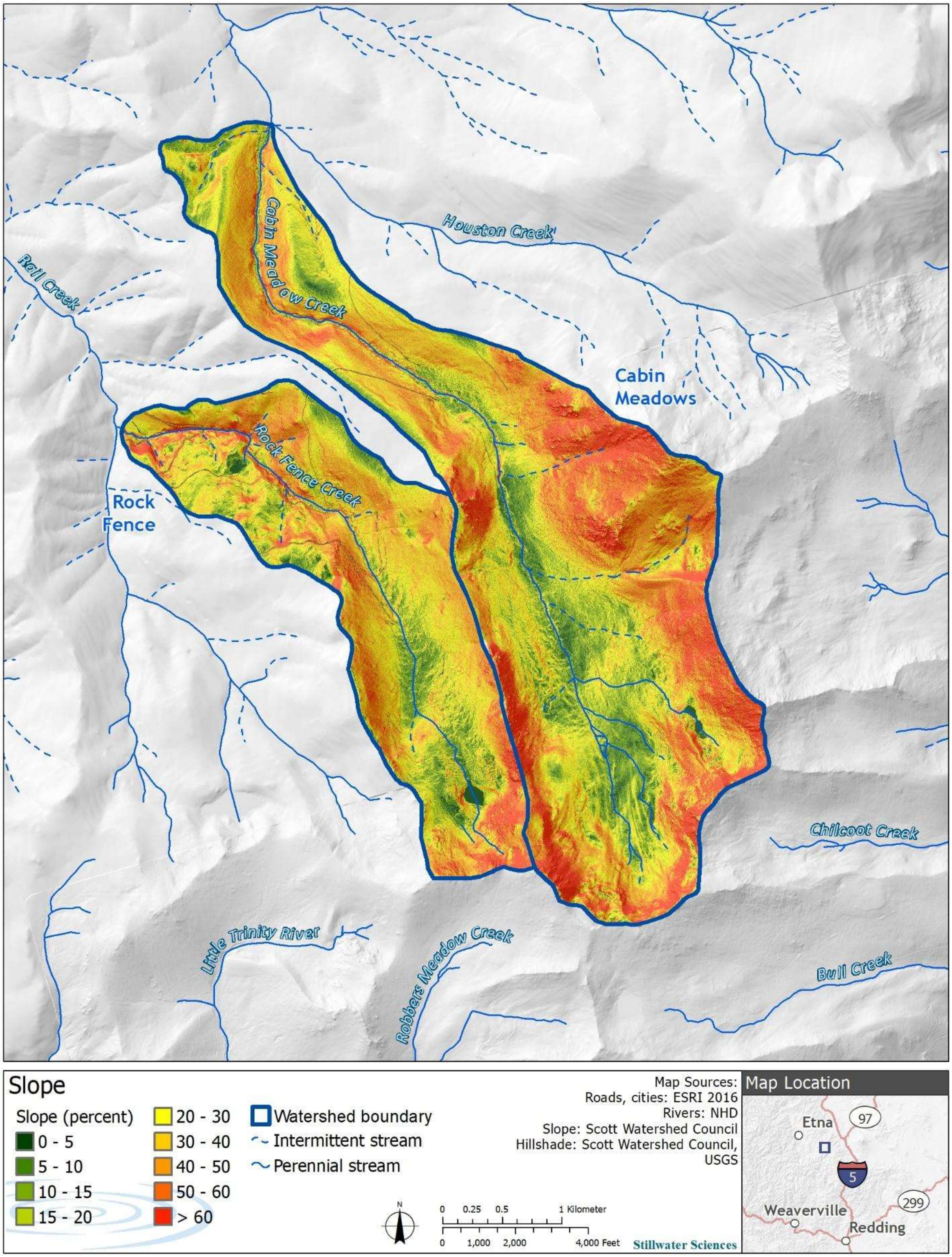


Figure 3-3. Hillslope gradient in the Cabin Meadow Creek and Rock Fence Creek watersheds.

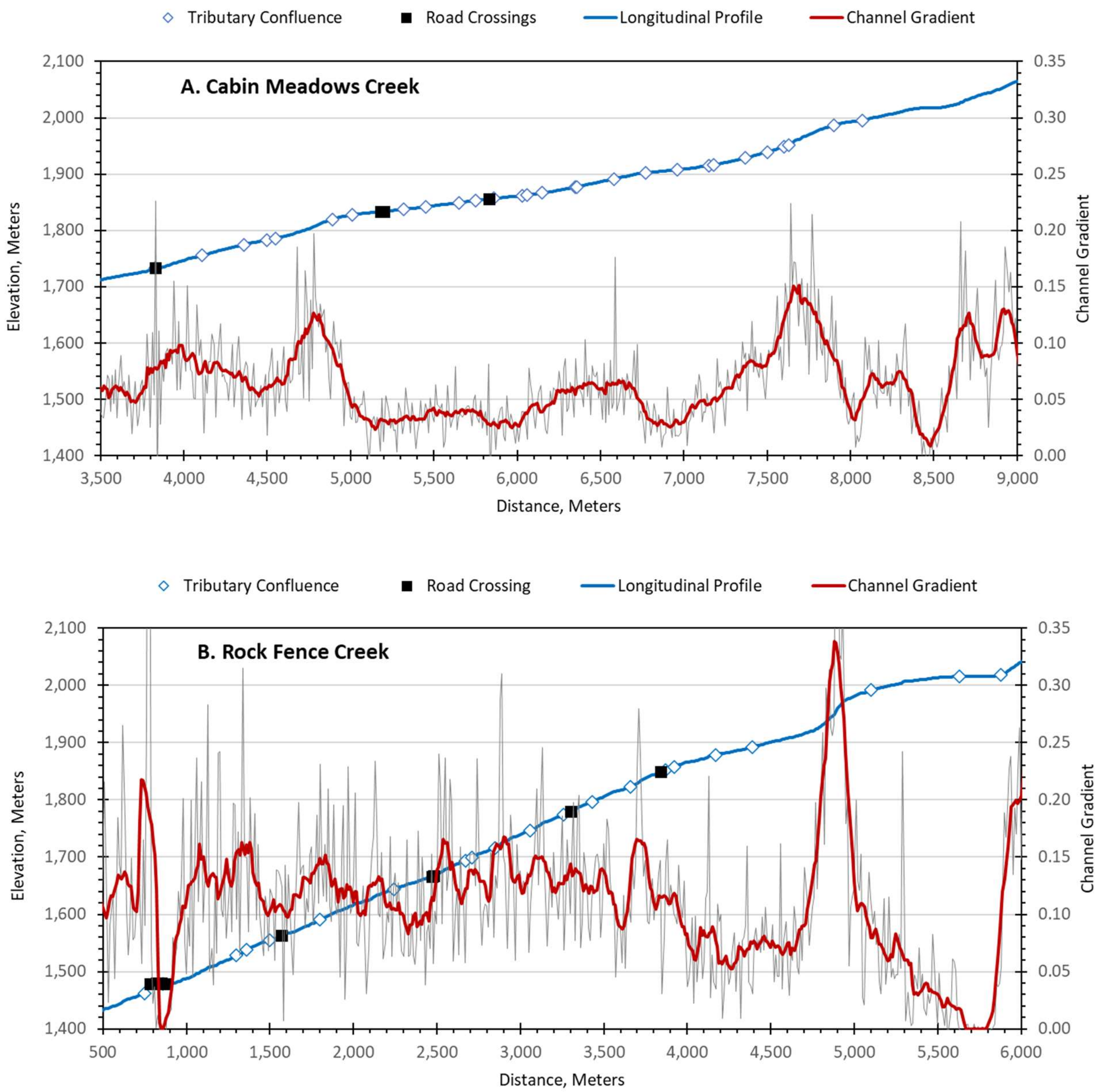


Figure 3-4. Longitudinal profiles and gradient in the Cabin Meadow Creek (A) and Rock Fence Creek (B) mainstream channels.

3.3 Climate

Cabin Meadow Creek and Rock Fence Creek watersheds are located in the KNF within northwestern California, where they experience a typical Mediterranean climate characterized by wet, cool winters and warm, dry summers. Because of the elevation of these watersheds, the majority of the precipitation comes as snow during the winter with high interannual variability in average precipitation. Average minimum temperature across the KNF has increased by 2.15°F since 1959 (Butz et al. 2022). This affects the number of months that have temperatures below freezing and ultimately influences the ratio of snow to rain. Over the period of record there has been a significant decrease in total snowfall recorded at the nearest weather station located in Callahan and a significant decrease of snow water equivalent (the amount of available water in the snowpack) across the entire KNF. Furthermore, average spatial extent of snow above 3000 feet in elevation on April 1st has declined across the Klamath Mountains and earlier snowmelt has resulted in earlier peak runoff and shifts in the timing of streamflow.

3.4 Hydrology

As noted above, Cabin Meadow and Rock Fence Creeks are snow driven run-off systems in California's Mediterranean climate. As such, precipitation occurs largely in the winter months and, at the higher elevations, mainly as snow. Spring and summer snowmelt releases water into the systems during the dryer time of year (Fayad et al. 2017) with a late summer baseflow period, fall recharge, and winter baseflow interspersed with run-off events. Figure 3-5 illustrates this typical hydrograph with data from the East Fork Scott River from water year (WY) 2010.

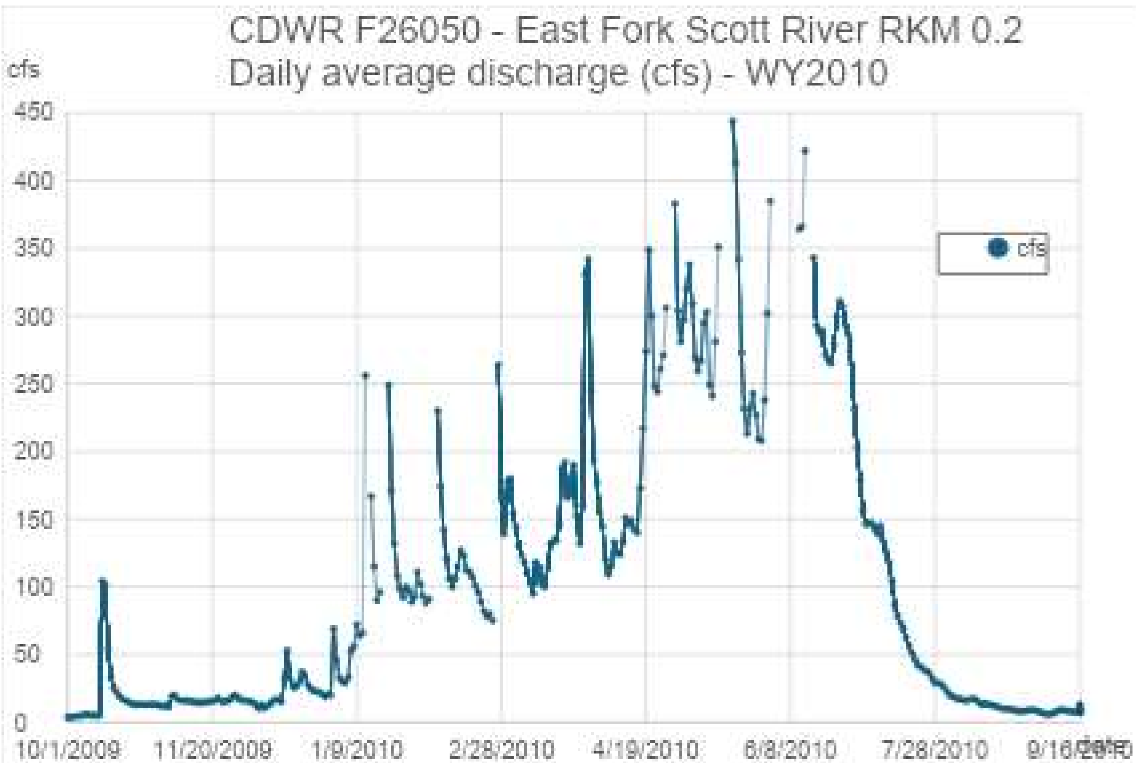


Figure 3-5. Representative hydrograph of the East Fork Scott River - WY2010.

Table 3-1, below, contains selected basin characteristic data from United States Geological Survey's (USGS) StreamStats , for both Cabin Meadow Creek and Rock Fence Creek. For the complete StreamStats report for each watershed, including the Scenario Flow Reports, see Appendices A and B.

Table 3-1. StreamStats for Cabin Meadow Creek and Rock Fence Creek.

Parameter	Cabin Meadow	Rock Fence
Mean basin slope computed from 30 m DEM (%)	33.8	30.8
Area that drains to a point on a stream (square miles)	4.3	2.1
Percent of area above 6000 ft	73.6	56.4
Mean Basin Elevation (ft)	6408	6050
Maximum basin elevation (ft)	8202	7655
Minimum basin elevation (ft)	4715	4529
Percentage of area covered by forest	32.6	37.5
Mean Maximum January Temperature (°F)	36.28	36.78
Mean Minimum January Temperature (°F)	24.38	25.59

April 1st snow water equivalent (SWE) can be used to compare snowpack between water years. The closest snow course (a snowpack monitoring location) is Middle Boulder 3, which is 6200 feet in elevation (similar to the Project area) and also in the Scott Mountains. The data shows significant variability in snowpack, but with a downward trend (Figure 3-6). The average SWE between 1949 to 2000 was 28.2 inches and the average between 2001 and 2023 was 23.9 inches, a decrease of 4.3 inches, or 15% (2023 email from M Meneks to E Yokel).

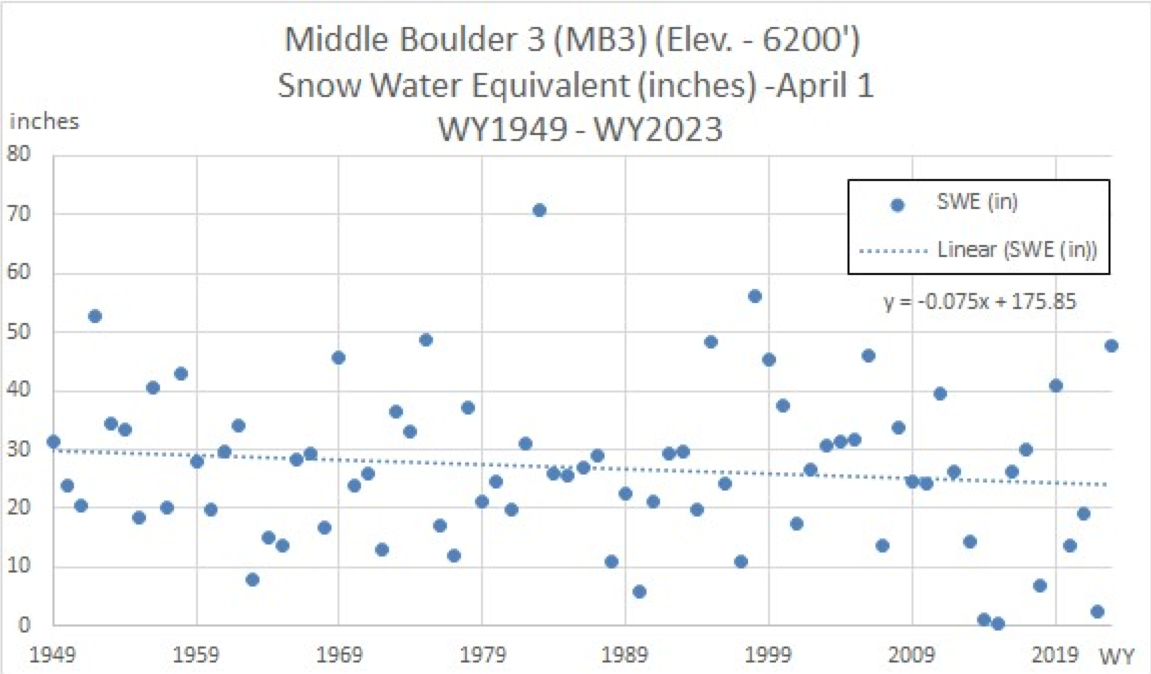


Figure 3-6. Middle Boulder 3 Snow Water Equivalent April 1, Water Years 1949-2023.

Cabin Meadow Creek and Rock Fence Creek are both sub-basins of the East Fork Scott River. The USGS operated a stream discharge station (11518050) in the East Fork Scott River at RKM 2.7 from October 1, 1959 (WY1960) through September 29, 1974 (WY1974) – Map 1. Approved daily average discharge data for the USGS station was retrieved from https://waterdata.usgs.gov/. The California Department of Water Resources (CDWR) established a stream discharge station (F26050) on the East Fork Scott River at RKM 0.2 on June 28, 2002 (WY2002). The CDWR discharge station has operated to date except for WY2004 and WY2006. The approved daily average discharge data for the CDWR station was retrieved from https://wdl.water.ca.gov/.

The stream discharge at the locations of the USGS and CDWR gages is significantly altered by upstream surface water diversions. The USGS station was operated before the Scott River Adjudication Decree was finalized on January 30, 1980, and the CDWR station has been operating since the Decree has been in place.

Analysis of the historic USGS and CDWR discharge data was performed to determine if the hydrologic regime in the East Fork Scott River has changed from the period of WY1960 – WY1974 and WY2002 to the present. In an attempt to analyze the discharge data during comparable water year types, the accumulated precipitation at the Fort Jones Ranger Station from October 1 through April 1 and the SWE of the April 1 snowpack at the Middle Boulder 3 (MB3) was analyzed over the period of record. For the complete analysis, see Appendix C.

3.5 Soils

A query of the Natural Resources Conservation Service web-based Soil Mapper (accessed on 11/25/2024) shows that the existing valley bottom meadow complexes are located predominantly within the Merkel Family and Buell Family soil types (Figure 3-7). Merkel soils are a well-drained loamy soil series formed by glacial till and derived from granite. Buell soils are colluvium derived from metamorphic rocks.

The other main soil types within the project watersheds include Deadfall-Lithic Cryobdis association derived from weathered serpentinite and the Rock outcrop ultramafic rubble series and Rock outcrop lithic Cryobdis Deadfall derived from unweathered bedrock and metavolcanics.

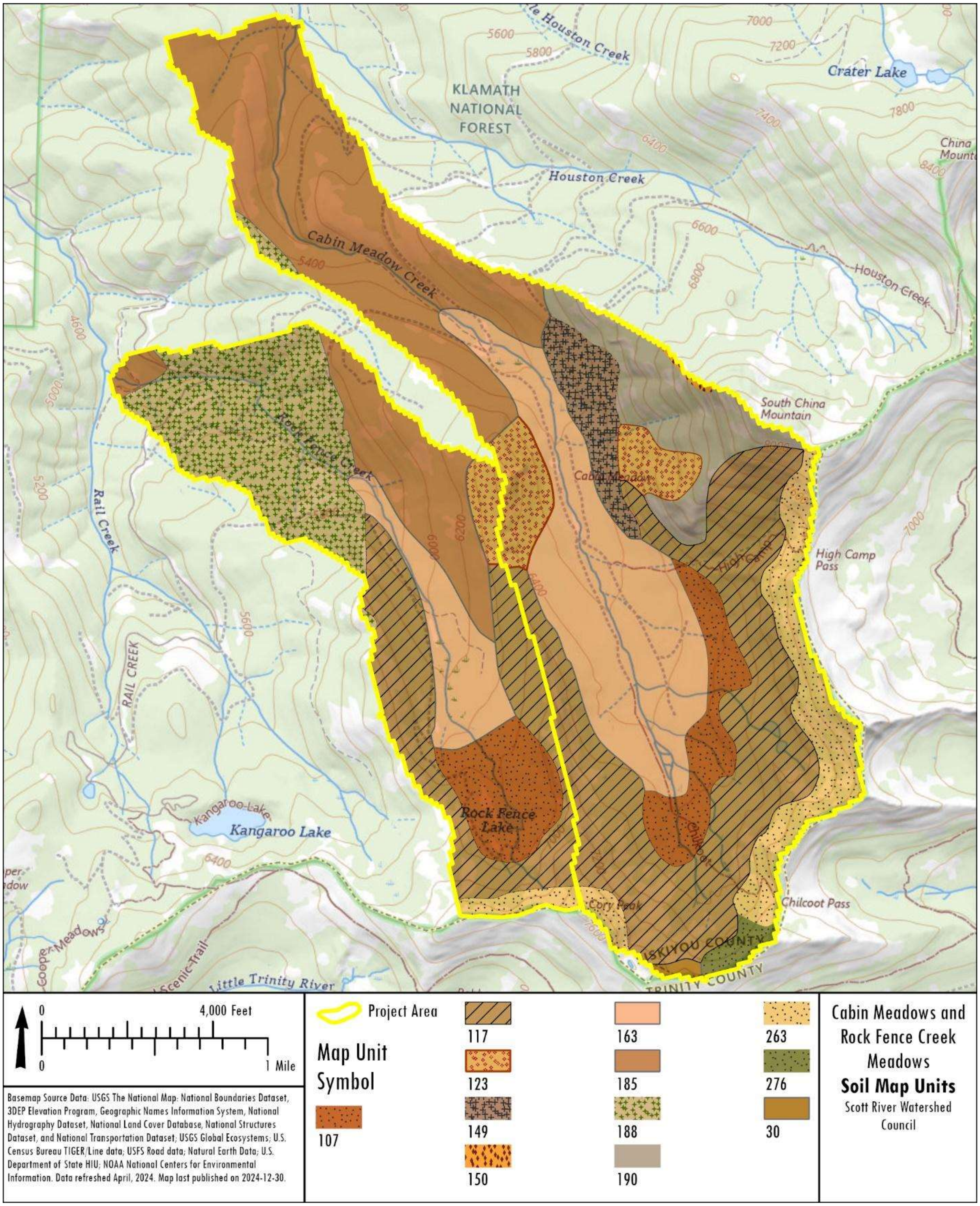


Figure 3-7. Existing meadows in the valley bottoms are typically associated with Merkel Family Soil Type (163) and Buell Family Soil Type (107). Other common types are Deadfall family-Lithic cryobolls Association (117), Skalan family-Lithic Mollic Haploxeralfs association (185), Tangle family (188), and Rock outcrop-Lithic Cryochrepts-Deadfall family complex (263).

3.6 Vegetation

3.6.1 Vegetation Types

The California Wildlife Habitat Relationships (CWHR) System was developed to support habitat conservation and management, land use planning, impact assessment, education, and research involving terrestrial vertebrates in California (Wildlife Habitats - California Wildlife Habitat Relationships System). According to CWHR and USFS mapping (Region 5, US Forest Service, USDA), the Cabin Meadow and Rock Fence Creek basins contain 19 types (Table 3-2). The map in Figure 3-8 illustrates the distribution of these vegetation types.

The Klamath mixed conifer habitat is bounded by many other vegetation types. At the lower, westernmost elevations, it intergrades with montane hardwood-conifer and montane hardwood habitats. Numerous but small meadows and seeps occur throughout this habitat, contributing greatly to wildlife diversity. At lower elevations on its eastern border, Klamath mixed conifer interfaces with Sierran mixed conifer, ponderosa pine, montane hardwood-conifer and mixed chaparral. On drier or very rocky sites or on rock outcrops, montane chaparral occurs at the same elevation as Klamath mixed conifer (Benson 2005). This habitat interfaces with the subalpine conifer habitat at its uppermost elevations. The area along Cabin Meadow Creek and Rock Fence Creek contains riparian vegetation and mid-high elevation meadows within a mixed conifer forest. Ultramafic soils provide favorable conditions for California pitcher plant (*Darlingtonia californica*) and Jeffrey pine (*Pinus jeffreyi)* (Bohlman et al. 2021).

Table 3-2. CWHP vegetation types in Cabin Meadow Creek and Rock Fence Creek basins.

Veg Type	CWHR Vegetation Types	Area (acres)
Forest	Douglas Fir	5.0
Forest	Eastside Pine	84.8
Forest	Jeffery Pine	161.4
Forest	Klamath Mixed Conifer	53.4
Forest	Ponderosa Pine	103.5
Forest	Red Fir	814.7
Forest	Sierran Mixed Conifer	3,839.7
Forest	Subalpine Conifer	795.8
Forest	White Fir	112.1
Forest Total		**5,970.4**
Meadow	Annual Grassland	186.1
Meadow	Perennial Grassland	42.7
Meadow	Wet Meadow	5.2
Meadow Total		**234**
Riparian	Montane Riparian	9.5
Riparian total		**9.5**
Shrub	Alpine Dwarf Shrub	118.9
Shrub	Mixed Chaparral	2,9
Shrub	Montane Chaparral	376.1
Shrub	Sagebrush	224.6
Shrub total		**722.5**
Water	Lacustrine *Note: Rock Fence Lake is on private land and therefore not part of project area*	14
Water total		**14**
Barren	Barren	406.1
Barren total		**406.1**
Grand total		**7,357**

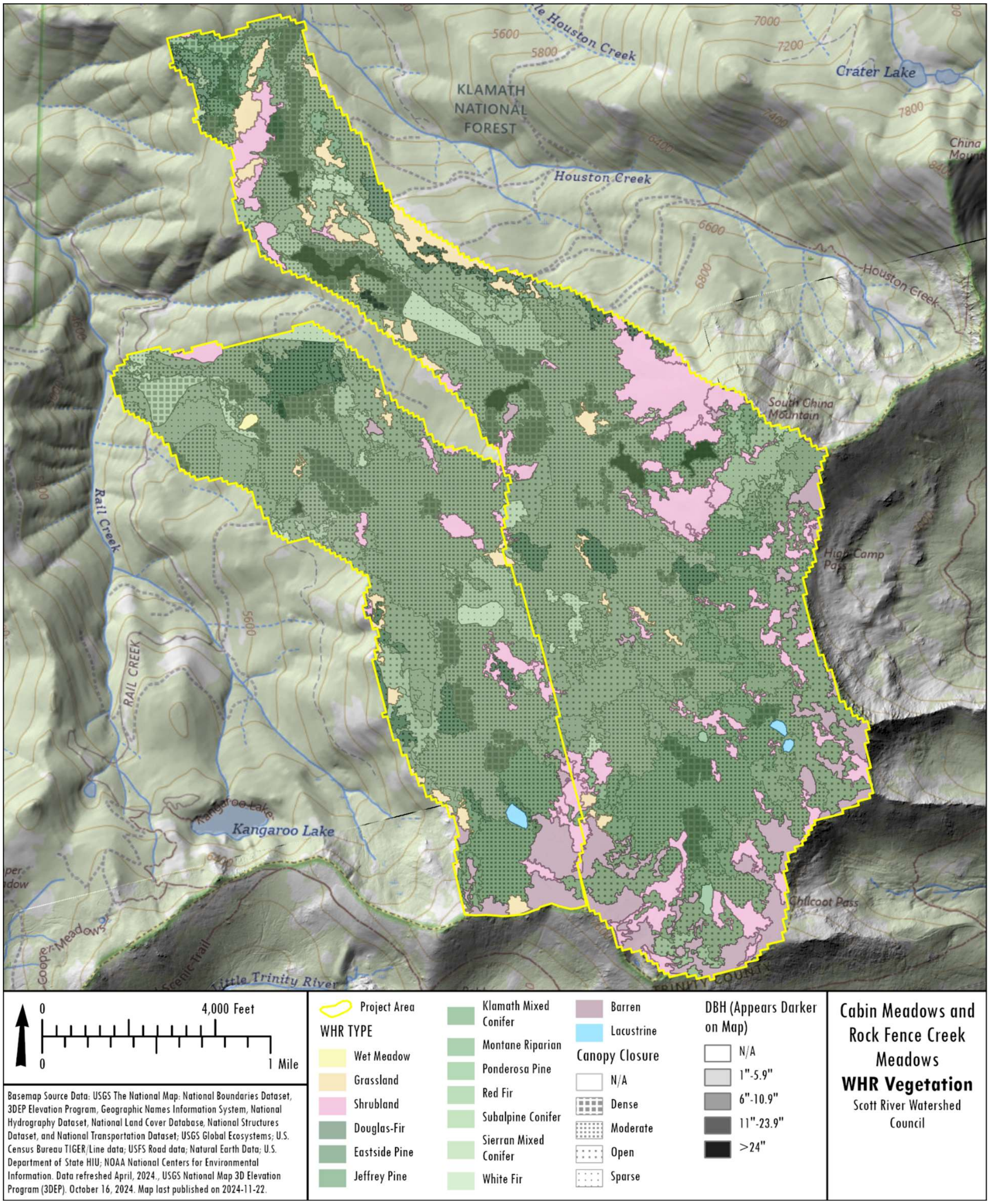


Figure 3-8. CWHR vegetation types for Cabin Meadow Creek and Rock Fence Creek sub-watersheds.

It should be noted that the CWHRs mapping is not of a fine enough scale for the meadow restoration project planning and monitoring, but it provides a big picture description of the main habitat types in the project area watersheds. It is notable that the CWHR mapping does not accurately display the montane and wet meadow or grassland polygons that exist within the mixed conifer forest types in the Rock Fence Creek and the Cabin Meadow Creek basins.

The National Wetlands Inventory (NWI) mapping based upon 1983 color infrared mapping, shows several wetland habitat types mapped in the project watersheds including freshwater forested/shrub wetland, freshwater emergent wetlands, freshwater ponds and lacustrine wetlands (National Wetlands Inventory). Note the lacustrine open water of Rock Fence Lake that is mapped is on private land that is not part of the project area.

3.6.2 Rare and Sensitive Plants

A list of special-status plant species with potential to occur in the project area was compiled by completing a review of the California Natural Diversity Database (CNDDB) and California Native Plant Society (CNPS) Inventory of Rare and Endangered Plants of California database records for the U.S. Geological Survey (USGS) quadrangles containing and surrounding the project area (9 quadrangles total) with elevation adjustment) (CNDDB 2024; CNPS 2024) as well as the U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) tool (USFWS 2024) (Table 3-3). For details about individual species, see Appendix D.

The project watersheds contain high elevation ultramafic soils and as a result harbors many rare and sensitive plant species. Examples include *Galium serpenticum* ssp. *scotticum*, *Epilobium siskiyouens*e, *Phacelia dalesian*a, Phacelia greenei, *Eriogonum alpinum* and *Raillardella pringlei*. In addition, both foxtail pine (*Pinus balfouriana*) and whitebark pine (*Pinus albicaulis*) can be found on the ridge tops. Both of these species have a limited distribution within the KNF. Whitebark pine is especially limited as this species is seldom found below 8000' elevation.

Table 3-3. Rare and sensitive plant species present or possible in Cabin Meadow Creek and Rock Fence Creek basins.

Common name	Scientific name	Present	Potential	Federal List	State List	CA Rare Plant Rank*
California pitcher plant	*Darlingtonia californica*	X		no	no	4.2
Clustered lady's slipper	*Cypripedium fasciculatum*		X	no	no	4.2
Crested potentilla	*Potentilla cristae*	X		no	no	1B.3
Klamath manzanita	*Arctostaphylos klamathensis*		X	no	yes	1B.2
Klamath sedge	*Carex klamathensis*			no	no	1B.2
Modoc frasera	*Frasera albicaulis* var. *modocensis*	X		no	no	2B.3
Mt. Eddy draba	*Draba carnosula*	X		no	no	1B.3
Oregon fireweed	*Epilobium oreganum*		X	no	no	1B.2
Pickering's ivesia	*Ivesia pickeringii*		X	no	no	1B.2
Pink-margined monkeyflower	*Erythranthe trinitiensis*	X		no	no	1B.3
Scott Mountain bedstraw	*Galium serpenticum* ssp. *scotticum*	X		no	no	1B.2
Scott Valley phacelia	*Phacelia greenei*	X		no	no	1B.2
Showy raillardella	*Raillardella pringlei*	X		no	no	1B.2
Siskiyou fireweed	*Epilobium siskiyouense*	X		no	no	1B.3
Siskiyou sedge	*Carex scabriuscula*	X		no	no	4.3
Trinity buckwheat	*Eriogonum alpinum*	X		no	yes	1B.2
Woolly balsamroot	*Balsamorhiza lanata*		X	no	yes	1B.2

*CA Rare Plant Rank	Description
1B.2	Plants rare, threatened, or endangered in California and elsewhere; fairly threatened in California
1B.3	Plants rare, threatened, or endangered in California and elsewhere; not very threatened in California
2B.3	Plants rare, threatened, or endangered in California, but more common elsewhere; not very threatened in California
4.2	Plants of limited distribution; fairly threatened in California
4.3	Plants of limited distribution; not very threatened in California

3.6.3 Noxious Weeds

There are known infestations of dyer's woad (*Isatis tintora*) and Canada thistle (*Cirsium canadensis*) in Cabin Meadow Creek watershed, located by KNF biologists. No invasive species were observed in any of the vegetation transects and plots measured in 2023 and 2024

3.6.4 Forest

Project area

The predominant forest type within the Cabin Meadow and Rock Fence Creek drainages is Klamath mixed conifer and Sierran mixed conifer by Jeffrey pine, lodgepole pine and western white pine. These forest types interface with the subalpine conifer habitat at its uppermost elevation. The locations of the vegetation monitoring plots show some evidence (stumps) of past timber harvest and firewood cutting. From reconnaissance level surveys and the detailed vegetation plot data, the Project area forests generally show a diversity of ages, classes and species with a heterogeneous forest structure.

Heterogeneity is often associated with increased biodiversity. The project area does not appear to have significant pest or drought induced mortality beyond what would be expected for the forest types.

Table 3-4 lists tree species known to be present within the Cabin Meadow Creek and Rock Fence Creek drainages. For details about individual species, see Appendix E.

Table 3-4. Tree species present in Project area.

Common Name	Scientific Name
Douglas fir	*Pseudotsuga menziesii*
Foxtail pine	*Pinus balfouriana*
Incense cedar	*Calocedrus decurrens*
Jeffrey pine	*Pinus jeffreyi*
Lodgepole pine	*Pinus contorta* ssp. *murrayana*
Mountain hemlock	*Tsuga mertensiana*
Ponderosa pine	*Pinus ponderosa*
Red fir	*Abies magnifica*
Western white pine	*Pinus monticola*
White fir	*Abies concolor*
Whitebark pine	*Pinus albicaulis*
Willow	*Salix* spp.

USFS Forest Inventory Analysis

The project area watersheds were analyzed using the USFS Forest Inventory Analysis (FIA) data and tools. Although the FIA plot density is low in the project area, the output from the six plots in or near the project watersheds provides a general picture of the forest characteristics for the ecoregion and project area. FIA plots are permanent plots that are remeasured over time. The data below is based on the six plots that are within 4.5 miles of the Project area, except for Table 3-5, which is for the ecoregion (Tables 3-5 to 3-11).

Table 3-5. Aboveground biomass of live trees (at least 1 inch diameter).

All live stocking	tons/acre
total	51.6197
fully stocked	112.8907
medium stocked	40.0961
poorly stocked	18.4904
non-stocked	0.3336

Table 3-6. Short tons of carbon/acre.

All live stocking	tons/acre
total	26.9589
fully stocked	58.9705
medium stocked	20.9095
poorly stocked	9.6643
non-stocked	0.1702

Table 3-7. Basal area (BA) per acres of trees > 1 inch diameter.

All live stocking	BA /acre
total	133.4561
fully stocked	288.9055
medium stocked	111.8761
poorly stocked	44.8293
non-stocked	3.3043

Table 3-8. Biomass of Fine Woody Debris in dry short tons/acre on forest land.

All live stocking	tons/acre
total	1.5315
fully stocked	1.7018
medium stocked	0.9684
poorly stocked	1.0472
non-stocked	2.8375

Fine Woody Debris (FWD): Pieces or portion of pieces of down woody debris with a diameter less than 3 inches at the point of transect intersection. Excludes dead branches attached to standing trees, dead foliage, bark fragments, and cubical rot.

Table 3-9. Biomass of coarse woody debris, in dry short tons/acre, on forest land.

All live stocking	tons/acre
total	5.6302
fully stocked	12.4073
medium stocked	0.00000
poorly stocked	1.9689
non-stocked	5.2753

Coarse woody debris (CWD): Pieces or portions of pieces of down dead wood with a minimum small-end diameter of at least 3 inches and a length of at least 3 feet (excluding decay class 5). CWD pieces must be detached from a bole and/or not be self-supported by a root system with a lean angle more than 45 degrees from vertical.

Table 3-10. Total volume of down woody material (FWD, CWD and piles) in cubic feet, on forest land.

All live stocking	cubic foot/acre
total	865.7350
fully stocked	1,667,0493
medium stocked	101.0402
poorly stocked	459.0765
non-stocked	891.2502

Down woody material (DWM): FWD, CWD and natural or human-created piles

i-Tree Canopy Analysis of Project Area

Using the United States Department of Agriculture (USDA) i-Tree Canopy tool (https://canopy.itreetools.org/), 325 random plots or points were located (Figure 3-10) on aerial imagery within the Project area watersheds to determine a general forest canopy cover. The results of the analysis show the percentage of area and total cover for grass or meadow, bare soil or rock, water surface and tree/shrub cover (Nowak 2021) in Table 3-11 and Figure 3-9.

Table 3-11. Project watershed cover by type.

Vegetation type	Percent cover	Area (square miles)
Tree/shrub	59.2	3.84
Soil/bare ground	23.8	1.54
Grass/herbaceous	16.7	1.08
Water	1	0.02
Impervious surface	0	0

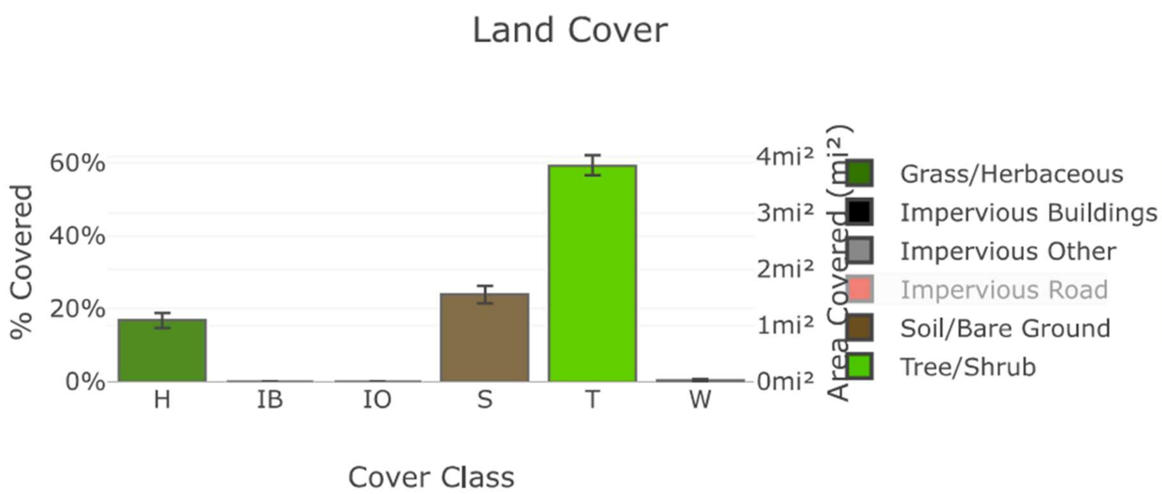


Figure 3-9. Project area watersheds land cover analysis from i-Tree.

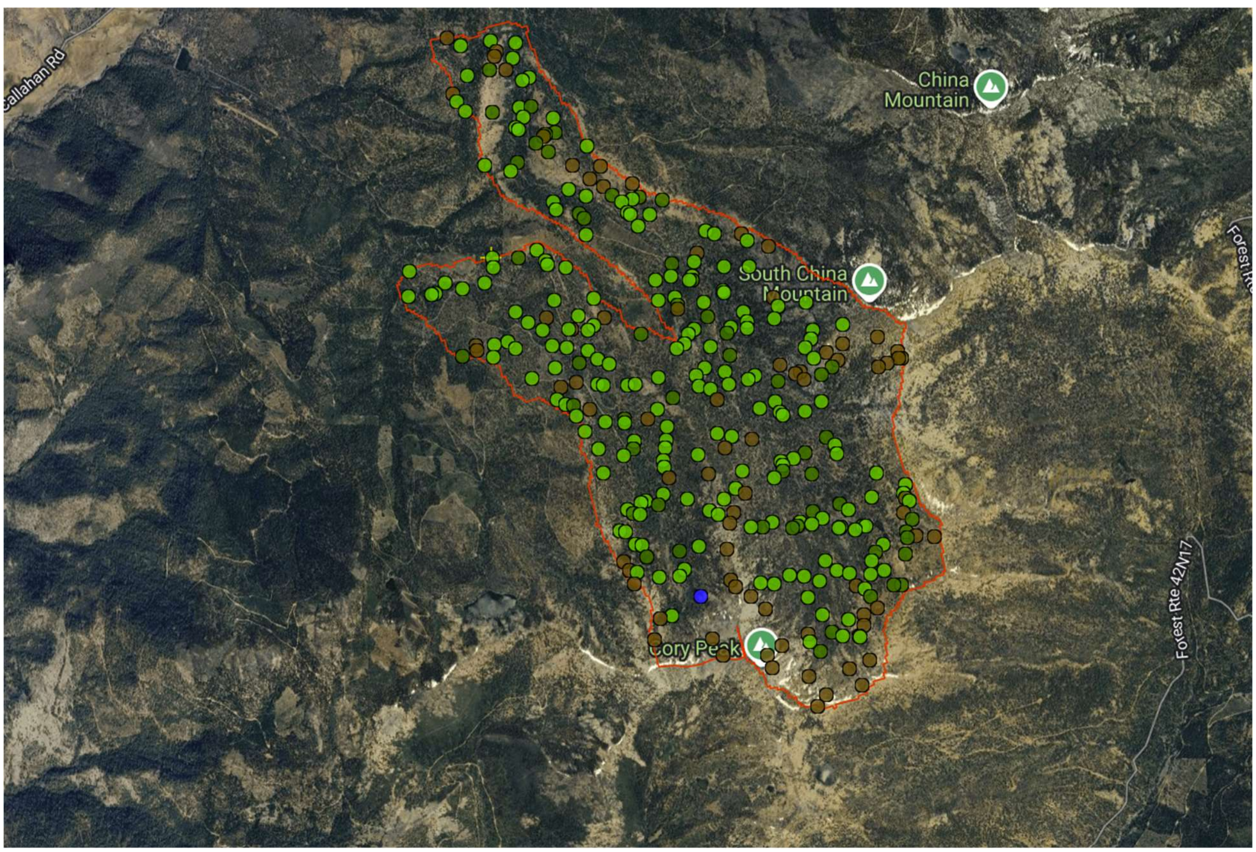


Figure 3-10. Location of 325 randomly located plots in the project used by the i-Tree analysis program.

3.7 Fire Return Interval

The mean reference fire return interval (FRI) is an approximation of how often, on average, a given pre-settlement fire regime (based on vegetation type) burned in the several centuries before settlement by Euro-Americans. For the majority of the Project area, the mean FRI is 16 years or less (Figure 3-11). Despite this relatively short mean FRI, there is no recorded history of fire in the project area. (Safford & van de Water 2014; van de Water & Safford 2011)

Fire regimes have varied over millennia primarily due to variations in climate. The record of fire in the Klamath Mountains covers the post-glacial Holocene and extends back to about 13,000 to 15,000 years B.P. and is preserved as variation in fossil charcoal abundance in lake sediments (West 1985, 1988, 1989, 1990; Mohr et al. 2000; Daniels 2001; Whitlock et al. 2001; Briles 2003

Many areas in the Klamath Mountains experienced a pre-settlement fire regime until fire suppression became effective sometime after establishment of the Forest Reserve system in 1905 (Shrader 1965). Fire suppression had become effective in more-accessible areas by the 1920s (Agee 1991; Stuart and Salazar 2000), whereas fire suppression did not become effective in more remote areas until after 1945 (Skinner 1995).

