APPENDIX A – Wilderness Minimum Requirement Analysis

SEQUOIA AND KINGS CANYON NATIONAL PARKS

MINIMUM REQUIREMENT ANALYSIS WORKSHEET

". . . except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act..."

– The Wilderness Act, 1964

Instructions:

A Minimum Requirement Analysis (MRA) is required for ***all*** administrative actions in wilderness that either propose a Wilderness Act Section 4(c) prohibited use or have an effect on wilderness character (per Director's Order 41). **See the Minimum Requirement Instructions for directions and background materials to assist you with this analysis**. Additional instructions may be found at: http://www.wilderness.net/mrdg/

Routing Information:

1) Complete the Minimum Requirement Analysis Worksheet (MRA). Name the file as follows: SubmissionDate_ShortTitle_LastName_Version1.docx.
2) Email the MRA (WORD version) to the Assistant Wilderness Coordinator (AWC) and the Environmental Protection Specialist (EPS) (nancy_hendricks@nps.gov) for review. **You must submit your MRA at least two weeks before your proposed action is to occur.**
3) **If revisions are necessary**, the EPS will:
    a. Return the MRA to the project proponent for revisions. Once revisions are made, project proponent will rename file as Version2. Then, repeat Step 2.

    If no revisions are needed, the EPS will:
    a. Rename the file as Final and save it under: S:\SUPT\Environmental Compliance Office\Wilderness\MRMTs and MRAs*Year*\Final
    b. Forward the electronic copy to the Division Chief for review and signature and "cc:" the project lead.
4) Division Chief will review and forward a printed copy to the Superintendent for signature. If the Division Chief changes the MRA, they will return the updated version electronically to the AWC and EPS. **If the MRA is part of a larger environmental compliance or permitting package, the entire package must go to the Superintendent for signature at the same time.**
5) The signed MRA will be sent to the EPS for record keeping. Signed/scanned copies will be filed as PDFs under: S:\SUPT\Environmental Compliance Office\Wilderness\MRMTs and MRAs*Year*\Signed MRAs
6) The EPS will email a PDF of the signed MRA Worksheet to the project proponent so that he/she can review mitigation, monitoring, and reporting requirements.

GENERAL INFORMATION:

Project Title:___ Cahoon Meadow Restoration Plan _____

Project Duration:_ Implementation not yet funded; potential window of 2018-2028 for implementation, if funding received._____
(For longer projects, review the MRA yearly to determine accuracy. Prepare a new MRA if the project is modified, new prohibited actions are proposed, or at a minimum every 5 years.)

Date Submitted:__ 10/04/2015_____

Project Proponent:___Athena Demetry_____

Contact Information: __athena_demetry@nps.gov, 559-565-4479_____

Tracking Number (Office Use Only):_____

STEP 1:
Determine if any administrative action is necessary.

Description of Situation:

What is the situation that may prompt administrative action? What is the reason that you are proposing an action (or actions) in wilderness? Do not describe the action itself. Rather, describe the desired goal or outcome.

Cahoon Meadow is within a parcel of land that was acquired by the NPS in 1980; previously it was under private ownership and used as summer cattle pasture. The earliest records indicate that in 1918, 250 head of cattle were permitted in Cahoon Meadow. By 1935 the permitted number of cattle was 70; this level of grazing seems to have been maintained until the NPS purchased the property in 1980. At that time, grazing was discontinued in Cahoon Meadow.

The erosion problem at Cahoon Meadow was first documented in 1970, ten years before the land was acquired by the NPS. The main purpose of the work in 1970 was to locate the private property boundary and to establish photo points to document the erosion gully. The photographs and notes describe significant trampling from cattle, erosion of the meadow surface, and recent major bank collapse into the "8-12 foot deep gully. . .gully width averages 41 feet" (Briggs 1971). Ten years later, in 1980, when the NPS purchased the land, the erosion gully at Cahoon Meadow was recommended for restoration action. An unattributed report from approximately 1983, titled "Cahoon Meadow Project Proposal," described the gully in Cahoon as having a maximum width of 65 feet and depth of 15 feet.

As part of an effort to understand the origins, impacts, and restoration potential of erosion gullies in wetlands across the Sierra Nevada, in 2011, the Sierra Nevada Conservancy provided funding to Sequoia and Kings Canyon National Parks (SEKI) to investigate Cahoon Meadow. The

project objectives included collecting topographic information to create a base map, assessing the success of past meadow restoration efforts in other SEKI locations by the SEKI Soil and Moisture Conservation Crew (SMCC), developing a range of feasible restoration goals and alternatives for Cahoon Meadow, and creating a conceptual plan that could be used to develop an environmental assessment (EA).

In June of 2014, an interdisciplinary team, including wetlands scientists from Colorado State University, visited Cahoon Meadow to collect data on the meadow topography, soil, hydrology, and vegetation. Cahoon Meadow is a 25 acre fen and wet meadow wetland complex with patches of dry meadow and upland. The site ranges from 7,430 to 7,260 feet in elevation and is located 2.8 miles west of Hockett Meadow in the southwestern portion of Sequoia National Park.