More on the Subalpine Zone

Most tree species in the subalpine zone, including mountain hemlock, Shasta red fir, whitebark pine, western white pine, foxtail pine, lodgepole pine, and curl-leaf mountain mahogany have thinner bark than species found at lower elevations and are easily damaged or killed by moderate-intensity fire or the consumption of heavy surface fuels at the base of the tree. The only fire history data for the subalpine zone in the Klamath Mountains are from stands on China Mountain (Mohr et al. 2000, Skinner 2003). Species present in these stands are mountain hemlock, Shasta red fir, whitebark pine, western white pine, foxtail pine, and lodgepole pine. Fire-scar samples were collected from 14 trees on three 1-ha (2.5-ac) sites in the Crater Creek watershed. Over the period spanned by the fire-scar record (1404–1941), the median fire return intervals for these sites were 11.5, 12, and 13 yrs. However, 44 of 51 fires were detected on only single trees. This suggests that fires in this subalpine basin were mainly low intensity and small. Ranges of individual-tree median fire-return intervals were 9 to 276 years with a grand median of 24.5 years. No fires were detected after 1941. (Skinner et al. 2006)

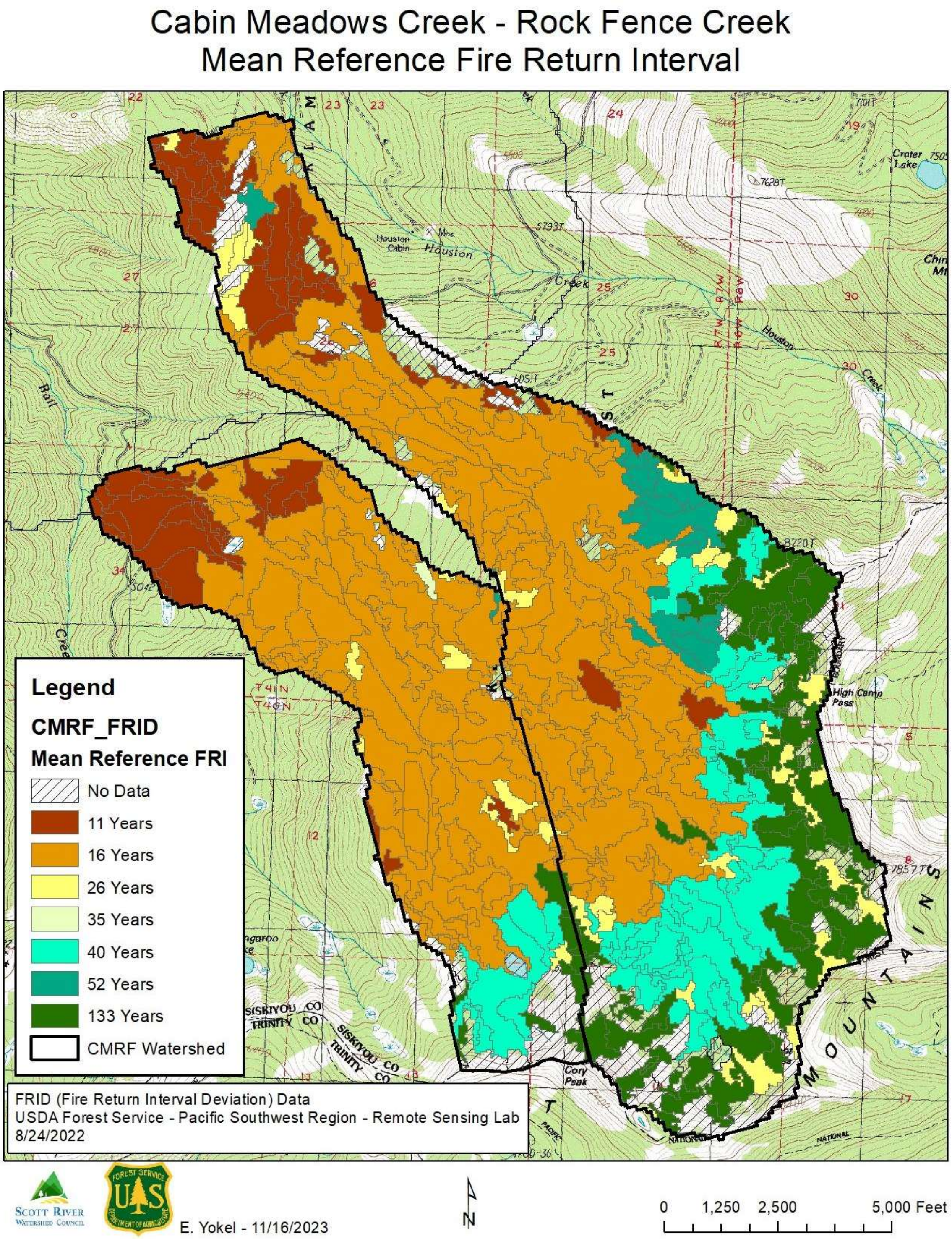


Figure 3-11. Fire return intervals for Project area.

3.8 Aquatic Species and Habitats

Aquatic vertebrate species known or potentially present within the Cabin Meadow Creek and Rock Fence Creek drainages are provided in Table 3-12. We provide life history details about the species in Appendix F. Monitoring focused on the Cascades frog because the species is currently being considered for listing on the California Endangered Species List and because an objective of the project is to improve habitat quality for the species. Distribution and relative abundance of Cascades frogs will be tracked throughout the project area before, during, and after restoration through periodic visual encounter surveys (see Section 4.7).

Table 3-12. Fish and amphibian species known or possibly occurring within the Cabin Meadow Creek and Rock Fence Creek Project areas.

Common Name	Scientific Name	Present	Potential
Fish			
Brook Trout	*Salvelinus fontinalis*	X	
Rainbow Trout	*Oncorhynchus mykiss*	X	
Amphibian			
Cascades Frog	*Rana cascadae*	X	
Coastal Giant Salamander (Pacific Giant Salamander)	*Dicamptodon tenebrosus*	X	
Long-Toed Salamander	*Ambystoma macrodactylum*	X	
Rough-Skinned Newt	*Taricha granulosa*	X	
Sierran Treefrog (Pacific Chorus Frog)	*Pseudacris sierra*	X	
Tailed Frog	*Ascaphus truei*		X
Western Toad	*Anaxyrus boreas*	X	

3.9 Terrestrial Species and Habitats

Terrestrial species known or potentially present within the Cabin Meadow Creek and Rock Fence Creek drainages are listed in Table 3-13. Details about the species are in Appendix G.

Table 3-13. Mammal, bird, and insect species known or possibly occurring within the Cabin Meadow Creek and Rock Fence Creek Project areas.

Common Name	Scientific Name	Present	Potential
American badger	*Taxidea taxus*		X
Fisher	*Pekania pennanti*		X
Gray wolf	*Canis lupus*		X
North American porcupine	*Erethizon dorsatum*		X
Northern goshawk	*Accipiter gentilis*		X
Northern spotted owl	*Strix occidentalis caurina*		X
Osprey	*Pandion haliaetus*		X
Pacific marten	*Martes caurina*		X
Pallid bat	*Antrozous pallidus*		X
Sierra Nevada red fox - southern Cascades DPS	*Vulpes vulpes necator* pop. 1	X	
Western bumble bee	*Bombus occidentalis*		X
Wolverine	*Gulo gulo*		X

3.10 Land Use and Infrastructure

The project is located in a region utilized by Shasta populations at the time of Euro-American contact. Indigenous populations used the local region for seasonal and/or permanent settlement, as well as for the gathering of plants, roots, seeds, domestic materials, and hunting seasonal game (Weaver 2024).

The project includes parcels that were, until the 2019 Trinity Divide Project, privately owned. The Trinity Divide Project transferred ownership of a number of "checkerboard" parcels from the Michigan-California Timber Company to the KNF (Figure 3-12). However, not all privately owned land in the two basins was included in the transaction. (2024 email from M Meneks to M Ireson) The Project watersheds are predominantly Federal Responsibility Area (FRA) but there are 605 acres of State Responsibility Area (SRA) private lands (Figure 3-12). Most of the meadow ecosystems are on KNF federal lands.

Also in 2019, the KNF completed the East Fork Scott Environmental Assessment that included treatment units in the Project area, but not in any of the newly acquired parcels (Figure 3-13).

The Project area has a history of roads, logging, grazing and recreation. The Project team digitized 46.6 miles of current and historical road and trail scars within the project area, many of which have captured and modified flow paths. Of the 47 miles, 15.7 miles are current, official roads. There are seven stream crossings (of either active or historic roads) in Cabin Meadow Creek and its tributaries and four in Rock Fence Creek and its tributaries. (Figure 3-14.)

Based on a query of the CAL FIRE CALTREES database, the Timber Harvest Plans have been operated on private lands since 2000 (Figure 3-15):

- 2-05-007-SIS: 126 acres
- 2-00-251-SIS: 254 acres
- 2-08-034-SIS: 151 acres
- 2-14-010-SIS: 195 acres

From historical air photo analysis, it appears that the USFS has also conducted timber sales and timber harvest activities within the project area. That information will be provided at a later date.

KNF completed some conifer removal and legacy channel treatment in Cabin Meadow in 2021 and 2023.

Two failing culverts were removed in 2023. The culvert in Cabin Meadow Creek was replaced with an armored ford and the one in Rock Fence Creek, on a closed road, was graded to match the surrounding bed and bank. (Figure 3-14.)

There are multiple “dispersed camping” campsites, including some that are on meadow edge. There are two existing trails in Cabin Meadow, the Chilcoot Pass Trail and the High Camp Pass Trail. (Figure 3-14.)

There is an active Forest Service grazing allotment, the East Fork Allotment, that encompasses both catchments.

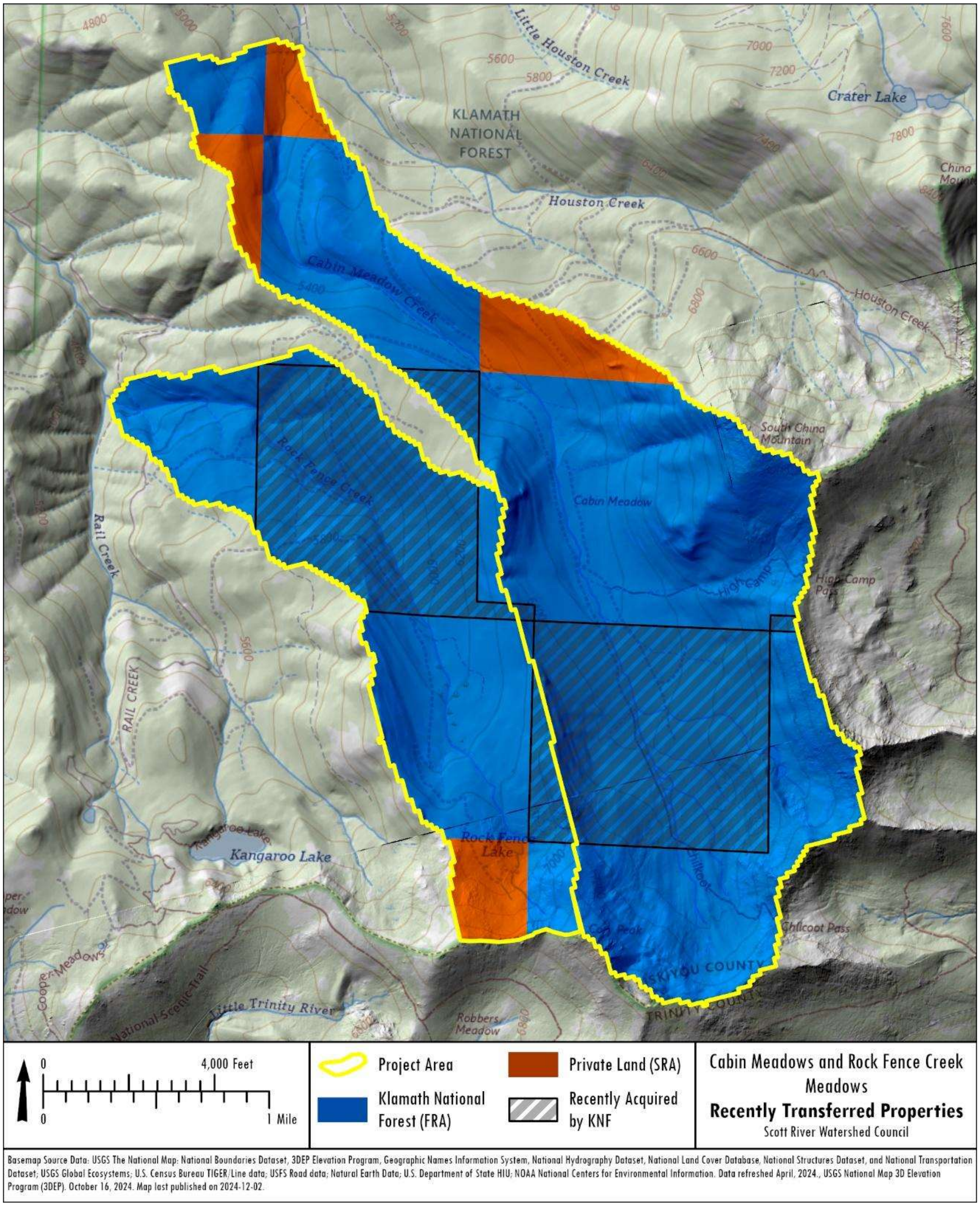


Figure 3-12. Existing land ownership and recent transfer of private land to federal ownership.

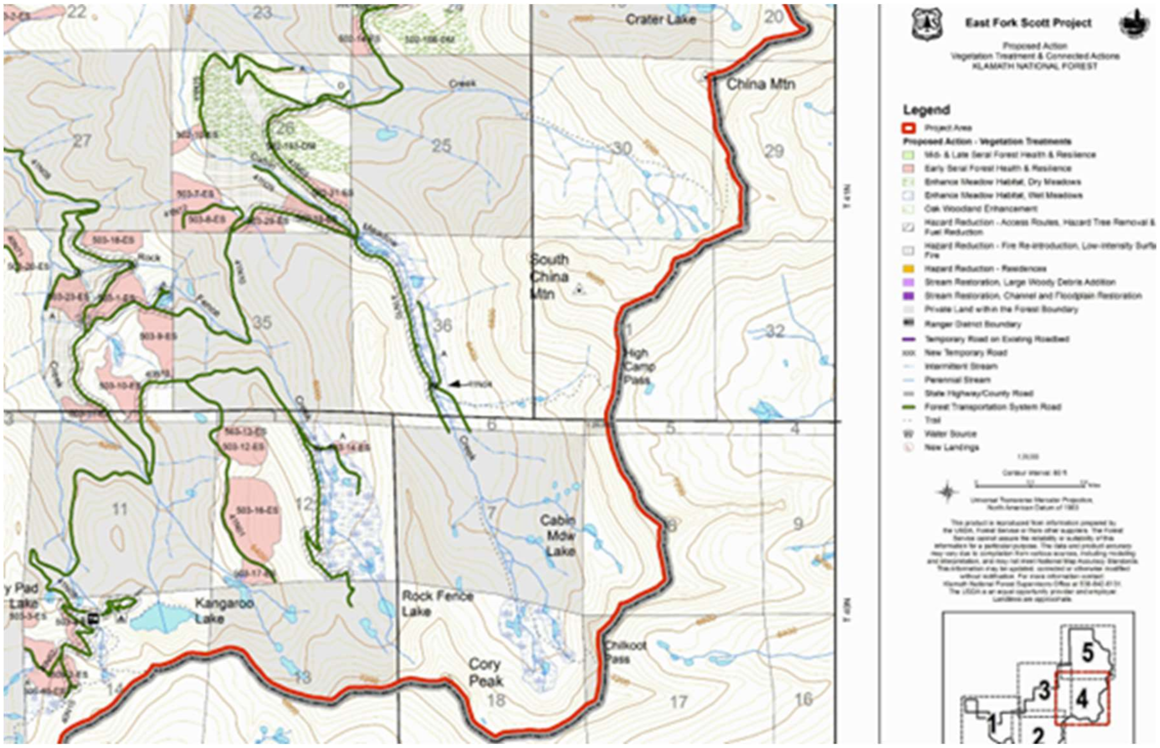


Figure 3-13. Portion of the KNF's East Fork Scott Project that includes Cabin Meadow Creek and Rock Fence Creek.

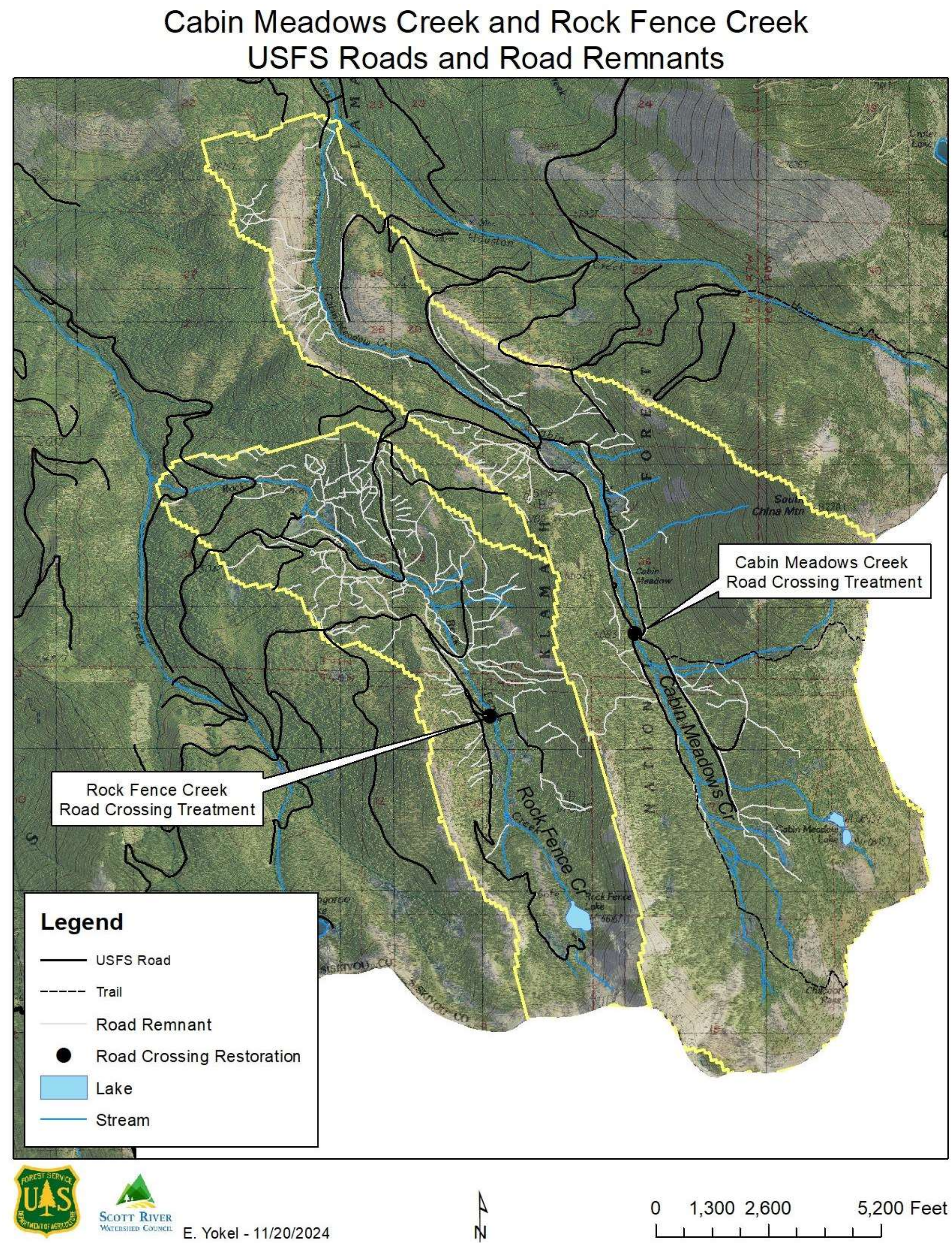


Figure 3-14. Map of roads, road remnants, road crossing treatments, and trails.

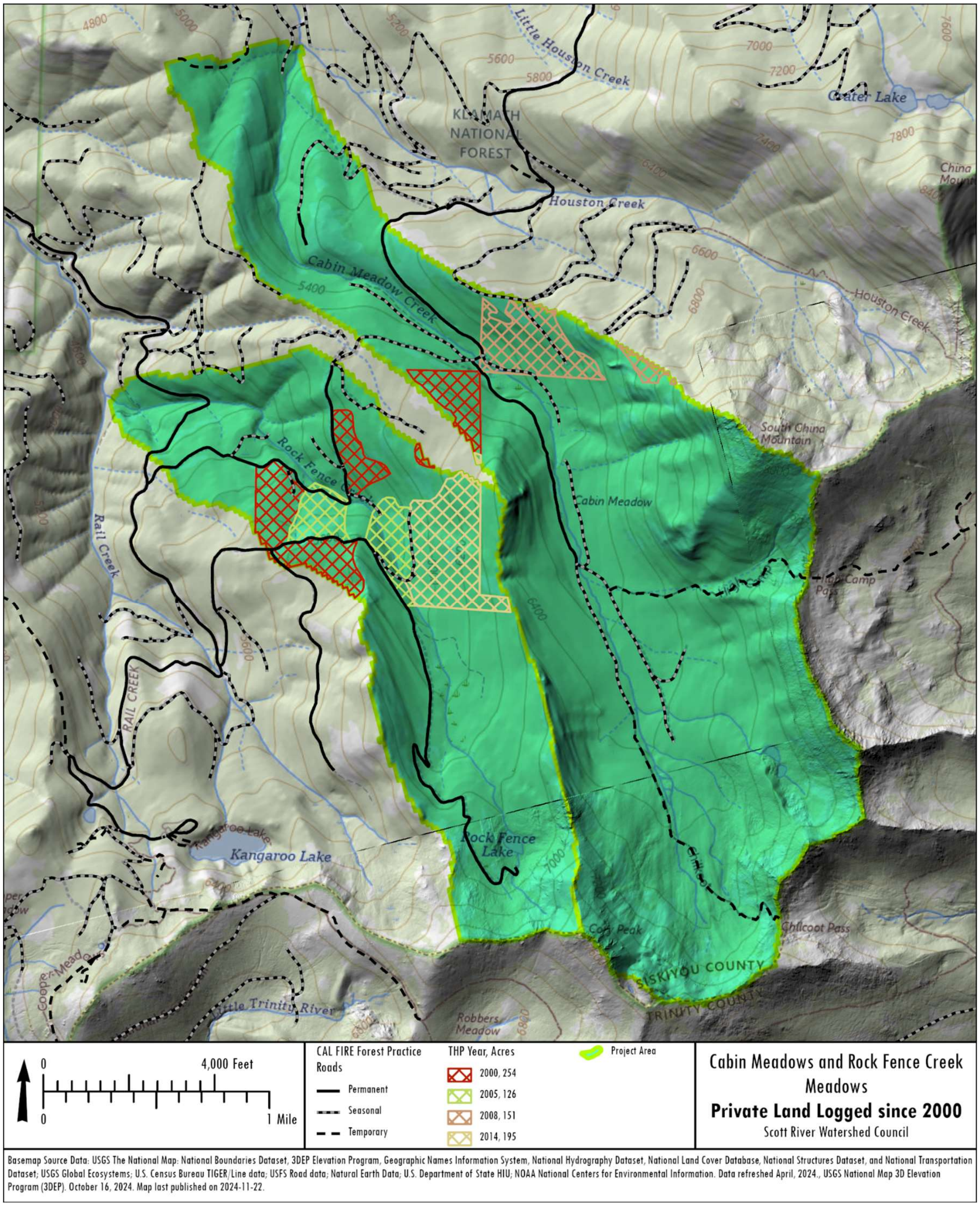


Figure 3-15. Timber Harvest History on Private Lands 2000-2024.

4 BASELINE CONDITIONS ASSESSMENT AND MONITORING

4.1 Related data: Seedbank

A team of undergraduate students from Southern Oregon University, working on their capstone project with Dr. Chhaya Werner, are conducting a seed bank study in the Project Area. They collected soil samples in plots sharing the same center point as some of the vegetation monitoring plots discussed in section 4.2 (Figure 4-1). These plots represent both actual and potential meadow areas. Actual meadow was identified based on characteristic wet meadow vegetation and open canopy, while potential meadow plots occurred within the potential meadow polygons identified by the Lost Meadow Model (Pope and Cummings 2023; Cummings et al. 2023) in areas that were dryer and more forested than the actual meadow, but not in areas that were elevated or rockier where meadow was less likely to have existed in the past. Soil samples were grown in a greenhouse with irrigation designed to mimic meadow-appropriate soil moisture. (Bauer et al. 2024)

Sample collection in 2023, during the first pilot year, was later than ideal due to the NEPA process taking more time than was initially anticipated. Results from the first year found that while there was a difference in the plants present above-ground in the actual and potential plots, there was no significant difference in species that grew in the greenhouse in soil samples from actual or potential meadow sites. (Bauer et al. 2024)

In 2024, Werner and students repeated the sample collection as soon as snow melted enough to access plots for a second year of study. Preliminary results from year two “continue to be consistent with the first year’s greenhouse results that the species emerging from the seed bank are much more similar between current and potential meadow plots than the species present above-ground in those plots” (2024 email from C Werner to M Ireson).

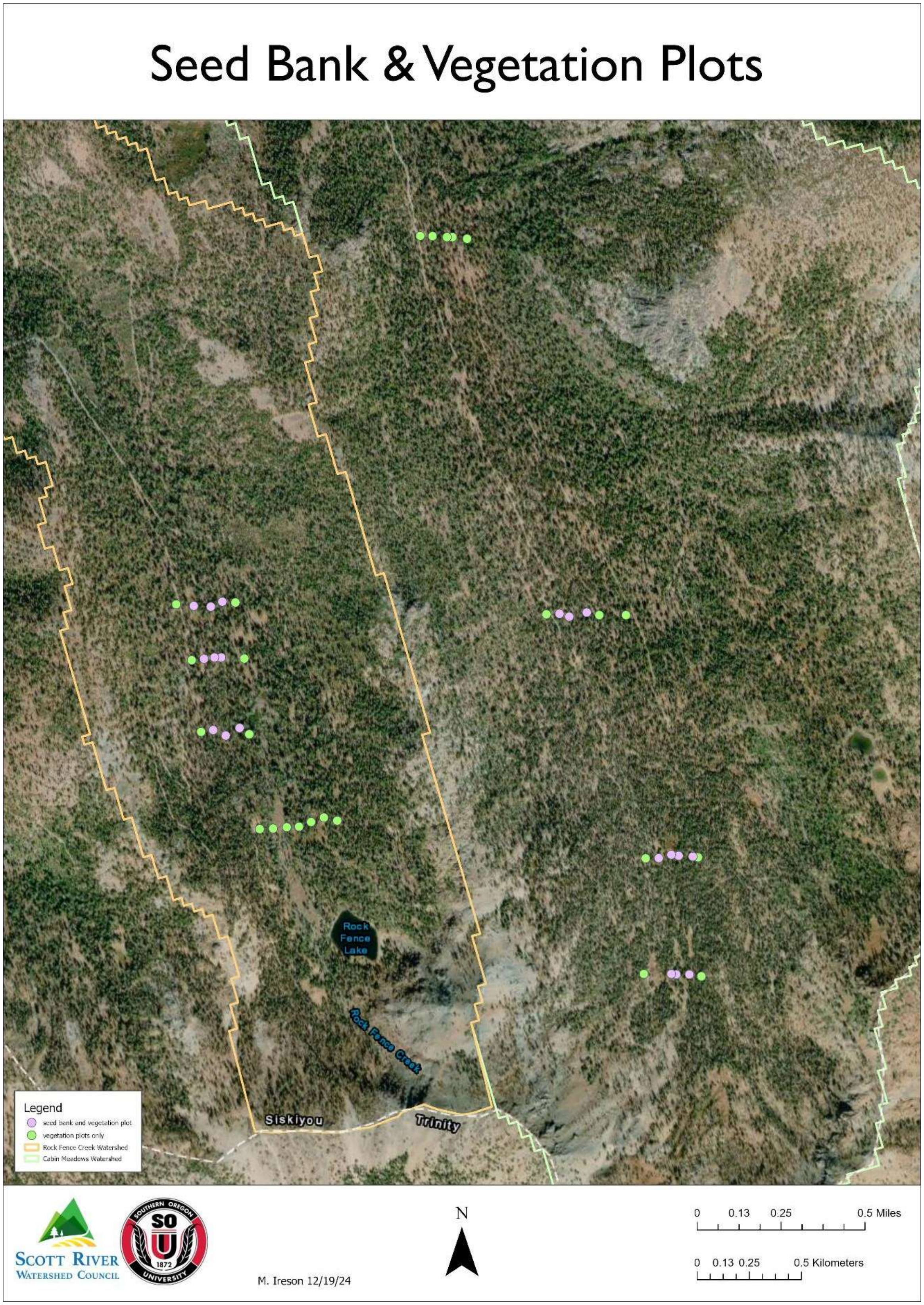


Figure 4-1. Location of seedbank and vegetation plots in Project area.

4.2 Vegetation and Forestry

Vegetation Monitoring Plots

During the 2023-2024 field seasons, a total of 44 vegetation monitoring plots were established across the Rock Fence Creek and Cabin Meadow Creek watersheds (22 plots located in each, Figure 4-2). These plots were established along transects running perpendicular to the main channels with the goal of capturing conditions in the upland, transition, and wet meadow zones within the project area. Each plot was 405 sq. m in size, representing about 1/10th of an acre where data were collected on vegetation covers, ground covers, overstory trees, and surface fuels. A subplot 60 sq. m. in size (1/70th of an acre) was used for collecting data on tree seedlings and saplings. Select data is summarized below, grouped by watershed and separated further based on their location along the transects (i.e. "upland", "transition", "wet"). Fuels data are not summarized in this document due to missing data at this time.

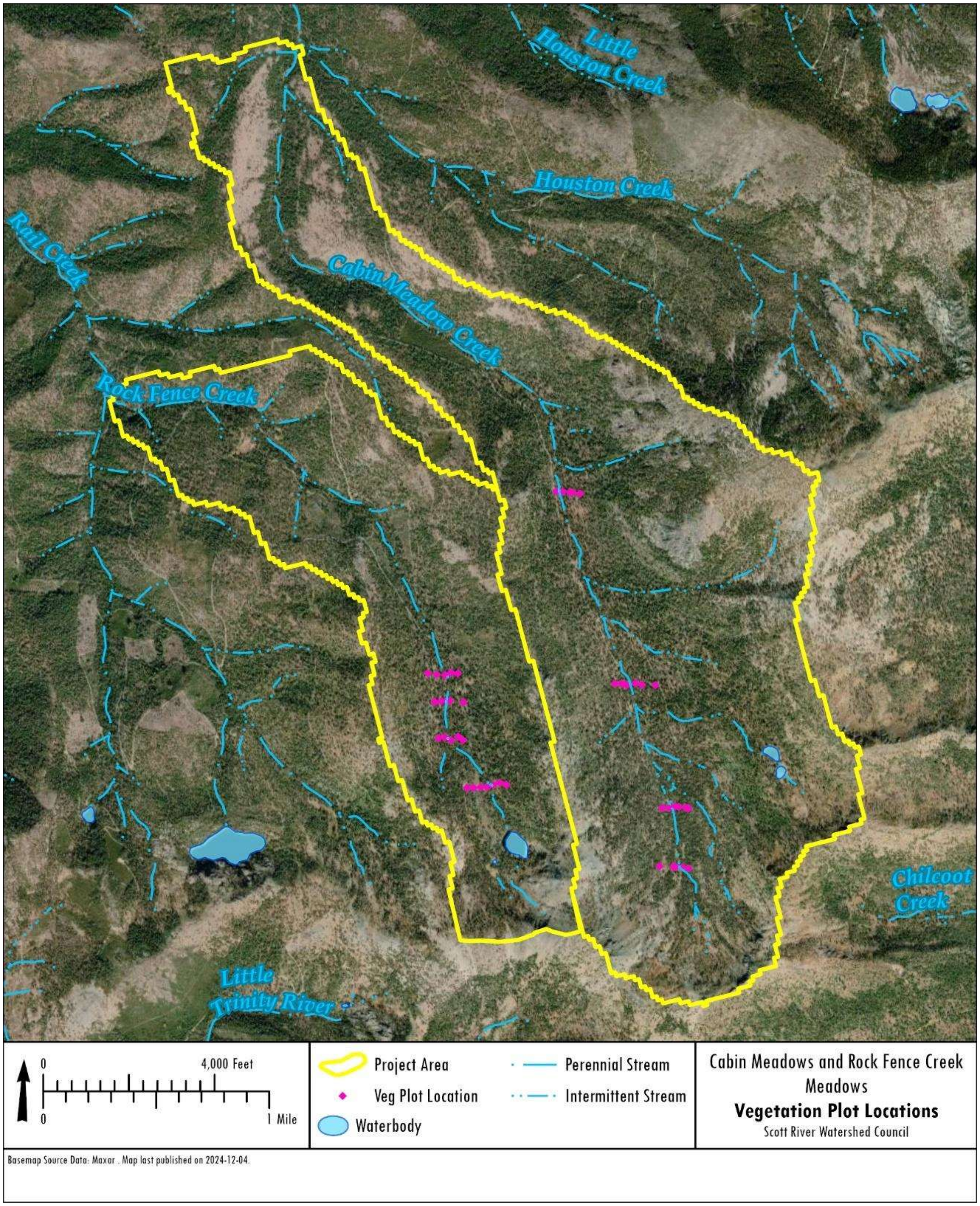


Figure 4-2. Location of vegetation plots in Project area.

4.2.1 Vegetation and Groundcovers

Cover estimates for both vegetation and groundcover were conducted across all plots. Vegetation was separated by lifeform (i.e. tree, shrub, forb, graminoid) and groundcovers included basal vegetation, litter, bareground, wood (>3 inch diameter), rock (separated out into size classes), and nonvascular plant cover (i.e. moss, lichen). Table 4-1 shows a summary of mean vegetation cover and groundcover across the two watersheds. Figure 4-3 displays these vegetation data across the upland, transition, and wet meadow zones.

In general, Cabin Meadow follows more of the patterns one would expect to see, with the upland areas having the highest percent tree cover and the wet meadow areas having the lowest, with the transition areas falling right in between the two. Rock Fence on the other hand shows tree cover to be fairly evenly distributed across all three positions on the landscape. The rocky nature of Rock Fence Creek (21% compared to 14% in Cabin Meadow Creek) may be what is driving somewhat unexpected patterns across a gradient from wet meadow to upland. Shrub cover was highest in the Rock Fence upland area but was otherwise relatively low, with the wet meadow areas in Cabin Meadow exhibiting the lowest shrub cover. Forb and graminoid cover were both highest in the transition and wet meadow areas and lowest in the upland areas in both watersheds.

Table 4-1. Mean percent vegetation cover and groundcover across Rock Fence Creek and Cabin Meadow Creek watersheds separated by zone (i.e. upland, transition, wet). The number of plots within each is also provided. *BV = Basal vegetation (Note: Estimates may be higher than they actually are due to difficulty in producing visual estimates across a large plot); Rock = Sum of boulder, gravel, stone, and cobble; Cryptogram/moss/lichen cover was <1% across all zones and bedrock was 0 across all zones, both were omitted from table.

		# of Plots	Vegetation Cover (%)				Groundcover (%)*				
			Tree	Shrub	Forb	Gram	BV	Litter	Wood	Bare	Rock
Rock Fence Creek	**Overall**	22	24	16	17	22	37	31	6	4	21
	Upland	10	23	24	3	5	10	49	4	4	31
	Transition	7	19	9	31	36	62	14	8	2	11
	Wet	5	22	9	24	35	57	17	5	9	13
Cabin Meadow Creek	**Overall**	22	36	7	10	29	39	34	6	4	14
	Upland	10	50	9	6	3	15	56	8	2	17
	Transition	6	23	8	17	36	47	20	6	8	16
	Wet	6	11	1	11	66	71	11	3	4	6

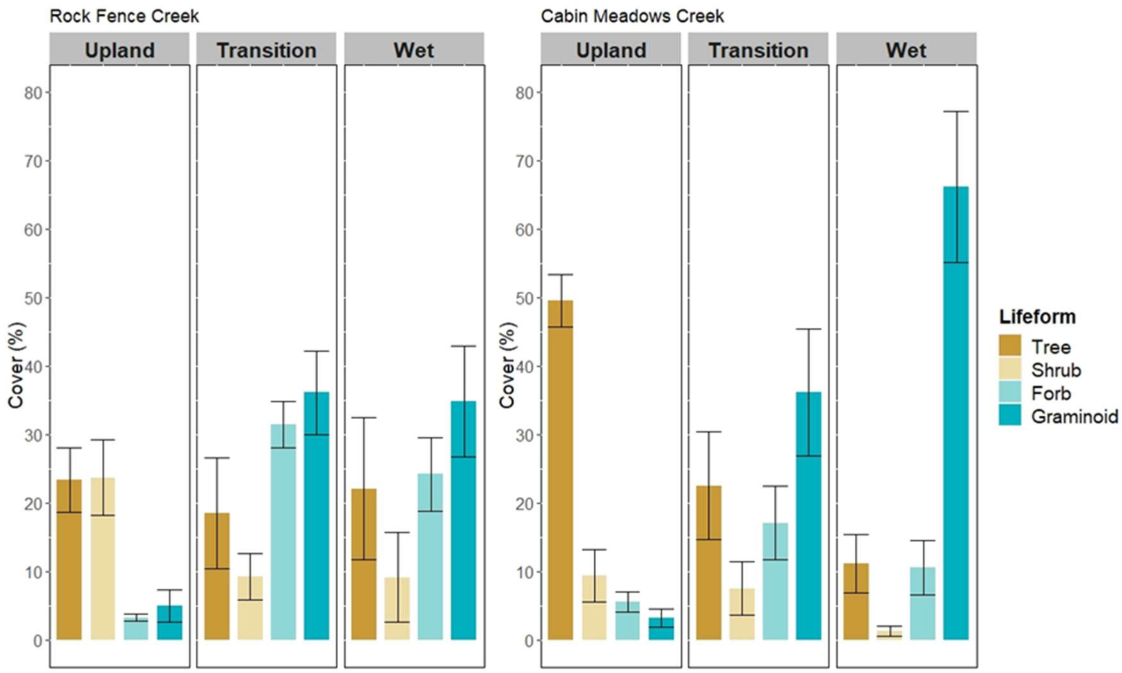


Figure 4-3. Mean percent vegetation cover with standard error bars shown for Rock Fence Creek and Cabin Meadow Creek watersheds separated by position.

4.2.2 Tree Densities

Tree densities were highly variable ranging from 10 to 281 trees per acre (TPA) in Rock Fence Creek and 0 to 361 TPA in Cabin Meadow Creek. For both watersheds, densities were highest in upland plots with an average of 105 TPA in Rock Fence Creek and 212 TPA in Cabin Meadow Creek. For Cabin Meadows, the transition zone had the second highest density (129 TPA) followed by the wet meadow areas (60 TPA). Rock Fence Creek on the other hand had similar densities in the transition and wet meadow areas, with 75 TPA and 85 TPA respectively. Tree densities across both watersheds were driven largely by smaller size classes (<25 cm and 25-40 cm diameter at breast height [DBH]; Figure 4-4).

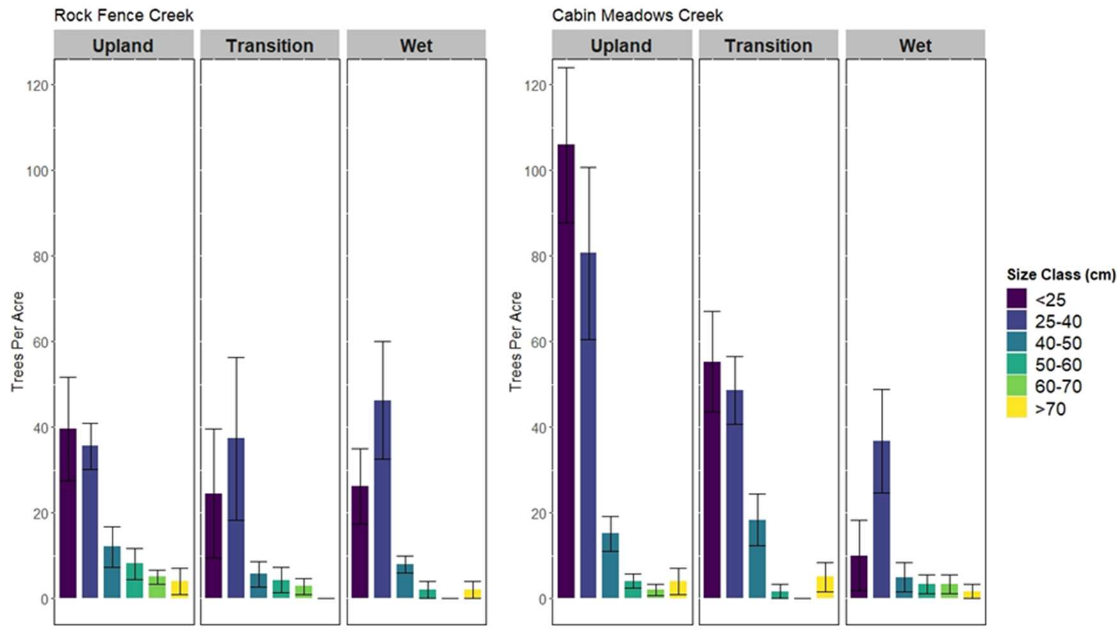


Figure 4-4. Mean trees per acre (TPA) with standard error bars shown for Rock Fence Creek and Cabin Meadow Creek watersheds separated by position and broken down by size class. Note that saplings (i.e. trees greater than 1.37 m tall with a DBH less than 2.54 cm) are excluded from this figure.

In both watersheds, the only species present in the two largest size classes (60-70 cm and >70 cm) were the pine species: Jeffrey pine (*Pinus jeffreyi*), lodgepole pine (*P. contorta*), and western white pine (*P. monticola*). Lodgepole pine and white fir (*Abies concolor*) were the most prominent in the smallest size classes (<25 cm and 25-40 cm). Red fir (*A. magnifica*) was absent from Cabin Meadow Creek plots and was present in small numbers in the smallest size classes within Rock Fence Creek plots. Incense cedar (*Calocedrus decurrens*) was not present in any of the plots but was observed adjacent to the plots.

The patterns in tree densities, composition, and size classes across both watersheds indicate structural and compositional shifts often associated with fire exclusion. Across most yellow pine and mixed conifer forests in northwestern California, substantial increases in tree densities as a result of fire exclusion, particularly among smaller size classes and shade-tolerant species, have been well documented (Bohlman et. al. 2021). Furthermore, the disruption of fire regimes due to the removal of indigenous populations and their associated burning practices, in addition to the onset of fire suppression policies, has led to a decrease in the size and complexity of forest openings and has increased the distance between these openings (Skinner 1995).

Tree densities in Rock Fence Creek and Cabin Meadow Creek were likely much lower historically based on what is known from stand reconstructions and historical data elsewhere in the Klamath Mountains as well as in similar forest types throughout California. Safford and Stephens (2017) reported that historical densities in yellow pine and mixed conifer forests across the Sierra and southern Cascade ranges ranged from about 24 to 133 TPA with an average of 64 TPA. In the Klamath Mountains and North Coast Ranges, historical densities ranged from about 6 to 127 TPA with an average of 49 TPA (Bohlman et al. 2021). Note that these numbers come from both mixed conifer forests, as well as lower elevation yellow pine forests, and in some cases do not include all size classes in their estimates. Nonetheless, they provide a useful baseline for which to assess conditions within this project area.

Stand densities within the Rock Fence Creek and Cabin Meadow Creek watersheds may have been on the higher end of the ranges presented here because of their elevation, however the underlying serpentine soils in much of the area would have kept densities lower than other more productive areas. Site-specific conditions are critical to take into consideration when trying to understand historical conditions. Furthermore, estimates of historical stand densities come from forested sites, so given that our sampling includes wet meadow and transition zones, average density across all plots is not appropriate when comparing current densities with available estimates of what would be expected historically. When considering densities within just the upland areas, at 105 TPA in Rock Fence Creek and 212 TPA in Cabin Meadow Creek, these densities are well above average from what might be expected historically, with densities in Cabin Meadow Creek being particularly high.

4.2.3 Snags

Snag densities ranged from 0-111 snags per acre in Rock Fence Creek and 0-91 snags per acre in Cabin Meadow Creek. For Rock Fence Creek, mean snag densities were similar between upland and wet meadow areas (27 and 28 snags per acre respectively) and lowest in the transition zone with 20 snags per acre. Cabin Meadow Creek on the other hand had the highest snag densities in the upland areas with a mean density of 27 snags per acre. Transition and wet meadow areas were similar to one another with mean snag densities of about 19 and 20 snags per acre respectively. Snag densities followed a similar pattern to tree densities with regard to size class with the majority falling in the smallest size classes (Figure 4-5).

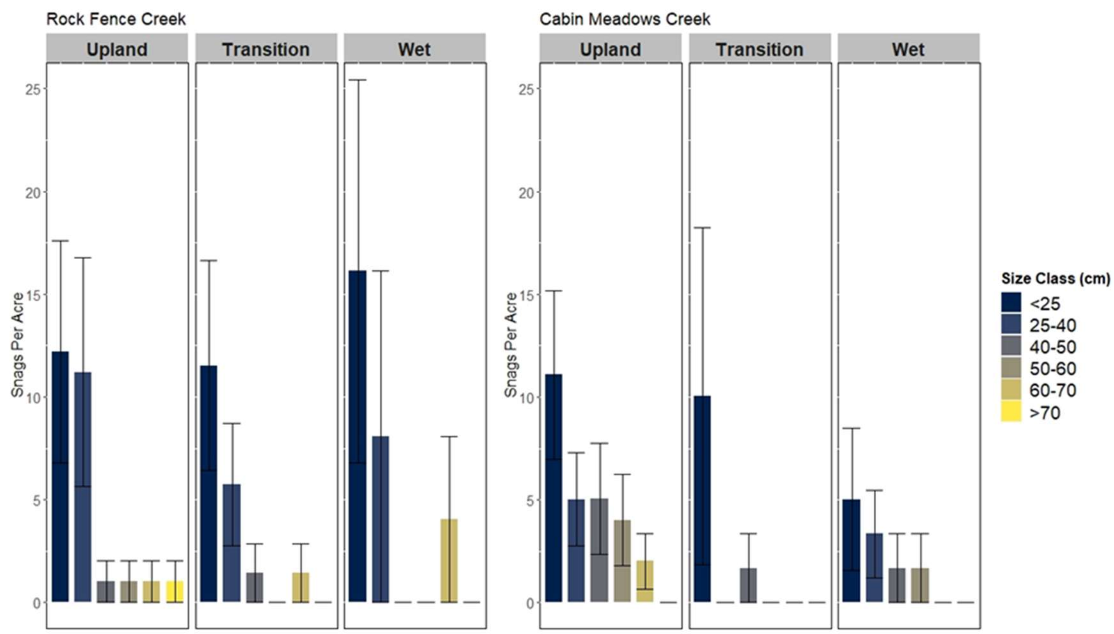


Figure 4-5. Mean snags per acre with standard error bars shown for Rock Fence Creek and Cabin Meadow Creek watersheds separated by position and broken down by size class.

4.2.4 Tree Regeneration

Tree regeneration was highly variable across plots, ranging from 0 to 771 seedlings and saplings per acre across Rock Fence Creek and 0 to 2,036 seedlings and saplings per acre across Cabin Meadow Creek. On average, tree regeneration was most abundant in the transition zones, with Rock Fence Creek averaging 270 seedlings and saplings per acre and Cabin Meadow Creek averaging 550 seedlings and saplings per acre across transition zone plots. The most abundant regenerating species in Rock Fence Creek was white fir, followed by lodgepole pine, western white pine, and then red fir. There were no Jeffrey pine seedlings or saplings found in Rock Fence Creek. The most abundant regenerating species in Cabin Meadow Creek was lodgepole pine, followed by white fir, western white pine, and then Jeffrey pine. There were no red fir seedlings or saplings found in Cabin Meadow Creek (Figure 4-6).

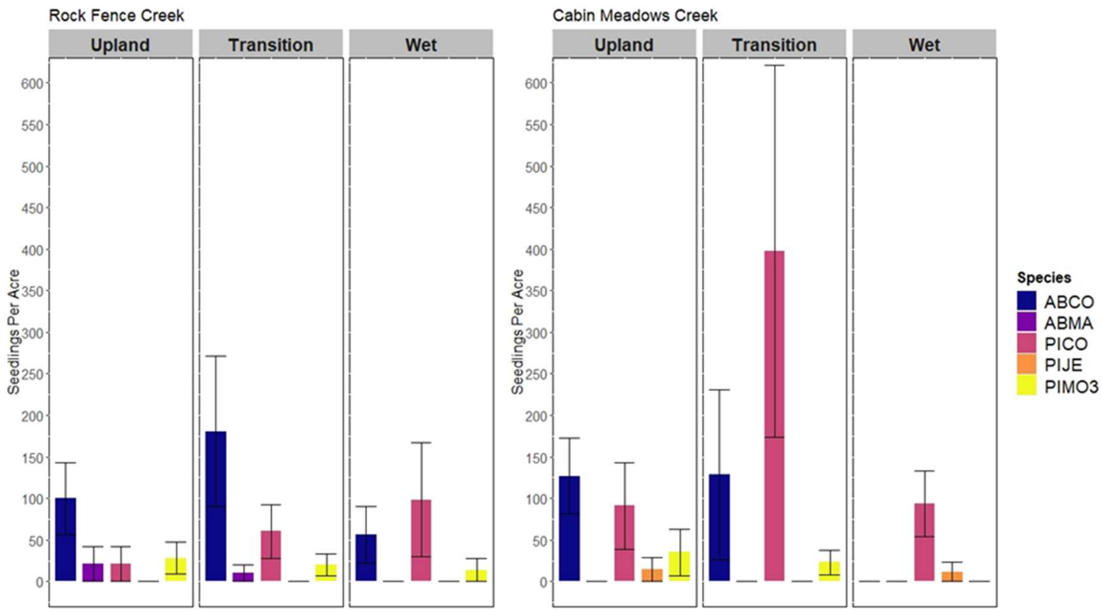


Figure 4-6. Mean seedlings and saplings per acre with standard error bars shown for Rock Fence Creek and Cabin Meadow Creek watersheds separated by position and broken down by species. Species codes: ABCO = *Abies concolor*; ABMA = *A. magnifica*; PICO = *Pinus contorta*; PIJE = *P. jeffreyi*; PIMO3 = *P. monticola*.

Lodgepole pine and white fir appear to be the most abundant regenerating tree species across the forest and meadow transects that were surveyed. This is an indicator that lack of fire is potentially shifting the overall composition of these forests and leading to increased encroachment into the meadows.

4.2.5 General Forest Conditions

The CAL FIRE Fire and Resource Assessment Program has mapped the project watersheds as a high priority for potential treatment to reduce wildfire risk based on threats and assets to forested lands.

The vegetation plots and surrounding forest stands do not show signs of major pest conditions or drought mortality. Given current tree density, the forest is at risk for future wildfire, stress and mortality from drought and pest conditions. The KNF East Fork Scott Project (2019) describes ecological restoration forest treatments designed to reduce wildfire risk, enhance natural processes, and increase forest health.

Forest fuels reduction consists of treating understory trees and brush with the goals of reducing fire hazards, improving tree growth, stabilizing carbon in retained trees, and increasing forest resilience to high intensity wildfire disturbances. Forest thinning activities can be manual or mechanical and must be designed to change stand structure to: 1) concentrate carbon storage in widely-spaced and larger trees that are more resilient to wildfire, drought, and pest outbreaks; 2) reduce the likelihood of wildfire transitioning into the forest canopy; and 3) provide co-benefits such as fish and wildlife habitat, increased biodiversity, and wildlife adaptation to climate change.

4.2.6 Plant Community Mapping

Plant communities were mapped in the Rock Fence Creek drainage (Figure 4-7). Appendix H contains the list of herbaceous plants and shrubs identified in the drainage, along with the wetland associations that were used in the community mapping.

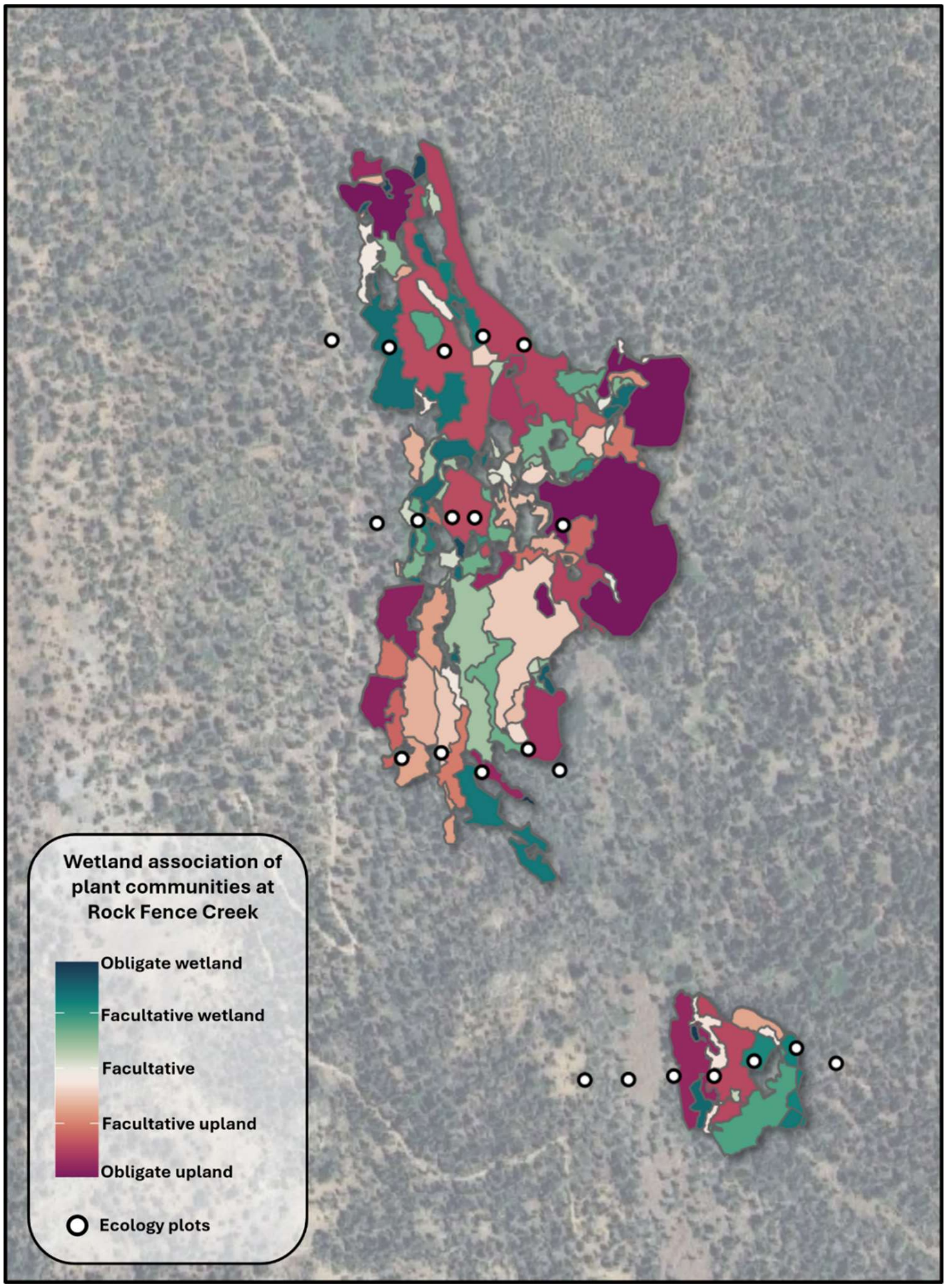


Figure 4-7. Wetland association of plant communities at Rock Fence Creek with locations of vegetation plots. Each species in a community was assigned a wetland association metric (obligate upland, facultative upland, facultative, facultative wetland, obligate wetland) using USDA PLANTS database (USDA Natural Resource Conservation Service: http://plants.usda.gov). The weighted mean by cover of this metric for all species within a community is given by color.

4.3 Hydrology

4.3.1 Groundwater Monitoring: Water Surface Elevation Network

Twenty-eight water surface elevation (WSE) stations were installed in October 2023 and two more were installed in July 2024 (Figure 4-8). The locations were identified by Karen Pope and Adam Cummings of the Forest Service's Pacific Southwest Research Station as locations likely to show change as a result of future meadow restoration work.

Vented steel casings were driven into the ground and Onset U20L pressure transducers were deployed into the casings to document continuous (30 minute) water depth and temperature. The location of the thirteen (13) WSE stations in Rock Fence Creek and seventeen (17) stations in Cabin Meadow Creek is illustrated in Figure 66.

The 2016 LiDAR Bare Earth DEM was utilized to generate ground elevation transects at two locations with WSE transects in Rock Fence Creek (Figures 4-9 to 4-11).

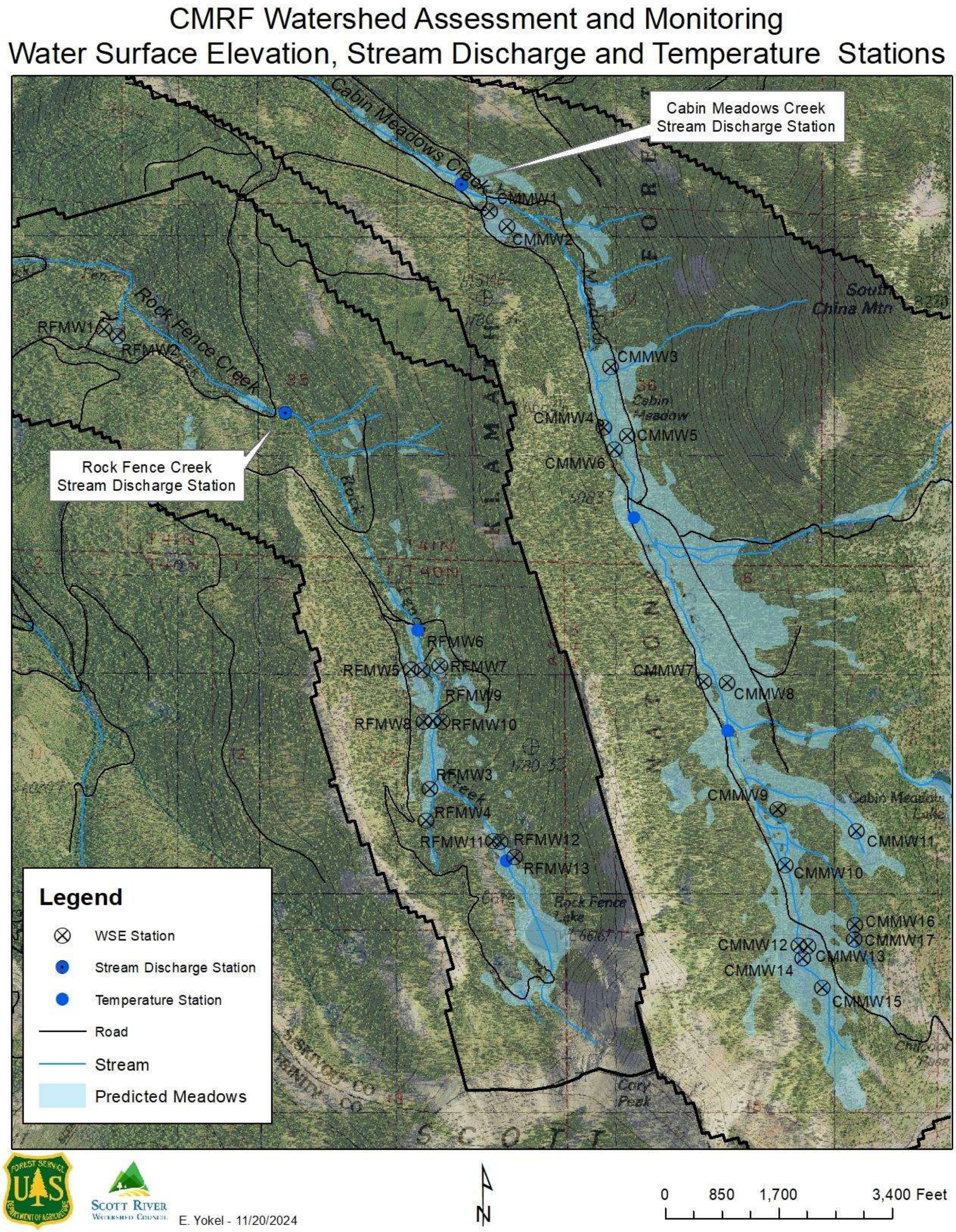


Figure 4-8. WSE, Stream Discharge, and Surface Water Temperature Stations in Rock Fence and Cabin Meadow Creeks. All three of these station types collect water temperature data.

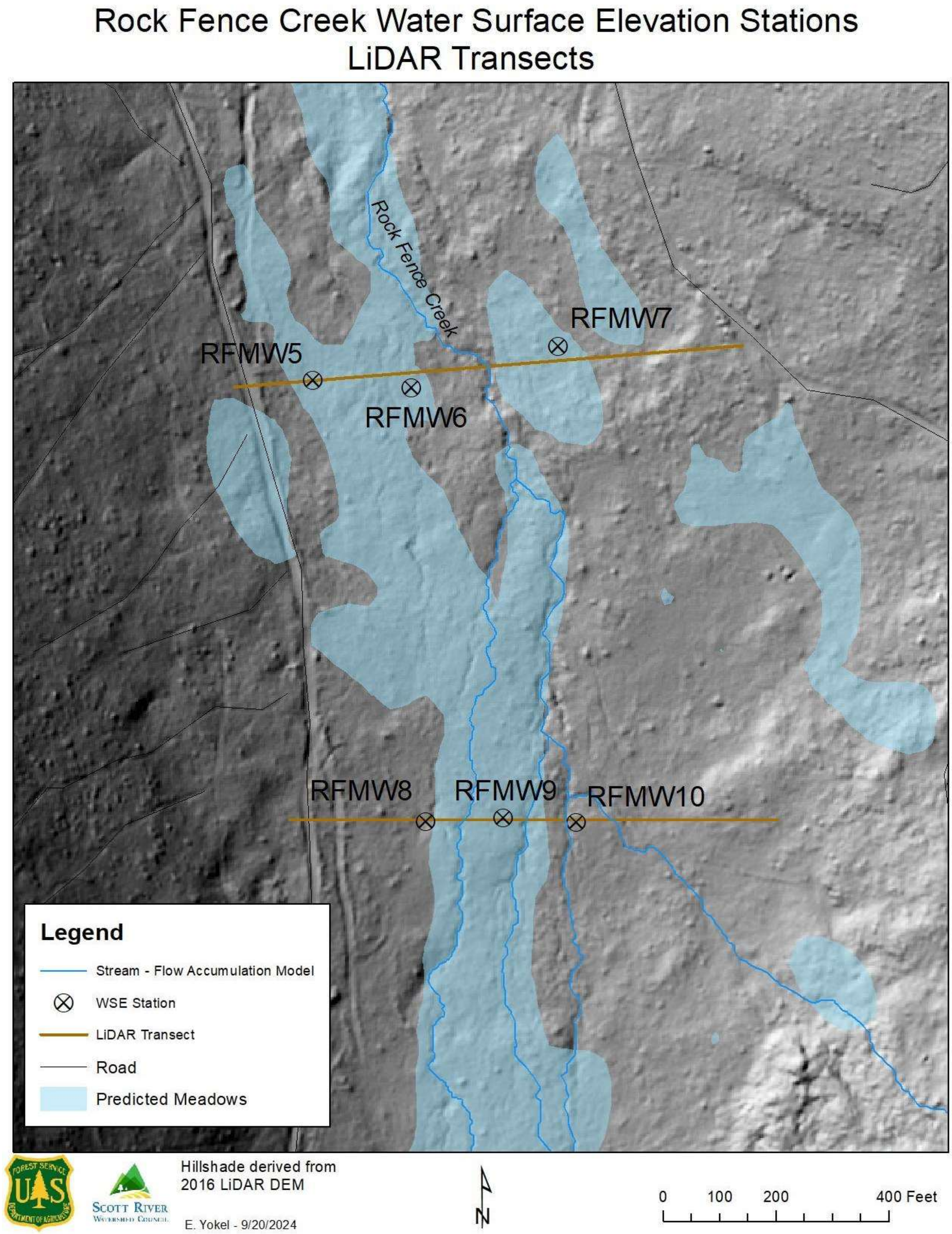


Figure 4-9. LiDAR transects at Rock Fence Creek WSE stations.

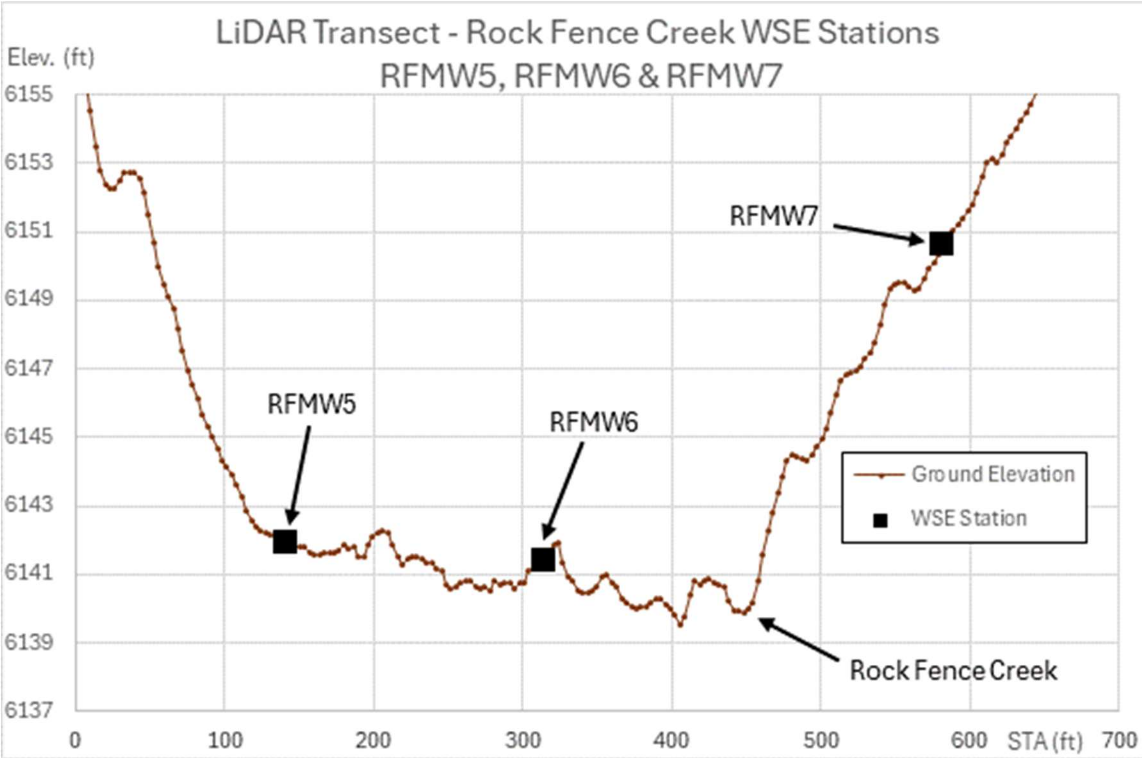


Figure 4-10. LiDAR transect at RFMW5, RFMW6 and RFMW7 WSE stations.

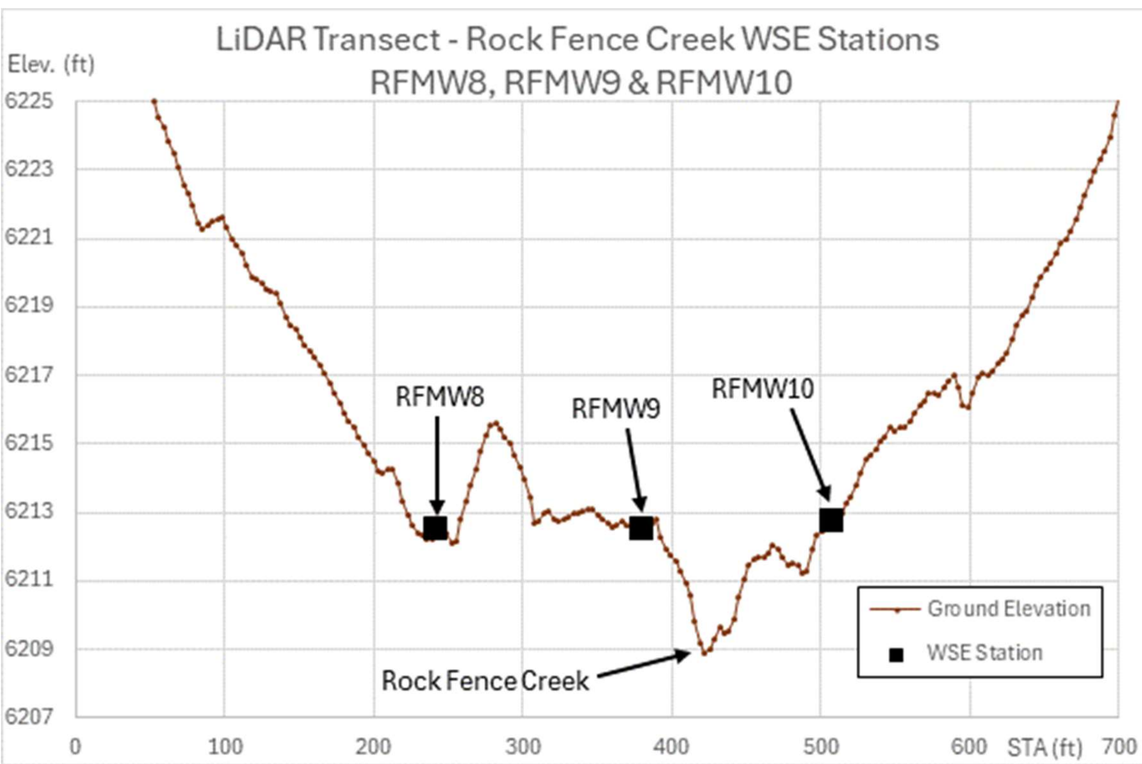


Figure 4-11. LiDAR transect at RFMW8, RFMW9 and RFMW10 WSE stations.

One use of data from the ground water monitoring network is to determine the level of influence of ground water versus surface water at each station. One way to make that determination is to look at water temperature. The temperature of surface water fluctuates more than the temperature of groundwater due to daily changes in solar loading, changes in weather conditions and seasonal changes (Figures 4-12 and Table 4-2).

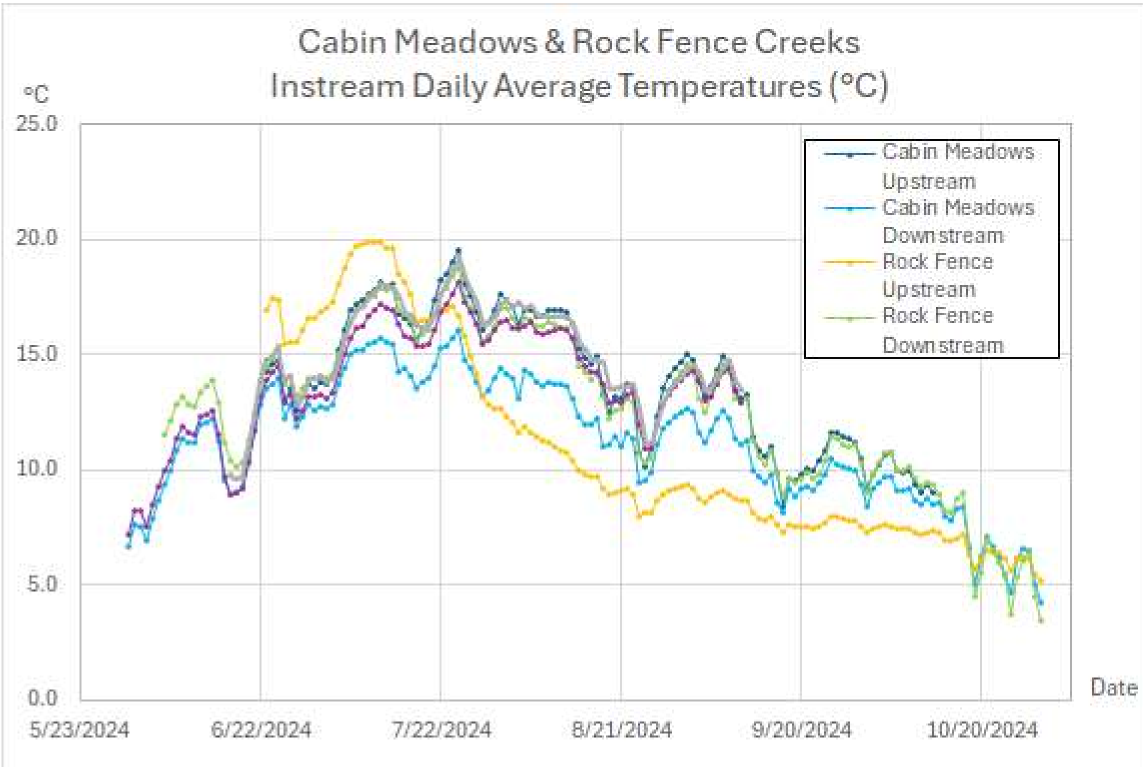


Figure 4-12. Average daily surface water temperatures at four stations in Cabin Meadow Creek and Rock Fence Creek.

Table 4-2. 2024 Maximum daily average surface water temperatures.

Station Name	Date	Temperature (°C)
Cabin Meadow Upstream	7/24/24	19.6
Cabin Meadow Downstream	7/24/24	16.0
Cabin Meadow Stream Discharge Station	7/24/24	18.2
Rock Fence Upstream	7/7/24-7/9/24	19.0
Rock Fence Downstream	7/24/24	18.7
Rock Fence Stream Discharge Station	7/24/24	19.2

4.3.1.1 Rock Fence Creek Water Surface Elevation Monitoring

The water surface elevation and temperature data from the transects identified above (in figures 4-9 to 4-11) illustrate that some stations are influenced more by surface water and some by ground water.

The WSE stations on Rock Fence Transect 2, RFMW05, RFMW06, and RFMW07, demonstrate this (Figures 4-13 to 4-16). While the ground elevation at RFMW05 and RFMW06 are within a foot of each other in elevation, RFMW06 is closer to the creek (Figures 4-9 and 4-10) and its greater variability in WSE indicates that it is influenced by the surface water, whereas once the groundwater is recharged by initial fall precipitation, the WSE at RFMW05 remains fairly stable until after snowmelt. The ground elevation at RFMW07 is more than six feet higher than RFMW06, and the RFMW07 station is more than

100 feet away from Rock Fence Creek; it also shows a surface-water influenced pattern of greater WSE variation.

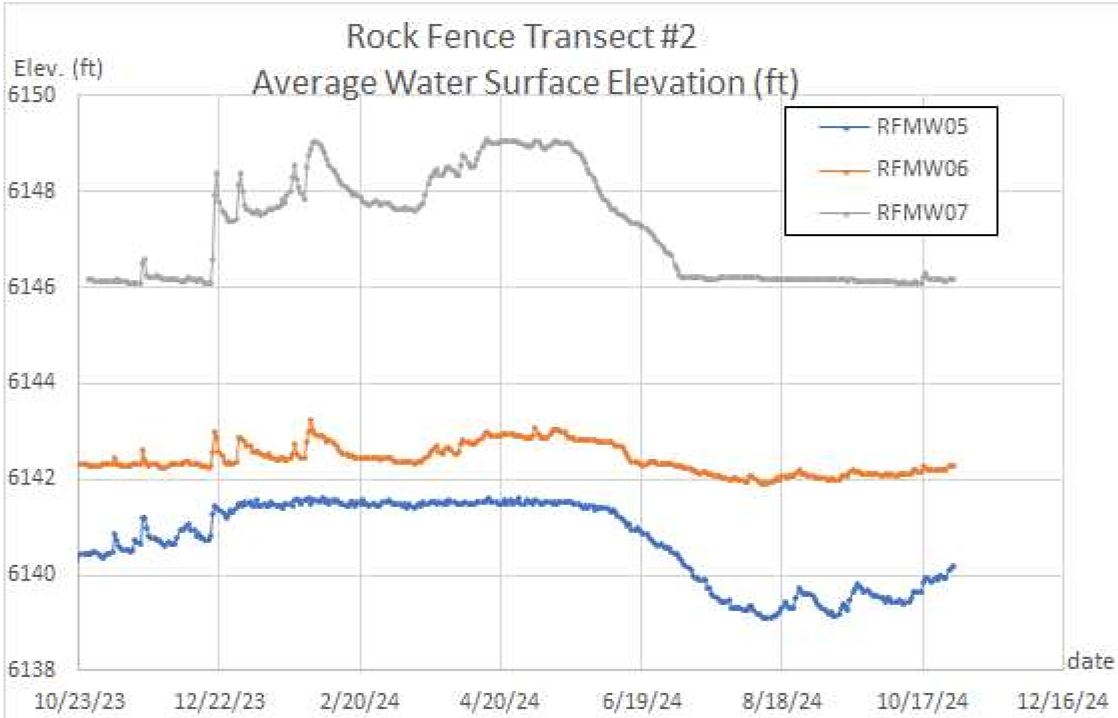


Figure 4-13. Daily average WSE—Rock Fence Transect #2.

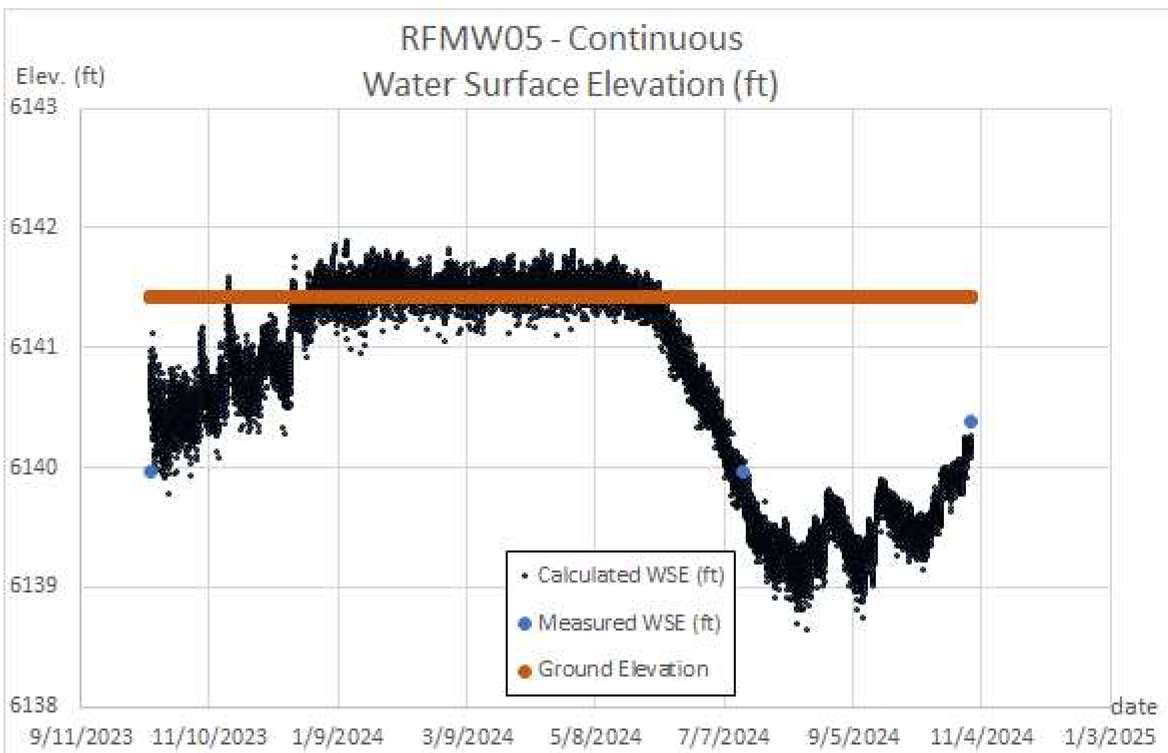


Figure 4-14. WSE for monitoring station RFMW05.

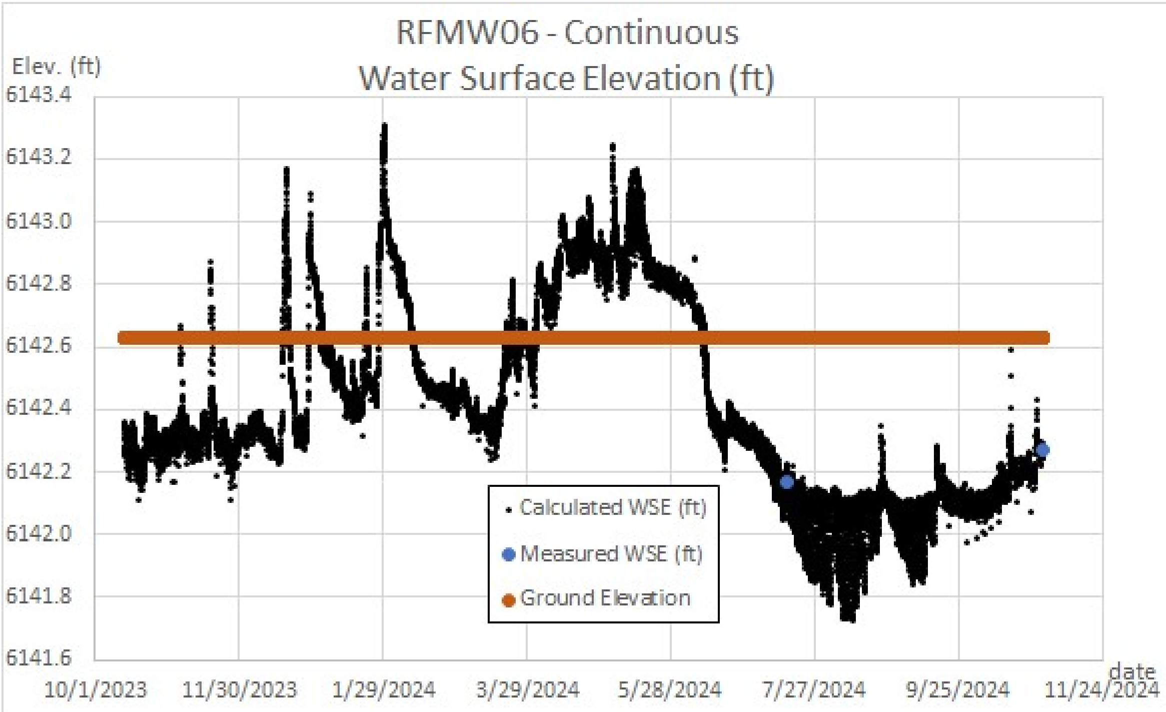


Figure 4-15. WSE for monitoring station RFMW06.

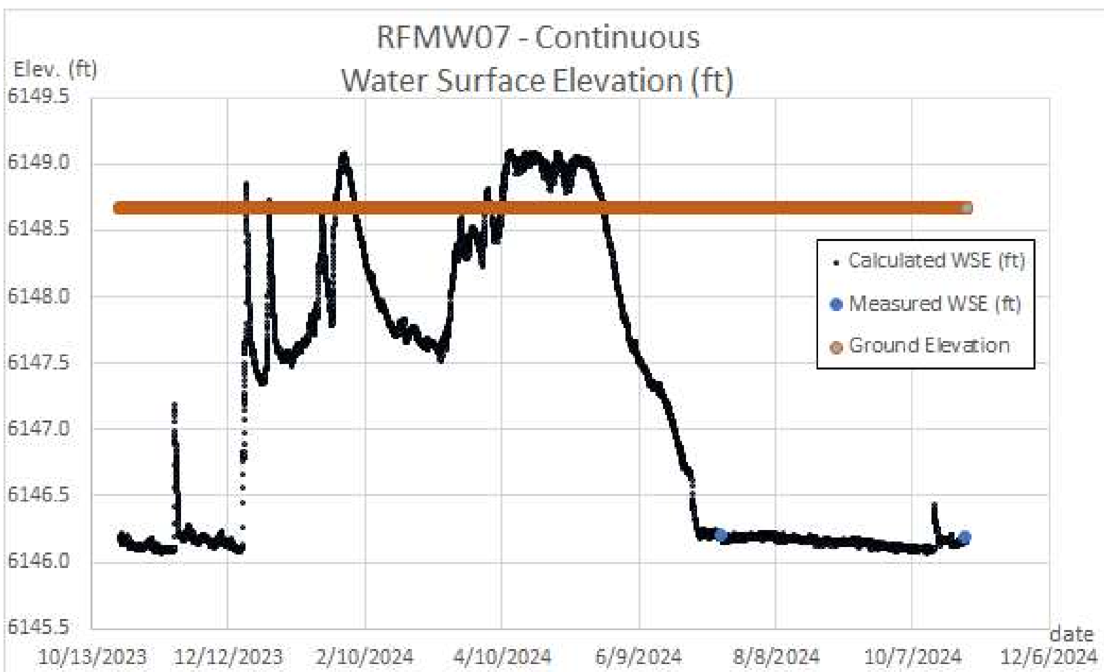


Figure 4-16. WSE for monitoring station RFMW07.

Temperature in each station (Figures 4-17 and Table 4-3) further supports the groundwater or surface water influences: The water temperatures at RFMW07 show the greatest variability with the changing weather, showing a higher maximum temperature that occurs only 10 days after the maximum surface water temperatures at the Rock Fence Downstream and RF Flow stations, whereas RFMW05 is more insulated from the weather and therefore maximum temperature is cooler and temperature changes more slowly; the maximum temperature at RFMW05 occurs 25 days later than the maximum temperatures at RockFence Downstream and RF Flow. RFMW06's temperature signal is between that of RFMW5 and RFMW7, indicating mixed influence from both ground water and surface water.

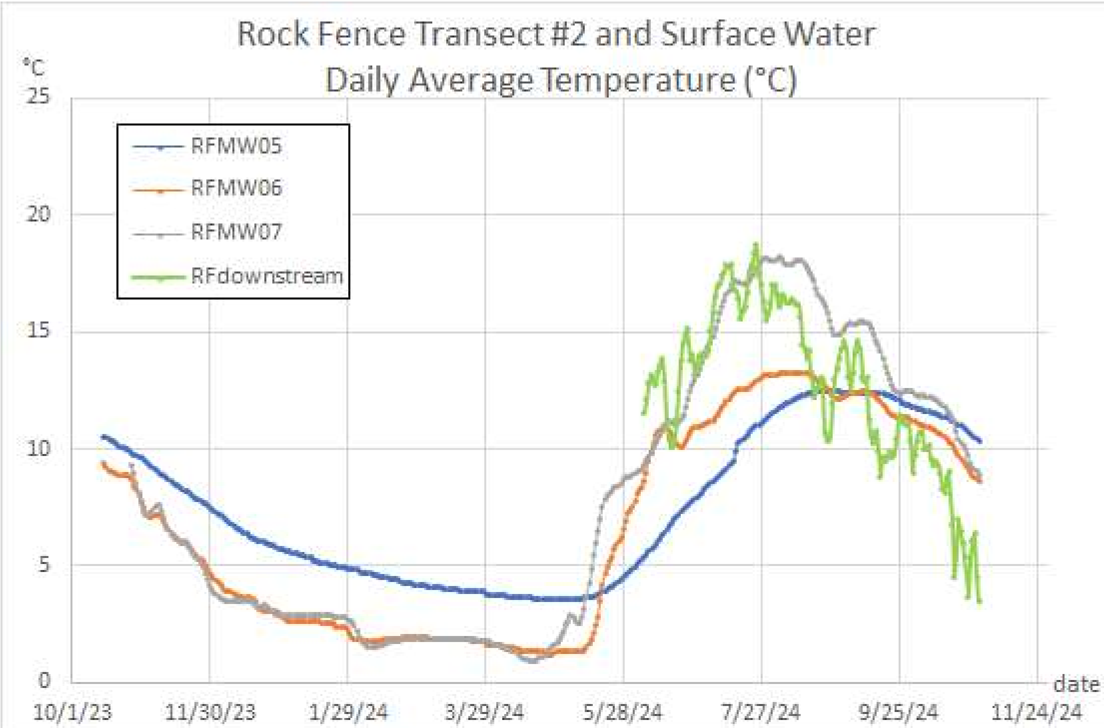


Figure 4-17. Daily average temperature—Rock Fence Transect #2 and Rock Fence Downstream Temperature Station.

Table 4-3. 2024 Maximum daily average temperature.

Station Name	Station Type	Date	Temperature (°C)
RFMW05	ground water	8/18/24-8/29/24	12.5
RFMW06	ground water	8/4/24-8/15/24	13.3
RFMW07	ground water	8/3/24	18.2
Rock Fence Upstream	surface water	7/7/24, 7/8/24, 7/9/24	19.0
Rock Fence Downstream	surface water	7/24/24	18.7
Rock Fence Stream Discharge Station	surface water	7/24/24	19.2

Rock Fence Transect #3 shows similar patterns, with RFMW10 showing a groundwater signal and RFMW08 and RFMW09 showing greater variability, indicating the influence of surface water. (Figures 4-18 to 4-21.)

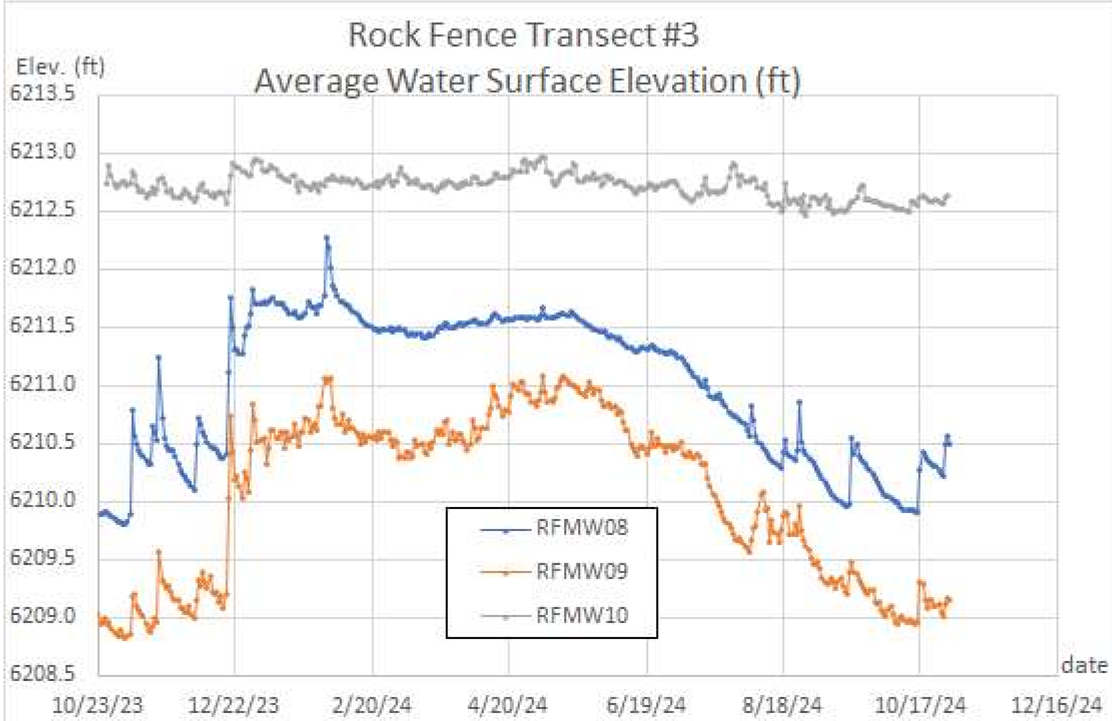


Figure 4-18. Daily average WSE—Rock Fence Transect #3.