The gully, at its deepest point, is incised 17 feet below the adjacent, and approximately the original, meadow surface. Gully width varies considerably, but averages about 60 feet, with a maximum width of 90 feet. The total surveyed gully length is 1150 feet. The gully tapers a further 150 feet of unsurveyed length downstream. The most deeply and widely eroded portion of the gully is the upstream and southernmost ~570 feet of gully, terminating on its upstream end in three separate and nearly vertical headcuts, each 7-8 feet high.

A fen and wet meadow wetland complex extends for about 820 feet upstream from the gully headcut. The contributing watershed area above the headcut is approximately 520 acres (0.815 square miles), with the intact wetland covering about 14.9 acres. Downstream of the headcut the meadow drains into the gully and the water table is more than a meter below the surface. Dry, bare peat is exposed in large areas of the meadow adjacent to the gully. The total area of meadow that is dewatered and no longer a wetland is approximately 5.0 acres, of which 0.9 acres is occupied by the erosion gully banks; an additional 0.8 acres of riparian channel wetland occupies the gully bottom for a total of 5.8 acres of dewatered wetland and gully.

The presence of peat layers observed throughout the meadow stratigraphy, as observed in the 15+ foot high cut banks created by the gully and in the 25 augured soil samples in the meadow, indicate that Cahoon Meadow was formed over thousands of years in relatively stable, saturated wetland conditions (peat layers accumulate very slowly, but decompose more rapidly when drained). Periodic large sedimentation events, as evidenced by the coarse sand layers, occasionally buried the meadow, but the wetland plants and hydrology reformed peat layers on top of these disturbance deposits. Several sand layers contained pieces of charcoal, suggesting that some sedimentation events may have followed forest fires.

Prior to disturbance by possible 1800s and documented 1900s livestock grazing, these data indicate that Cahoon Meadow was a perennially-saturated wetland-fen complex supported by a sheet-flow hydrologic regime, with a water table near the soil surface, and shallow water flowing downgradient across the entire site in early to mid-summer. There were no deeply-incised channels. Any channels would likely have been shallow and braided, shifting course over time as sediments were deposited. Highly-productive, sod-forming obligate wetland species such as *Scirpus microcarpus* and *Carex scopulorum* would have dominated the vegetation layer, along with a carpet of mosses, and kept the meadow surface from eroding.

If not for the past human action of livestock grazing, Cahoon Meadow would almost certainly still be an intact wetland as described above. Grazing primarily impacts meadow vegetation as livestock eat the most palatable plants, decreasing or destroying populations of sedges, rushes

and other long-lived clonal plants with dense, sod-forming root systems. In sloping meadows in Kings Canyon, vegetation removal and trampling due to livestock grazing exposed soil to erosion, leading to gully formation (Sumner 1947). Gullies concentrate water flow, accelerate erosion, lower the water table, and dry out the meadow surface, further reducing the ability of wetland plants to recolonize and form a protective sod. After livestock were removed from these meadows, the erosion gullies remained and continued to expand, causing greater drainage and drying. The formation of an erosion gully represents the crossing of an ecological threshold and a transition to an alternate state, because removal of grazing (the original perturbation) will not reverse or halt erosion and water-table depression.

The purpose of this project is to protect the remaining intact wetlands and restore wetland ecosystem function to Cahoon Meadow in such a manner that minimizes impacts to park resources, while ensuring a sustainable and feasible solution.

A. Options Outside of Wilderness

Can actions taken outside of wilderness adequately address the situation and meet project goals?

Yes: ☐ **No:** ☒

Explain: This situation is specific to Cahoon Meadow, and any actions taken to improve conditions at Cahoon Meadow must be implemented at the meadow itself, in wilderness.

B. Valid Existing Rights or Special Provisions of Wilderness Legislation

Is action necessary to satisfy valid existing rights or a special provision in wilderness legislation (the Wilderness Act of 1964 or subsequent wilderness laws)? Cite law and section.

Yes: ☐ **No:** ☒

Explain:

C. Requirements of Other Legislation

Is action necessary to meet the requirements of other federal laws? Cite law and section.

Yes: ☐ **No:** ☒

Explain: The Organic Act directs the NPS "to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." Over 5 acres of Cahoon Meadow are dewatered and no longer function as wetlands, and the remaining 14 acres of intact wetland is threatened by active headcutting and erosion. Active restoration of Cahoon Meadow is **consistent** with the direction given by the Organic Act; without action, 14.9 acres of wetland/fen complex is likely to be lost, not conserved for the enjoyment of future generations (the loss of Cahoon Meadow, e.g. 14.9 acres of wetland-fen complex from a total of

2,599 acres of fen and fen/wet meadow complex in SEKI, is of small enough scale on the landscape to not be considered impairment). However, the Organic Act does not **require** action in wilderness.