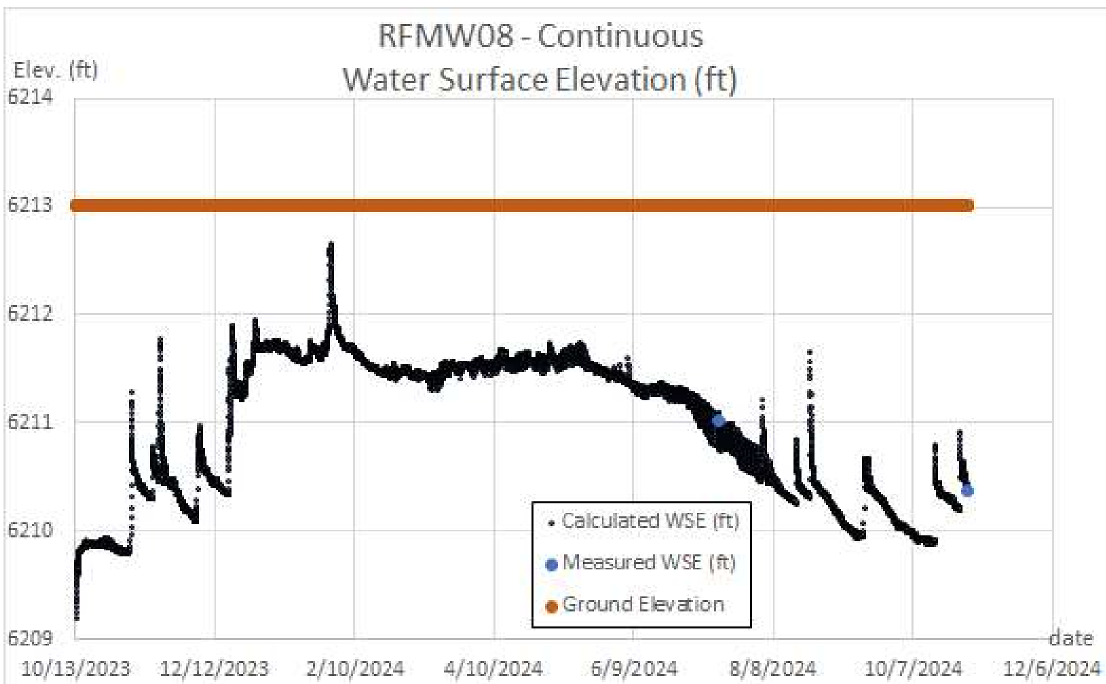


Figure 4-19. WSE for monitoring station RFMW08.

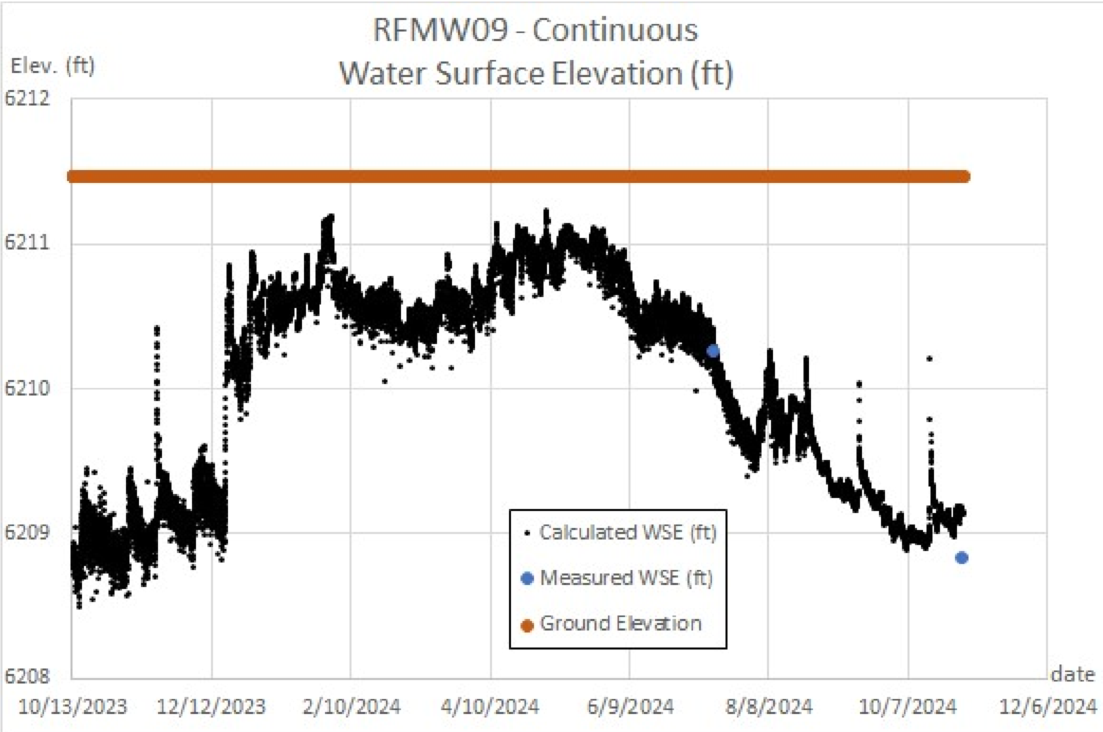


Figure 4-20. WSE for monitoring station RFMW09.

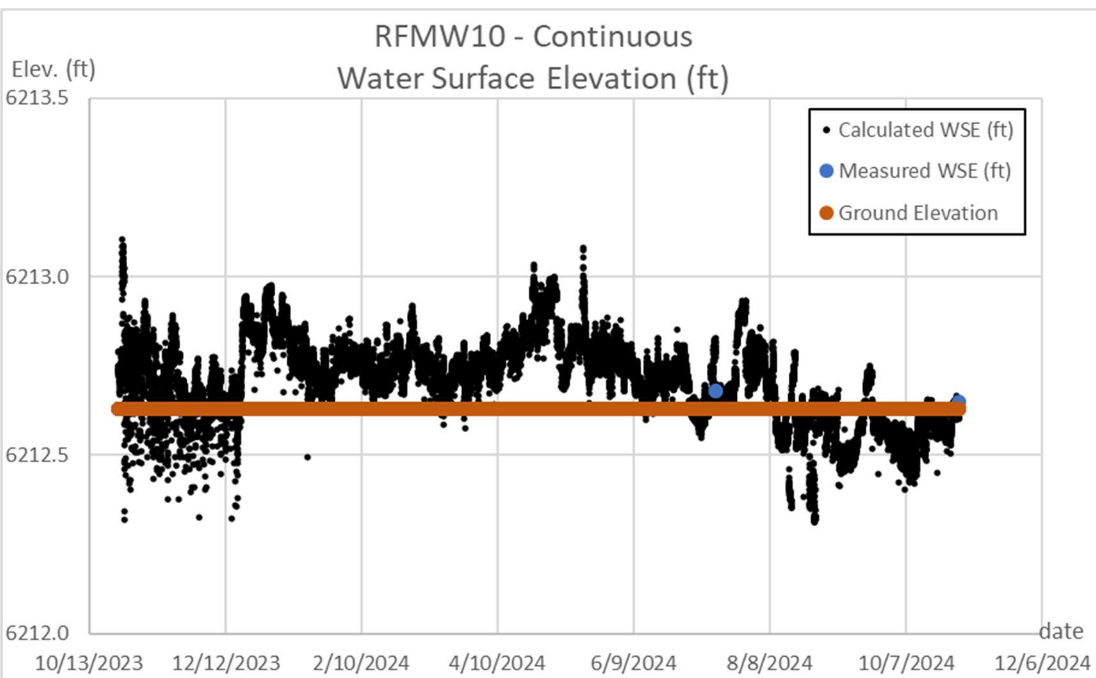


Figure 4-21. WSE for monitoring station RFMW10.

The temperatures of Rock Fence Transect #3 largely supports the WSE data in regards to the influence of ground and surface water on each station. RFMW10 has the least change and the lowest maximum daily average temperature, indicating a largely groundwater influenced location and RFMW08 has the greatest variability and the highest maximum temperature, reflecting greater surface-water influence. RFMW09, however, has a temperature profile that is mixed, with greater total variability than RFMW10 and less than RFMW08. (Figure 4-22 and Table 4-4))

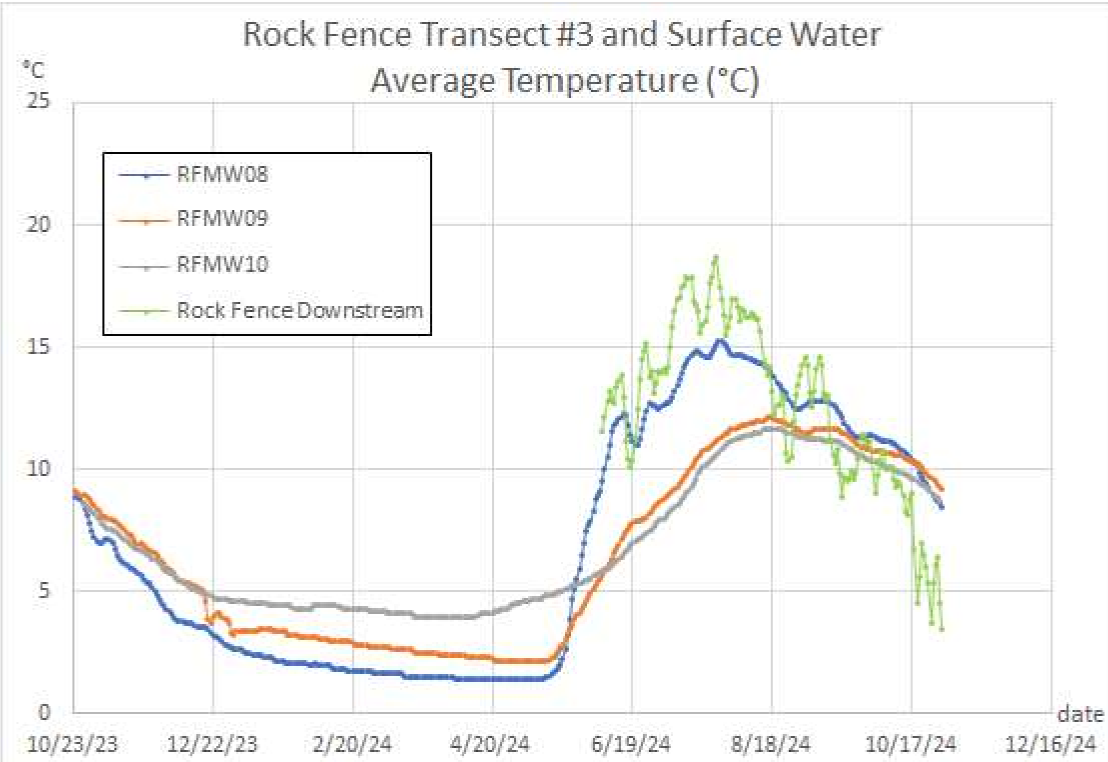


Figure 4-22. Daily average temperature—Rock Fence Transect #3.

Table 4-4. Maximum Average Daily Temperature for Rock Fence Transect #2 and Rock Fence Creek surface water temperature stations.

Station Name	Station Type	Date	Temperature (°C)
RFMW08	ground water	7/25/24-7/26/24	15.3
RFMW09	ground water	8/14/24-8/18/24	12.1
RFMW10	ground water	8/14/24-8/22/24	11.6
Rock Fence Upstream	surface water	7/7/24, 7/8/24, 7/9/24	19.0
Rock Fence Downstream	surface water	7/24/24	18.7
Rock Fence Stream Discharge Station	surface water	7/24/24	19.2

4.3.1.2 Cabin Meadow Creek Water Surface Elevation Monitoring

Cabin Meadows Transect #4 is an interesting case. (Figures 4-23 to 4-25.) Both stations are in the same general location, approximately 240 feet apart, and both near the stream channel. CMMW17 is upslope with a ground elevation about 4 feet higher than CMMW16. The stream appears to flow year-round next to CMMW16 but the stream next to CMMW17 goes dry late in the summer. The WSE of CMMW16, next to the connected stream, fluctuates approximately one foot over the course of the year, while that of CMMW17, next to the seasonally disconnected stream reach, fluctuates more than four feet over the year.

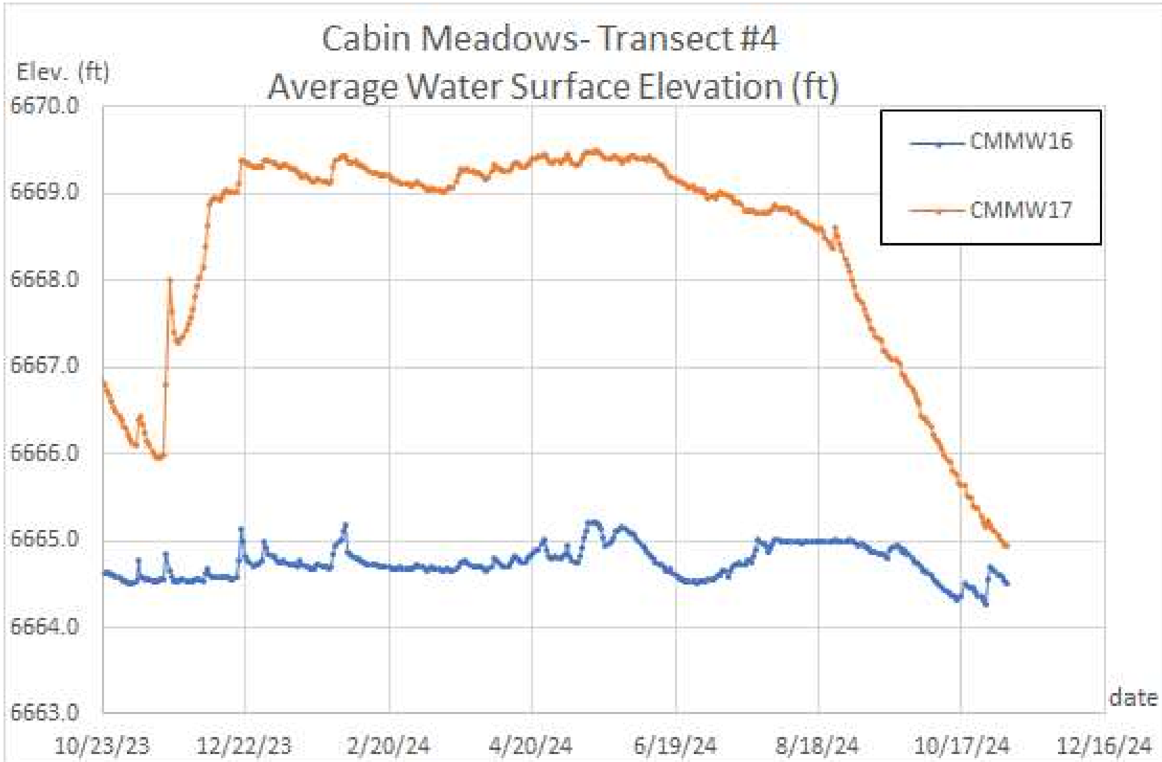


Figure 4-23. Daily average WSE—Cabin Meadows Transect #4.

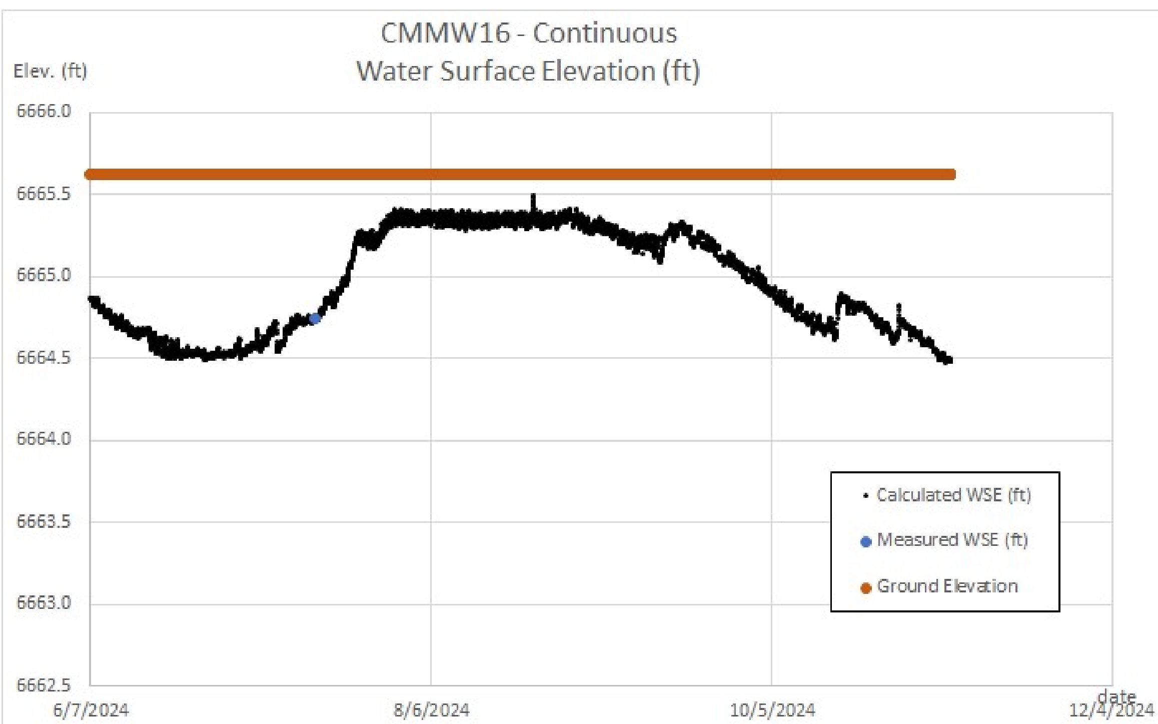


Figure 4-24. WSE for monitoring station CMMW16.

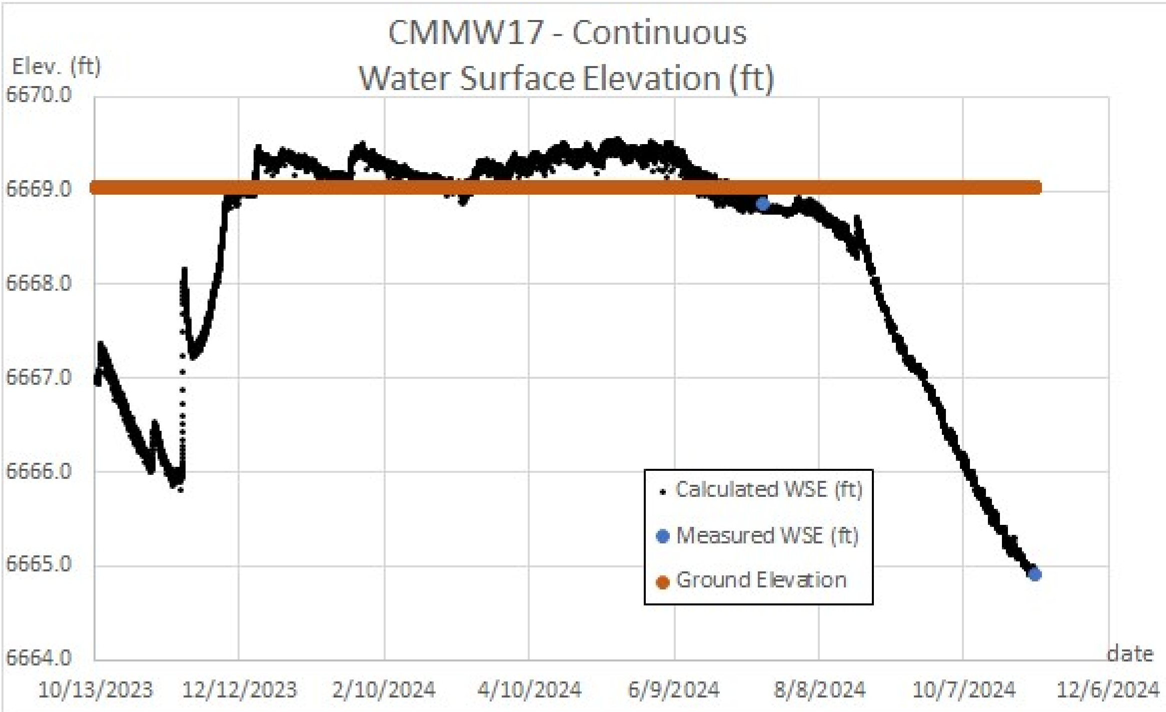


Figure 4-25. WSE for monitoring station CMMW17.

The daily average temperature of CMMW17, next to the reach that becomes disconnected, behaves like ground water in the summer, with less variation and lower and later maximum temperature. Temperatures at CMMW16 reflect its year-round influence from the adjacent stream channel. (Figure 4-26 and Table 4-5.)

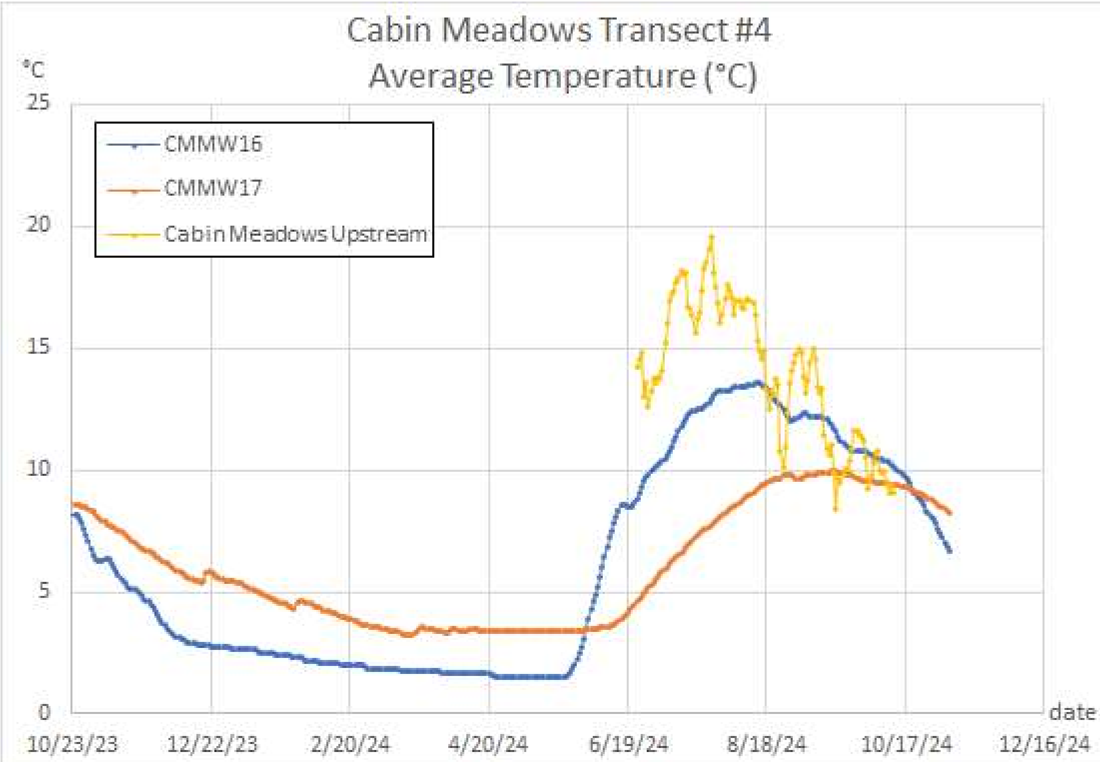


Figure 4-26. Daily average temperature—Cabin Meadows Transect #4.

Table 4-5. 2024 Maximum daily average temperature.

Station Name	Station Type	Date	Temperature (°C)
CMMW16	ground water	8/13/24-8/14/24	13.6
CMMW17	ground water	9/14/24-9/16/24	10.0
Cabin Meadow Upstream	surface water	7/24/24	19.6
Cabin Meadow Downstream	surface water	7/24/24	16.0
Cabin Meadow Stream Discharge Station	surface water	7/24/24	18.2

4.3.2 Discharge Monitoring

In WY 2023 a continuous stream discharge station was established in Rock Fence Creek and in WY 2024 a continuous stream discharge station was established in Cabin Meadow Creek (Figure 4-27). Periodic manual discharge measurements were performed at the two stations to develop rating curves and calculate the stream discharge. Continuous (15 minute) and daily average discharge (cfs) were calculated for each station. Water temperature was also recorded at each station.

The elevation of the two stations are similar. Rock Fence Creek station is at 5492 feet and the Cabin Meadow Creek station is at 5652 feet. At 2,155 acres, the catchment area of the Cabin Meadow Creek station is approximately 2.5 times the size of the 860 acre basin above the Rock Fence Creek station. The maximum discharge measured at the Cabin Meadow Creek station in WY2024 is 2.5 times greater than the maximum discharge measured at the Rock Fence Creek station, but the minimum discharge measured in Cabin Meadow Creek during the base flow period of WY2024 is seven times that of the minimum discharge in Rock Fence Creek (Figure 4-27 and Tables 4-6 and 4-7).

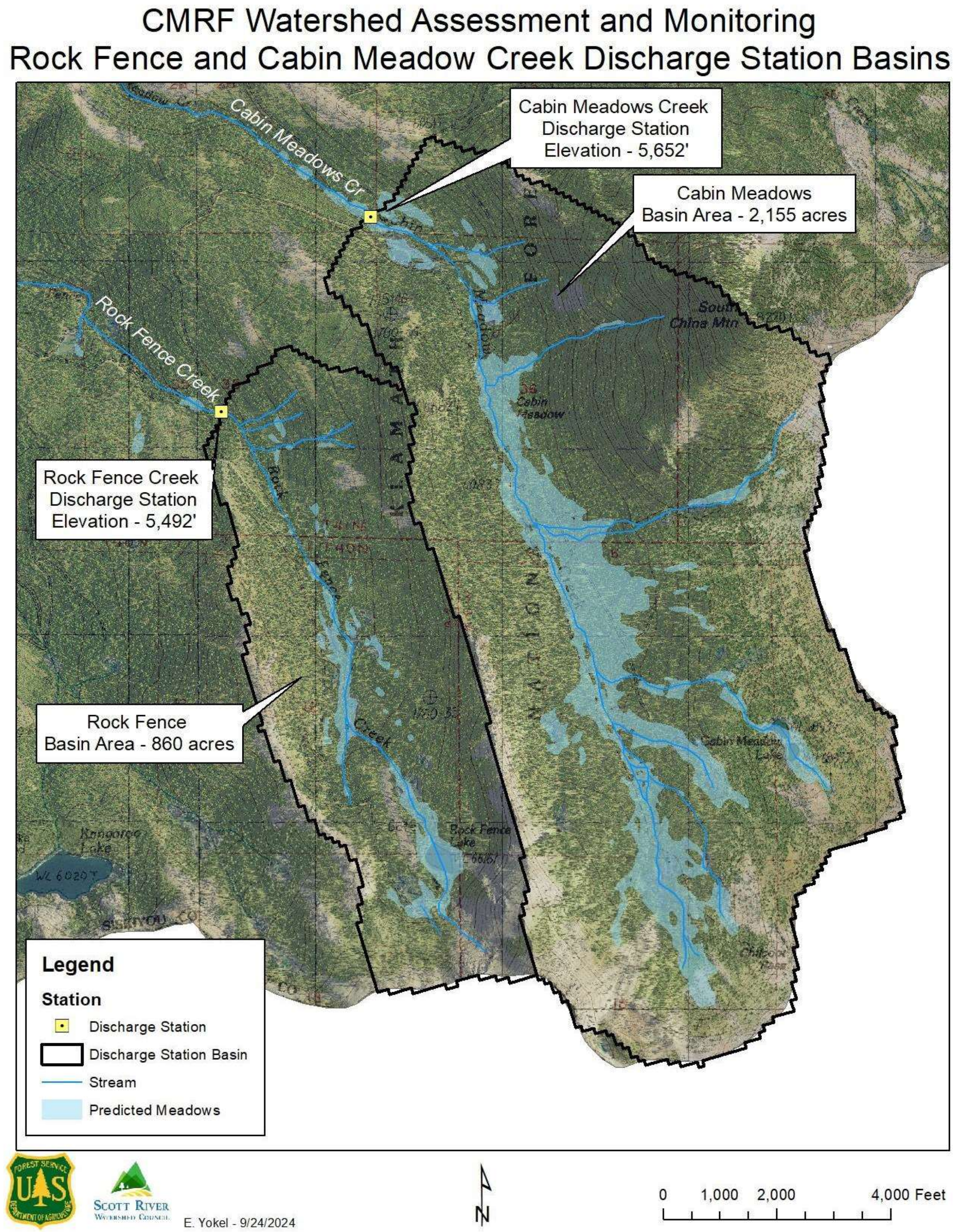


Figure 4-27. Rock Fence and Cabin Meadow Creeks stream discharge station locations and basins.

4.3.2.1 Rock Fence Creek Stream Discharge Monitoring

In 2023, the Rock Fence Discharge Station (stream gage) and periodic discharge measurement transect were established later in the season than is ideal, with the transect in a less than ideal location. It is very difficult to get good discharge measurements at flows less than 1 cubic foot per second (cfs) in a natural open channel; the combination of very low flow in an open channel, the location of the transect and the late deployment of the stream gage led to an inability to develop a reliable rating curve in 2023.

The station was re-established on June 12, 2024, with a better transect location and early enough in the season to capture the tail of spring run-off, and six periodic measurements were performed through August. The periodic discharge measurements ranged from a minimum of 0.1 cfs to a maximum of 5.0 cfs (Table 4-6). Rock Fence Creek was connected in this location throughout the baseflow period.

Table 4-6. Rock Fence Creek 2024 discharge measurements.

Date	Q (cfs)
6/12/2024	5.0
6/21/2024	2.0
7/5/2024	1.1
7/11/2024	0.2
7/24/2024	0.2
8/2/2024	0.1

Rating curves were developed from the periodic discharge measurements and the continuous (15 minute) discharge (in cfs) was calculated (Figure 4-28). Daily average discharge was also calculated (Figure 4-29).

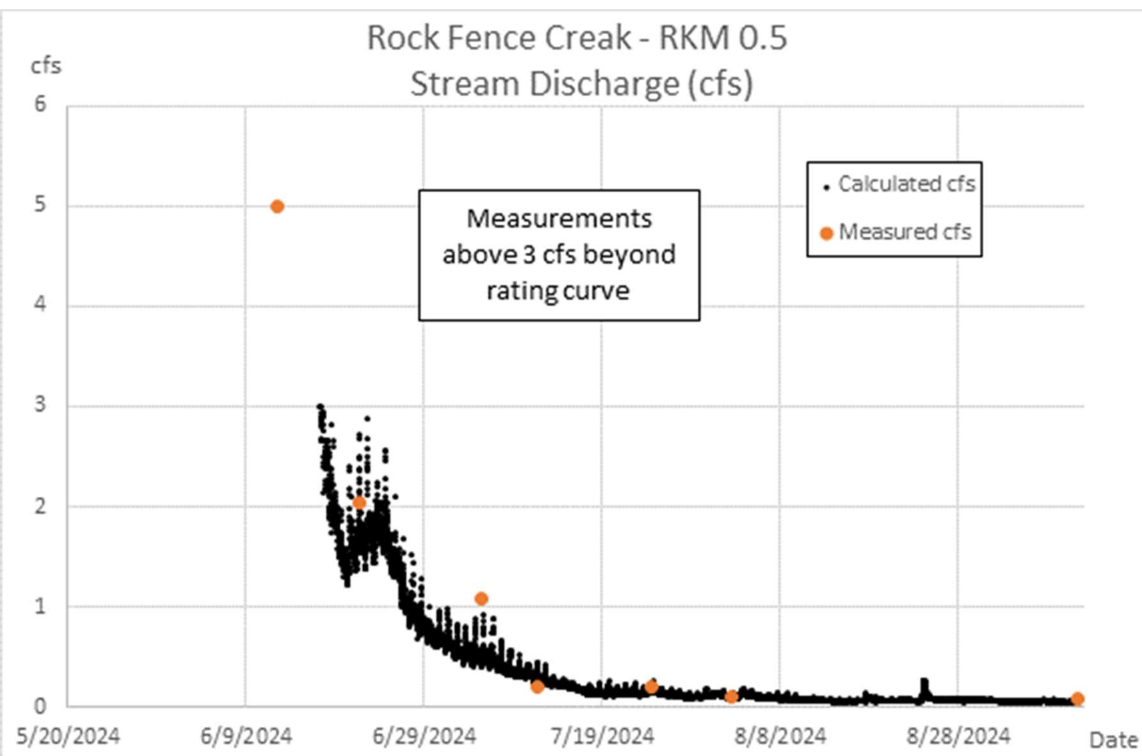


Figure 4-28. Continuous and measured discharge—Rock Fence Creek station.

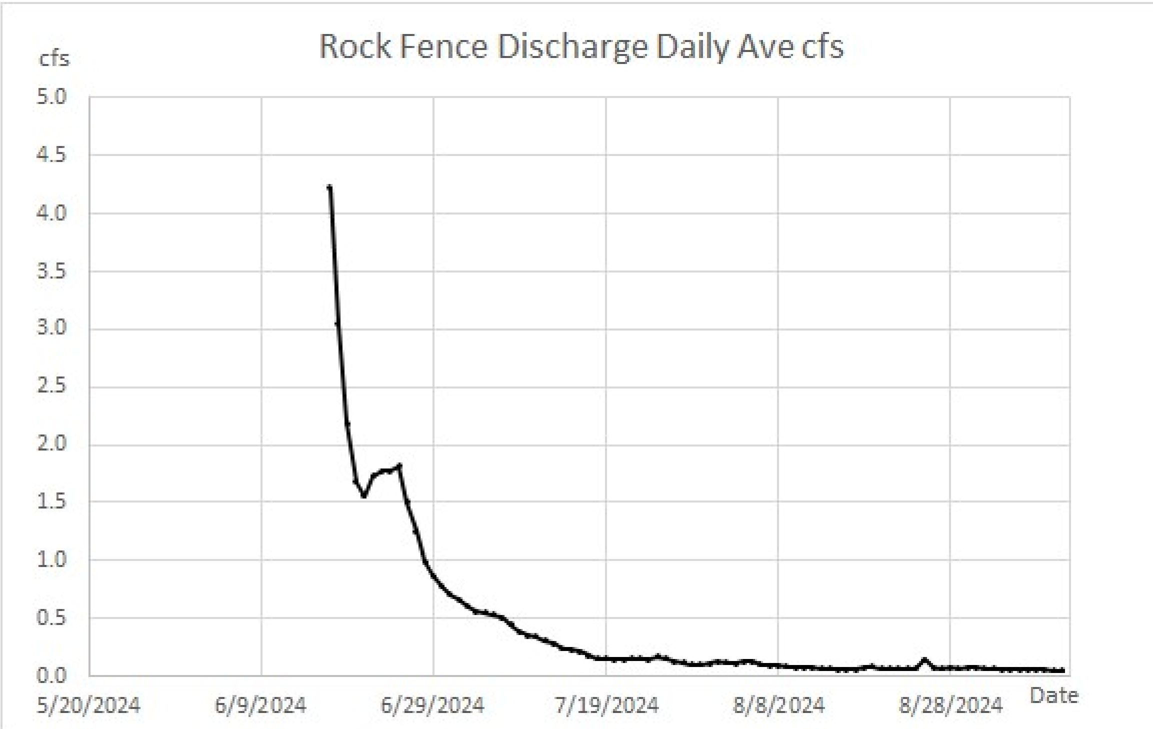


Figure 4-29. Daily average discharge—Rock Fence Creek station.

Summer precipitation events on 7/14/24 and 8/24/24 are visible as a decrease in water temperature (Figures 4-30 and 4-31). These events were identified using data from the closest weather station at Callahan Ranger Station (CHA), which is relatively close (about 10 miles). Summer precipitation events, however, can be very localized, in which case the Callahan station may not capture all precipitation events that affect the project area.

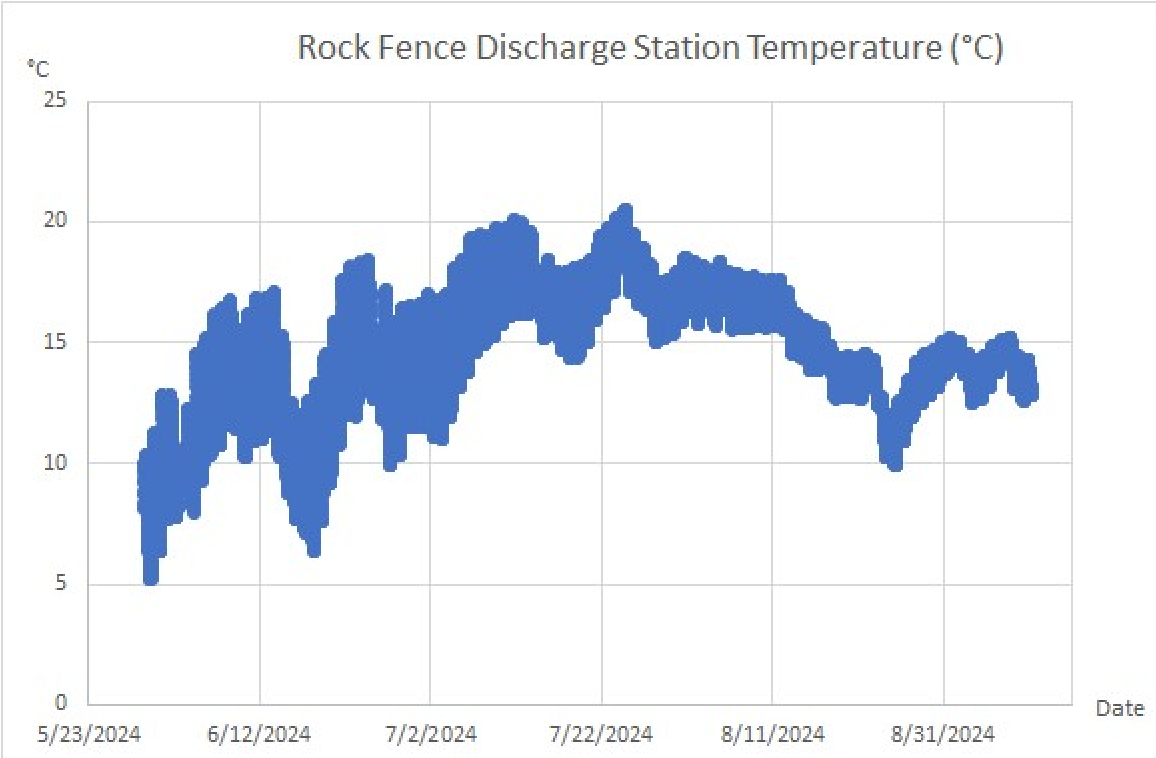


Figure 4-30. Continuous temperature—Rock Fence Creek Discharge Station.

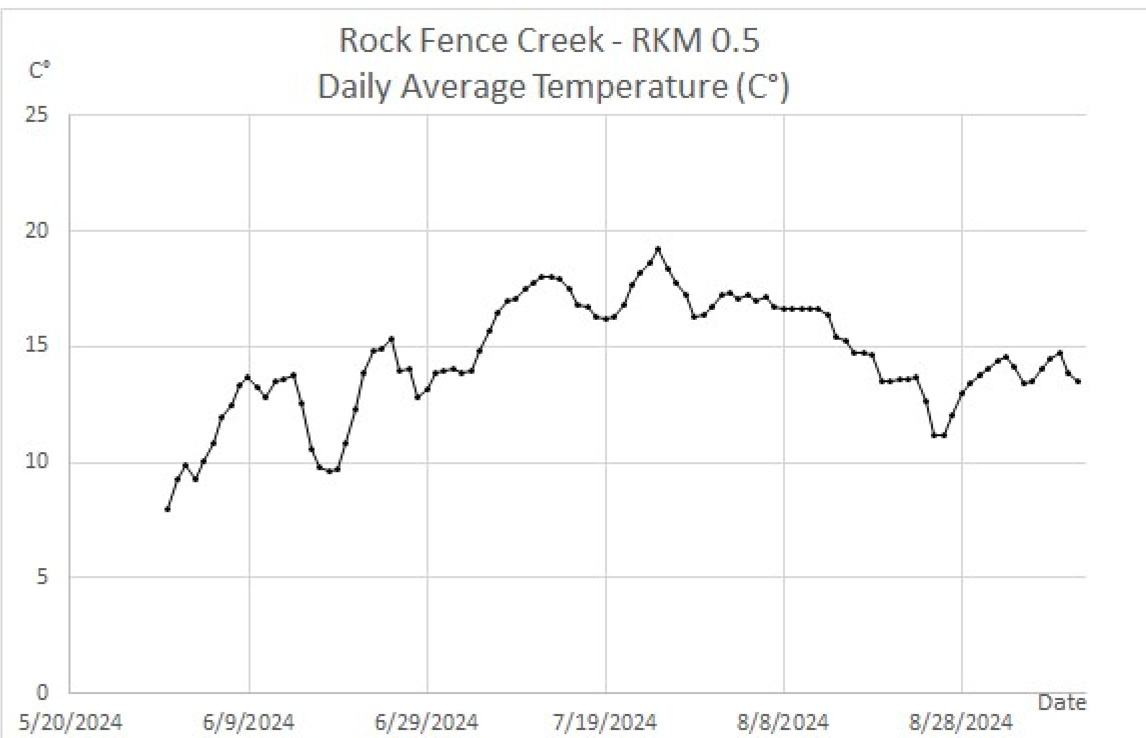


Figure 4-31. Daily average temperature—Rock Fence Creek station.

4.3.2.2 Cabin Meadow Creek Stream Discharge Monitoring

The Cabin Meadow Creek flow station was established on June 12, 2024, and six periodic measurements were performed through August. The periodic discharge measurements ranged from a minimum of 0.7 cfs to a maximum of 12.6 cfs (Table 4-7). There was discharge throughout the baseflow period.

Table 4-7. Measured discharge—Cabin Meadow Creek station.

Date	Q (cfs)
6/12/2024	12.6
6/21/2024	4.1
7/5/2024	2.7
7/11/2024	1.7
7/24/2024	0.7
8/2/2024	0.7

Rating curves were developed from the periodic discharge measurements and the continuous (15 minute) discharge (in cfs) was calculated (Figure 4-32). Daily average discharge was also calculated (Figure 4-33).

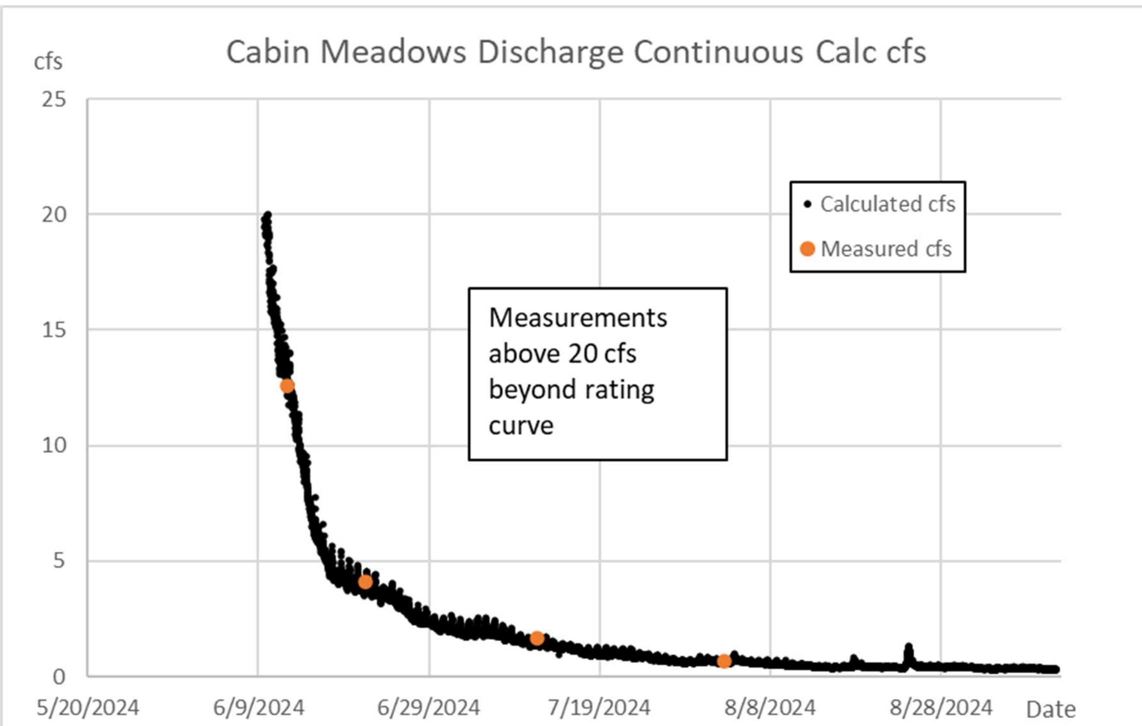


Figure 4-32. Continuous and measured discharge—Cabin Meadow Creek station.