The National Park Service Omnibus Management Act of 1998 directs the Secretary of the Interior ”to assure that management of units of the National Park System is enhanced by the availability and utilization of a broad program of the highest quality science and information.” In order to address the problem at Cahoon Meadow, science was required to describe the condition of the intact meadow, from which the restoration goals were formed, and to assess the condition of the gully and the dewatered meadow. This project continues to require science to evaluate the results of restoration actions.

D. Wilderness Character

Is action necessary to preserve one or more qualities of wilderness character?

Untrammeled: **Yes:** ☐ **No:** ☒

Explain: There is no current trammeling (i.e. manipulation) at Cahoon Meadow that requires action.

Undeveloped: **Yes:** ☐ **No:** ☒

Explain:

Natural: **Yes:** ☒ **No:** ☐

Explain: The purpose of this project is to protect 14.9 acres of existing, high quality fen/wetland complex from further loss and to restore ecological integrity (landforms, hydrology, and vegetation that support sustainable wetland function) to dewatered wetlands in Cahoon Meadow. These properties no longer function to sustain wetlands in Cahoon Meadow as a direct result of the historic human action of livestock grazing. The erosion gully is unstable and dynamic, with recent slumping and calving observed at the gully edges in 2014. Without intervention, headcuts will continue to migrate upstream, draining intact wetland and degrading downstream aquatic habitats. Without intervention, the intact wetland above the gully may completely convert to upland and nearly 15 acres of wetland would be lost as a natural feature.

Here we are defining “natural” in the sense of ecological integrity: the ability of Cahoon Meadow to sustain wetland conditions in the face of changing environmental conditions. Analysis of sediments indicates that Cahoon Meadow has remained a functional wetland during the changing environmental conditions of the past several thousand years, and that it only changed to a new state with the advent of livestock grazing in the last 150 years. While it is not the management goal to restore Cahoon Meadow to a specific pre-European condition, the landforms, hydrology, and vegetation characteristic of Cahoon Meadow prior to the advent of livestock grazing provides the best target for sustainable wetland conditions in the future. Restoring ecological integrity will also increase ecosystem resilience to future climate-induced changes.

Wet meadows are a rare but important vegetation type in the Sierra Nevada, particularly in the southern Sierra, where they occupy only 1.8% of the land area of Sequoia and Kings Canyon National Parks. The 25-acre Cahoon Meadow is one of the largest montane meadows (between 5,000 and 8,000 feet elevation) in SEKI. It is one of only nine montane meadows larger than 15 acres; the total area of these nine meadows is 167 acres.

Cahoon Meadow is also important within the East Fork Kaweah watershed. It is the second largest wet meadow in the East Fork, exceeded only by Hockett Meadow. Only two wet meadows in the East Fork have more peat-accumulating area than Cahoon Meadow. It is the headwaters meadow for the stream flowing through the Cahoon Grove of giant sequoias, so could be important for storing and releasing late-season water to the giant sequoias. It is one of only 10 locations of the insectivorous plant *Drosera rotundifolia* (sundew) in SEKI and may support other uncommon taxa that occur in fens. The natural function of Cahoon Meadow is not only important as a wilderness value, but is an important component of the forested ecosystem surrounding it, as it provides habitat for invertebrates that breed in meadows but populate forested uplands in maturity, forming the base of forest food chains.

Outstanding Opportunities for Solitude or Primitive and Unconfined Recreation:

Yes: ☐ **No:** ☒

Explain: Action is not necessary to preserve outstanding opportunities for solitude or primitive and unconfined recreation at Cahoon Meadow.

Other Features of Value (e.g. Cultural Resources):

Yes: ☐ **No:** ☒

Explain: Action is not necessary, within the scope of this project, to preserve cultural resources or other features of value at Cahoon Meadow.

E. Public Purposes

Is action necessary to achieve one or more of the public purposes for wilderness (as stated in Section 4(b) of the Wilderness Act): ***"recreational, scenic, scientific, educational, conservation, and historical use"***?

Yes: ☒ **No:** ☐

Explain: This project is necessary for achieving the conservation public purpose: to sustain the natural conditions and the natural function of ecological processes in wilderness through protection and restoration. The purpose of this project is to restore the ecological integrity of Cahoon Meadow, using the landforms, hydrology, and vegetation that existed in the thousands of years prior to livestock grazing as a guide. These are the conditions that have sustained wetland

function in Cahoon Meadow over thousands of years of climatic variability and are likely to sustain wetland function in the future.

This project is consistent with improving the scientific purpose of wilderness. Scientists and managers seek to learn more about meadow function through the science of ecological restoration. In attempting to rebuild a wet meadow, ecologists test their assumptions about what is important for proper meadow function. The proposed action includes monitoring hydrology and vegetation to increase the scientific value of this project. Through the Halstead Meadow laboratory, we've learned more about the extent of actions necessary to improve the natural quality of wilderness character in severely-eroded wetlands, which has informed the actions proposed here for restoring Cahoon Meadow. In its turn, the Cahoon Meadow laboratory will inform restoration options being considered for improving the natural quality in other degraded remote and/or wilderness meadows throughout the Sierra.