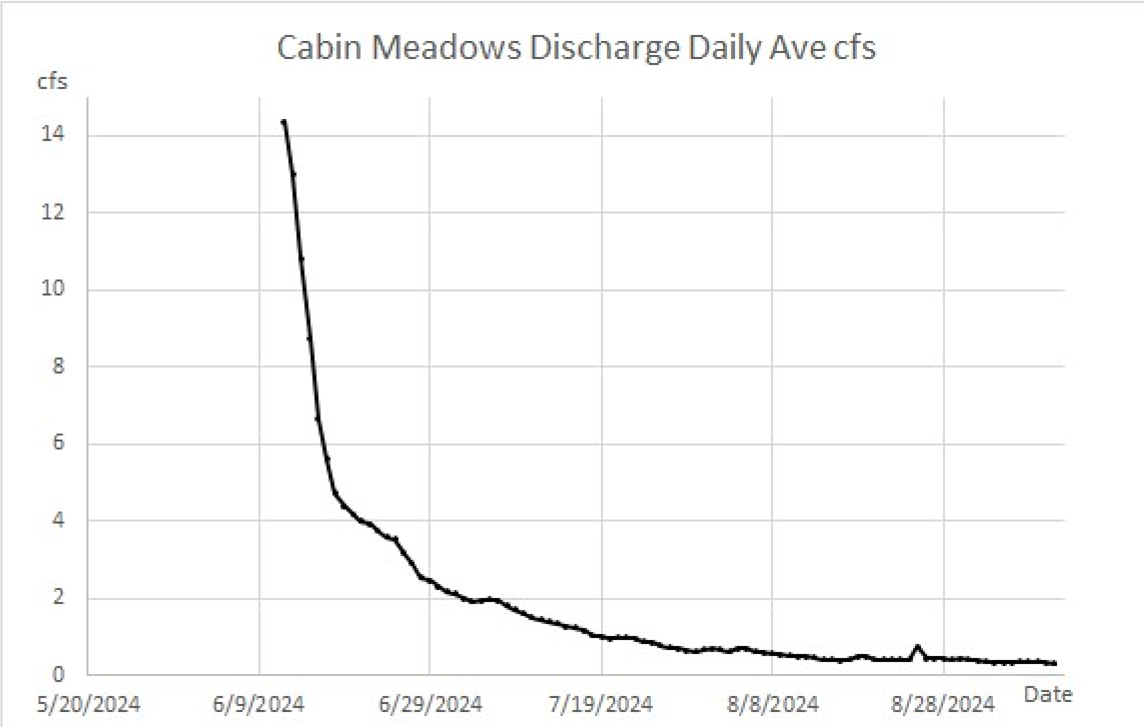


Figure 4-33. Daily average discharge—Cabin Meadow Creek station.

Summer precipitation events on 7/14/24 and 8/24/24 are visible as a decrease in water temperature (Figures 4-34 and 4-35). As noted above, the closest weather station (CHA, in Callahan) likely did not capture all the localized precipitation in the project area.

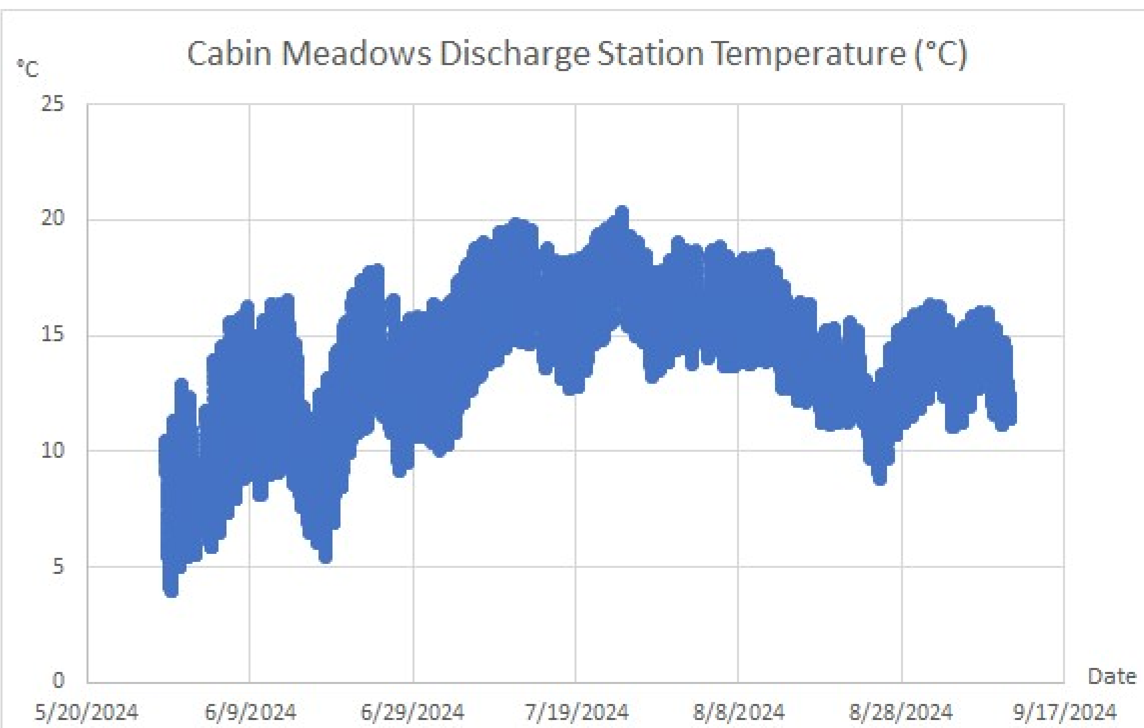


Figure 4-34. Continuous temperature—Cabin Meadow Creek Discharge Station.

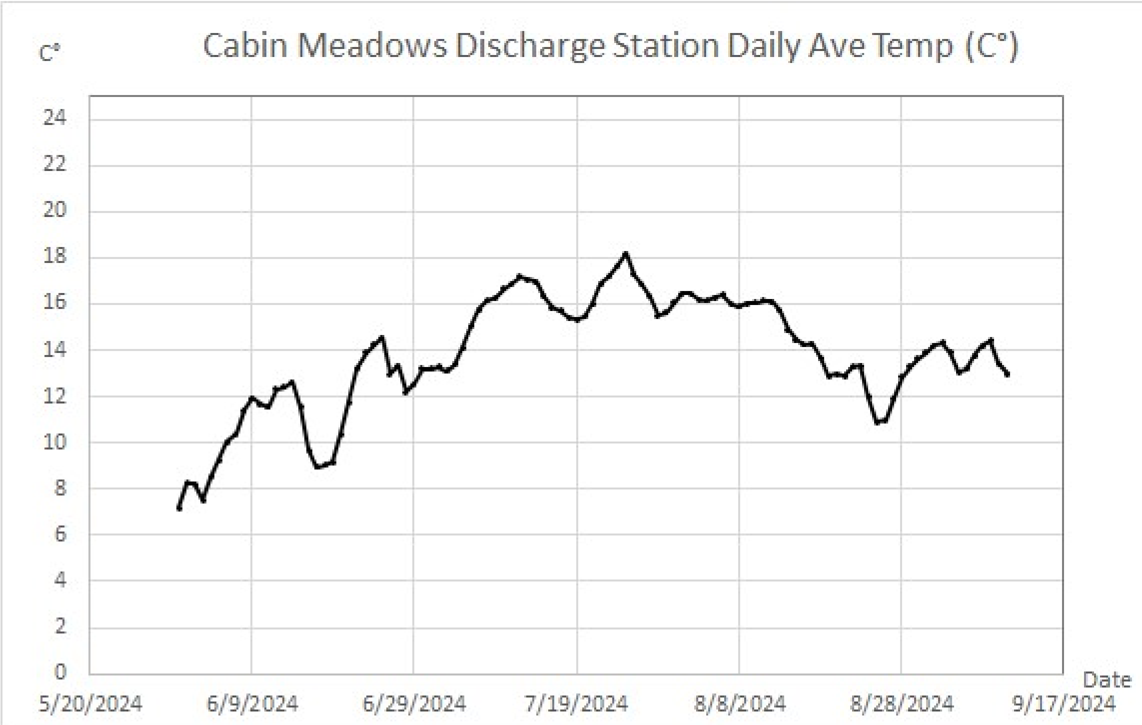


Figure 4-35. Daily average temperature—Cabin Meadow Creek station.

4.4 Water Quality

Water sampling locations were established in September 2023 (Figure 4-36). Initial data collected were general water quality parameters including dissolved oxygen, conductivity, pH, turbidity and microbial contamination (*Escherichia coli* and coliform). In 2024, concentrations of nitrogen and phosphorus were also measured.

Testing occurred three times late in the 2023 season and twice in 2024. In 2025, testing will begin in June and continue throughout the season to capture a wider range of seasonal variations and potential impacts from grazing.

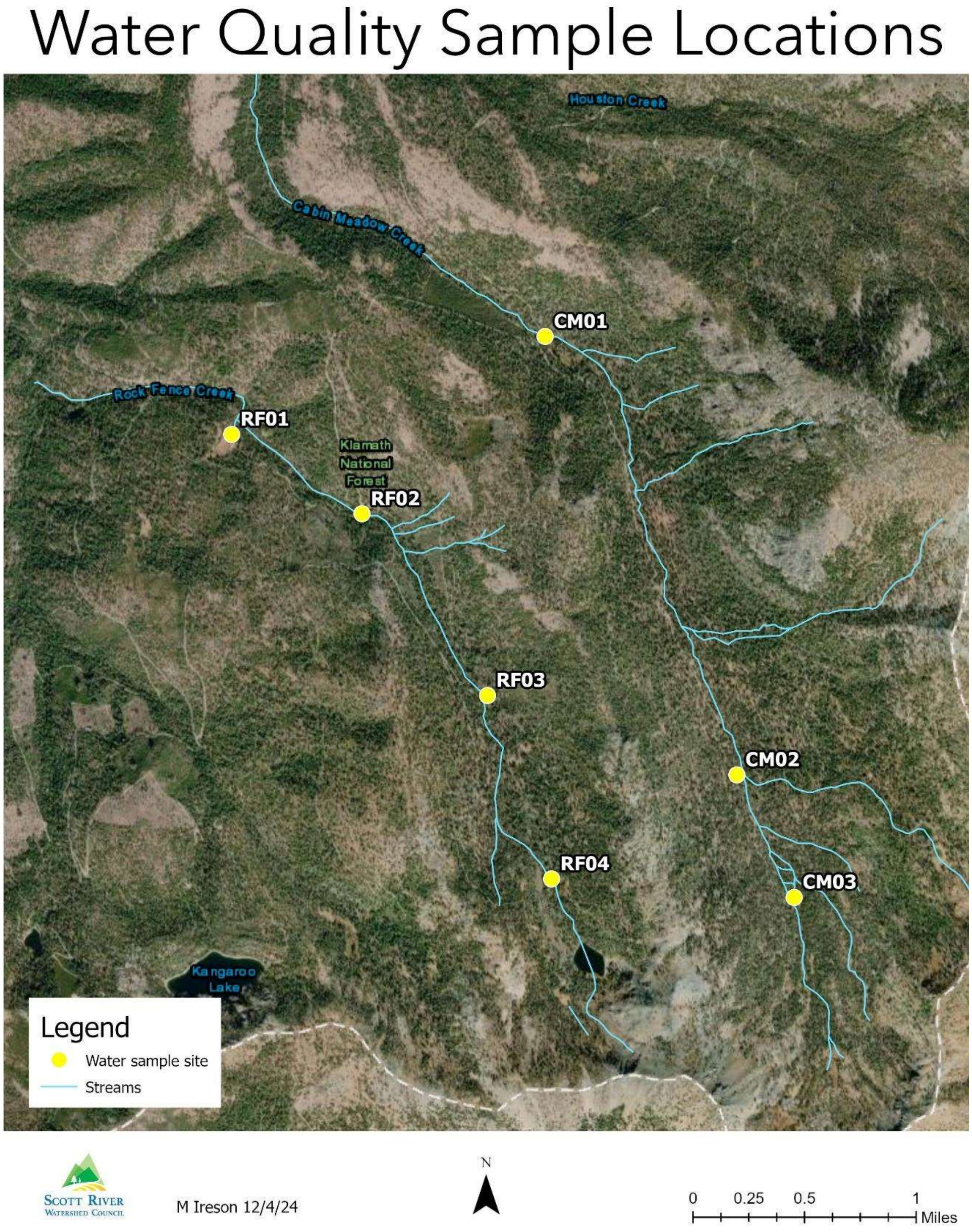


Figure 4-36. Water quality sample locations.

4.4.1 General Water Quality Parameters

This dataset provides a broad perspective on water quality in the Cabin Meadow and Rock Fence Creek Meadow, incorporating dissolved oxygen (DO), conductivity, pH, turbidity, and microbial contamination

(*E. coli* and coliform). These measurements create a picture of the water's chemical, physical, and microbial state (Figure 4-37).

Figure 4-37. General water quality parameters for Cabin Meadow Creek and Rock Fence Creek. (a) Dissolved oxygen; (b) Conductivity; (c) pH; (d) Turbidity; (e) Coliform bacteria; (f) *E. coli*.

Dissolved oxygen levels ranged from 71.1% to 92.5% across all sites, supporting well-oxygenated conditions. RF03 and RF04 showed consistent levels throughout the sampling period, while other sites exhibited minor fluctuations (Figure 4-37, graph a.) that may be tied to temperature changes, water flow, or biological activity. Dissolved oxygen can be influenced by variations in shade cover and riparian vegetation, and therefore may be affected by restoration work.

Specific conductance values ranged from 164 to 332 mS/cm. Conductivity at each site was generally stable in 2023 but showed more variability in 2024. RF01 has generally higher conductivity values than the other sites, potentially indicating higher levels of dissolved salts or minerals which could be influenced by land use practices in the surrounding area (Figure 4-37, graph b).

Potential hydrogen (pH) levels ranged between 7.5 and 9.4. The North Coast Regional Water Quality Control Board's Basin Plan for the Scott River sets and upper pH limit for the Scott River and its tributaries at 8.5 (E. Scott, personal communication, December 13, 2024). Of the eight measurements above 8.5, three of them occurred at CM03, while no other site has more than one measurement above 8.5 (Figure 4-37, graph c). Possible explanations for elevated pH include biological activity (algae), the geology of the site, or the presence of animal waste (2024 email from E. Scott to M Ireson, Marques et al. 2008).

Turbidity values remained low at most sites, ranging from 0.04 to 3.6 NTU/FNU, with almost 90% of the measurements lower than 1 NTU/FNU. Overall, water clarity was high across the sampling period (Figure 4-37, graph d).

Coliform bacteria levels showed significant variability, with some sites recording levels below detection (<1 MPN/100 mL) and others exceeding 2,419.6 MPN/100 mL. RF01 consistently exhibited the highest levels of bacteria. Four other sites (CM02, RF02, RF03, and RF04) had single measurements over 1500 MPN/100mL (Figure 4-37, graph e).

E. coli levels ranged from undetectable (16 of 48 measurements) to 69.7 MPN/100mL (RF03). RF03 consistently had among the highest levels for each sampling date, while CM01 and CM02 also had *E. coli* levels above 20MPN/100mL (Figure 4-37, graph f). The presence of *E. coli* is a strong indicator of fecal contamination and poses a potential risk to human and animal health. Further investigation is needed to pinpoint the sources of contamination.

4.4.2 Nutrient Concentrations

Samples for nutrient testing were collected on two dates in July 2024. The samples were tested for Total Nitrogen (Total-N), Nitrate + Nitrite (NO3+NO2), Total Phosphorus (Total-P) and Soluble Reactive Phosphorus (SRP).

Across all sites, Total-N levels showed a consistent decline between July 18, 2024, and July 25, 2024. For example, CM03 recorded a decrease from 0.188 mg/L to 0.087 mg/L, while RF04 started with the highest level at 0.22 mg/L before falling to 0.058 mg/L. This trend may indicate natural nutrient uptake by plants, dilution due to increased streamflow, or seasonal shifts in water chemistry. Similarly, Total-N concentrations at CM02 and RF01 also declined, suggesting a pattern of reduced nitrogen availability across sites.

NO3+NO2 concentrations were uniformly low, with values ranging from below the detection limit of 0.01 mg/L to 0.061 mg/L, suggesting slight site-specific variability in nitrate and nitrite dynamics.

Total-P levels were low, ranging from below detection limits (<0.002 mg/L) to 0.003 mg/L. SRP ranged from below detection limits to at the detection limit of 0.001 mg/L across all sites and dates, indicating minimal bioavailable phosphorus in the system.

4.5 Roads and Stream Crossings

An assessment of the existing road networks was conducted within the Cabin Meadow Creek and Rock Fence Creek Project areas. The assessment had the following general objectives:

1. Identify road and road drainage infrastructure conditions related to their hydrologic and geomorphic setting, construction and use, hydrology and hydraulic characteristics, and erosion and sedimentation processes;
2. Identify potential impacts that roads and drainage infrastructure may have on nearby slopes, stream channel processes and morphology, floodplain and meadow conditions, and other related ecosystem functions; and
3. Identify and prioritize potential prescriptive treatments to reduce and/or eliminate these negative impacts.

The roads assessment included both desktop and field-based analyses. A description of the methods and results of the roads assessment are included in the existing conditions sections below, while prioritized recommendations for prescriptive treatments will be provided in the subsequent Restoration and Enhancement Plan.

4.5.1 Existing Information Sources and Desktop Analyses

A LiDAR based bare earth DEM of the Cabin Meadow Creek and Rock Fence Creek Project areas provided the basis for most of the desktop terrane analyses. Visible road traces were mapped within the Project areas using satellite imagery and LiDAR. The LiDAR DEM was also used to create flow accumulation and slope rasters of the basins in ArcGIS, which provided context related to surface hydrology and hillslope morphology. The flow accumulation raster, used in tandem with road network mapping, aerial photography, and slope maps allowed for the identification of road features and drainage issues (e.g. stream channel diversion) and helped guide field assessment priorities.

4.5.2 Field Assessment Methods

Field assessments of road networks within the Cabin Meadow Creek and Rock Fence Creek Project areas were conducted by vehicle and on foot during June and July of 2024. Assessment of roads within these Project areas were prioritized due to the importance of potential road-related hydrologic and erosion impacts on meadows and other forest, botanical, and aquatic resources of interest in these areas. The USFS road mapping layer, as well as the flow accumulation, hillshade, and slope rasters were used to navigate the road and stream channel networks.

Discrete road segments were delineated during surveys based on access, geomorphic and hydrologic setting, type of construction, and similarity in prevalent issues. A description and suite of potential treatment recommendations was compiled for each road segment in a standardized data collection form using the ArcGIS Survey 123 mobile application. Specific road features of interest were mapped using differential GPS. In addition to classifying road segments and describing standardized attributes along each segment, the assessment also focused on identifying alterations to the hydrology and sediment dynamics (erosion and sedimentation) in stream channels and meadows directly affected by road-related runoff and crossings.

In addition to the information included in this summary report, data collected in the field are available as a geodatabase of attributed point and line features. Georeferenced photographs of road segments, features, and other notable field assessment points are also available as a KMZ filetype.

4.5.2.1 Road Segment Attributes

Protocols for assessing road segments and descriptive attributes used in the Survey123 design reflect current best practices (e.g. Black et al. 2012, Nevares et al. 2009, Weaver et al. 2015) and were adapted to address the unique environmental setting, infrastructure, and specific objectives of this study. Baseline conditions data collection included information about (1) road prism and road surface conditions, (2) drainage and hydrologic connectivity, (3) stream crossing condition, (4) road-related erosion and depositional features (e.g., ruts, rills, gullies, channel incision, headcuts, fans), and (5) hydrologic alterations. An outline of the survey structure with all attribute fields is provided in Appendix I. Field surveys included inventory of the road network, adjacent hillslopes, and affected nearby portions of the drainage network.

4.5.2.2 Road Segment Delineation

Each road segment was surveyed on foot. A Survey123 form was initiated to categorize the road segment. Road segment endpoints were defined by changes in attributes such as geomorphic setting (e.g., landform, gradient, stratigraphy), road construction and/or surface type, road condition, and/or drainage patterns. Notable features throughout each segment were recorded using a Trimble Geo7x differential GPS unit and the ArcGIS Field Maps application. Notable features included stream crossings, springs and other hydrologic features; culverts, waterbars, rolling dips, and other road infrastructure; road prism characteristics; and erosion and sedimentation. Feature points, lines, and polygons were assigned unique identifiers according to the basin name (e.g., Rock Fence Creek = RF, Cabin Meadow Creek = CM) and the order in which they were collected (e.g., RF-1, RF-2, CM-1, CM-2) and referenced in the Survey123 form to delineate the start and end points of the road segment.

The Survey123 form was completed at the end of each road segment. Road segments with associated Survey123 forms were named for reference in subsequent analysis according to the basin name (e.g., Rock Fence Creek = RF, Cabin Meadow Creek = CM) and the order in which they were collected (e.g., RF-1, RF-2, CM-1, CM-2). Other road segments where drainage issues and other impacts were insignificant or unlikely to require treatment were not described using a Survey123 form. The features within these low impact road segments were recorded using GPS points with comments for reference in subsequent analyses.

4.5.3 Results

A total length of approximately 23 miles of road was surveyed across both basins during the field assessment. Most of the road network is inaccessible during the winter months due to snowpack. Roads were classified as either “seasonal by snowpack” or “not trafficable.” Each basin has a primary access road that follows the long axis of the basin on the west (river left) side of the mainstem channel. These primary roads generally remain within the valley bottom and toe slopes. The primary road in the Rock Fence Creek basin climbs to the mid-slope position near Rock Fence Lake. These roads appear to be maintained at least every several years, are generally 12- to 15-feet wide, and are gravel surfaced (Figure 4-38). In the Cabin Meadow Creek basin, this primary road was divided into segments CM-15 through CM-18. In the Rock Fence Creek basin, the primary road was divided into segments RF-1, RF-2, and RF-8. Outside of these primary roads, secondary “seasonal” type roads do not appear to be regularly maintained and have a range of widths and surface types (Figure **4**-39). Roads classified as “not trafficable” range from having a defined prism but with very coarse substrates or waterbars that limit some vehicle access to legacy skid roads that lack a well-defined road prism and are barely visible on the landscape due to erosion, deposition, and/or natural revegetation (Figure 4-40).

Figure 4-38. Looking south along the primary seasonal access road in the Cabin Meadow Creek basin (segment CM-15).

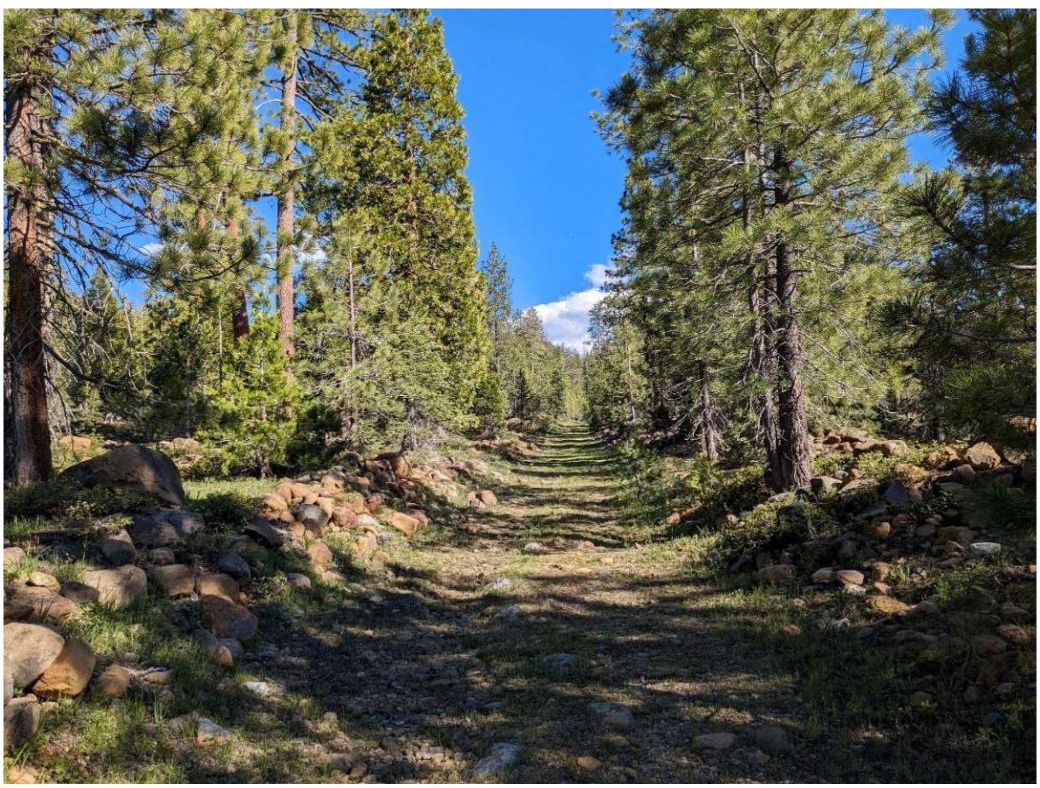


Figure 4-39. A secondary seasonal access road in the Cabin Meadow Creek basin (segment CM-4).

Figure 4-40. A not trafficable, legacy spur road in the Rock Fence Creek basin that intersects segment RF-4.

The most common issues observed throughout the road network in both basins include (1) the presence of sidecast outboard berms that confine drainage and force accumulation of runoff within the road surface and (2) a lack of design features (e.g., culverts, waterbars, and rolling dips) to sufficiently convey water sources across the road prism or remove drainage from the road surface. Several road segments also have incised inboard ditches with inadequate drainage relief. These persistent drainage issues commonly have the effect of intercepting flow from low order channels entering the road, diverting small watercourses, and concentrating overland flow. These concentrated flows are commonly then discharged to open slopes or to other parts of the existing stream channel network, resulting in rilling, gullying, channel incision, bank erosion and other forms of channel alteration.

In general, the prevalence of large resistant particles (i.e., boulder, cobble, and gravel) at the ground surface and in the shallow soil layers mitigates the potential for severe erosion resulting from road-related runoff and drainage issues. With some notable exceptions described below in sections 4.5.3.1 and 4.5.3.2, most of the concentrated runoff from roads is dissipated by hillslope surface roughness without delivering sediment or driving notable channel incision. However, the widespread hydrologic alterations caused by the road network may impact meadow and stream hydrology in less visible ways.

4.5.3.1 Cabin Meadow Creek Project Area

Approximately 12 miles of road were surveyed within the Cabin Meadow Creek Project area, 5.5 miles of which were delineated as distinct road segments (Figure 4-41 through 4-43). Additionally, 25 stream crossings were identified (Table 4-8). Important features and attributes of the distinct road segments are summarized in Table 4-9. A comprehensive summary of road feature characteristics and affected drainage attributes are available as a geodatabase in ArcMap, and a library of georeferenced photographs of road segments and channel features throughout the field survey area is available as a KMZ file. A selection of road segments and features with the more severe potential impacts are described below.

Table 4-8. Cabin Meadow Creek stream crossing summary.

Stream crossing label	Road type	Crossing type	Erosion severity	Field notes
STX 1	Seasonal	Ford	Low	Somewhat newly constructed armored ford crossing. Overall looks good, however channel cross section at upstream edge of ford is reduced, and there is a side cast berm along the right bank.
STX 2	Not trafficable	Ford	Medium	Road captures a small Class III drainage, which flows around the corner, where flow is then split into two channels by road drainage features. Current flow path appears stable due to coarse cobble and boulder substrates.
STX 3	Not trafficable	Ford	Low	Upslope drainage captured and delivered down road surface within outboard side cast berm to cross channel drain/berm
STX 4	Not trafficable	Ford	Medium	Road captures anastomosing channel, concentrates it, then discharges to outboard edge at berm into incised channel.
STX 5	Seasonal	Culvert	Low	18-inch CMP ditch relief culvert. ~35-foot long, 7–8% grade, 50–60% rust line, at grade with stream. Significant diversion potential, needs critical dip. Structure drains long inboard ditches from both roads. Likely jurisdictional since the CM-8 inboard ditch intercepts a small watercourse
STX 6	Seasonal	Culvert	Low	18-inch CMP ditch relief culvert, 70% rust line (undersized), flowing 5-foot bankfull watercourse entering inboard ditch 15 feet upstream, and so likely jurisdictional. At grade, inlet and outlet look good. Discharges to open slope with only minor channelization. No erosion problems.
STX 7	Seasonal	Ford	Low	Subtle natural drainages captured here and routed down road, causing moderate to severe surface erosion and rilling. Captured road drainage delivered to larger road below (CM-9) where passed by a small, rocked ford in good condition. Downslope conditions generally stable without channelization or gullying.
STX 8	Not trafficable	Ford	None	Ford stable channel at grade due to coarse substrate. No evidence of past or ongoing channel adjustment. No erosion or drainage issues.
STX 9	Seasonal	Ford	Medium	Watercourse captured, diverted down road to next dip
STX 10	Seasonal	Ford	Low	Crossing is several feet below meadow surface. 6 inches to 1 foot of incision for 50 feet above crossing, arrested at boulder and root, stable. Flow across road channelizes through side cast fill. Not channelized or incised below. Ford surface looks good.
STX 11	Seasonal	Ford	Medium	Old crossing of Cabin Meadow Creek. Fill prism projects maybe 10 feet out into channel from right bank but appears stable. Fill occludes right bank side channel. Significant left bank erosion into river of terrace deposits of well-rounded gravel and sand.

Stream crossing label	Road type	Crossing type	Erosion severity	Field notes
STX 12	Seasonal	Ford	Medium	Drainage with flow captured at inboard edge/berm and ponded then moves subsurface onto road. Water sourced from spring 100 feet upstream of road. Little flow in channel downstream of road.
STX 13	Seasonal	Ford	Low	Small armored ford stream crossing
STX 14	Seasonal	Culvert	Low	5-foot wide, 3-foot tall, corrugated metal arch culvert. Rust line 1.5 feet from bottom. Well-armored at headwall and outlet. Appears to overtop in high flow events, but very well armored, so minimal signs of erosion
STX 15	Seasonal	Ditch relief culvert/ culvert	Medium	Cross drainage in 8-inch CMP relieves short section of inboard ditch originating at spring. Install dip at spring source and route across road to meadow
STX 16	Seasonal	Culvert	None	18-inch CMP 40% filled with sediment, conveys spring drainage. Outlets into ditch with berms. No erosion issues. Outfall is at grade so could remove berms and allow water to better disperse across natural grade.
STX 17	Seasonal	Ditch relief culvert/ culvert	Medium	Inboard ditch captures spring and diverts across road in 18-inch, CMP, inlet clear, outlet 20% filled with gravel, actively flowing several gallons a minute. Some incision downslope and creates small gravel channel that flows parallel to road.
STX 18	Seasonal	Ford	Low	Ford of small Class III water course. no major issues. Could use minor amounts of surface rock armor
STX 19	Seasonal	Culvert	Low	18-inch CMP, likely somewhat undersized and 10–20% infilled with gravel conveys Class II/Class III watercourse. Channel confined by ~90-foot long berms on downslope side, but no real issues related to erosion or incision. Flow fans out into meadow without impact
STX 20	Seasonal	Ford	Low	Ford of small Class III water course. No major issues. Could use minor amounts of surface rock armor
STX 21	Seasonal	Ford	Low	Ford of small Class III water course. No major issues. Could use minor amounts of surface rock armor
STX 22	Not trafficable	Ford	Moderate	Sizeable multi thread channel network (flowing during visit) is mostly diverted 100 feet down road. Road surface is well armored with boulders, and the diversion pathway appears stable all the way to cabin meadow creek confluence.
STX 23	Not trafficable	Ford	Low	Minor rock armoring/roughness needed at upstream end of Class III crossing. Dry during visit.
STX 24	Not trafficable	Ford	Low	Small rocked ford needed at Class III stream crossing. Flow currently diverted a little ways down road. Dry during visit.
STX 25	Not trafficable	Ford	Medium	Small Class III channel diverted onto road surface at upslope end of road segment, creating moderate channelization and rilling erosion generally around 6-inches deep or less. Fix diversion or roughen new flow path.

Table 4-9. Cabin Meadow Creek road segment summary.

Road segment name	Road location	Segment length (Feet)	Road type	Road maintained	Surface Type	Road surface condition	Road profile	Road drainage	Erosion severity	Cause comments
CM-1	Predicted / existing meadow	344	Seasonal	Yes	Crushed rock/ gravel	Stable and well drained	Flat	Springs or seeps present in cutbank or road surface, Water effectively directed off road surface, Diffuse or no drainage/flat	Low	Channel too narrow and constricted at upstream edge of Ford. Road surface runoff directed onto eastern approach of ford. Boulder side cast on downstream edge of ford partially blocks flow into side channel.
CM-2	Valley bottom upland	2,182	Seasonal	No	Earthen	Rutted	Outsloped	Outboard drainage	Low	Most relief points ineffective, water exiting as outboard sheet flow at bottom of hill
CM-3	Valley bottom upland	530	Seasonal	No	Earthen: exposed soil	Standing water, Rilled, rutted	Flat	Springs or seeps present in cutbank or road surface, Persistent saturation of road surface, Diffuse or no drainage/flat	Medium	Subsurface movement of water from adjacent channel onto road. Is a ditch at this point. Road itself is a through-cut (modest).
CM-4	Toeslope	577	Seasonal	No	Earthen: exposed soil	Standing water, Rilled, Gulllied, Rutted	Flat	Persistent saturation of road surface, Outboard drainage, Springs or seeps present in cutbank or road surface, Water effectively directed off road surface	Medium	

Road segment name	Road location	Segment length (Feet)	Road type	Road maintained	Surface Type	Road surface condition	Road profile	Road drainage	Erosion severity	Cause comments
CM-5	Midslope	1,408	Not trafficable	No	Earthen	Rilled, Rutted	Flat	Outboard drainage	High	Capturing upslope tributaries
CM-6	Toeslope	2,093	Seasonal	No	Earthen	Rilled	Flat	Outboard drainage	Low	Outboard berm receiving flow from upslope hill
CM-7	Toeslope	1,110	Not trafficable		Earthen: exposed soil	Stable and well drained	Flat	Inboard drainage	Low	Inboard ditch.
CM-8	Midslope	1,372	Not trafficable	No	Earthen: exposed soil	Rilled, Rutted	Flat	Inboard drainage, Outboard drainage	Medium	Steep, infrequent relief, inboard ditch, outboard berm
CM-9	Midslope	1,380	Not trafficable	No	Earthen: exposed soil	Rutted, Rilled	Flat	Springs or seeps present in cutbank or road surface, Persistent saturation of road surface, Outboard drainage	Low	Not a lot of concentrated runoff
CM-10	Valley bottom upland	533	Not trafficable	No	Earthen: exposed soil, Vegetated: herbaceous	Rilled	Flat	Outboard drainage	Low	Overland flow off gradual toeslope, over road and onto outboard side clearing. Little effect on channel through surface.
CM-11	Toeslope	270	Not trafficable	No	Earthen: exposed soil, Vegetated: herbaceous, shrub	Stable and well drained	Outsloped	Outboard drainage, Water effectively directed off road surface	Low	

Road segment name	Road location	Segment length (Feet)	Road type	Road maintained	Surface Type	Road surface condition	Road profile	Road drainage	Erosion severity	Cause comments
CM-12	Toeslope	1,997	Decom-missioned	No	Earthen: exposed soil, Vegetated: shrub, tree	Stable and well drained	Outsloped	Outboard drainage, Water effectively directed off road surface	Low	
CM-13	Ridge	1,194	Seasonal	Yes	Earthen: exposed soil, Vegetated: herbaceous	Stable and well drained	Outsloped	Outboard drainage, Water effectively directed off road surface	Low	
CM-14	Midslope	987	Not trafficable	No	Earthen: exposed soil, Vegetated: shrub	Rilled	Insloped	Outboard drainage	Low	
CM-15	Toeslope	3,161	Seasonal	Yes	Crushed rock/ gravel	Rilled, Dry rock powder, fine sediment, Rutted	Outsloped	Springs or seeps present in cutbank or road surface, Outboard drainage	Medium	Dips too infrequent and shallow to effectively direct water over outboard edge.
CM-16	Valley bottom upland	2,504	Seasonal	Yes	Crushed rock/ gravel	Stable and well drained	Flat	Springs or seeps present in cutbank or road surface, Inboard drainage, Diffuse or no drainage/ flat	Low	
CM-17	Valley bottom upland	3,189	Seasonal	Yes	Earthen: exposed soil	Rilled, Rutted	Flat	Outboard drainage	Medium	

Road segment name	Road location	Segment length (Feet)	Road type	Road maintained	Surface Type	Road surface condition	Road profile	Road drainage	Erosion severity	Cause comments
CM-18	Midslope	1,613	Seasonal	No	Earthen: exposed soil, Vegetated: herbaceous, shrub	Rilled, Gulllied	Outsloped	Outboard drainage	High	

Road Detail Mapping

The following mapping shows point and line data collected during the road network survey in the Cabin Meadow Creek Project area, which includes delineation of road segments and a cataloguing of all stream crossings, current and proposed road drainage features, and other field assessment points.

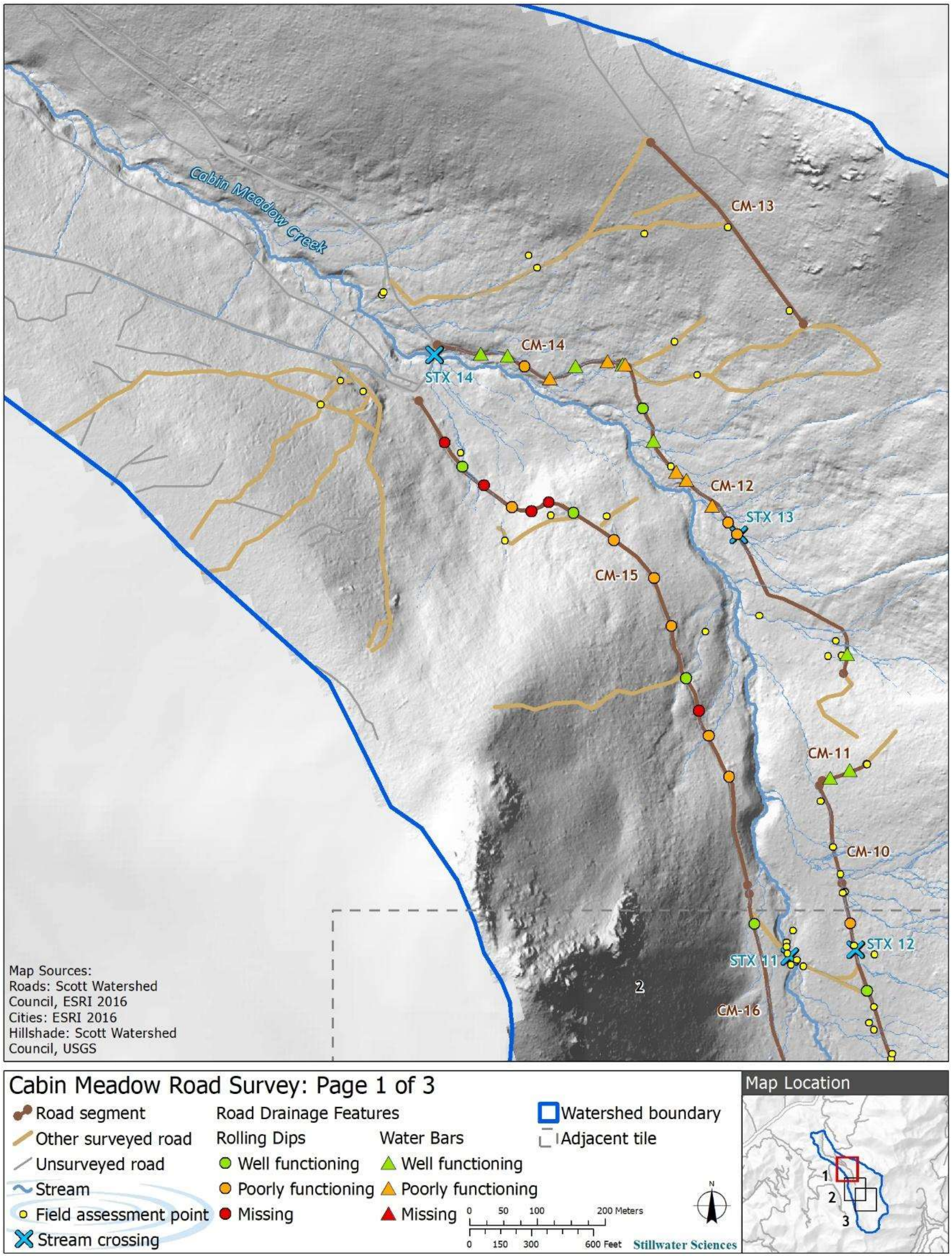


Figure 4-41. Road segments, road drainage features, stream crossings, and other field assessment points recorded during the field survey in the Cabin Meadow Creek basin. Page 1.

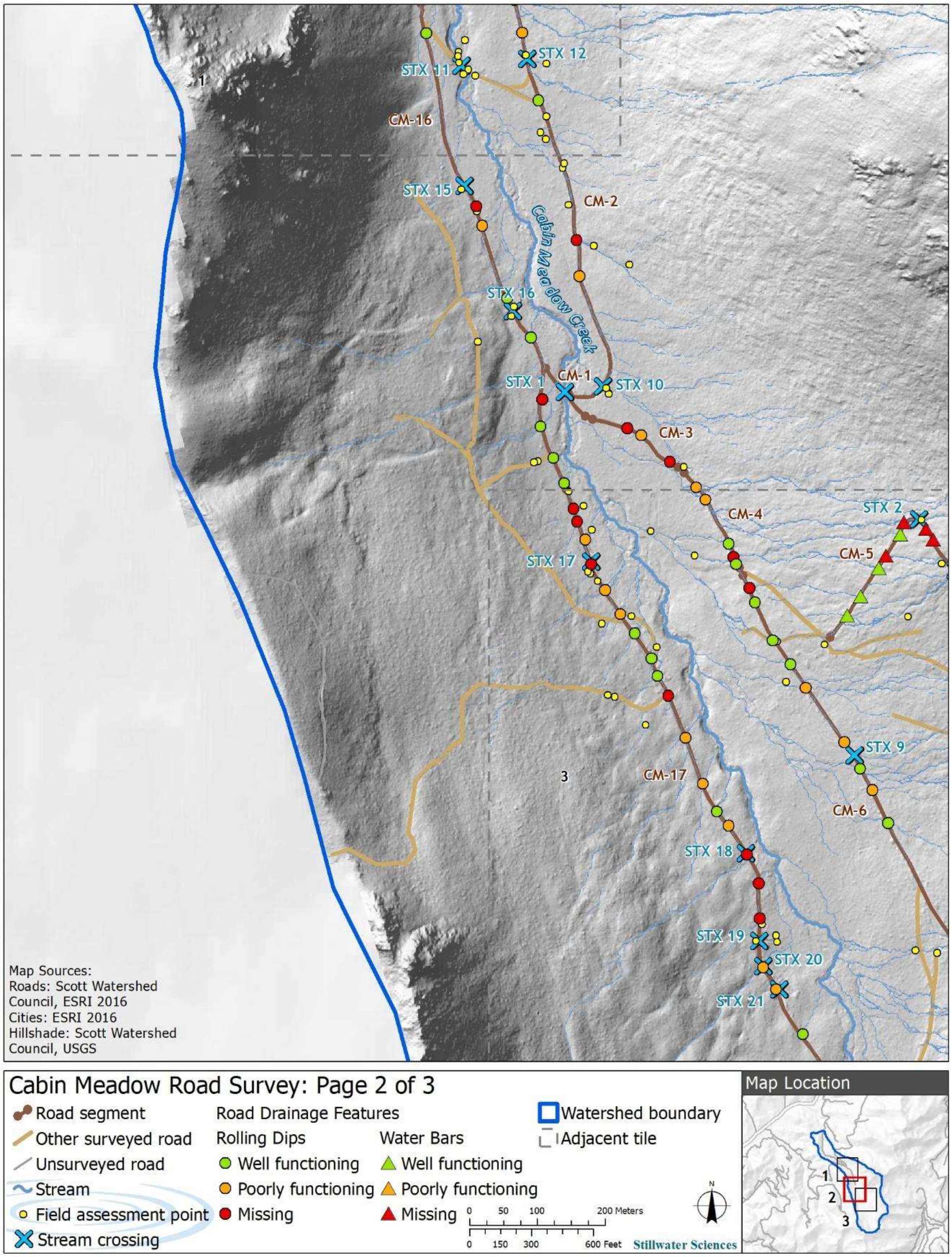


Figure 4-42. Road segments, road drainage features, stream crossings, and other field assessment points recorded during the field survey in the Cabin Meadow basin. Page 2.