This project is consistent with improving the scenic public purpose of wilderness. Wet meadows in the Sierra are considered significant scenic resources, and the current erosion gully threatens the continued existence of Cahoon Meadow. In addition, the dewatered portions of Cahoon Meadow have increased bare soil, sparse vegetation, and lack the deep green and showy flowering plants typical of wet meadows and fens, degrading the scenic resources.

This project is consistent with the educational public purpose of wilderness, though not necessary to achieve it. By taking no action, there is an educational opportunity to show the effects of poor livestock grazing management practices and their lasting effects on the land. By taking action, there is an educational opportunity to show how management intervention can restore wetland function to former wetlands severely degraded by poor livestock grazing management practices.

F. Other Guidance

Is action necessary to conform to direction contained in agency policy, unit and wilderness management plans, species recovery plans, or agreements with tribal, state and local governments or other federal agencies?

Yes: ☒ **No:** ☐

Explain: While no specific agency policy or plan **requires** action in all situations, there are a number of laws, executive orders, and policies that provide direction to preserve and restore natural conditions/functions and wetlands values in National Parks when feasible.

NPS Management Policies (2006) supports intervention to the extent necessary "to restore natural ecosystem function that has been disrupted by past or ongoing human activities" (4.1):

> Biological or physical processes altered in the past by human activities may need to be actively managed to restore them to a natural condition or to maintain the closest approximation of the natural condition when a truly natural system is no longer attainable. (section 4.1 General Management Concepts)

NPS Management Policies (2006), section 4.1.5 (Restoration of Natural Systems) states:

> The Service will reestablish natural functions and processes in parks unless otherwise directed by Congress.
>
> Impacts on natural systems resulting from human disturbances include . . . changes to hydrologic patterns and sediment transport; the acceleration of erosion and sedimentation; and the disruption of natural processes. The Service will seek to return such disturbed areas to the natural conditions and processes characteristic of the ecological zone in which the damaged resources are situated. The Service will use the best available technology, within available resources, to restore the biological and physical components of these systems, accelerating both their recovery and the recovery of landscape and biological community structure and function. Efforts may include, for example:
>
> - Restoration of abandoned mineral lands, abandoned or unauthorized roads, areas overgrazed by domestic animals, or disrupted natural waterways and/or shoreline processes.

Specific to wetlands, Executive Order 11990, Protection of Wetlands (42 Fed. Reg. 26961), directs the NPS and other federal agencies to protect and manage wetlands as follows:

> Section 1. (a) Each agency shall provide leadership and shall take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for (1) acquiring, managing, and disposing of Federal lands and facilities; and (2) providing Federally undertaken, financed, or assisted construction and improvements; and (3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

This regulation is translated into agency policy in Director's Order #77-1: Wetland Protection. Section 2.7 of DO 77-1 states:

> Where natural wetland characteristics or functions have been degraded or lost due to previous or ongoing human activities, the NPS will, to the extent appropriate and practicable, restore them to pre-disturbance conditions.

This restoration directive has also been incorporated into NPS Management Policies (2006), Section 4.6.5:

> The Service will implement a “no net loss of wetlands” policy. In addition, the Service will strive to achieve a longer-term goal of net gain of wetlands across the national park system through restoration of previously degraded or destroyed wetlands.
>
> When natural wetland characteristics or functions have been degraded or lost due to previous or ongoing human actions, the Service will, to the extent practicable, restore them to predisturbance conditions.

> When practicable, the Service will not simply protect but will seek to enhance natural wetland values by using them for educational, recreational, scientific, and similar purposes that do not disrupt natural wetland functions.

For natural resources management in wilderness, NPS Management Policies (2006) Section 6.3.7 states that:

> The principle of nondegradation will be applied to wilderness management, and each wilderness area's condition will be measured and assessed against its own unimpaired standard. Management intervention should only be undertaken to the extent necessary to correct past mistakes, the impacts of human use, and influences originating outside of wilderness boundaries.

This project is supported by SEKI's long-term plans. The 2007 General Management Plan states that:

> Wetlands that have been damaged or degraded by previous uses will be considered for restoration. . . original functions and values of each wetland will be restored to the greatest extent practicable.

The 1999 SEKI Resource Management Plan prioritizes Halstead and Cahoon meadows as those most in need of restoration.

The NPS Director's Memo "Applying National Park Service Management Policies in the Context of Climate Change" (2012) reinforces that restoring ecological integrity is an important strategy to adapt to climate change: "restoring naturally functioning ecosystems. . .and continuing other actions that build and support system resilience – remain as viable management strategies that are also consistent with our need to adapt to climate change."

Decision:

Is administrative action necessary in wilderness?

To determine if an action is necessary in wilderness, review questions A-F above.
NOTE: The questions vary in weight. A-D have first priority, E has second priority, and F has third priority.

In addition, consider the following: If you do not accomplish the work, what would be the resulting impacts? Would there be adverse effects on wilderness? Would you fail to meet the mandate of other laws and/or policies?