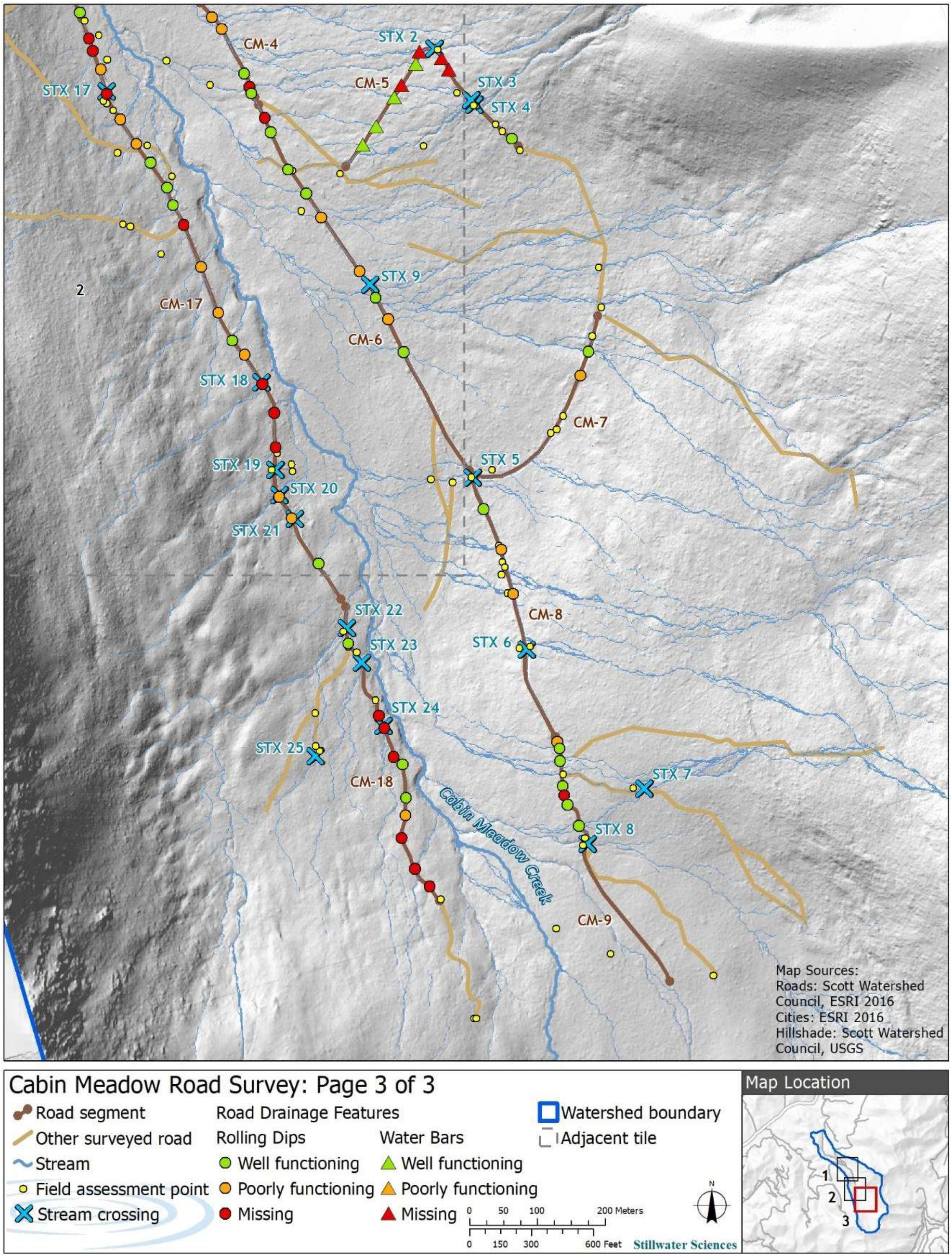


Figure 4-43. Road segments, road drainage features, stream crossings, and other field assessment points recorded during the field survey in the Cabin Meadow basin. Page 3.

Focus Areas

The following section discusses selected road segments and associated features within the surveyed portions of the Cabin Meadow Creek road network where the more severe impacts occur and/or are characteristic of recurring problems.

Road segment CM-5 is a steep and not trafficable legacy road segment of 9-12% grade that climbs the eastern valley wall of the Cabin Meadow Creek basin. The road surface shows evidence of significant concentrated flow and associated erosion driven by insufficient waterbar spacing, the presence of an outboard berm, and the diversion of small watercourses at stream crossing (STX)-2 and STX-3. The abundant coarse rock fragments in the native soils have partially stabilized the surface from further erosion, but like other road segments without continuous outboard drainage, CM-5 unnecessarily concentrates and diverts flow (Figure 4-44).

Figure 4-44. Looking downslope from STX-2, where a small watercourse has been diverted down the CM-5 road segment, resulting in surface erosion.

Road segment CM-7 is a seasonal road that appears to receive very little traffic and has a long (~480-foot) section of inboard ditch which intercepts all diffuse flow from the hillslope, routing it to a culvert crossing at STX 5 (Figure 4-45). This culvert crossing also passes flow from the inboard ditch draining road segment CM-8 and while functioning, it is undersized and has no critical dip, posing a significant risk of diversion and erosion potential in the event of failure.

Road segment CM-8 has periodic but poorly functioning ditch relief culverts, and additionally intercepts a small watercourse at STX-6. The road surface is also rilled from concentrated flow. Both CM-7 and CM-8 collectively concentrate diffuse and channelized hillslope drainage from approximately 120 acres of the basin, and the inboard ditches of both segments had substantial flow during the field assessment.


Figure 4-45. Looking upslope at road segment CM-8, with active flow visible in the inboard ditch to the left, as well as on the road surface to the right.

STX-11 is a legacy stream crossing of Cabin Meadow Creek where remnant portions of the road fill prism impinge on the channel (Figure 4-46). The remnant road fill prism projects approximately 10 feet into the stream channel along the right bank, partially obstructing flow within a multi-threaded right bank side channel. Flow deflected from the right bank impinges on and is actively eroding remnant road fill and natural terrace deposits on the left bank.

Figure 4-46. Looking downstream at STX-11. Legacy road fill protrudes into the channel along the right bank where the people are standing.

Road segment CM-17 is a segment of the primary access road into the basin and follows the western edge of the Cabin Meadow Creek valley bottom. This segment, like others, contains many sections of sidecast outboard berm that inhibit drainage and concentrate flow on the road surface (Figure 4-47). Surface erosion is limited by the lower gradient (5-8%) and prevalence of coarse particles armoring the surface. However, the hydrologic impact of poor drainage and flow concentration is perhaps most significant in this setting due to the large upslope watershed area and the presence of several large meadow features located immediately downstream of the road. Additionally, two stream crossings along this segment, STX-17 and STX-19, have confining berms at their outlets which channelize flow and inhibit it from spreading out across the meadow surface.

Figure 4-47. Looking south and upslope along road segment CM-17. An outboard berm is visible to the left which concentrates runoff on the road surface.

4.5.3.2 Rock Fence Creek Project Area

Approximately 11 miles of road were surveyed within the Rock Fence Creek Project area, 3.4 miles of which were delineated as distinct road segments (Figures 4-48 and 4-49). Additionally, 7 stream crossings were identified (Table 4-10). Important features and attributes of the distinct road segments are summarized in (Table 4-11). A comprehensive summary of road feature characteristics and drainage attributes are available as a geodatabase in ArcMap, and a library of georeferenced photographs of road segments and channel features throughout the field survey area is available as a KMZ file. A selection of road segments and features with the more severe potential impacts are described below.

Table 4-10. Rock Fence Creek stream crossing summary.

Stream crossing label	Road type	Crossing type	Erosion severity	Field notes
STX 1	Not trafficable	Ford	Low	Fine sediment on laid-back fill prism slopes but seems to be plenty of course material in the matrix as well, which provides decent bank armoring within the thankful channel width. boulders at crossing outlet provide good grade control
STX 2	Not trafficable	Ford	Low	RF8 ford crossing. Appears good enough. Very minor erosion along left bank outlet. Boulders at outlet provide grade control. Channel below looks pretty good with no obvious incision. A portion of the diffuse flow above is not captured in ford, flows west in inboard ditch
STX 3	Seasonal	Ford crossing	Low	Relatively new looking ford, appears to be functioning well.
STX 4	Seasonal	Ford	Low	Armored fill crossing. Overall looks good, though it may need some more armoring at outlet. Flow dissipates into small meadow feature.
STX 5	Seasonal	Culvert	None	18-inch CMP, 30 feet long, 30% rust line, good inlet head wall armoring, 10-foot downspout bolted onto outlet with 2-foot drop at end onto boulders. Appears good with no real erosion. Pipe likely undersized relative to drainage but seems to be functioning well.
STX 6	Not trafficable	Ford	Low	Minor erosion of fill prism at small Class III ford crossing. Appears to be stable.
STX 7	Seasonal	Culvert	High	6-foot diameter CMP conveys Rock Fence Creek under a primary access road. culvert in good shape, ~25% rust line, but outlet is perched ~1–2 feet. Channel bed stable, but severe erosion of downstream road prism threatens integrity of road

Table 4-11. Rock Fence Creek road segment summary

Road segment name	Road location	Segment length (Feet)	Road type	Road maintained	Surface Type	Road surface condition	Road profile	Road drainage	Erosion severity	Cause comments
RF-1	Midslope	3,399	Seasonal	Yes	Earthen: exposed soil	Rilled, Rutted	Outsloped	Outboard drainage	Low	
RF-2	Toeslope	3,587	Seasonal	Yes	Earthen: exposed soil	Rilled, Rutted	Insloped	Outboard drainage	Low	
RF-3	Midslope	998	Seasonal	No	Crushed rock/ gravel	Stable and well drained	Insloped	Inboard drainage	Low	
RF-4	Midslope	2,687	Not trafficable	No	Earthen: exposed soil	Rilled	Outsloped	Outboard drainage, Water effectively directed off road surface, Diffuse or no drainage flat	Low	Road was water barred/ decommissioned. Water bars generally effective, sometimes need to be enhanced. Low water bar frequency leads to minor surface erosion in some areas, though erosion does not seem to extend far downslope.
RF-5	Midslope	1,268	Not trafficable	No	Earthen: exposed soil, Vegetated: herbaceous	Stable and well drained	Outsloped	Water effectively directed off road surface, Outboard drainage	Low	Out-sloping, water bars and dips are adequately draining road surface.
RF-6	Midslope	1,820	Not trafficable	No		Stable and well drained	Outsloped	Water effectively directed off road surface	Low	

Road segment name	Road location	Segment length (Feet)	Road type	Road maintained	Surface Type	Road surface condition	Road profile	Road drainage	Erosion severity	Cause comments
RF-7	Midslope	1,104	Seasonal	Yes		Stable and well drained, Rutted	Outsloped	Water effectively directed off road surface, Outboard drainage	Low	
RF-8	Midslope	2,907	Seasonal	Yes		Stable and well drained	Outsloped	Outboard drainage, Inboard drainage	Medium	Inboard ditch causing some erosion and channelization downslope

Road Detail Mapping

The following mapping (Figures 4-48 and 4-49) shows point and line data collected during the road network survey in the Rock Fence Creek Project area, which includes delineation of road segments and a cataloguing of all stream crossings, current and proposed road drainage features, and other field assessment points.

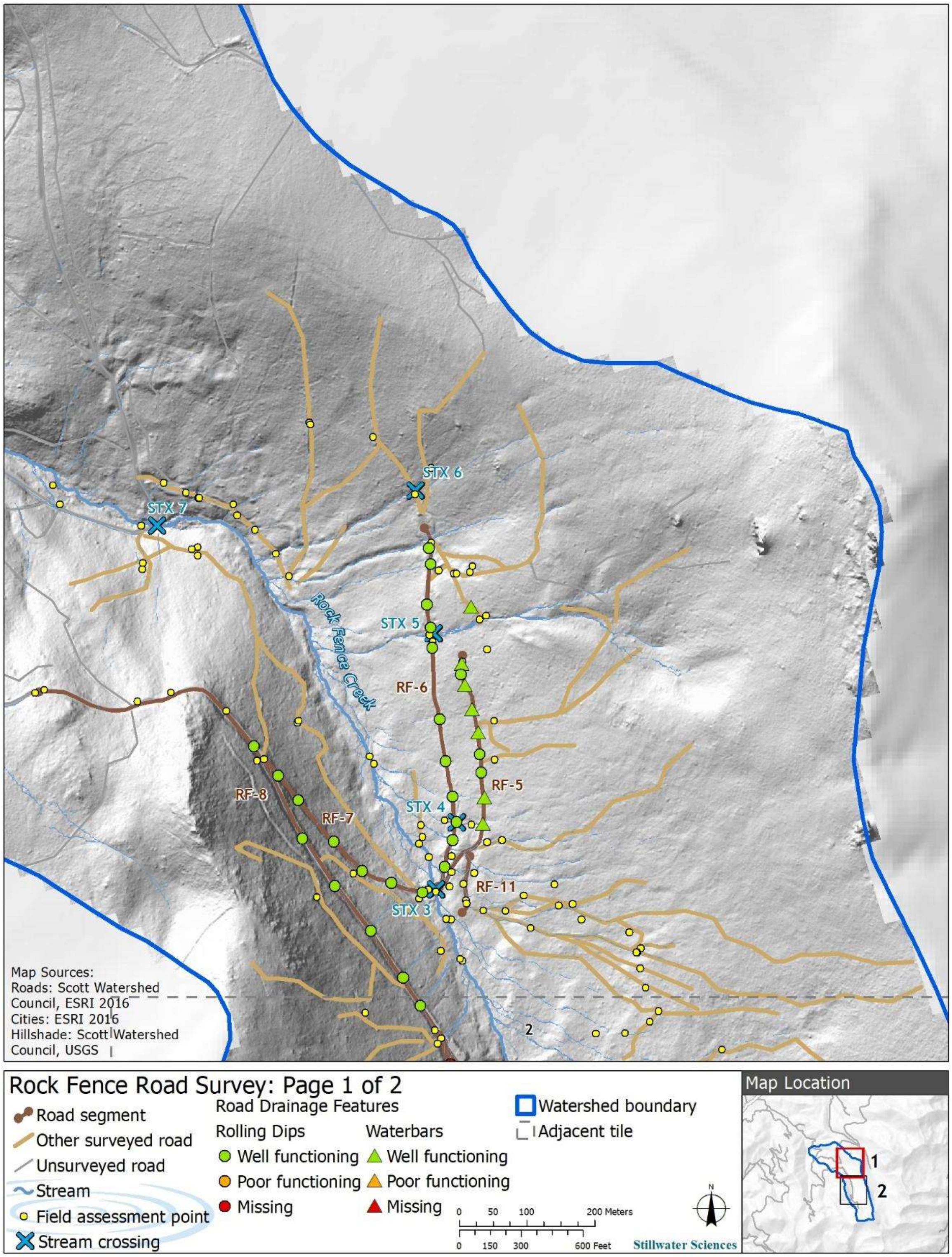


Figure 4-48. Road segments, road drainage features, stream crossings, and other field assessment points recorded during the field survey in the Rock Fence Creek basin. Page 1.

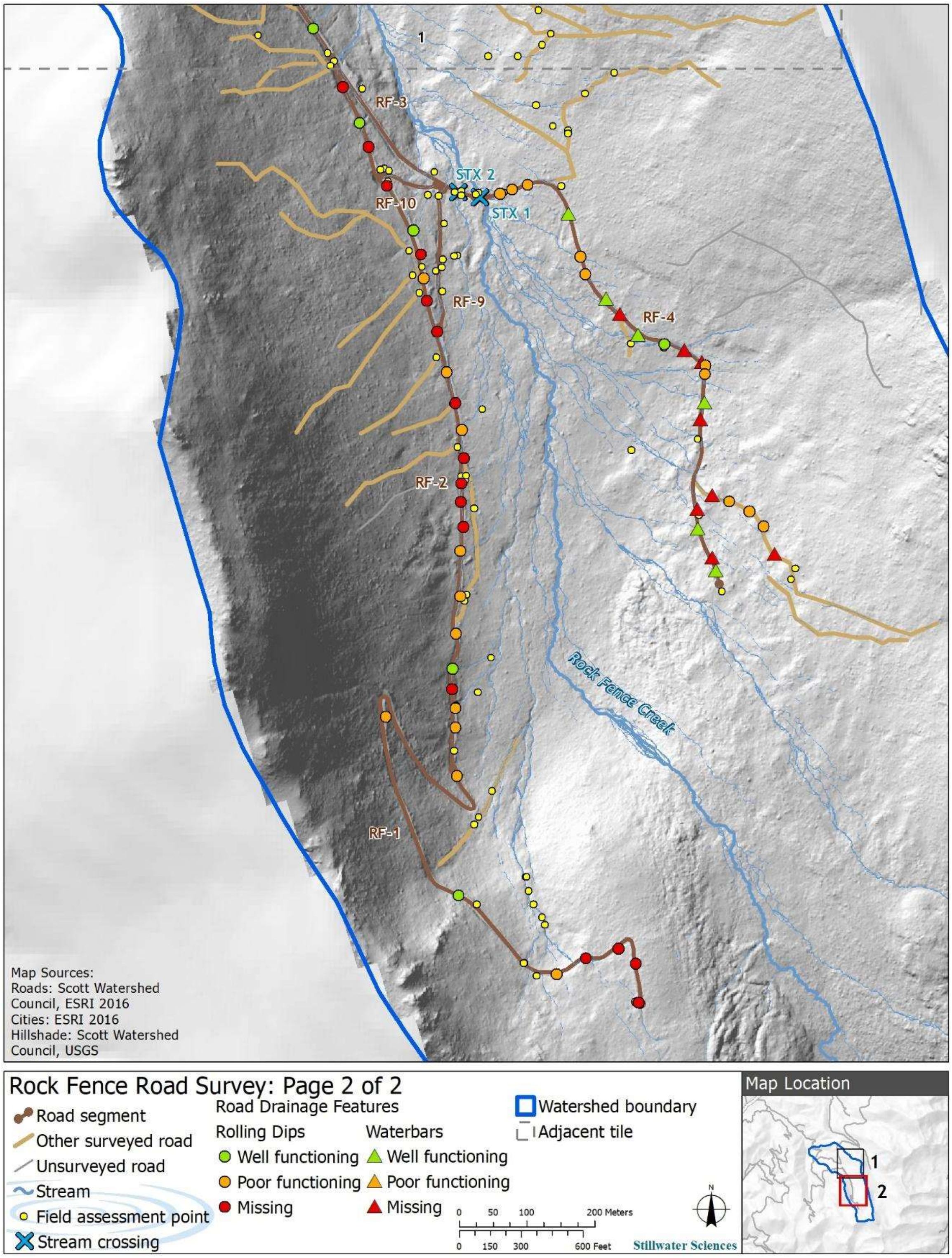


Figure 4-49. Road segments, road drainage features, stream crossings, and other field assessment points recorded during the field survey in the Rock Fence Creek basin. Page 2.

Focus Areas

The following section discusses selected road segments and associated features within the surveyed portions of the Rock Fence Creek road network where the more severe impacts occur and/or are characteristic of recurring problems.

Road segment RF-1 is the southernmost segment surveyed along the basin's primary access road. Moderate erosion of the road surface has occurred as the road is not consistently out-sloped and lacks rolling dip drainage features in critical locations. Importantly, concentrated runoff from the road surface is discharged into a meadow feature near its upslope end, resulting in channel incision in some of the meadow watercourses (Figure 4-50).

Figure 4-50. A watercourse which receives substantial road runoff from road segment RF-1 appears to show signs of active channel incision.

Road segment RF-2 is another segment along the primary access road. This segment runs along the western toeslope of the basin, paralleling a large meadow feature for much of its length. Similar to road segment CM-17 in the Cabin Meadow basin, a combination of a flat or in-sloping road profile, the presence of outboard berms, and lack of regularly spaced rolling dip features contributes to significant flow accumulation on the road surface (Figure 4-51). Drainage features are inadequately sized to accommodate the concentrated flow, and small channels have been eroded downslope of their outlets. The potential for future erosion of the road is limited by coarse particles armoring the surface. These issues have resulted in moderate surface erosion of the road prism and continue to concentrate a large volume of runoff from the hillslope to the lower parts of the meadow.

Figure 4-51. A representative section of road segment RF-2 looking north, showing the generally flat road profile and outboard berm which tends to concentrate flow from the western hillslope.

Road segment RF-9 is a steep, legacy skid road. Concentrated runoff from RF-2 is routed down segment RF-9. This road segment is in-sloped, with three large waterbar features that direct channelized flow to the east into adjacent meadow watercourses. While the combination of concentrate flow from these discharges does not seem to significantly impact channel morphology, scour has removed vegetation from the left bank in at least one location (Figure 4-52) and resulted in nearby sand and gravel deposition.

Figure 4-52. Concentrated runoff from road segment RF-9 has scoured vegetation along the left bank of a meadow watercourse.

STX-7 is a stream crossing of Rock Fence Creek along the primary access road leading into the Cabin Meadows basin (Figure 4-53). The crossing comprises a 6-foot diameter corrugated metal pipe culvert. While the culvert has effective headwall armoring, the downstream edge of the road prism shows severe erosion, which will likely compromise the integrity of the road and the crossing unless treated.

Figure 4-53. The outlet of STX-7. Severe erosion of the road fill prism is evident.

4.6 Channel Morphology and Condition

4.6.1 Channel Morphology

The LiDAR DEM was also used to create a flow accumulation raster of the Project basins in ArcGIS, which provided context related to surface hydrology and channel characteristics. The flow accumulation raster was used in tandem with aerial photography and slope maps to identify drainage network and channel features and helped guide field assessment priorities.

The stream channel network in the Project Area is typically steep and coarse grained (e.g., boulder, cobble, and gravel). The channel network is steeper in the Rock Fence basin, where average gradient is approximately 8 percent in the upper Project Area (Stations 3,840 to 4,750) steepening to over 12 percent throughout the middle and lower Project reaches (Stations 530 to 3,840) (Figure 3-4). The channel network is typically less steep in the Cabin Meadows basin, where average gradient is approximately 5 percent in the upper Project Area (Stations 4,890 to 7,500) steepening to approximately 7 percent in the lower Project reaches (Stations 3,500 to 4,890) (Figure 3-4).

There are a wide range of channel types represented within the Project Area. Channels are less defined in the upper portions of each project basin, comprised of a dense network of small seasonal and ephemeral tributaries emanating from within the valley floor and surrounding hillslopes (Figure 4-54). These channels are typically at the valley grade but may become incised one to three feet where affected by concentrated runoff from roads and other legacy land uses or where channel substrates are finer (e.g., sand and silt). The perennial mainstem channels range from boulder, cobble, and gravel bedded pool-riffle to cascade morphology (Figure 4-55). Channel morphology is typically controlled by glacial landforms (e.g., lateral, terminal, and ground moraines), landslide deposits, large wood, large boulders, and intermittent bedrock outcrops exposed mainly where channels occur near the valley margin.

The mainstem channels are more meandering, contain more complex secondary floodplain flow paths and side channels, and are typically composed of finer gravel and sand substrates in lower gradient reaches (i.e., less than 2 percent). An analysis of points and/or channel segments where main channel flow may diverge into secondary flow paths across the floodplain (referred to as switch points) was conducted to inform channel and floodplain restoration and enhancement opportunities. The mainstem channels in both basins become incised four to eight feet in the more downstream portions of each Project Area. Additional assessment and description of site-specific channel conditions will be included for select reaches addressed in the restoration plans.

Figure 4-54. Ephemeral tributary channels in the upper portions of the Project basins.

Figure 4-55. Perennial mainstem channels in the Project basins.

4.6.2 Sedimentation in Pools

In 2024 in-channel sediment deposition in pools was measured to create a baseline condition of sedimentation ahead of the 2025 winter and spring flows. Pools are defined as mostly still water with greater than three times the depth of the surrounding channel and a clearly defined riffle crest. The V star (V^*) method (Lisle and Hilton 1992) was used to measure the volume of fine sediment and particulate that accumulated in every other pool encountered while walking up the main and some side channels through both). V* is the fraction of the total pool volume occupied by fine sediment and was calculated for 12 pools in Cabin Meadow Creek and 11 pools in Rock Fence Creek. Six pools of the pools were behind recently constructed BDAs in Rock Fence Creek and the rest were naturally formed. See Figures 4-54 to 4-56 for images showing substrate and survey method.

Figure 4-56. V* survey of Pool 7.

Figure 4-57. V* survey of Pool 10.

Figure 4-58. V* survey of Pool S6.

Mean V* for all pools was 0.16 at Cabin Meadow Creek and 0.18 at Rock Fence with 0.14 in structure pools and 0.24 in natural pools. Overall pool volume (water + sediment) was 150 m^3 in Cabin Meadow Creek and 64 m^3 in Rock Fence Creek. Structure pools tended to be larger than natural pools (91 m^3 versus 31 m^3), but most structure pools were consolidated lower in the watershed while natural pools occurred throughout.

4.7 Cascades Frog Monitoring

The team surveyed streams, ponds, and wet meadows in the Project area twice in 2024 looking for Cascades frogs and other amphibians. A standard visual encounter survey protocol was used (Crump and Scott 1994), in which crew members walked the shorelines and shallow water of all aquatic habitats searching for amphibians. When amphibians were found, they recorded location, species, numbers, life stage, and sex, if possible to detect.

Surveys were conducted June 16 and 17, 2024, soon after snowmelt with a primary goal of finding breeding locations and also August 19-21, 2024, to identify how broadly frogs disperse throughout the Project area.

During the spring surveys, Cascades frog breeding was identified at Cabin Meadows in Upper Cabin Lake and at Rock Fence Creek in a wet meadow at the bottom of the Project area (Figure 4-57). Egg masses were only observed at Upper Cabin Meadow Lake with 23 masses found, while about 200 larvae were found in two spring pools in the lower elevation Rock Creek meadow. Post-metamorphic frogs were found in the streams flowing through both watersheds with 26 frogs found in Cabin Creek watershed and 6 frogs found in Rock Fence.

During the summer surveys, 108 recently metamorphosed frogs were observed in Cabin Creek and 10 were observed in Rock Fence showing that recruitment occurred in both watersheds. In addition, frogs were observed in stream reaches throughout the Project area.

Visual encounter surveys will continue post-restoration to see if frogs use restored reaches more or less than the pre-treatment surveys.

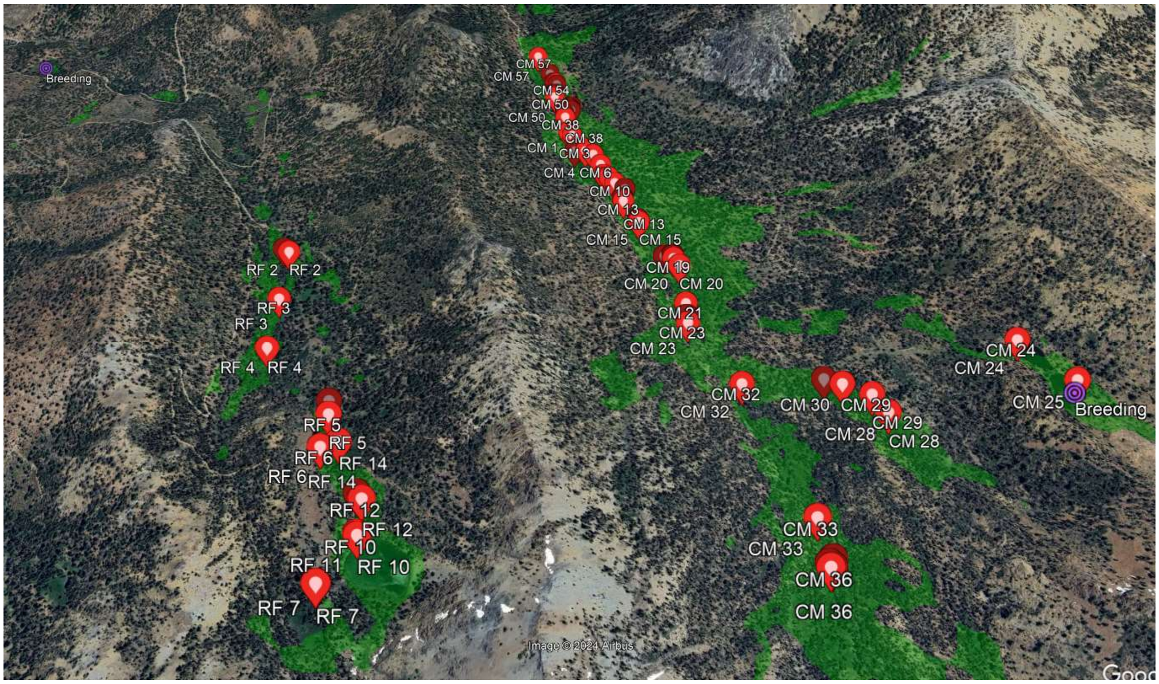


Figure 4-59. Project area with red pins representing locations where post-metamorphic Cascades frogs (*Rana cascadae*) were observed and purple circles representing where signs of breeding (egg masses or larvae) were observed.

4.8 Photo Monitoring

4.8.1 Photopoints

In 2020 and 2022 the KNF established photopoints in Cabin Meadows (Figure 4-28). Locations were selected that captured broad views of meadows as well as specific locations that would show changes with implementation. Points have been retaken in locations where conifer removal and legacy channel remediation work was conducted since 2020 by KNF, as described in Section 3.9.

In 2024, SRWC added three “Point of Interest” drone photo points in Cabin Meadows (Figure 4-28). At each of these points, the drone was flown in a circle around the point, looking back obliquely toward the point while recording a video. These points were selected because they have potential to show change after restoration implementation.

In 2023, SRWC established five 360° photo points in the Rock Fence Creek catchment area. Each photo point consists of eight photographs that capture a full 360° of the area around the point. In 2024, SRWC established three more photo points in Rock Fence and added a drone “Point of Interest” flight to each existing and newly established photo point (Figure 4-28). The points were selected to capture potential changes due to future implementation in the meadow and in the forest surrounding the meadow.

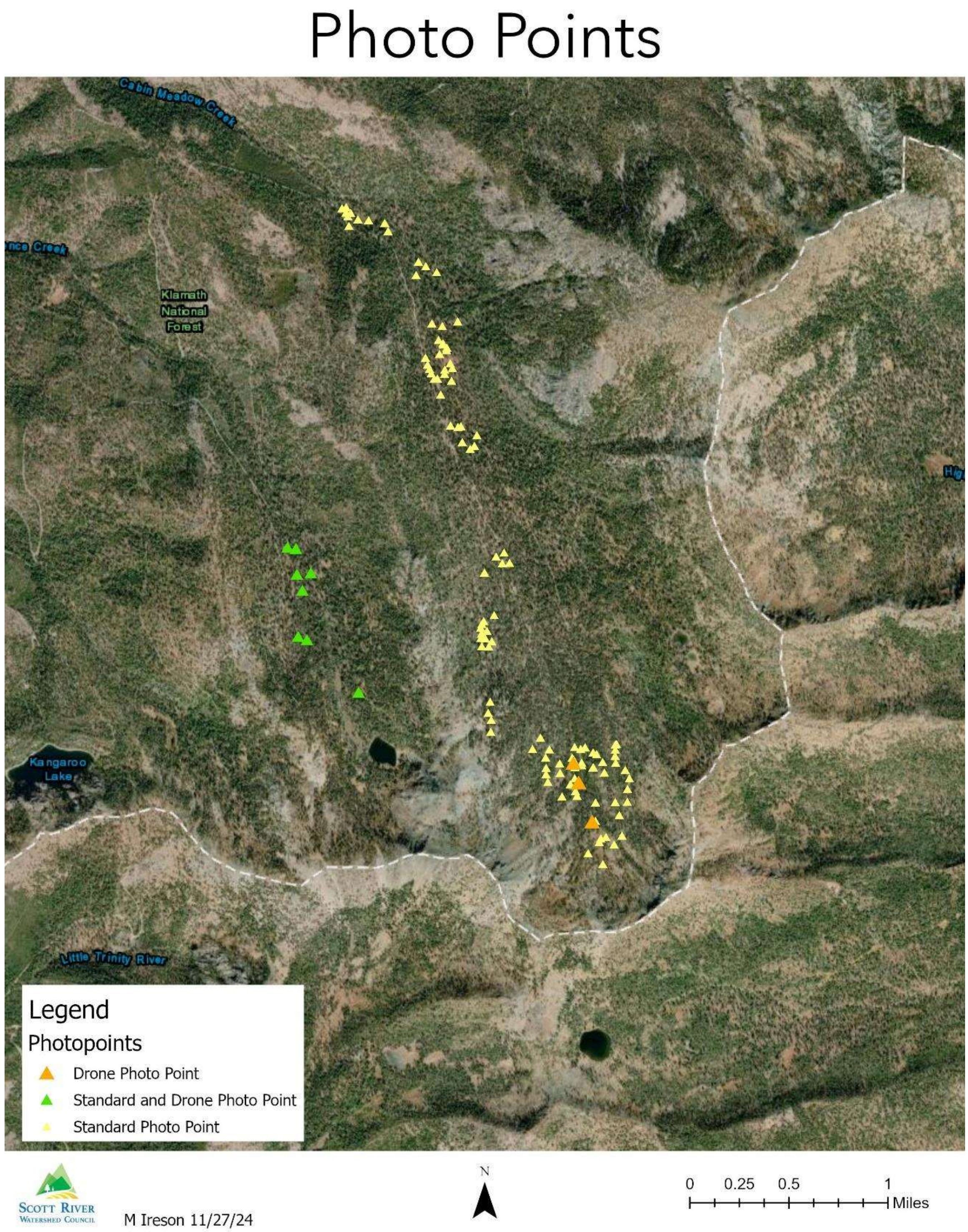


Figure 4-60. Map of the locations of standard and drone photo points in both Cabin Meadows and Rock Fence Creek meadows.

4.8.2 Cameras

In the fall of 2023, Quartz Valley Indian Reservation and Scott River Watershed Council set one timelapse camera and three game cameras in each catchment (Figure 4-59). The timelapse cameras show the change of snow depth, surface water, and green-ness over the course of the seasons. (https://scottriver.org/cabin-and-rock-fence-meadows-timelapse-2024/)

The game cameras captured images of the wildlife in the area. Wildlife was identified using Wildlife Insights. Wildlife Insights' software uses AI to initially identify species in images for confirmation by a human. To date, of the 26,858 images captured by the trail cameras, 620 have been identified as containing wildlife. Table 4-12 lists the most common species identified.

Table 4-12. Most common species identified in trail camera images.

Species	Number of images
Tamiasciurus douglasii Douglas's Squirrel	139
Canis latrans Coyote	117
Odocoileus hemionus Mule Deer	113
Ursus americanus American Black Bear	36
Turdus migratorius American Robin	19

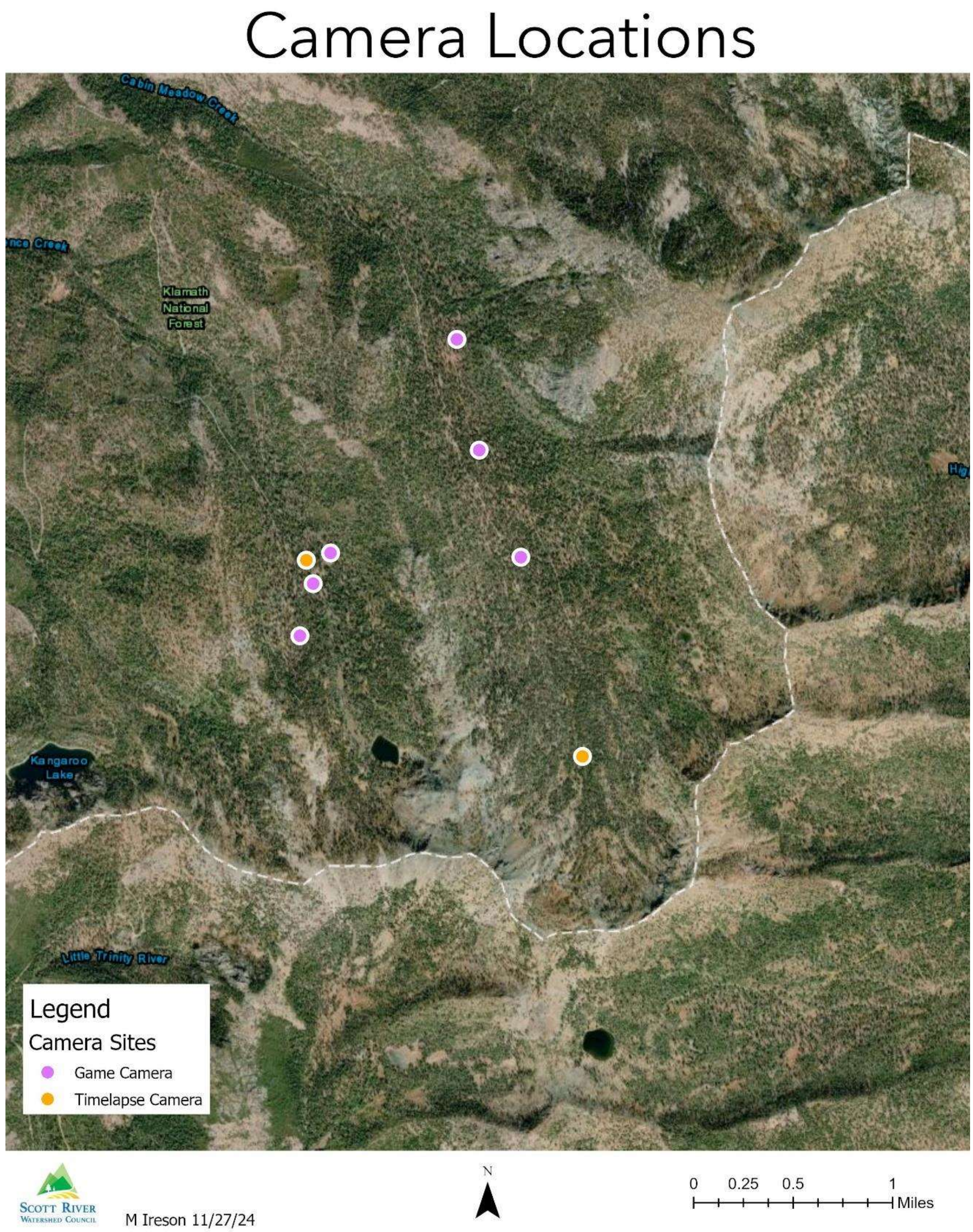


Figure 4-61. Location of timelapse and game cameras in Project area.

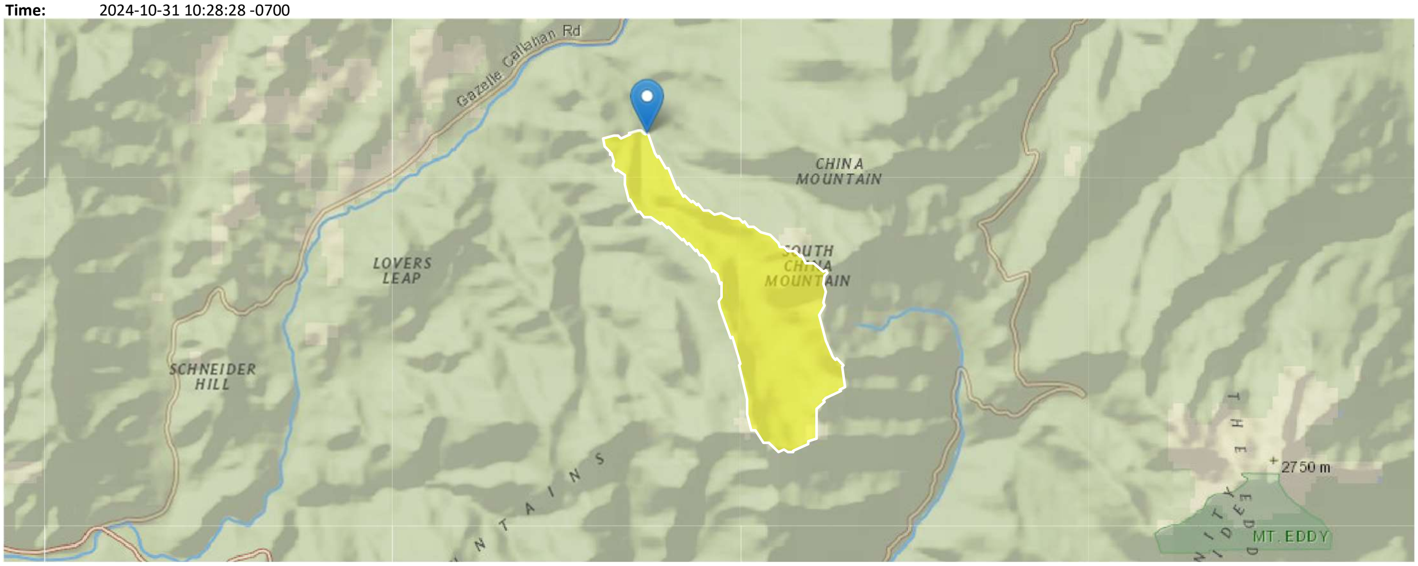
5. RESTORATION PLANS

Following the completion of the Baseline Assessment, and using the knowledge gained in that process, the next step is to develop comprehensive, phased, prioritized and implementable restoration plans for the 4,190 acres of the Project area. Plans will include restoration of wet and montane meadow, instream structures and floodplain reconnection, forest health treatments, and road and stream crossing improvements and/or decommissioning.