If you are unable to determine if action is necessary based on Step 1 information, consult your Division Chief or supervisor. Researchers should consult the Research Permit Coordinator.

Yes: ☒ **No:** ☐

Explain: Without the action, the wetland would continue to destabilize, and the condition of the meadow/wetland would not be consistent with the goals and directives of the National Park Service, executive orders, and NPS policy. Without stabilization or restoration, the intact wetland above the gully would eventually convert to upland and nearly 15 acres of wetland would be lost

as a natural feature. Thus, the natural quality of wilderness character in the Cahoon Meadow area would be degraded in this location, adversely affecting wilderness.

Compliance Pathway:

Is the action covered under an existing plan, management directive and/or other compliance document (i.e., MD-49, EA, EIS, CE/programmatic CE).

Yes: ☐ **No:** ☒

If yes, provide document name and PEPC reference number: A separate compliance document (environmental assessment) is being prepared for this project.

If no (or if you are unsure), contact the Environmental Protection Specialist for instructions.

STEP 2:
Determine the need to develop alternatives.

Does your project propose a Section 4(c) prohibited activity?

Section 4(c) prohibited activities include: the use of mechanical transport and/or motorized equipment and vehicles, the landing of aircraft, and the installation of materials, equipment and/or structures.

NOTE: Installations include items used to support activities such as communications, water development, stock use, or wildlife management. It includes debris such as old dump sites, plane crash sites, or locations of unexploded ordinance. It includes memorials or other monuments other than those placed during land surveys. It also includes unattended measurement or other device(s) left in place for the purpose of recording environmental data or marking a study plot.

Yes: ☒ **No:** ☐

If *yes*, proceed to Step 3.

STEP 3:
Determine the minimum activity.

Develop a range of reasonable and feasible alternatives. You should have at least two alternatives *plus* a "no action" alternative. Add additional pages as necessary. Be sure to describe in detail those aspects of your project that involve 4(c) general prohibitions. These are usually contained in the Untrammeled and/or Undeveloped qualities.

You should also include a list of alternatives that were considered but dismissed, with a brief explanation for dismissal. Alternatives should not be eliminated simply because of the cost or time involved. The potential disruption of wilderness character and resources will be considered before, and given significantly more weight than, economic efficiency and convenience.

Please refer to the MRA Instructions for additional information on developing alternatives and identifying effects.

Alternative #1: No Action

Description of the Alternative:

What are the details of this alternative? When, where, and how frequently will the action occur? What methods and techniques will be used? How long will the activity last? What mitigation measures will be taken?

NOTE: *The positive and negative effects of this alternative should not be included in the description.*

Under the no action alternative, no stabilization or restoration of the gully would occur. NPS biologists and/or cooperators would monitor the site periodically to document any headward erosion, bank collapse, expansion of dewatering, and any other signs of rapid changes to the meadow.

Ideally, monitoring would include relocating the 2014 survey monuments, documenting the topography of the gully margins (especially at headcuts), and measuring the depth to water table and vegetation composition at the meadow plots. In addition, the photopoints established in 1970 would be located and photographed, and, if warranted, new photopoints would be established to document the changing condition of the site.

A. Wilderness Character:

Does this alternative affect the qualities of wilderness character? What mitigation measures will be taken? *For definitions of wilderness character qualities, see the MRA Instructions.*

Untrammeled: **Yes:** ☐ **No:** ☒

Explain: The no action alternative maximizes the untrammeled quality of wilderness character, since managers would refrain from taking actions that manipulate, control, or intervene with the ecological system, even if some elements of ecological integrity are lost due to this restraint. This alternative fosters scientific and management humility and avoids the unintended adverse consequences that may arise when managers intervene in a system that is insufficiently understood.

Undeveloped: **Yes:** ☐ **No:** ☒

Explain: No structures would be installed and no trails would be built.

Natural: **Yes:** ☒ **No:** ☐

Explain: The 14.9 acres of intact fen and wet meadow above the three vertical headcuts would be threatened by further headward erosion of the gully. High discharge

events will be concentrated into the unprotected gully, causing further headward erosion of the headcut, undercutting and collapse of steep gully banks, and disturbance and possible erosion of the vegetated areas within the gully. The existing dewatered meadow adjacent to the gully would continue to degrade as peat soils decompose and erode. This alternative would almost certainly lead to degradation or complete loss of wetland function in Cahoon Meadow. In addition, there are potential riparian impacts as fine-grained meadow sediment is washed downstream.

Opportunities for Solitude or Primitive and Unconfined Recreation:

Yes: ☐ **No:** ☒

Explain: Few staff and infrequent visits would be required for monitoring, so effects on OSPUR would be negligible.

Other Features of Value (e.g. Cultural Resources):

Yes: ☐ **No:** ☒

Explain: NA

B. Safety:

How does this alternative affect visitor and/or employee safety? Does it present a new or changed situation that threatens visitor safety? If there are adverse effects, what mitigation measures will be taken? Which hazards cannot be mitigated?

Visitor Safety: Taking no action would not threaten visitor safety. There are few visitors to Cahoon Meadow and expansion of the gully or loss of the wetland would not produce any additional hazards.

Employee Safety: Taking no actions would not threaten employee safety, as above.

C. Other Criteria

Does this alternative help maintain proficiency in the use of primitive and traditional skills? Does it affect the special provisions (grazing, mining, water developments, access to non-federal land, etc.) identified in Sections 4 and 5 of the Wilderness Act? Are there any timing requirements or cost constraints that need to be considered?

Yes: ☐ **No:** ☒

Explain: NA

Alternative #2

Description of the Alternative:

What are the details of this alternative? When, where, and how frequently will the action occur? What methods and techniques will be used? How long will the activity last? What mitigation measures will be taken?

NOTE: *The positive and negative effects of this alternative should not be included in the description.*

STABILIZE HEADCUT WITH MACHINE-BUILT ROCK STRUCTURE

The goal of alternative 2 is to stabilize the gully headcut, preventing further headward erosion, to protect the remaining 14.9 acres of intact wetland upstream of the gully.

Alternative 2 Design

A "rock chute" would be constructed along the headcut to prevent further erosion of the intact meadow. A standard engineering design for sloped transitions of water flow would be utilized. A backhoe or excavator would be used to contour the headcuts to a 3:1 slope. The slope would then be lined with geotextile and armored with rock sufficiently large to resist erosion from high flow events. One or two low (one foot tall) check dams constructed of logs would be installed in the stream channel below the rock chute.

Regrading the upper headcut area to create a 3:1 slope (33%) would require excavating and placing approximately 1,060 cubic yards of sediment (regrading of the headcut) and 512 cubic yards of 8-inch diameter rock (imported). A small excavator would be used to place the rock. A 16-inch layer of rock would be placed on the over-excavated 3:1 grade, on top of geotextile fabric. The final rock surface would be at grade with an inlet apron receiving water at the intact wetland surface, and an outlet apron collecting and discharging water into the bottom of the gully.

Alternative 2 Implementation

Alternative 2 would be implemented as a two-year project. In year one, the informal trail from Cahoon Rock to Cahoon Meadow would be upgraded to provide for temporary access to the project site. This trail has not been maintained by park staff in many years and is in poor condition. Per the Wilderness Stewardship Plan / Environmental Impact Statement (2015) there are no long term plans to reestablish and formalize this trail. However, this trail is important for access to the project site, and therefore would be reestablished for the duration of the project work. To reestablish this trail, the trail crew camp at Hockett Meadow or a temporary crew camp closer to Cahoon Rock would be used. Upon completion of the trail work, all items at the temporary crew camp would be removed and the area restored, as needed.

During stabilization work at the meadow, a temporary crew camp would be established either in the dewatered portion of the meadow or nearby outside of the meadow area. Crews would be resupplied by stock staged at the Hockett Meadow Ranger Station. Upon completion of

the stabilization and/or restoration work, all items at the crew camp would be removed and the area restored, as needed.

In year two, the rock structure and check dam(s) would be constructed. A large helicopter (such as a Chinook) would be used for about 6 days (approximately 25 flight hours and 105 round trips) in July or August, within a window of 6-21 days. The helicopter would transport a small excavator weighing approximately 15,000 pounds. The excavator would be used to clear trees, downed logs, and other debris from the 0.5-acre headcut area and grade to a 3:1 slope. The helicopter would then be used to import 520 cubic yards of 8-inch diameter rock for the rock chute. This would be placed by the excavator. Rock would be transported 5.5 cubic yards at a time over about three days, requiring an estimated 100 of the 105 round trips. Additional items transported by the helicopter would include food and supplies for the contractor's camp, diesel fuel for the excavator, supplies for water diversion, and a shipping container for contractor equipment (such as pumps, compressors, wattles, erosion blanket, equipment repair, food, drinking water). The helicopter would be staged either out of the "Wolverton Helispot," located at 5200 feet elevation off the Mineral King Road (in the frontcountry), or from a Tulare County staging area located at lower elevation outside of the park off the South Fork Road. In year two of the project, the total duration of project work would be about 3-5 weeks.

Also in the second year of project implementation, one or two minimal (one-foot high) downstream check dams may be constructed within an 80-foot long reach at the shallowest sloped (1.3%) portion of the gully, located about 600 feet downstream of the headcut. Over a one-week period, check dams would be constructed by hand-crews using chainsaws and hand tools and would require the cutting of about two trees for a single dam. Logs would be installed perpendicular to flow and keyed into both the banks and the channel bed to create a backwater to retain sediment.

Project Follow-Up and Long-term Maintenance Requirements

Follow-up repair would be needed in year three (one year after construction), after the structure has sustained a season of flooding and spring runoff. Minor maintenance of the structure would be needed about every 25 years. The 25-year maintenance would likely require about 2-4 weeks of crew time and helicopter support. The total life of the structure would be about 100 years.