5 APPENDIX A: USGS STREAMSTATS CABIN MEADOW CREEK

StreamStats Report

Region ID: CA
Workspace ID: CA20241031172805025000
Clicked Point (Latitude, Longitude): 41.38512, -122.63093
Time: 2024-10-31 10:28:28 -0700



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
BASINPERIM	Basin perimeter measured along entire drainage-basin divide	14.9	miles
BSLDEM30M	Mean basin slope computed from 30 m DEM	33.8	percent
CENTROXA83	X coordinate of the centroid, in NAD_1983_Albers, meters	-2180219.2	meters
CENTROYA83	Basin centroid horizontal (y) location in NAD 1983 Albers	2345777.3	meters
DRNAREA	Area that drains to a point on a stream	4.3	square miles
EL6000	Percent of area above 6000 ft	73.6	percent
ELEV	Mean Basin Elevation	6408	feet
ELEVMAX	Maximum basin elevation	8202	feet
FOREST	Percentage of area covered by forest	32.6	percent
JANMAXTMP	Mean Maximum January Temperature	36.28	degrees F
JANMINTMP	Mean Minimum January Temperature	24.38	degrees F
LAKEAREA	Percentage of Lakes and Ponds	0	percent
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	0	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	0.1	percent
LFPLENGTH	Length of longest flow path	5	miles
MINBELEV	Minimum basin elevation	4715	feet
OUTLETELEV	Elevation of the stream outlet in feet above NAVD88	4715	feet
PRECIP	Mean Annual Precipitation	67.2	inches
RELIEF	Maximum - minimum elevation	3487	feet
RELRELF	Basin relief divided by basin perimeter	234	feet per mi

Peak-Flow Statistics

Peak-Flow Statistics Parameters [2012 5113 Region 1 North Coast]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	4.3	square miles	0.04	3200
PRECIP	Mean Annual Precipitation	67.2	inches	20	125

Peak-Flow Statistics Flow Report [2012 5113 Region 1 North Coast]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error, PC: Percent Correct, RMSE: Root Mean Squared Error, PseudoR^2: Pseudo R Squared (other -- see report)

Statistic	Value	Unit	PIL	PIU	ASEp
50-percent AEP flood	426	ft^3/s	174	1040	58.6
20-percent AEP flood	761	ft^3/s	364	1590	47.4
10-percent AEP flood	999	ft^3/s	495	2010	44.2
4-percent AEP flood	1310	ft^3/s	671	2560	42.7
2-percent AEP flood	1540	ft^3/s	787	3010	42.7
1-percent AEP flood	1780	ft^3/s	888	3570	44.3
0.5-percent AEP flood	2010	ft^3/s	1000	4040	44.4
0.2-percent AEP flood	2310	ft^3/s	1120	4750	46

Peak-Flow Statistics Citations

Gotvald, A.J., Barth, N.A., Veilleux, A.G., and Parrett, Charles,2012, Methods for determining magnitude and frequency of floods in California, based on data through water year 2006: U.S. Geological Survey Scientific Investigations Report 2012–5113, 38 p., 1 pl. (http://pubs.usgs.gov/sir/2012/5113/)

Bankfull Statistics

Bankfull Statistics Parameters [Pacific Mountain System D Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	4.3	square miles	6.1776	8079.9147

Bankfull Statistics Parameters [Pacific Border P Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	4.3	square miles	6.169878	3938.976756

Bankfull Statistics Parameters [USA Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	4.3	square miles	0.07722	59927.7393

Bankfull Statistics Disclaimers [Pacific Mountain System D Bieger 2015]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Bankfull Statistics Flow Report [Pacific Mountain System D Bieger 2015]

Statistic	Value	Unit
Bieger_D_channel_width	23.7	ft
Bieger_D_channel_depth	1.53	ft

Statistic	Value	Unit
Bieger_D_channel_cross_sectional_area	45.1	ft^2

Bankfull Statistics Disclaimers [Pacific Border P Bieger 2015]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Bankfull Statistics Flow Report [Pacific Border P Bieger 2015]

Statistic	Value	Unit
Bieger_P_channel_width	20.8	ft
Bieger_P_channel_cross_sectional_area	42.3	ft^2
Bieger_P_channel_depth	1.53	ft

Bankfull Statistics Flow Report [USA Bieger 2015]

Statistic	Value	Unit
Bieger_USA_channel_width	20.7	ft
Bieger_USA_channel_depth	1.64	ft
Bieger_USA_channel_cross_sectional_area	37.6	ft^2

Bankfull Statistics Flow Report [Area-Averaged]

Statistic	Value	Unit
Bieger_D_channel_width	23.7	ft
Bieger_D_channel_depth	1.53	ft
Bieger_D_channel_cross_sectional_area	45.1	ft^2
Bieger_P_channel_width	20.8	ft
Bieger_P_channel_cross_sectional_area	42.3	ft^2
Bieger_P_channel_depth	1.53	ft
Bieger_USA_channel_width	20.7	ft
Bieger_USA_channel_depth	1.64	ft
Bieger_USA_channel_cross_sectional_area	37.6	ft^2

Bankfull Statistics Citations

Bieger, Katrin; Rathjens, Hendrik; Allen, Peter M.; and Arnold, Jeffrey G.,2015, Development and Evaluation of Bankfull Hydraulic Geometry Relationships for the Physiographic Regions of the United States, Publications from USDA-ARS / UNL Faculty, 17p (https://digitalcommons.unl.edu/usdaarsfacpub/ 1515? utm_source=digitalcommons.unl.edu%2Fusdaarsfacpub%2F1515&utm_medium=PDF&utm_campaign=PDFCoverPages)

Maximum Probable Flood Statistics

Maximum Probable Flood Statistics Parameters [Crippen Bue Region 17]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	4.3	square miles	0.1	10000

Maximum Probable Flood Statistics Flow Report [Crippen Bue Region 17]

Statistic	Value	Unit
Maximum Flood Crippen Bue Regional	20600	ft^3/s

Maximum Probable Flood Statistics Citations

Crippen, J.R. and Bue, Conrad D.1977, Maximum Floodflows in the Conterminous United States, Geological Survey Water-Supply Paper 1887, 52p. (https://pubs.usgs.gov/wsp/1887/report.pdf)

Application Version: 4.24.0

StreamStats Services Version: 1.2.22

NSS Services Version: 2.2.1

6 APPENDIX B: USGS STREAMSTATS ROCK FENCE CREEK

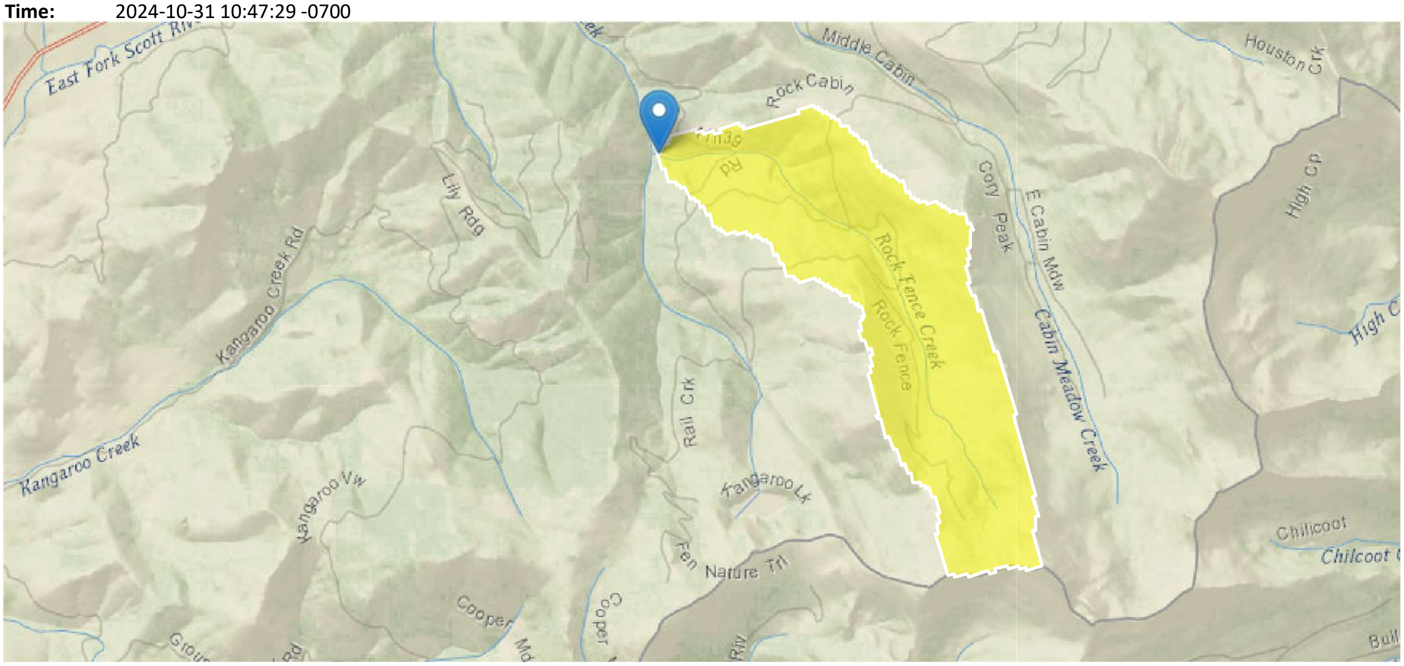
Rock Fence Creek StreamStats Report

Region ID: CA

Workspace ID: CA20241031174706031000

Clicked Point (Latitude, Longitude): 41.36236, -122.64583

Time: 2024-10-31 10:47:29 -0700



Collapse All

⍰ Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
BASINPERIM	Basin perimeter measured along entire drainage-basin divide	9.51	miles
BSLDEM30M	Mean basin slope computed from 30 m DEM	30.8	percent
CENTROXA83	X coordinate of the centroid, in NAD_1983_Albers, meters	-2181639.5	meters
CENTROYA83	Basin centroid horizontal (y) location in NAD 1983 Albers	2345727.6	meters
DRNAREA	Area that drains to a point on a stream	2.1	square miles
EL6000	Percent of area above 6000 ft	56.4	percent
ELEV	Mean Basin Elevation	6050	feet
ELEVMAX	Maximum basin elevation	7655	feet
FOREST	Percentage of area covered by forest	37.5	percent
JANMAXTMP	Mean Maximum January Temperature	36.78	degrees F
JANMINTMP	Mean Minimum January Temperature	25.59	degrees F
LAKEAREA	Percentage of Lakes and Ponds	0.16	percent
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	0.2	percent

Parameter Code	Parameter Description	Value	Unit
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	0.4	percent
LFPLENGTH	Length of longest flow path	4	miles
MINBELEV	Minimum basin elevation	4529	feet
OUTLETELEV	Elevation of the stream outlet in feet above NAVD88	4529	feet
PRECIP	Mean Annual Precipitation	67.5	inches
RELIEF	Maximum - minimum elevation	3126	feet
RELRELF	Basin relief divided by basin perimeter	329	feet per mi

Peak-Flow Statistics

Peak-Flow Statistics Parameters [2012 5113 Region 1 North Coast]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.1	square miles	0.04	3200
PRECIP	Mean Annual Precipitation	67.5	inches	20	125

Peak-Flow Statistics Flow Report [2012 5113 Region 1 North Coast]

PIL: Lower 90% Prediction Interval, PIU: Upper 90% Prediction Interval, ASEp: Average Standard Error of Prediction, SE: Standard Error, PC: Percent Correct, RMSE: Root Mean Squared Error, PseudoR^2: Pseudo R Squared (other -- see report)

Statistic	Value	Unit	PIL	PIU	ASEp
50-percent AEP flood	224	ft^3/s	91.5	549	58.6
20-percent AEP flood	405	ft^3/s	193	850	47.4
10-percent AEP flood	533	ft^3/s	263	1080	44.2
4-percent AEP flood	700	ft^3/s	357	1370	42.7
2-percent AEP flood	827	ft^3/s	421	1620	42.7
1-percent AEP flood	959	ft^3/s	477	1930	44.3
0.5-percent AEP flood	1080	ft^3/s	535	2180	44.4
0.2-percent AEP flood	1250	ft^3/s	605	2580	46

Peak-Flow Statistics Citations

Gotvald, A.J., Barth, N.A., Veilleux, A.G., and Parrett, Charles,2012, Methods for determining magnitude and frequency of floods in California, based on data through water year 2006: U.S. Geological Survey Scientific Investigations Report 2012–5113, 38 p., 1 pl. (http://pubs.usgs.gov/sir/2012/5113/)

Bankfull Statistics

Bankfull Statistics Parameters [Pacific Mountain System D Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.1	square miles	6.1776	8079.9147

Bankfull Statistics Parameters [Pacific Border P Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.1	square miles	6.169878	3938.976756

Bankfull Statistics Parameters [USA Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.1	square miles	0.07722	59927.7393

Bankfull Statistics Disclaimers [Pacific Mountain System D Bieger 2015]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Bankfull Statistics Flow Report [Pacific Mountain System D Bieger 2015]

Statistic	Value	Unit
Bieger_D_channel_width	17.8	ft
Bieger_D_channel_depth	1.24	ft
Bieger_D_channel_cross_sectional_area	28.2	ft^2

Bankfull Statistics Disclaimers [Pacific Border P Bieger 2015]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Bankfull Statistics Flow Report [Pacific Border P Bieger 2015]

Statistic	Value	Unit
Bieger_P_channel_width	15.2	ft
Bieger_P_channel_cross_sectional_area	25.4	ft^2
Bieger_P_channel_depth	1.2	ft

Bankfull Statistics Flow Report [USA Bieger 2015]

Statistic	Value	Unit
Bieger_USA_channel_width	16.1	ft
Bieger_USA_channel_depth	1.41	ft
Bieger_USA_channel_cross_sectional_area	25.5	ft^2

Bankfull Statistics Flow Report [Area-Averaged]

Statistic	Value	Unit
Bieger_D_channel_width	17.8	ft
Bieger_D_channel_depth	1.24	ft
Bieger_D_channel_cross_sectional_area	28.2	ft^2
Bieger_P_channel_width	15.2	ft
Bieger_P_channel_cross_sectional_area	25.4	ft^2
Bieger_P_channel_depth	1.2	ft
Bieger_USA_channel_width	16.1	ft
Bieger_USA_channel_depth	1.41	ft
Bieger_USA_channel_cross_sectional_area	25.5	ft^2

Bankfull Statistics Citations

Bieger, Katrin; Rathjens, Hendrik; Allen, Peter M.; and Arnold, Jeffrey G.,2015, Development and Evaluation of Bankfull Hydraulic Geometry Relationships for the Physiographic Regions of the United States, Publications from USDA-ARS / UNL Faculty, 17p. (https://digitalcommons.unl.edu/usdaarsfacpub/1515? utm_source=digitalcommons.unl.edu%2Fusdaarsfacpub%2F1515&utm_medium=PDF&utm_campaign=PDFCoverPages)

Maximum Probable Flood Statistics

Maximum Probable Flood Statistics Parameters [Crippen Bue Region 17]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.1	square miles	0.1	10000

Maximum Probable Flood Statistics Flow Report [Crippen Bue Region 17]

Statistic	Value	Unit
Maximum Flood Crippen Bue Regional	11300	ft^3/s

Maximum Probable Flood Statistics Citations

Crippen, J.R. and Bue, Conrad D.1977, Maximum Floodflows in the Conterminous United States, Geological Survey Water-Supply Paper 1887, 52p. (https://pubs.usgs.gov/wsp/1887/report.pdf)

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Government.

Application Version: 4.24.0

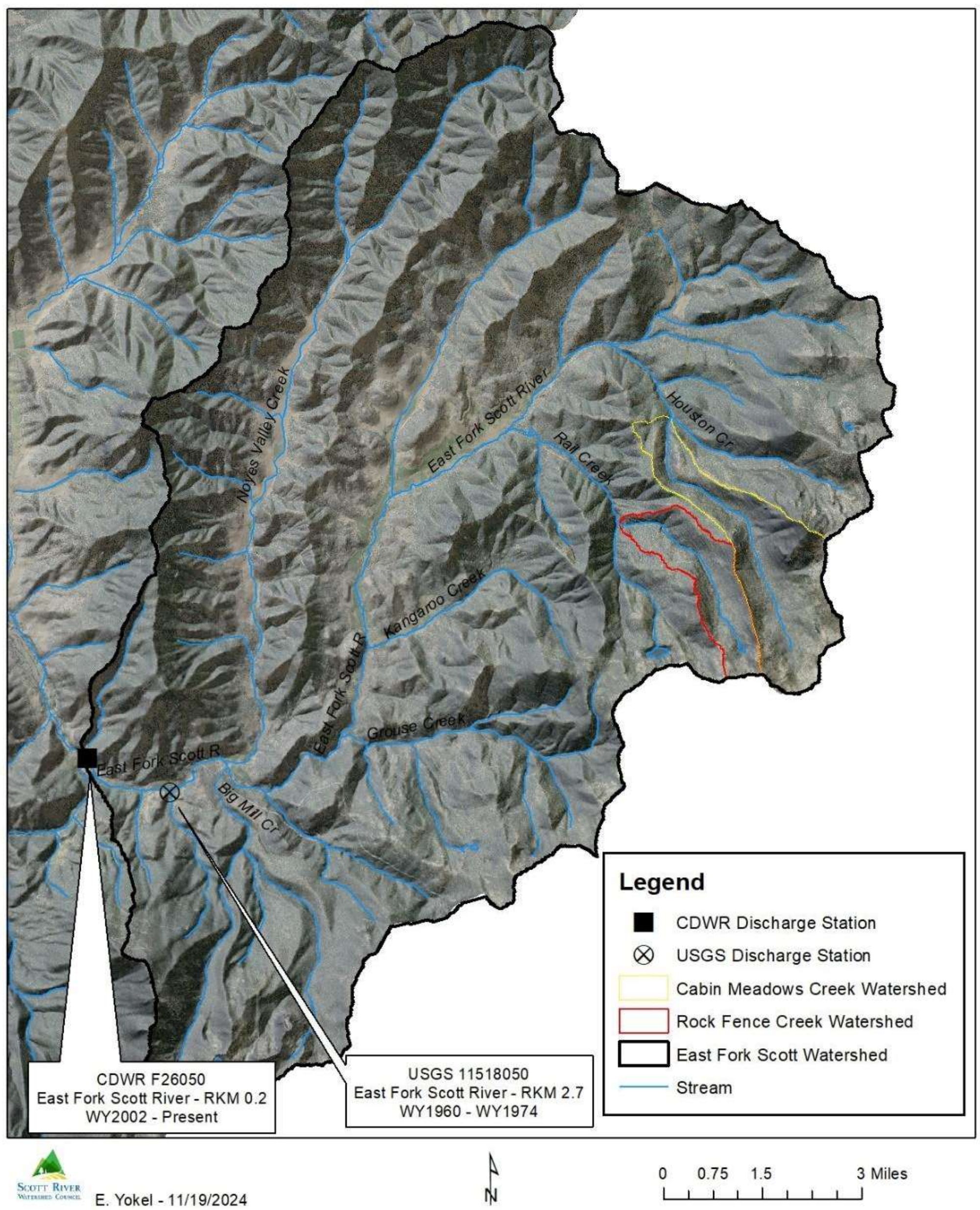
StreamStats Services Version: 1.2.22

NSS Services Version: 2.2.1

7 APPENDIX C: EAST FORK SCOTT RIVER STREAM DISCHARGE MONITORING

The USGS operated a stream discharge station (11518050) in the East Fork Scott River at RKM 2.7 from October 1, 1959 (WY1960) through September 29, 1974 (WY1974) – Map 1. Approved daily average discharge data for the USGS station was retrieved from https://waterdata.usgs.gov/. The California Department of Water Resources (CDWR) established a stream discharge station (F26050) on the East Fork Scott River at RKM 0.2 on June 28, 2002 (WY2002). The CDWR discharge station has operated to date except for WY2004 and WY2006. The approved daily average discharge data for the CDWR station was retrieved from https://wdl.water.ca.gov/.

East Fork Scott River Watershed - Stream Discharge Stations



Map 1 – Location of stream discharge stations in East Fork Scott River watershed
The East Fork Scott River is a snow dependent runoff system in a mediterranean climate. The daily average discharge for a representative water year (WY2010) is illustrated in Figure 1.

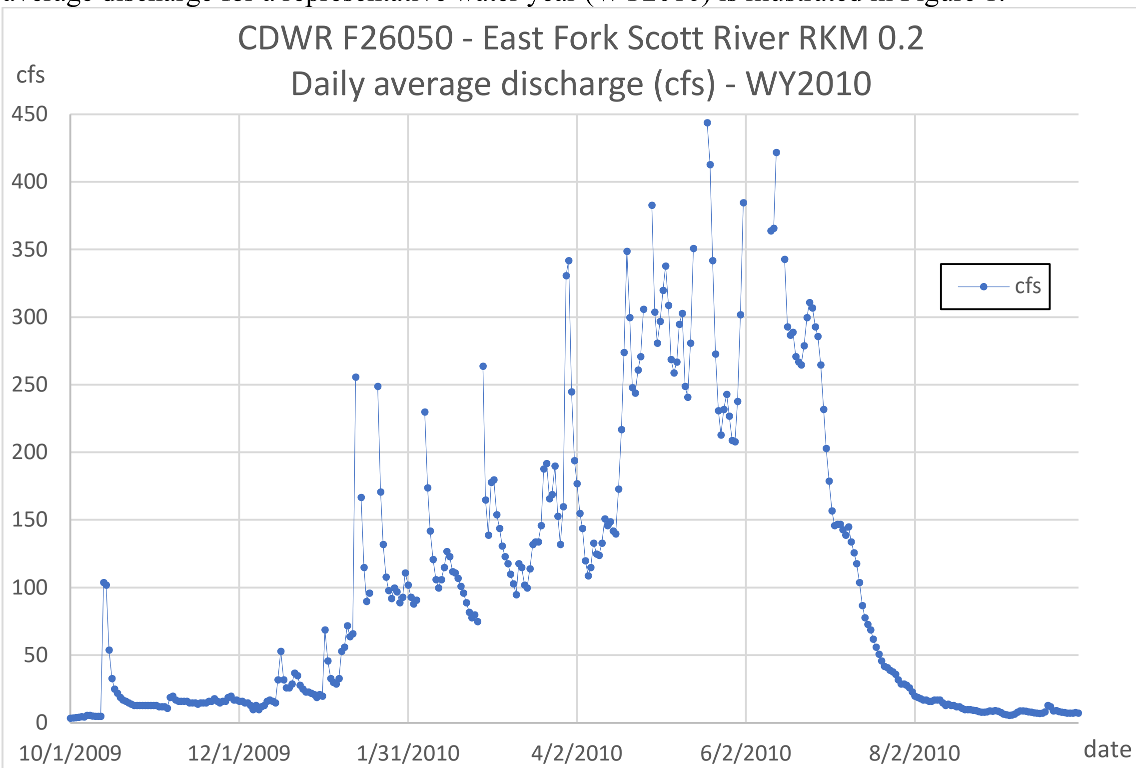


Figure 1 – Representative hydrograph of the East Fork Scott River – WY2010

The stream discharge at the locations of the USGS and CDWR gages is significantly altered by upstream surface water diversions. The USGS station was operated before the Scott River Adjudication Decree was finalized on January 30, 1980 and the CDWR station has been operating since the Decree has been in place.

Analysis of the historic USGS and CDWR discharge data was performed to determine if the hydrologic regime in the East Fork Scott River has changed from the period of WY1960 – WY1974 and WY2002 to the present. In an attempt to analyze discharge during comparable water year types, the accumulated precipitation at the Fort Jones Ranger Station from October 1 through April 1 and the Snow Water Equivalence (SWE) of the April 1 snowpack at the Middle Boulder 3 (MB3) was analyzed over the period of record.

Analysis of the April 1st SWE at MB3 vs the April 1st accumulated precipitation at the Fort Jones Ranger Station shows a correlation between the two with a significant amount of variation over the period of record – Figure 2.

The seventy-six (76) years of record at the MB3 station and eighty-seven (87) years of record at the Fort Jones Ranger Station were assigned a "dryness" ranking to identify wet, average and dry water year types. A ranking of 1 indicates that is the dryest (e.g. least precipitation) year on record.

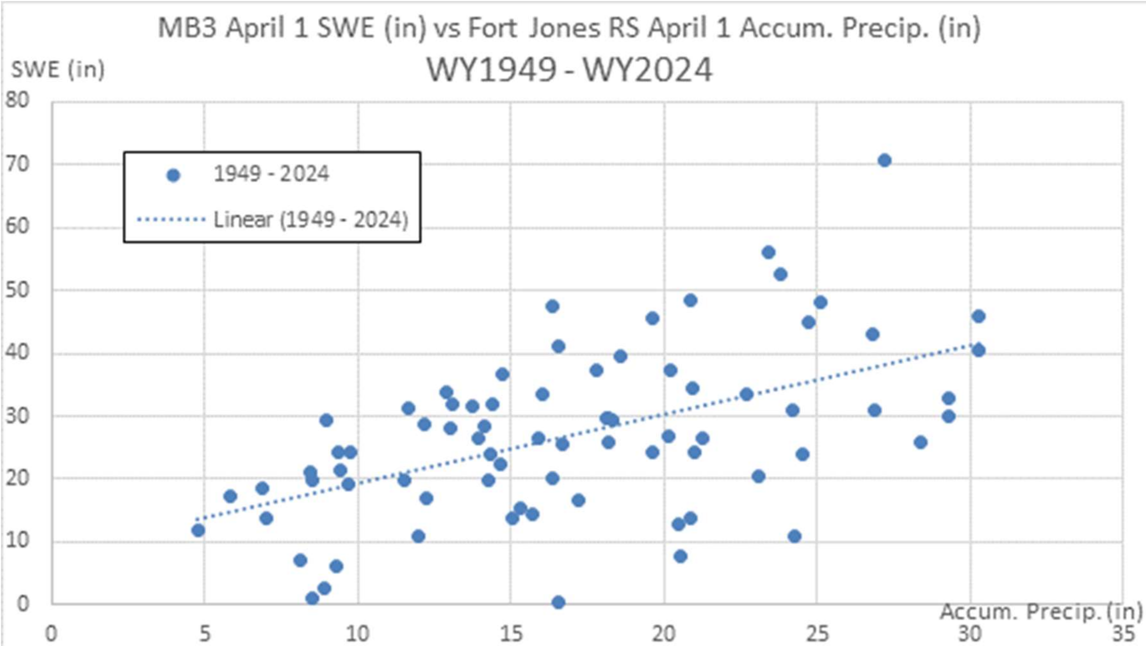


Figure 2 – April 1 SWE (in) at MB3 versus the accumulated precipitation (Oct 1 – March 31) at the Fort Jones Ranger Station

Average Water Year Type

Water Year 1966 (WY1966) was an average water year type in the period of discharge data at the USGS gage. The April 1 SWE (in) at MB3 was slightly above the average for the period of record and the accumulated precipitation at the Fort Jones Ranger Station was below the average during WY1966 (Table 1). The discharge at the CDWR gage during two average water years (WY2002 and WY2010) was compared to the discharge during WY1966. The April 1 SWE at MB3 and the accumulated precipitation in Fort Jones was below average in WY2002. The CDWR gage began operation in late June 2002, allowing for a comparison of base flow conditions and fall/ early winter runoff. The hydrographs from WY1966 and WY2002 are relatively similar with base flow occurring and ending at the same times with the WY2002 base flow discharge slightly greater than the WY1966 base flow discharge (Figure 3).

WY	MB3 April 1 SWE (in)	Dry Rank	Fort Jones RS April 1 Accum. Precip. (in)	Dry Rank
1966	28.3	43	14.1	31
2002	26.5	40	15.9	40
Average	27.0	76 Years	17.0	87 Years

Table 1 – April 1 MB3 SWE (in) & Fort Jones RS Accumulated Precipitation (in) – WY1966 & WY2002

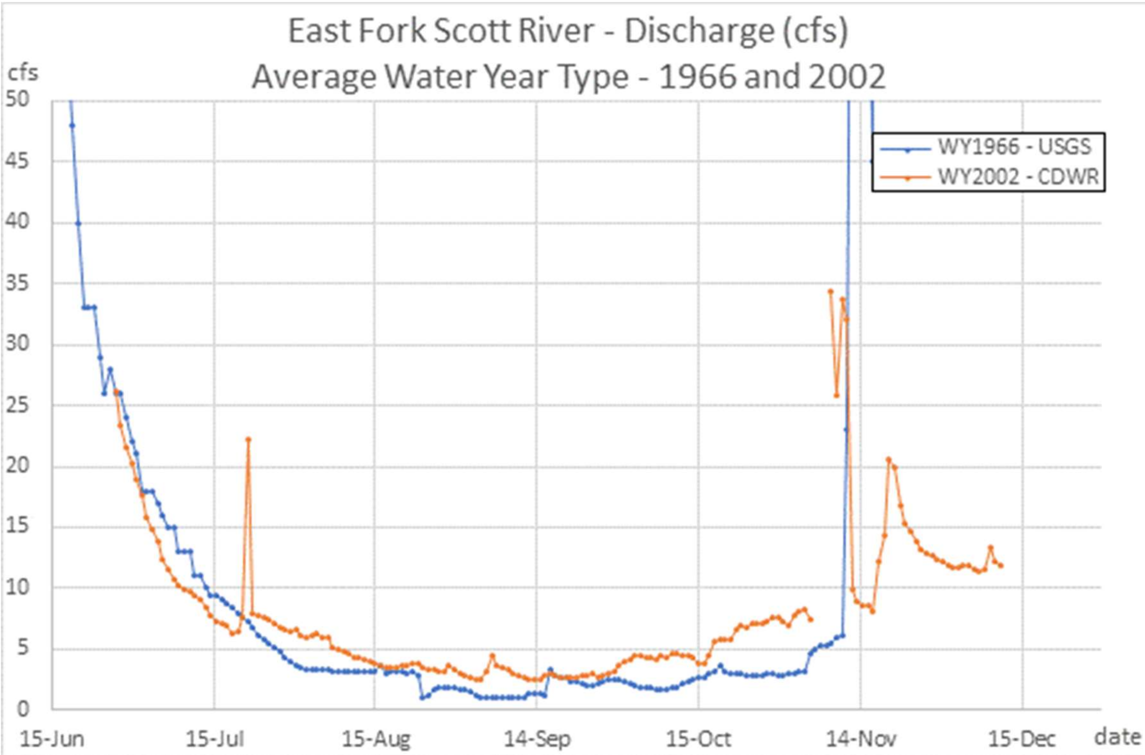


Figure 3 – East Fork Scott River discharge during an average water year type – WY1966 and WY2002

The stream discharge in the East Fork Scott during WY2010 was compared to the discharge during WY1966. The SWE at MB3 was below average and the accumulated precipitation at Fort Jones was significantly below average for the period of record (Table 2). Comparison of the two water years illustrates a significantly later entrance into the base flow period and higher discharge during base flow in WY2010 compared to WY1966 (Figures 4 and 5).

WY	MB3 April 1 SWE (in)	Dry Rank	Fort Jones RS April 1 Accum. Precip. (in)	Dry Rank
1966	28.3	43	14.1	31
2010	24.2	31	9.36	12
Average	27.0	76 Years	17.0	87 Years

Table 2 – April 1 MB3 SWE (in) & Fort Jones RS Accumulated Precipitation (in) – WY1966 & WY2010

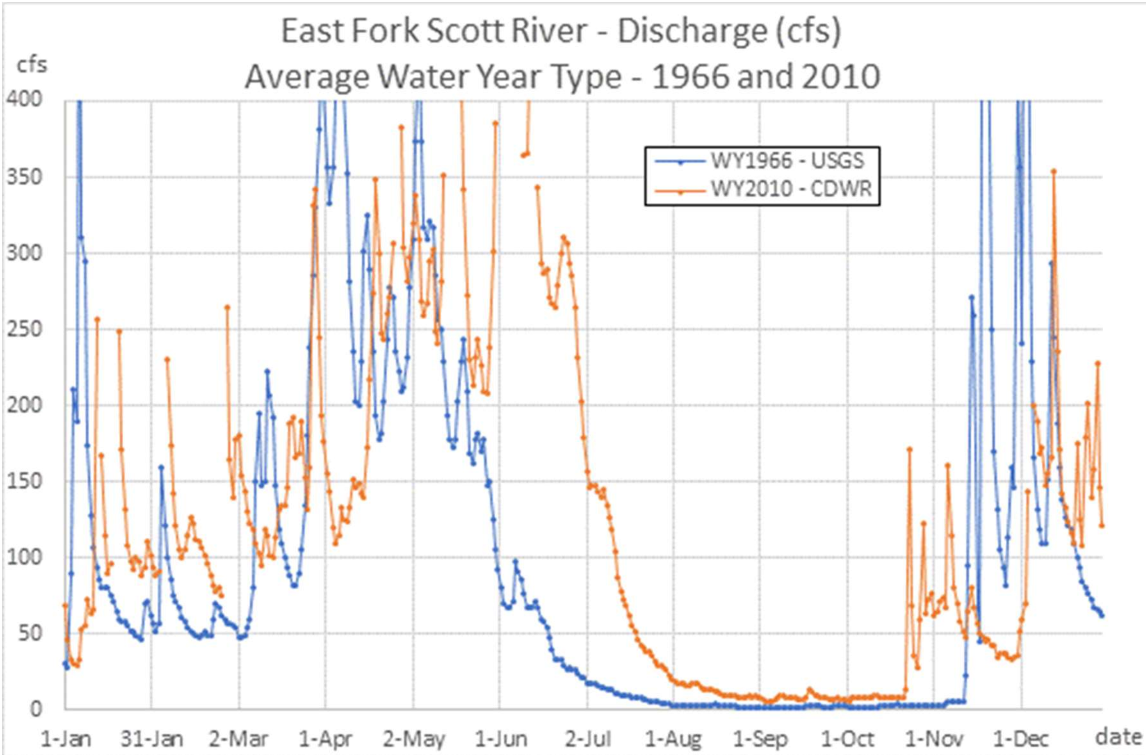


Figure 4 – East Fork Scott River discharge during an average water year type – WY1966 and WY2010

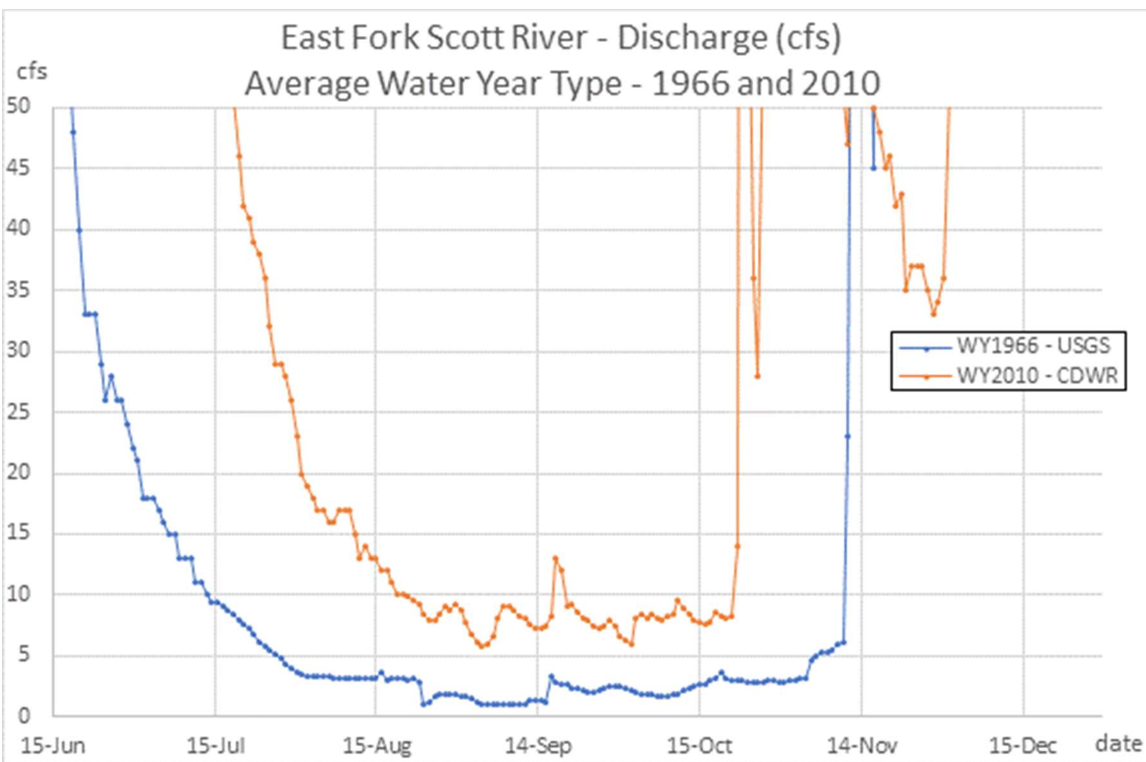


Figure 5 – East Fork Scott River discharge during an average water year type – WY1966 and WY2010

Dry Water Year Type

WY1963 was selected as a representative dry water year from the period of record for the USGS gage due to the significantly below average SWE on April 1 at the MB3 station (Table 3). Though the snowpack in the Scott Mountains was significantly below average, the accumulated precipitation in Fort Jones was above average during WY1963.

WY2014 was one of the driest water years during the period of record. Comparison of WY1963 and WY2014 illustrates base flow occurring months earlier in WY2014 compared to WY1963 and base flow in WY2014 less than base flow in WY1963 (Figures 6 and 7).

WY	MB3 April 1 SWE (in)	Dry Rank	Fort Jones RS April 1 Accum. Precip. (in)	Dry Rank
1963	7.8	6	20.5	62
2014	1	2	8.49	7
Average	27.0	76 Years	17.0	87 Years

Table 3 – April 1 MB3 SWE (in) & Fort Jones RS Accumulated Precipitation (in) – WY1966 & WY2010

WY1964 and WY2018 were compared as dry water year types. The April 1 SWE at MB3 and accumulated precipitation at Fort Jones was less than average for both water years with WY2018 being significantly drier than WY1964 (Table 4).

Analysis of the hydrographs for WY1964 and WY2018 an earlier timing of the entry into base flow in WY2018 compared to WY1964 but a greater magnitude of base flow in WY2018 (Figures 8 and 9).

WY	MB3 April 1 SWE (in)	Dry Rank	Fort Jones RS April 1 Accum. Precip. (in)	Dry Rank
1964	15.2	15	15.3	38
2018	7	5	8.1	5
Average	27.0	76 Years	17.0	87 Years

Table 4 - April 1 MB3 SWE (in) & Fort Jones RS Accumulated Precipitation (in) – WY1964 & WY2018

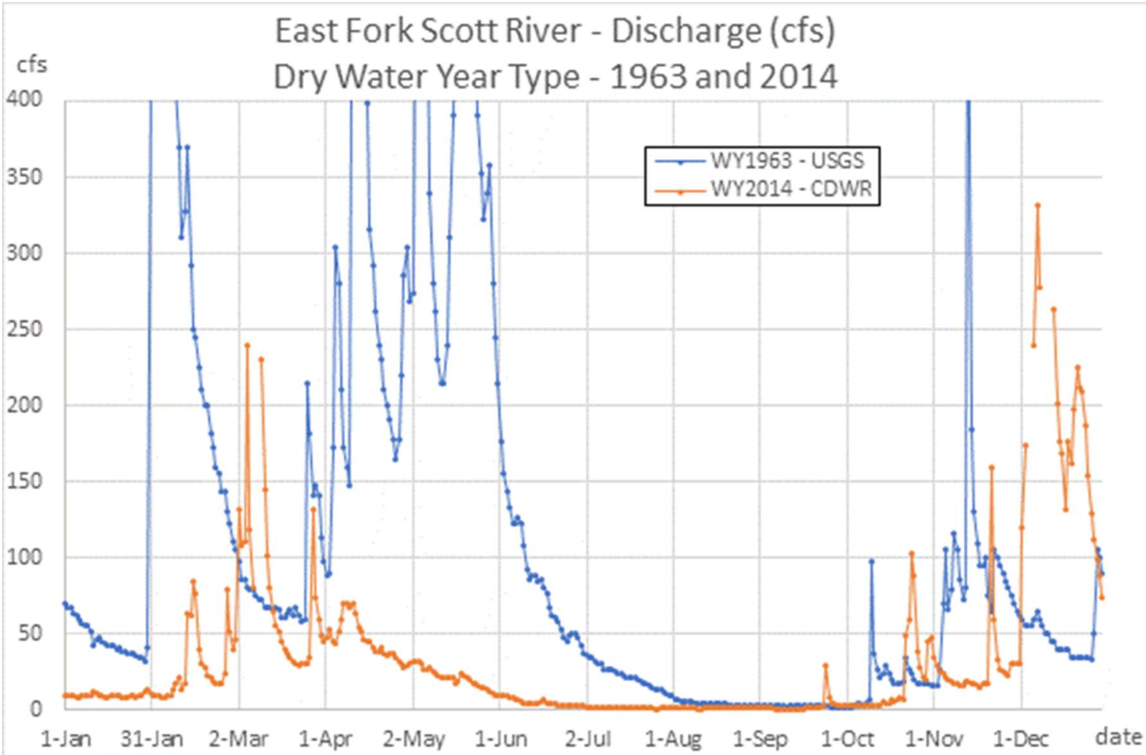


Figure 6 – East Fork Scott River discharge during a dry water year type – WY1963 and WY2014

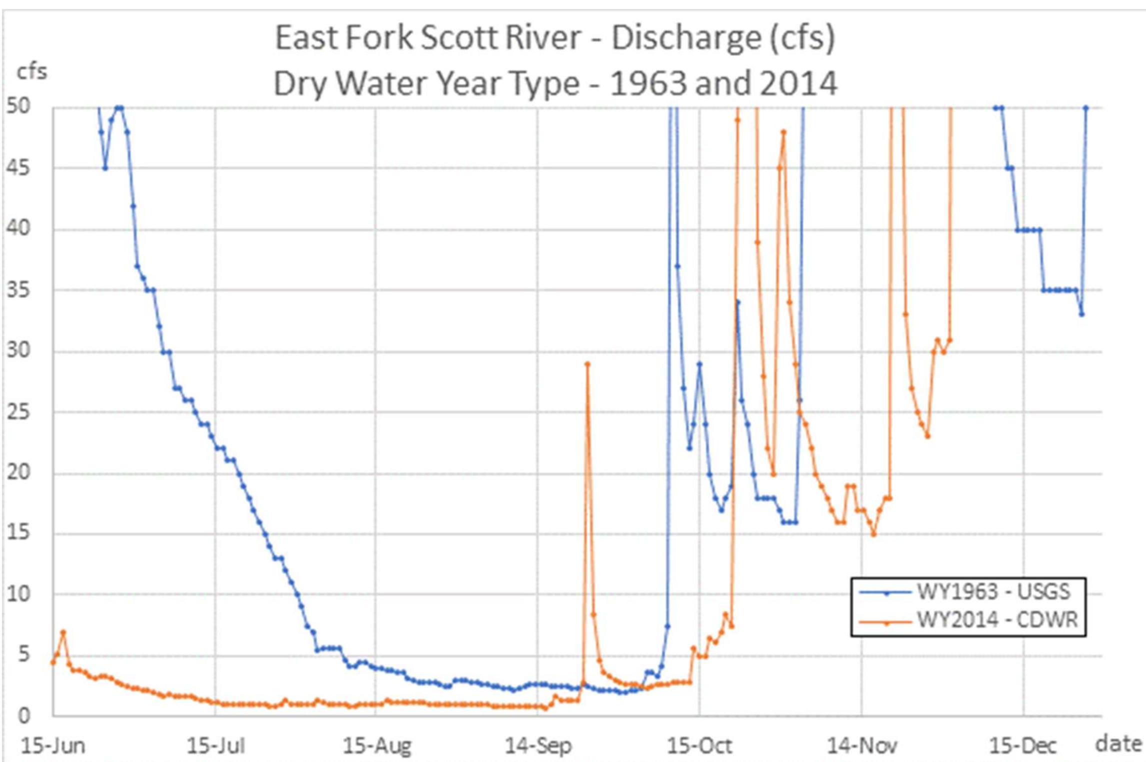


Figure 7 – East Fork Scott River discharge during a dry water year type – WY1963 and WY2014

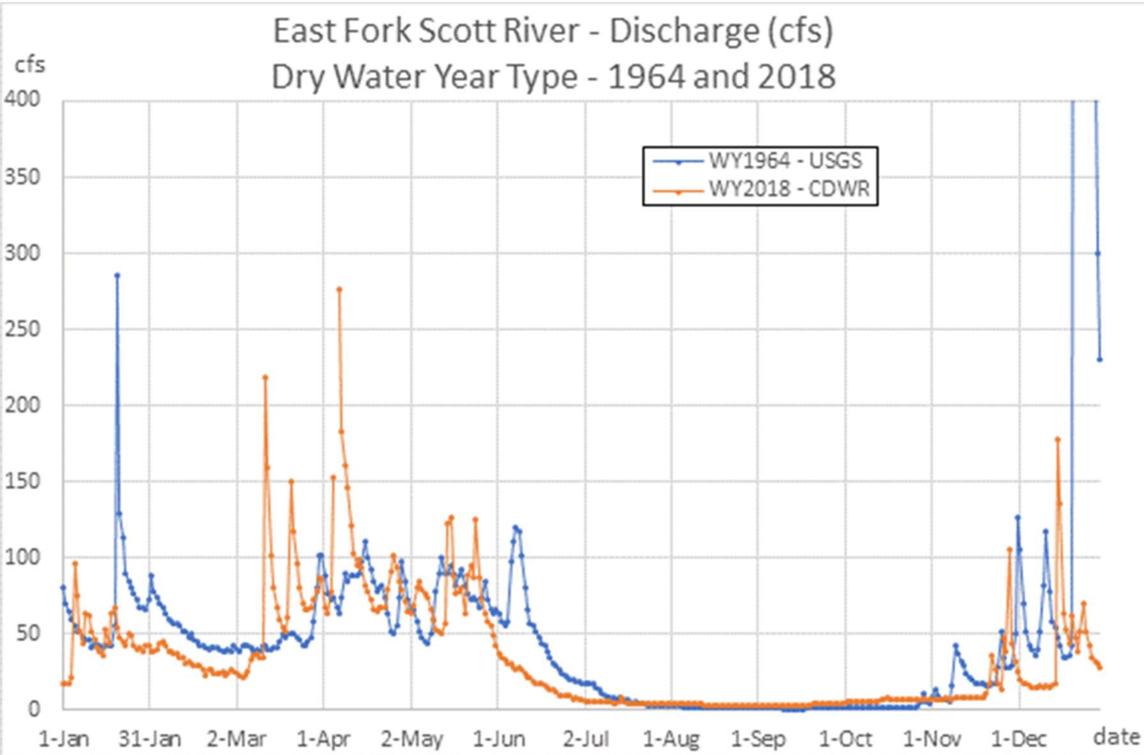


Figure 8 – East Fork Scott River discharge during a dry water year type – WY1964 and WY2018

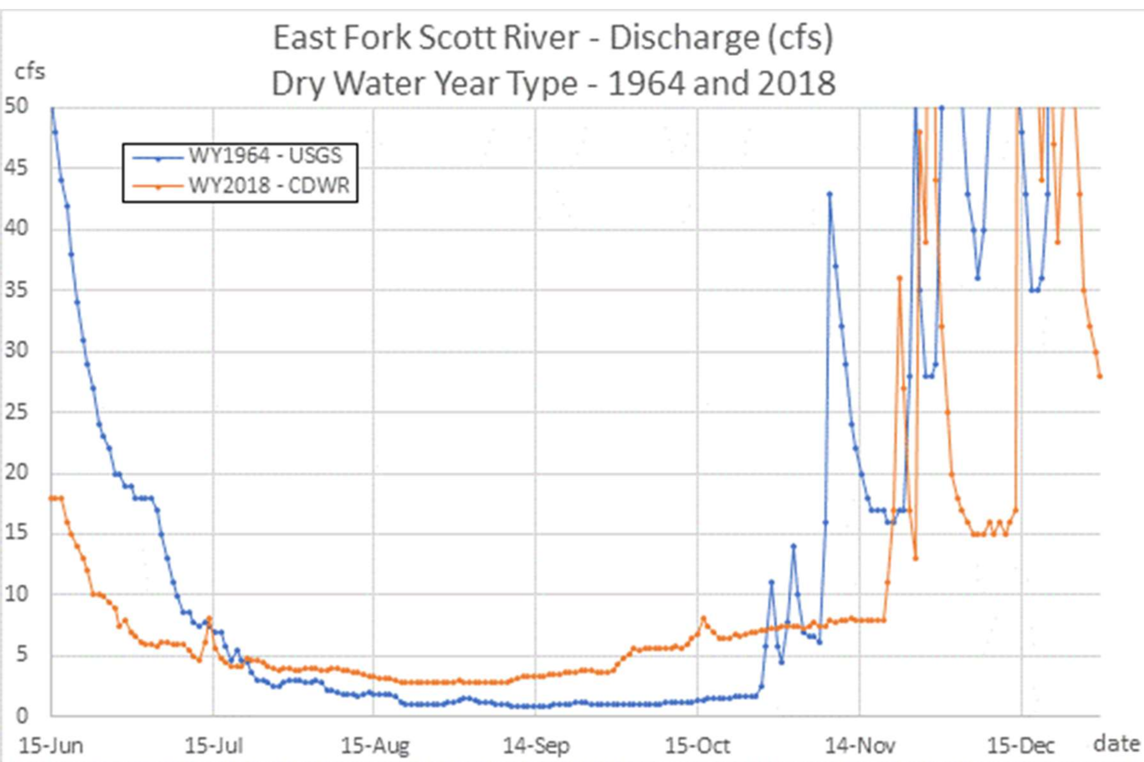


Figure 9 – East Fork Scott River discharge during a dry water year type – WY1964 and WY2018

Wet Water Year Type

East Fork Scott River discharge for WY1969 and WY2023 were compared to illustrate the wet water year type. SWE at MB3 in WY1969 and WY2023 was significantly above the average with the accumulated precipitation greater than average in WY1969 and slightly below average in WY2023 (Table 5). The hydrographs for the two wet water years look similar with the base flow in WY1969 less than the base flow in WY2023 (Figures 10 and 11).