Monitoring

The key monitoring need for alternative 2 is to track the function and integrity of the rock structure so that repairs can be made promptly, if needed. Since the site will be very difficult to access during the winter months when flood events might occur, a solar-powered camera that takes daily pictures and uploads remotely, via satellite if available, would be installed to aid in this monitoring.

A. Wilderness Character:

Does this alternative affect the qualities of wilderness character? *For definitions of wilderness character qualities, see the MRA Instructions.*

Untrammeled: **Yes:** ☒ **No:** ☐

Explain: There is a short-term trammeling of about 0.5 - 1 acre. The headcut area would be reshaped and manipulated so that the change in grade from the top of the headcut to the bottom of the gully is hardened, in order to prevent further headward erosion of the vertical face of the headcut. The meadow in this area would be manipulated into a novel condition uncharacteristic of natural meadows (it has a quality of being engineered). The duration of the trammel is estimated to be 3 to 5 weeks.

Because the rock structure is expected to be durable and require long-term maintenance on about a 25-year cycle, repeated trammeling would be minimized (compared, for example, to a log structure requiring more frequent maintenance).

Undeveloped: **Yes:** ☒ **No:** ☐

Explain: Reconstructing the access trail into the project site is considered a development, though the adverse effect on this quality would be short term as the trail would be rehabilitated and the area restored to natural conditions. There would be short-term adverse effects on the undeveloped quality because of the use of motorized equipment, motor vehicles, landing of aircraft, and construction of a rock chute using 520 cubic yards of imported rock. Landing of aircraft, which includes delivery of loads via long line, is estimated at 105 round trips by a Chinook helicopter. One excavator would be used in a localized area (approximately 0.5 – 1 acre) for 6 to 21 days. Water pumps, compressors, generators, and power tools would be needed for construction period of 3 to 5 weeks. In addition, there would be short-term construction installations (water diversion pipes) and long-term scientific installations (mounted camera). Long-term, the rock chute structure would remain evident as a human construction, though softened by vegetation growth.

Natural: **Yes:** ☒ **No:** ☐

Explain: There would be slight, short-term, adverse impacts to natural. A 0.5-1 acre area would be disturbed in the vicinity of the headcut. An excavator would clear trees and downed logs from the headcut area, grade to a 3:1 slope, and place the rock. The tree removal would not adversely affect wildlife or ecosystem function. There would likely be increased downstream turbidity for the 3-5 week duration of construction, but construction-related sedimentation would be mitigated and monitored.

There would be long-term beneficial impacts to the natural quality of wilderness character at Cahoon Meadow. Preventing further headward erosion of the vertical faces of the headcuts would protect the 14.9 acres of intact wetland from potential complete loss, including 4.9 acres of rare fen habitat, one of ten known locations of *Drosera rotundifolia* in SEKI, and the suite of ecosystem services provided by functioning wetlands.

Opportunities for Solitude or Primitive and Unconfined Recreation:

Yes: ☒ **No:** ☐

Explain: There would be short-term increases in administrative crew presence in the project area with adverse impacts to solitude, but because this is a seldom-visited area of the park, the impacts are expected to be slight. Crews would return for monitoring work and periodic maintenance (expected every 25 years) but crew sizes would be within the limits of standard wilderness group sizes, and therefore would not be noticeable. The short-term re-establishment of the trail could provide benefits to hikers wishing to visit Cahoon Meadow, but this benefit is short-term as the trail would be removed after project work is completed.

Visitors to the Hockett Meadow area, Evelyn Lake, or the Mineral King Road would be adversely affected by distant visual and noise effects of the helicopter. Use of the South Fork Road for staging the helicopter would reduce these effects on the Mineral King Road.

Other Features of Value (e.g. Cultural Resources):

Yes: ☐ **No:** ☒

Explain: NA

B. Safety:

How does this alternative affect visitor and/or employee safety? Does it present a new or changed situation that threatens visitor safety? If there are adverse effects, what mitigation measures will be taken? Which hazards cannot be mitigated?

Visitor Safety: Minor impacts due to increased truck traffic (rock-hauling, equipment-hauling) on either the Mineral King Road or the South Fork Road; moderate probability, moderate severity.

Employee Safety: This alternative places park crews in the field to construct the trail, which does not change employee risk compared to usual operational risk levels. However, contractor crews working in remote areas under helicopters and using heavy equipment is an elevated contractor risk level (low probability, high severity).

C. Other Criteria

Does this alternative help maintain proficiency in the use of primitive and traditional skills? Does it affect the special provisions (grazing, mining, water developments, access to non-federal land, etc.) identified in Sections 4 and 5 of the Wilderness Act? Are there any timing requirements or cost constraints that need to be considered?

Yes: ☐ **No:** ☒

Explain: NA

Alternative #3

Description of the Alternative:

What are the details of this alternative? When, where, and how frequently will the action occur? What methods and techniques will be used? How long will the activity last? What mitigation measures will be taken?