WY	MB3 April 1 SWE (in)	Dry Rank	Fort Jones RS April 1 Accum. Precip. (in)	Dry Rank
1969	45.6	69	19.6	57
2023	47.5	71	16.4	44
Average	27.0	76 Years	17.0	87 Years

Table 5 – April 1 MB3 SWE (in) & Fort Jones RS Accumulated Precipitation (in) – WY1966 & WY2010

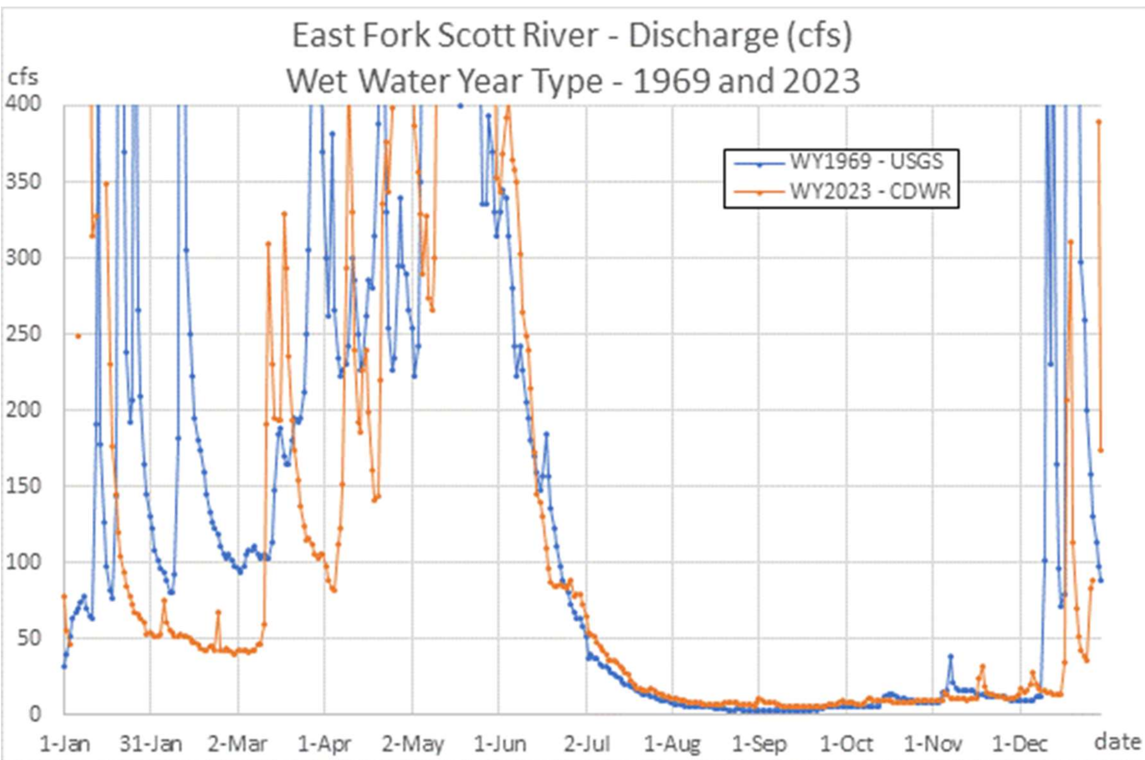


Figure 10 – East Fork Scott River discharge during a wet water year type – WY1969 and WY2023

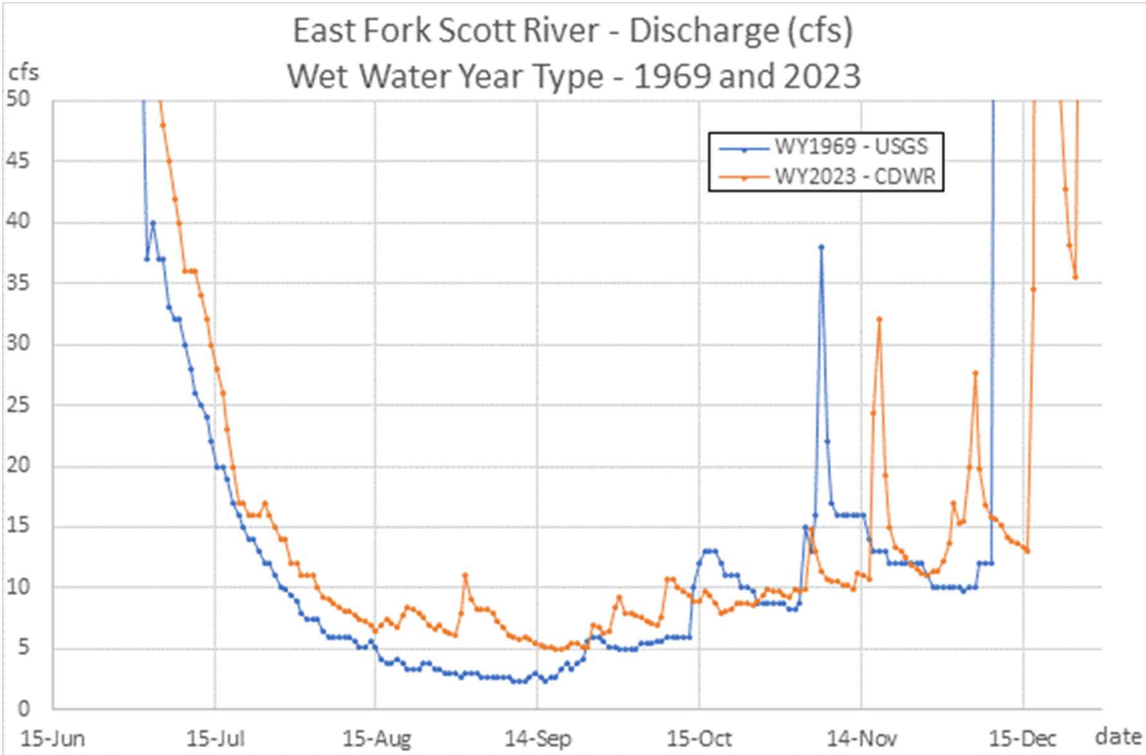


Figure 11 – East Fork Scott River discharge during a wet water year type – WY1969 and WY2023

8 APPENDIX D: DESCRIPTION OF KNOWN AND POTENTIAL RARE AND SENSITIVE PLANTS WITHIN THE PROJECT AREA

Clustered lady's slipper (*Cypripedium fasciculatum*) is a rare, perennial orchid that is found throughout the northwestern US. In California, plants occur in the understory of mixed conifer forests between 1,650 and 5,600 feet. Populations occur on a variety of soil types, but the majority are found on moist, northerly aspects with canopy cover providing filtered light to the forest floor. This species is not tracked in the California Natural Diversity Database, however Forest Service databases list 291 occurrences with 135 documented on the KNF. Of these, two occur within proposed activity units for the KNF East Fork Scott project. The U.S. Forest Service protects *C. fasciculatum* on all National Forests where the orchid occurs.

Crested potentilla (*Potentilla cristae*) is a rare species of cinquefoil known by the common name crested cinquefoil. It is endemic to the Klamath Mountains of far northern California, where it is known from a few occurrences in the subalpine and alpine climates of the high mountain ridge near Scott Valley. It is at high risk of extinction or elimination due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors. Known to occur near Corey Peak and South China Mountain, it grows in talus and moist rocky or gravelly serpentine soils.

California pitcher plant (*Darlingtonia californica*) is a perennial rhizomatous herb of carnivorous habit, possessing leaves modified to form a water-tight pitcher into which arthropods are lured. California pitcher plants flower between April and August with large, showy, sweet-smelling blooms. The plants are found in perennially wet meadows and seeps between sea level and 9500 feet. They typically grow on ultramafic soils derived from peridotite. The species' habitat is very patchy at the landscape level and is threatened by excessive collection for the horticultural trade, mining, and trampling by grazers.

Klamath manzanita (*Arctostaphylos klamathensis*) is a perennial that grows on rocky outcrops and slopes, sometimes on serpentine soils, between 4,690 and 7,380 feet in elevation. It blooms from May to August and may occur in the Project area.

Klamath sedge (*Carex klamathensis*) is a plant that is not conspicuous, is glaucous, produces rhizomes and occurs in serpentine fens.

Modoc frasera (*Frasera albicaulis* var. *modocensis*) is currently known from approximately 18 occurrences across Siskiyou, Modoc, and Lassen counties. In California, *F. albicaulis* var. *modocensis* mostly occurs in openings within pinyon and juniper woodland and Great Basin scrub and has occasionally been reported growing in upper montane coniferous forest.

Mountain lady's slipper (*Cypripedium montanum*) grows in a variety of mixed conifer forests between 1,500 and 6,500 feet. Its preferred habitat is variable, ranging from moist seeps to dry rocky hillsides.

Mt. Eddy draba (*Draba carnosula*) is a perennial that occurs in between 6,340 and 9,850 feet in elevation in subalpine and upper montane coniferous forest and talus or small boulder-fields. It grows on both serpentine and granitic soils and blooms between June and August.

Oregon fireweed (*Epilobium oreganum*) has a California Rare Plant Rank of 1B.2 (rare, threatened, or endangered in CA and elsewhere). Suitable habitat for *E. oreganum* is present in ultramafic wet meadows within the project area.

Pickering's ivesia *(Ivesia pickeringii)* is a small perennial herb in the rose family (30-50cm in height) that grows in lower montane coniferous forest, from 2,600 to 5,000 feet in elevation and is endemic to the

Scott, Trinity and Eddy Mountains. It is usually found on moderately rocky, mesic, serpentine clay substrates, and most plants concentrate in seasonally wet forest-clearings, along the edges of wet meadows, in washes, and commonly near ultramafic borne seeps (CNPS 2020; CNDDB 2020, Nakamura and Nelson 2001). Some plants extend into forested areas, but plants typically prefer areas with full sun exposure. Pickering's ivesia grows on seasonally wet meadow and fen margins, grasslands, and shrublands on ultramafic soils within pine and incense-cedar woodlands. It requires full sun and seasonally moist soils without stagnant water. Encroachment of young conifers could threaten habitat in meadow areas that have had fire exclusion for more than 50 years. The species has some tolerance to disturbance, as evidenced by re-colonization of old skid trails and where piles have been burned. Only 13 locations of this species are known (CNDDB 2024) and the closest location is six miles to the northeast of the project area.

Pink-margined monkeyflower (*Trythranthe trinitiensis*) is an annual herb in the Phrymaceae family that occurs in the vicinity of the Trinity Alps, Scott Mountain, and the Eddy Mountains in Humboldt, Siskiyou, and Trinity counties of northwestern California. *E. trinitiensis* occurs in serpentine seeps, wet meadows, and roadsides. Most of its known occurrences are in sites where the bedrock geology is mapped as peridotite or serpentine (Irwin 1994), which suggests that it is an ultramafic endemic.

Scott Mountain bedstraw (*Galium serpenticum* ssp. *Scotticum)* has a California Rare Plant Rank of 1B.2 (rare, threatened, or endangered in CA and elsewhere). Mature plants with woody root crown will resprout due to fire (Dempster and Ehrendorfer 1965; Kierstead pers. comm., 2021). Loss of tree canopy cover can be detrimental to this species.

Scott Valley phacelia (*Phacelia greenei*) is endemic to the Klamath Mountains bioregion in Siskiyou County. It has been observed in and near Scott Valley, the Scott Mountains, and the Mineral Range, as well as in the vicinity of Yreka Creek southwest of Yreka. Of the 26 documented occurrences, 13 occur at least partly on Forest Service land (all KNF); none are located in Wilderness Areas. It is a serpentine soils endemic.

Showy raillardella (*Raillardella pringlei*) is a perennial, rhizomatous herb that blooms from July to September. Plants are found in fens, meadows, seeps, stream edges, and montane coniferous forest on mesic, serpentinite soils or related ultramafics, occurring between 4,000-7,500 feet in elevation (CNPS 2020, Ferlatte 1978). Observed in 2003 on Cabin Meadow Creek, between Cabin Meadow and Cabin Meadow Lake, about 1.25 miles north of Cory Peak.

Siskiyou fireweed (*Epilobium siskiyouense*) is a perennial that grows on slopes and moist ledges in gravelly, serpentine soils. It is found between 5,490 and 8,010 feet in elevation and blooms between July and September.

Siskiyou sedge (*Carex scabriuscula*) is found on serpentine soils in moist to wet habitats at intermediate to high elevations. Although fire and fire-suppression activities are listed on some survey forms as a threat, this species may also be threatened by lack of fire, because without it, fens and other types of montane wetlands are encroached by woody vegetation (Jules et al. 2011).

Trinity buckwheat (*Eriogonum alpinum)* is a rare plant endemic to California, where it is known from only about ten occurrences in the vicinity of Mount Eddy near the border between Siskiyou and Trinity Counties. It is a state-listed endangered species because of its rarity. (CNPS 2024).

Woolly balsamroot (*Balsamorhiza lanata*) is endemic to California and is only known to occur in the Klamath and High Cascade Ranges. It is a perennial herb that blooms from April to June. Plants are found on rocky soils on a variety of substrates, including ultramafic, sedimentary, and volcanic in grassy flats near open woodland, including disturbed pasture and roadsides.

9 APPENDIX E: DESCRIPTION OF TREE SPECIES OCCURRING WITHIN THE PROJECT AREA

Douglas fir (*Pseudotsuga menziesii*), once mature, is very resistant to low- to moderate-intensity surface fires due to a variety of characteristics. Douglas fir has very thick bark, a deep rooting habit, and high crowns (Agee 1993). Douglas fir is found in the project watersheds, mainly the lower elevation portions. Douglas fir was not located in the project vegetation monitoring plots.

Foxtail pine (*Pinus balfouriana* are remnants of an extensive subalpine forest that existed in the mountains of California ten to twelve million years ago. As climate changed, foxtail pine's distribution contracted to its present-day distribution, in the northern Klamath Mountains and many miles south in the Sierra Nevada, with the two subspecies over 300 miles apart. Very rare plants found with foxtail pine include Trinity buckwheat (*Eriogonum alpinum*), a serpentine endemic and imperiled plant species known from Mt. Eddy and Cory Peak in the Shasta-Trinity National Forest, and Mt. Eddy draba (*Draba carnosula*), a serpentine endemic and imperiled plant species known only from northwestern California. Other Klamath-Siskiyou regional endemic companions to foxtail pine are Siskiyou buckwheat (*Eriogonum siskiyouense*), and Siskiyou fireweed (*Epilobium siskiyouens*e). Foxtail pine does not occur in the Project vegetation plots.

Incense cedar (*Calocedrus decurrens*) is typically subdominant to other conifer species in a stand. Incense cedar is very drought tolerant. Saplings are highly susceptible to even low-severity fires, but trees become very resistant to low- and moderate-intensity fires as they approach maturity due to thick, insulating bark and high crowns. Incense cedar has also been found to withstand high levels of crown scorch (Stephens and Finney 2002). This species was observed in the project meadow area vegetation transects but was not tallied on any of the vegetation monitoring plots.

Jeffery pine (*Pinus jeffreyi*) dominated stands are found primarily on soils derived from ultramafic rock and they occur in the lower montane through the subalpine zones (Sawyer and Thorn burgh 1977). Incense cedar is a common associate with huckleberry oak and California coffeeberry as common understory shrubs. Jeffrey pine is similar to ponderosa pine in that it develops thick bark relatively early in life rendering it resistant to most low- and moderate-intensity fires. The Jeffrey pine and incense cedar overstory, generally from 20% to upwards of 30%, can vary from either species being dominant to the two being codominant, but total canopy cover is always greater than that seen in the Jeffrey pine savanna community. Jeffrey pines in this community can reach 300 to 400 years of age and incense cedars typically develop a contorted appearance with age.

Lodgepole pine (*Pinus contorta* ssp. *Murrayana*) often occupies areas with at least seasonally wet soils and appears to be the dominant conifer that is encroaching on meadows in the Project area. Fire can create the conditions necessary for rapid, often dense reseeding from its serotinous cones, which insulate the seeds from fire but require fire to open the scales and release the seeds. The high-elevation conditions that reduce ignition probabilities in montane and subalpine forests often allow these forest types to escape fire for centuries, which in turn promotes fuel build ups that may lead to broad-scale burns of mixed severity (Baker, 2009).

Mountain hemlock (*Tsuga mertensiana*) is a tree of the subalpine regions and in the colder areas of the red fir and mixed conifer forest. Because it grows at higher elevations, its branches are stiff to shed snow. This species is shade tolerant and does not occur in the project vegetation plots.

Ponderosa pine (*Pinus ponderosa*) is shade intolerant. Saplings and large pines are more fire resistant than many true firs and Douglas fir. Pines can survive and grow after fires even when half of their crowns have been scorched. This species was not located in the project vegetation plots but is found in the lower watersheds and on reforested plantations.

Red fir (*Abies magnifica* subsp. *Shastensis*) is occasionally found on high elevation serpentine soils with the more common foxtail pine, western white pine, and Jeffrey pine. Red fir is relatively shade tolerant and can carry large basal areas per unit area and maintain high growth rates for an unusually long time, partly as a result of its shade tolerance. In the Project vegetation plots, red fir was found primarily in the Rock Fence Creek transects.

White fir (*Abies concolor*) habitat in the Klamath Mountains, the Cascades, and the Sierra Nevada occurs between mixed conifer and red fir habitats (Parker and Matyas 1981). White fir is shade tolerant and fire intolerant. Seedlings were found to be common in both the Rock Fence and Cabin Meadows vegetation plots.

Whitebark pine (*Pinus albicaulis*) occurs on the high elevation ridge tops within the Project area. On December 15, 2022, the U.S. Fish and Wildlife Service published a final rule (87 FR 76882) to list the whitebark pine as a threatened species under the Endangered Species Act. Whitebark pine is declining rapidly throughout much of its range, particularly in the Northern Rockies, where some locations have experienced up to 90% tree mortality. Other major threats include predation by the native mountain pine beetle, impacts from altered fire regimes, climate change and the combined negative effects of these individual threats. This species does not occur in the project vegetation plots.

10 APPENDIX F: DESCRIPTION OF AQUATIC VERTEBRATES OCCURRING WITHIN THE PROJECT AREA

- **Fish**

Rainbow trout and **brook trout** are present within the drainages of Cabin Meadow Creek and Rock Fence Creek. Typical stream habitat is represented by cool or cold water, moderate to higher velocity flows, and gravel or small cobble bottoms. A complex environment is ideal with riffles, pools, boulders, submerged wood, aquatic vegetation, and other cover. Within the project watersheds fish are generally restricted to the respective mainstems, but may utilize perennial and seasonal tributaries when sufficient water is available. The upstream distribution of fish varies annually and is dependent upon flow conditions. However, fish are, in general, expected to be present as far upstream as possible dependent upon gradient, flow, and natural barriers. Fish are also present in Rock Fence Lake in the headwaters of Rock Fence Creek. While fish have been reported to be in Cabin Meadow Lake in the past, no recent observations are noted and it is believed they are extirpated. Connectivity between mainstem habitat and the lakes is very poor; and lake reintroduction in the event of extirpation is not expected without human assistance.

- **Amphibians**

Cascades Frog - Cascades frogs are highly aquatic amphibians that occur in montane lakes, ponds, meadows, and streams above about 4,500 feet. In California, they occur in the Klamath Mountains and in the Southern Cascades. Due to population declines, they are currently being considered for listing on the California Endangered Species List. They breed in still water habitats including perennial lakes/ponds, long-season ephemeral ponds, and spring-fed meadow pools. Larvae and young frogs are susceptible to predation by fishes including rainbow and brook trout so refugia from fish is important. Summer foraging habitat includes a wide range of aquatic habitats including flowing streams. In winter, the frogs gather in deep water such as lake/pond bottoms or springs where the water does not freeze solid. While frogs occasionally travel overland between habitats, especially during wet conditions, they are much more likely to use aquatic pathways for dispersal.

In summer, Cascades frogs are observed throughout both Cabin Meadow Creek and Rock Fence Creek drainages, primarily within stream and wet meadow environs. From previous surveys conducted by the US Forest Service and CDFW, breeding sites include Upper Cabin Meadow Lake, a dammed pond on private land at the top of Rock Fence Creek, and a lower elevation wet meadow at the bottom of the Rock Fence Creek project area. While additional breeding localities may be present, they may only be utilized occasionally when conditions are appropriate and, thus, have not been identified at this time. Overwintering habitats are unknown but likely to be at or near the breeding locations.

Coastal Giant Salamander (also known as Pacific Giant Salamander) **-** Habitat type is different depending on if considered for terrestrial adults versus aquatic larvae or neotic adults. Due to the difficulty in detecting the terrestrial lifestage, it is unclear what proportion of the local population remain sexually mature aquatic adults compared to fully terrestrial animals. Terrestrial adults often occur near streams and ponds/lakes, else upslope wet forests, usually under rocks, logs, leaves, and in burrows and logs. Habitat for aquatic stages, including neotic adults, is usually clear, cool or cold, well-oxygenated streams, and sometimes montane lakes and ponds. While suitable systems are normally believed to require a perennial channel, instances of individuals utilizing the hyporheic zone of seasonally intermittent streams have been reported. Females will lay eggs in stream habitats under rocks and logs or in crevasses.

Coastal giant salamanders have been reported in mainstem channels of both Cabin Meadow Creek and Rock Fence Creek. Full distribution within the drainages is unknown, but probably concentrated within perennial streams.

Long-Toed Salamander - Breeding occurs within permanent or seasonal lakes and ponds, in wet meadows, and sometimes in quiet water at the edge of low gradient streams. Fishless waters are preferred due to the palatability of larvae to fish, including introduced trout. Populations which transform to adults within one season may utilize ephemeral systems; and larvae at higher elevations which overwinter one or more years require a perennial waterbody. After metamorphosis, juvenile and adult salamanders are terrestrial, spending much of their time in subterranean locations such as mammal burrows, beneath forest litter, under logs, and in rock fissures.

The only location where long-toed salamander breeding has been reported is Upper Cabin Meadow Lake. A restricted distribution in the Cabin Meadow Creek and Rock Fence Creek drainages is expected due to the presence of fish in potentially suitable breeding waters such as Rock Fence Lake and likely requirement for perennial breeding waters most years due to high elevation necessitating larvae to overwinter.

Rough-Skinned Newt - A variety of aquatic and terrestrial habitats are used. Breeding preference is for ponds and lakes, although wet meadows and slow-moving streams may also be utilized. Populations which metamorph within one season may utilize ephemeral systems, but larvae at higher elevations may require two seasons of growth, necessitating a perennial waterbody. As juveniles and adults, rough-skinned newts generally spend most of their time on land underground in burrows or beneath logs, bark, or leaves. However, some adults will spend a substantial portion of the year, outside of breeding, within an aquatic environment.

Rough-skinned newts are observed in both Cabin Meadow Creek and Rock Fence Creek drainages. Known breeding sites include, in the Cabin Meadow Creek drainage, a seasonal headwater ridgeline pond southeast of Cory Peak and, in the Rock Fence Creek drainage, a seasonal headwaters pond. Additional unidentified breeding localities are likely present.

Sierran Treefrog (also known as Pacific Chorus Frog) - Habitat is variable; and individuals may be found far from water outside of the breeding season as long as a moist refugia is available. Forest, woodland, chaparral, meadows and grassland, livestock pasture, lakes/ponds, streams, desert and dryland riparian corridors, and urban areas are utilized; and presence is from sea level to high montane locales. Similar to the Cascades frog, breeding usually occurs within perennial lakes/ponds, long-season ephemeral ponds, and low gradient meadows with surface water, with preference for fishless habitat.

Sierran treefrog are observed in both Cabin Meadow Creek and Rock Fence Creek drainages, usually in or adjacent lakes/ponds, streams, or wet meadows. Known breeding sites in the Cabin Meadow drainage include Upper and Lower Cabin Meadow Lakes and a headwaters wet meadow with ephemeral pondlets. In the Rock Fence Creek drainage, known breeding sights are a seasonal headwaters pond and a lower elevation wet meadow. While additional breeding localities are likely present, they may only be utilized opportunistically when conditions are present and/or are sited at meadows rarely visited by surveyors.

Tailed Frog - Habitat is moderate to steep gradient perennial streams with clear, cold water and rocky substrate. All lifestages are adapted to a fast-flowing stream environment. They may be found in both fishless and fish-bearing systems. Primarily active at night, tailed frogs may also be found during the day, especially under rocks or other cover.

Tailed frogs have not been observed within either Cabin Meadow Creek or Rock Fence Creek drainage. The nearest known record within the greater East Fork Scott River watershed is Big Mill Creek, approximately eight miles to the southwest. However, few surveys targeting tailed frog have been conducted within the larger watershed; and none in association with Cabin Meadow Creek or Rock Fence Creek. As habitat is potentially present, this species may be present.

Western Toad - Habitat is wide-ranging, including wetlands, springs, creeks, ponds and small lakes, meadows, oak woodland, coniferous forest, and desert riparian. While often found near waterbodies or wet meadows, western toad will traverse and forage in terrestrial habitat far from water as long as refuges from heat and cold are present, such as moist soil litter, rodent burrows, or hollow root systems. Breeding requires perennial or seasonal open water habitats such as lakes/ponds or meadows with surface water. The breeding success of western toad is not impacted by fish presence because eggs and tadpoles are unpalatable.

Western toads are occasionally encountered in both Cabin Meadow Creek and Rock Fence Creek drainages. Although breeding sites have not been explicitly identified, juveniles have been observed, thereby implying presence of successful reproduction.

11 APPENDIX G: DESCRIPTION OF KNOWN AND POTENTIAL TERRESTRIAL SPECIES WITHIN THE PROJECT AREA

American badger (*Taxidea taxus*) is a California Species of Special Concern but has no federal listing. Although badgers are widely distributed in the state, they may be comparatively uncommon or absent from some areas where they historically occurred. Badgers are primarily solitary, although breeding pairs and family groups are sometimes observed. Badgers have short, stout legs and a flattened body. A badger's head is relatively small in proportion to its body and a distinctive white stripe extends from its nose over the back of the head. Its ears are short and it has a short, furry tail. Badgers use their claws to excavate dens for protection, sleeping sites, food storage, places to give birth, and as focal areas for foraging. Badgers are carnivores and are well-adapted to preying on burrowing rodents, including ground squirrels, but they will also prey on non-burrowing mammals. They are most abundant in the drier open stages of most shrub, forest, and herbaceous habitats with friable soils. Habitat does exist in the project area.

Fisher, also known as the Pacific Fisher (*Pekania pennanti*), has a range in California that includes the coast redwoods, Southern Cascades, and Klamath and Sierra Nevada Mountains. Fishers are associated with areas of high cover and structural complexity in large tracts of mature and old-growth forests. Other site characteristics that can be important include presence of nearby water, slope, elevation, and snow characteristics. Fisher denning habitat is typically conifer, hardwood, or conifer-hardwood habitats that contain green trees, snags or downed logs large enough to support a denning female fisher. Resting habitat is typically conifer, hardwood, or conifer-hardwood habitats which have trees large enough to support resting fisher on branches or other perches. Fishers are generalist predators. No formal surveys have been conducted in the Project area, but the area does contain suitable habitat for fisher.

Gray wolf (*Canis lupus*) is listed as endangered both federally and by the State of California. Wolves are habitat generalists and historically occupied diverse habitats in North America, including tundra, forests, grasslands, and deserts. Their primary habitat requirements are the presence of adequate ungulate prey, and water. Habitat use is strongly affected by the availability and abundance of prey, availability of den sites, ease of travel, snow conditions, availability of protected public lands, density of livestock, road density, human presence, and topography. (CDFG 2011). The CDFW Gray Wolf Activity Map, checked in November 2024, showed no known wolf packs in the Rock Fence and Cabin Meadow Creek drainages, which are located to the south of the mapped area of the Whaleback Pack. This species has a large range, so it is quite possible for the Project area to be within the range of this species in future years.

North American porcupine (*Erethizon dorsatum*) are herbivores. During spring and summer, they consume a varied diet of grasses, forbs, shrubs, wetland plants, and some agricultural crops. In winter, their diet consists largely of twigs, bark, and the cambium of hardwood and conifer trees. Anecdotal evidence seems to indicate their numbers are on the decline and the CDFW is requesting sightings of this species be reported to CDFW.

Northern goshawk (*Accipiter gentilis*) is a California Species of Special Concern (CDFW 2008). Its range includes much of the northern hemisphere, from near the timber line in the north to as far south as sub-tropical regions. The species ranges throughout California with most observations inland from the coast. Northern goshawk habitat includes the north coast and subalpine and upper montane coniferous forests. Within these habitats this species tends to nest on north slopes near bodies of water. This larger raptor is normally found in mature douglas fir stands with a scattered hardwood component and light understory/shrub layer. The northern goshawk is a medium-sized raptor and is the largest member of the Accipiter genus. The most important prey is small mammals and birds found in forest habitats. Goshawks are often seen flying along transition zones between habitat types, such as the edge of a forest or meadow, flying low and fast hoping to surprise unsuspecting prey. Adults return to their nesting territories by March or April and begin laying eggs in April or June.

Northern spotted owl (*Strix occidentalis caurina*) is the largest of three subspecies of spotted owls, and inhabits structurally complex forests from southwestern British Columbia, through the Cascade Range, coastal ranges, and intervening forested lands in Washington, Oregon, and northern California, as far south as Marin County. The southeastern boundary of its range is the Pit River area of Shasta County, California. In 2016, the California Fish and Game Commission approved listing the Northern Spotted Owl (*Strix occidentalis caurina*) as Threatened under the California Endangered Species Act. It has been listed as Threatened under the federal Endangered Species Act since 1990. The northern spotted owl is relatively long-lived, has a long reproductive life span, invests significantly in parental care, and exhibits high adult survivorship relative to other North American owls. Northern spotted owls are medium-sized, chocolate brown owls with dark eyes, and they have round or irregular white spots on their head, neck, back, and underparts. In the southern portion of the range (California and parts of Oregon) dusky-footed woodrats are the main component of the diet. Other prey include deer mice, tree voles, red-backed voles, shrews, gophers, snowshoe hare, rabbits, bushy-tailed woodrats, chipmunks, small to medium sized birds, bats, and insects. Northern Spotted Owl populations are declining throughout the range of the subspecies and annual rates of decline have been accelerating in many areas, including in California. Population sizes within three large study areas in California have declined 31-55% since the 1990s and these declines are accelerating. The ongoing and increasing effects of Barred Owls, coupled with other threats including habitat loss due to wildfire and timber harvest, and reduced recruitment due to climate change, will likely lead to additional declines into the future. The nearest northern spotted owl activity center is 3 miles west of the project area at Lovers Leap. There is also an activity center 4.3 miles east, on Eddy Creek, last observed in 2015.

Osprey (*Pandion haliatus*) are large, long-winged hawks that build large nests in treetops and cliff ledges within 15 miles of a fish-producing body of water, including oceans, bays, freshwater lakes, and large streams.

Pacific marten (*Martes caurina*) are a small to mid-sized forest carnivore in the weasel family. They need a variety of different-aged forest stands, particularly old-growth conifers and snags which provide cavities for nests and dens. The diet of Pacific martens is primarily small mammals, such as mice, voles, chipmunks and squirrels, but also includes mid-sized mammals and birds, insects, carrion and fruits/berries. Pacific martens need large areas of mature, dense forest.

Pallid bat (*Antrozous pallidus*) The pallid bat is a California species of special concern and a USFS sensitive species. Suitable roost sites for this species existing in the project are in the form of snags and large conifer trees. Usually found below 6,000 feet.

Sierra Nevada red fox (*Vulpes vulpes necator*) was historically found in much of the Sierra Nevada, the southern Cascades near Lassen Peak and Mount Shasta, and the Klamath Mountains near Mt. Eddy and the eastern Trinity Alps. *V. v. necator* uses dense vegetation and rocky areas for cover and den sites. Den sites include rock outcrops, hollow logs and stumps, and burrows in deep, loose soil. It hunts small and medium-sized mammals, ground squirrels, gophers, mice, marmots, woodrats, pikas, and rabbits. In the Sierra Nevada, it prefers forests interspersed with meadows or alpine fell-fields. The Sierra Nevada red fox has not been observed within either Cabin Meadow Creek or Rock Fence Creek drainage. The nearest known record is Big Mill Creek, approximately eight miles to the southwest. As habitat is present, this species may be present.

Western bumblebee (*Bombus occidentals*) is a California candidate species. Once common and widespread, species has declined precipitously from central California to southern British Columbia, perhaps from disease. The CNDDB shows this species was verified in 1984 but the locational description of Gazelle Mountain Pass does not provide accurate locational information. Threats to the western bumblebee include livestock grazing and conifer encroachment that can interfere with the habitat requirements of this species (availability of nectar and pollen throughout the colony season and availability of underground nest sites and hibernacula). The project area meadows could provide habitat for this species and treatments to reduce conifer encroachments should have beneficial effects.

Wolverine (*Gulu gulo*) is listed as threatened by California but has no federal listing. Very little is known about wolverine occurrence or abundance in California. The home range of this species has been reported to range from 100 to 1500 square kilometers; the planning watersheds would only comprise a portion of a single wolverine's home range. No wolverines or evidence of them were noticed during the KNF East Fork project planning or SRWC field work and project planning. Given a moderate amount of large cull trees, large snags or large woody debris that exist in these watersheds, it is possible that the project area would serve as a denning site for wolverines. It is also possible that portions of the project area could serve as foraging ground for this species. There are ten documented historic detections of wolverines on the KNF but no den sites are known (Cuenca 2019).

12 APPENDIX H: ROCK FENCE CREEK WATERSHED HERBACEOUS AND SHRUB SPECIES OCCUPANCY LIST.

Species	USDA Code	Wetland association
Achillea millefolium	ACMI2	FACU
Aconitum columbianum ssp. *columbianum*	ACCOC3	FACW
Adiantium aleuticum	ADAL	FAC
Allium validum	ALVA	OBL
Amelanchier alnifolia var. *pumila*	AMAL2	FACU
Anemone drummondii	ANDR	UPL
Angelica tomentosa	ANTO	UPL
Aquilegia formosa	AQFO	FAC
Bistorta bistortoides	BIBI5	FACW
Bromus spp.		
Bromus sitchensis var. *carinatus*	BRCA5	UPL
Calliscirpus criniger	ERCR4	OBL
Calochortus nudus	CANU2	FAC
Carex abrupta	CAAB2	FAC
Carex echinata	CAEC	OBL
Carex klamathensis	CAKL	OBL
Carex lemmonii	CALE7	OBL
Carex luzulina	CALU7	OBL
Carex praegracilis	CAPR5	FACW
Carex scabriuscula	CASC14	FACW
Castilleja applegateii	CAAP4	UPL
Castilleja miniata	CAMI12	FACW
Cirsium douglasii	CIDO2	OBL
Cirsium remotifolium	CIRE	UPL
Crepis pleurocarpa	CRPL	UPL
Danthonia californica	DACA3	FAC
Darlingtonia californica	DACA5	OBL
Dasiphora fruticosa	DAFR6	FAC
Delphinium nuttallianum	DENU2	FAC
Deschampsia cespitosa	DECE	FACW
Deschampsia elongata	DEEL	FACW
Draba spp.		
Drymocallis glandulosa	POGLG4	FAC
Eleocharis quinqueflora	ELQU2	OBL
Elymus glaucus	ELGL	FACU
Elymus trachycaulis	ELTR7	FAC

Species	USDA Code	Wetland association
Epilobium ciliatum	EPCI	FACW
Eremogone congesta var. *suffrutescens*	ARCOS3	UPL
Eriogonum nudem	ERNU3	UPL
Eriophyllum lanatum	ERLA6	UPL
Erythranthe trinitiensis		
Frangula californica	FRCA12	UPL
Frangula rubra	FRRU	UPL
Galium serpenticum ssp. *scotticum*	GASES2	UPL
Gentiana calycosa	GECA	FACW
Gentiana newberryi	GENE	FACW
Glyceria spp.		
Hastingsia alba	HAAL2	OBL
Helenium bigelovii	HEBI	FACW
Hieracium albiflorum	HIAL2	UPL
Ipomopsis aggregata	IPAG	UPL
Juncus balticus	JUARL	FACW
Juncus ensifolius	JUEN	FACW
Juncus nevadensis	JUNE	FACW
Juncus orthophyllus	JUOR	FACW
Ligusticum grayi	LIGR	FAC
Lilium pardalinum ssp. *shastense*	LIPAS	FACW
Luzula spp.		
Melica bulbosa	MEBU	FACU
Erythranthe linearifolia	MIPRL2	OBL
Narthecium californicum	NACA2	OBL
Oreostemma alpigenum	ORAL4	FAC
Perideridia parishii	PEPA21	FAC
Phacelia pringlei	PHPR	UPL
Phlox diffusa	PHDI3	UPL
Poa pratensis	POPR	FAC
Poa secunda	POSE	FACU
Poa bolanderii	POBO	UPL
Polygonum douglasii	PODO4	FACU
Potentilla gracilis	POGR9	FAC
Prunella vulgaris	PRVU	FACU
Pseudostellaria jamesiana	PSJA2	UPL
Quercus vaccinifolia	QUVA	UPL
Rhododendron columbianum	LEGL	OBL
Ribes binominatum	RIBI	UPL
Rosa gymnocarpa	ROGY	FACU

Species	USDA Code	Wetland association
Scuttelaria antirrhinoides	SCAN4	UPL
Senecio integerrimus	SEIN2	FACU
Senecio triangularis	SETR	FACW
Silene lemmonnii	SILE2	UPL
Sidalcea oregana	SIOR	FACW
Sisyrinchium idahoense	SIID	FACW
Spiraea splendens	SPSP2	UPL
Symphyotrichum spathulatum	SYSP	FAC
Triantha occidentalis	TROC7	FACW
Trifolium cyathiferum	TRCY	FAC
Trifolium longipes	TRLO	FAC
Trifolium monanthum	TRMO2	FAC
Veratrum californicum	VECA2	FAC
Viola adunca	VIAD	FAC
Viola mackloskeyii	VIMA2	OBL

13 APPENDIX I: ROAD SURVEY ATTRIBUTE FIELDS

Parameter	Answer required (y/n)	Answer format	Level 1	Level 2	Level 3	Include comment box
Road Location Descriptors						
Basin	y	Choose one	Cabin Meadow			
			Rock Fence			
Date	y	Short answer	Short answer			
Crew	y	Short answer	Short answer			
Feature number	y	Short answer	Short answer (001, 002, 003, etc.)			
GPS Coordinates	y	Short answer	Short answer			
Photo ID	y	Short answer	Short answer			
Road features						
Road location	y	Choose one	Ridge			x
			Midslope			
			Toeslope			
			Valley bottom upland			
			Predicted/existing meadow			
Road slope	y	Choose one	<2%			
			2-4%			
			5-8%			
			9-12%			
			>12%			
Road type	n	Choose one	Permanent year round			
			Seasonal			
			Not trafficable (closed/abandoned)			
			Decomissioned			
Road maintained	n	Choose one	Yes			

Parameter	Answer required (y/n)	Answer format	Level 1	Level 2	Level 3	Include comment box
			No			
Road surface type	y	Choose multiple	Paved			
			Crushed rock/gravel	Fresh		
				Weathered		
			Earthen	Exposed soil		
				Exposed bedrock		
				Vegetated	Wetland	
					Herbaceous	
					Shrub	
					Tree	
Road surface condition	y	Choose multiple	Stable and well drained			x
			Dry rock powder/fine sediment			
			Standing water			
			Potholes			
			Rilled			
			Rutted			
			Gullied			
Road profile	y	Choose one	Outsloped			
			Crowned			
			Insloped			
			Flat			
Road width	n	Short answer	Short answer			
Cut/fill presence	y	Choose one	Cutslope only			
			Fillslope only			
			Cutslope and fillslope			
Cutslope height	n	Choose one	<3'			
			3-6'			

Parameter	Answer required (y/n)	Answer format	Level 1	Level 2	Level 3	Include comment box
			>6'			
Cutslope morphology	n	Choose one	Uniform			
			Hummocky			
			Steplike			
			Complex			
Cutslope veg cover	n	Choose one	50%			
			<50%			
			None/barren			
Dom cutslope veg type	n	Choose one	Wetland			
			Herbaceous			
			Shrub			
			Tree			
Cutslope stability	n	Choose one	Stable			x
			Ravel			
			Unstable/failed			
Fillslope morphology	n	Choose one	Concave			
			Convex			
			Planar			
Fillslope veg cover	n	Choose one	50%			
			<50%			
			None/barren			
Dom fillslope veg type	n	Choose one	Wetland			
			Herbaceous			
			Shrub			
			Tree			
Fillslope stability	n	Choose one	Stable			x
			Minor erosion			
			Extreme erosion			

Parameter	Answer required (y/n)	Answer format	Level 1	Level 2	Level 3	Include comment box
			Unstable/failed			
Road drainage features						
Geomorphic association	y	Choose one	Ridgetop			x
			Headwall swale			
			Midslope swale			
			Hillslope			
			Hillslope bench			
			Inner gorge			
			Landslide scar			
			Landslide deposit			
			Alluvial fan			
			Glacial outwash/till			
			Moraine			
			Fluvial terrace			
			Valley bottom (dry/upland)			
			Wet meadow or fen			
Road drainage	y	Choose multiple	Springs or seeps present in cutbank or road surface			x
			Persistent saturation of road surface			
			Wetland vegetation on road surface			
			Water effectively directed off road surface			
			Inboard drainage	No inboard ditch		
				Inboard ditch	Clear and functioning well	

Parameter	Answer required (y/n)	Answer format	Level 1	Level 2	Level 3	Include comment box
					Plugged with debris	
					Buried with sediment	
					Flow diverted onto road surface	
					Incising	
					Gullied	
					Rocked	
				Ditch relief structure	short answer decribing type, size, condition, and stability at point of discharge	
				Distance between ditch relief structures	short answer (distance in ft)	
			Outboard drainage			
			Diffuse or no drainage (flat)			
Road-stream crossings	y	Choose one	captured by inboard ditch			x
			dip			
			ford			
			bridge			
			culvert			
Culvert type	n	Choose one	Steel			
			HDPE			
Culvert inlet type	n	Choose one	On grade			
			Above grade			

Parameter	Answer required (y/n)	Answer format	Level 1	Level 2	Level 3	Include comment box
			Below grade			
			Drop inlet			
			Trash rack			
			Other			
Culvert diameter (inches)	n	Choose one	<15"			
			15"			
			18"			
			24"			
			30"			
			>30"			
			Other			
Culvert inlet condition	n	Choose one	Good			y
			Damaged			
			Aggraded			
			Restricted			
Culvert inlet opening (% of original)	n	Short answer	0-10%			
			10-25%			
			25-50%			
			50-75%			
			75-100%			
Culvert angle (%)	n	Short answer	Short answer			
Culvert outlet type	n	Choose one	Downspout			
			Shotgun			
			At grade			
			Other (short answer)			
Culvert outlet condition	n	Choose one	Good			
			Damaged			
			Aggraded			

Parameter	Answer required (y/n)	Answer format	Level 1	Level 2	Level 3	Include comment box
			Restricted			
Culvert discharge to	n	Choose multiple	Non-eroding open slope			
			Gully			
			Ditch			
			Landslide			
			Wetland			
			Stream channel			
Diversion potential	n	Choose one	High			x
			Medium			
			Low			
Road Erosion Features						
Erosion process	y	Choose one	Surface erosion			x
			Rill			
			Gully			
			Shallow landslide			
			Deep-seated landslide			
			Debris flow/ torrent track			
			Debris slide slopes			
			Topples/falls			
			Other			
Associated with road	y	Choose one	None			
			Cut bank			x
			Fill slope			
			Sidecast			
			Other (short answer)			
Erosion severity	y	Choose one	High			
			Medium			
			Low			

Parameter	Answer required (y/n)	Answer format	Level 1	Level 2	Level 3	Include comment box
Geology	n	Choose multiple	Ultramafic (peridotite, pyroxene, serpentine)			
			Gabbro			
			Dioritic plutonic			
			Sedimentary (sandstone, shale, chert, limestone)			
			Landslide			
			Alluvial fan			
			Glacial outwash/till			
			Moraine			
			Fluvial terrace			
			Unconsolidated alluvium amd colluvium			
Bedrock condition	n	Choose one	Strong			x
			Moderate			
			Weak			
Hillslope morphology	n	Choose one	Uniform			x
			Hummocky			
			Steplike			
			Complex			
Slope steepness (%)	n	Short answer	Short answer (%)			
Soil condition	n	Choose one	Cohesive			
			Clast-supported			
			Matrix-supported			
			Loose			
Edge condition	n	Choose multiple	No problem			x
			Badly rilling			

Parameter	Answer required (y/n)	Answer format	Level 1	Level 2	Level 3	Include comment box
			Badly raveling			
			Badly slumping			
			Seep spring			
			Bedrock			
Dominant size of displaced material	y	Choose one	Boulder			
			Cobble			
			Gravel			
			Sand			
			Silt and clay			
Eroded volume (cubic ft)	y	Short answer	Height			
			Length			
			Width			
			Volume			
Estimated % delivery to stream	n	Short answer	Short answer			
Causes for road erosion/drainage problem(s) and recommendations						
Cause	y	Choose multiple	Road design			x
			Culvert design			
			Stream crossing			
			Offroad HOV use			
			Livestock grazing			
			Hiking trail-related disturbance			
			Concentrated runoff			
			Open slope mass wasting			
Recommendations	y	Choose multiple	Remove road			x
			Winterizing road			
			Restrict or limit OHV use			

Parameter	Answer required (y/n)	Answer format	Level 1	Level 2	Level 3	Include comment box
			Avoid concentrating surface runoff onto unstable slopes			
			Outslope road grade			
			Install rolling dips			
			Install water bars			
			Grade to address surface erosion and rilling of road surface			
			Rock road surface			
			Clean and maintain inboard drainage ditch			
			Clean and maintain drainage relief structures			
			Reduce distance between drainage relief structures by installing new cross drains			
			Replace culvert			
			Install drop inlet			
			Clean and maintain culvert inlet			
			Install downspout to culvert outlet			
			Dissipate outfall velocities with coarse rock			
			Remove berm			
			Repair/stabilize fillslope			
			Repair/stabilize cutslope			
			Stabilize gully			
			Revegetate			

Parameter	Answer required (y/n)	Answer format	Level 1	Level 2	Level 3	Include comment box
			Mulch bare erodible surfaces			
			Designate/construct parking and trail use areas			
			Periodic inspection needed			
			Additional evaluation recommended			

14 APPENDIX J: WORKS CITED

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