NOTE: *The positive and negative effects of this alternative should not be included in the description.*

FULL RESTORATION: REGRADE WITH MACHINERY TO RESTORE WETLAND TOPOGRAPHY, HYDROLOGY, AND VEGETATION

The goal of alternative 3 is to protect the remaining 14.9 acres of wetland upstream of the gully from further loss and to restore sustainable wetland function to the 5.4 acres of dewatered meadow and gully by reestablishing wetland topography, hydrologic regime, and vegetation similar to the pre-erosion meadow. This alternative includes filling the gully to recreate a sheetflow system and planting native wetland vegetation.

Alternative 3 Design

The gully would be filled using the top 0.5 to 5.5 feet of sediment from the adjacent dewatered meadow. The meadow would be graded to be flat in cross-section and eliminate all preferential flow paths, which would restore a sheetflow hydrologic regime and saturated soil conditions. Regrading the gully portion of Cahoon Meadow, using existing meadow sediment to fill the gully and create level topography, would require excavating, moving, and placing 12,500 cubic yards of sediment. Most of the fill is needed at the southern end of the gully (at the headcut), however, most of the cut material would be generated at the northern end. Therefore, substantial upslope transport of the fill material would be required.
The final meadow surface would be graded level in cross-section, with salvaged topsoil placed on top. Trees and other woody plants (e.g. willows) that are currently growing on the dewatered meadow surface or in the gully (within the grading limits) would be cut and placed into the gully. There would be about 100 small to medium lodgepole pines and 50 to 100 shrubs that would be cut and removed under this alternative. Log segments without branches could be buried sub-grade as long as they do not leave voids or interfere with compaction of the lower lifts.

Wetland plants, propagated in a nursery from seed collected at Cahoon Meadow, would be planted in the regraded and formerly dewatered areas. The plants would take several years to grow to sufficient density to prevent sediment erosion. Erosion blanket would be placed on the bare soil surface, and wetland plants embedded through the blanket.

Alternative 3 Implementation.

Alternative 3 would likely be implemented as a three-year project. In year one, the trail from Cahoon Rock to Cahoon Meadow would be reconstructed as described for alternative 2. During restoration work at the meadow, a temporary crew camp would be established either in the dewatered portion of the meadow or nearby outside of the meadow area. Crews would be supplied by helicopter and by stock staged out of the Atwell Mill administrative corral and grazing at Hockett Meadow and Pasture. Upon completion of the restoration work, all items at the crew camp would be removed and the area restored, as needed.

The grading would be completed by a contractor in year two of the project. Water would be temporarily diverted 1200 feet around the grading limits in plastic pipe. A large helicopter (such as a Chinook) would be used for 1 day (approximately 3 to 4 flight hours, or 15 to 20 round trips) in July to mobilize 3 to 4 pieces of earthmoving equipment, diesel fuel, and supplies; and for 1 day in August (approximately 3 flight hours, or 8 to 10 round trips) to demobilize earthmoving equipment and all supplies. A light helicopter (AStar) may be used for approximately 10-20 round trips as a construction contingency. Earthmoving equipment would likely consist of one tracked bulldozer (approximately 16,000 lbs), one 11-CY wheel tractor-scraper or two 5-CY wheel tractor-scrapers to both excavate and transport soil, and one small skid-steer loader, such as a Bobcat. Additional items transported by helicopter would include food and supplies for the contractor's camp, diesel fuel, supplies for water diversion, erosion control blanket, live plants, and a shipping container for contractor equipment (such as pumps, compressors, generators, power tools, wattles, erosion blanket, equipment repair items, food, drinking water). The helicopter would be staged either out of the "Wolverton Helispot," located at 5200 feet elevation off the Mineral King Road, or from a Tulare County staging area located at lower elevation off the South Fork Road. The total duration of construction in year two is estimated at 10 to 12 weeks (approximately 28-35 days of heavy equipment use). Topsoil and intact wetland vegetation would be salvaged prior to grading and replaced during finish grading.

Alternative 3 would include the placement of approximately 5 acres of erosion control blanket over all disturbed soils, the installation of approximately 90,000 container plants grown in a commercial nursery, and the placement of approximately 1000 coconut fiber (coir) wattles. The risk of importing nonnative plants with nursery materials would be minimized by using container plants rather than nursery-grown wetland sod, which was a significant vector for introduction of nonnative organisms to the Halstead Meadow restoration.

Half of the container plants would be installed in the fall, immediately after construction, and the remainder would be installed in early summer of year 3 of the project. Transporting these plants would require an estimated 5 round trips to transport by small helicopter. A crew of 5-8 people would require an estimated two to three weeks to install plants in year 3.

Project Follow-Up and Long-Term Maintenance Requirements

Maintenance to repair localized erosion gullies that may form prior to establishment of protective vegetation would be needed for one to three years, years until the plants grow to full density. No further long-term maintenance to the graded area is anticipated.

Monitoring

The resulting hydrology, vegetation, and wetland function would be monitored in order to assess success. Monitoring would likely be funded for 2-3 years, but final measurements may be taken at 10 years to assess long-term success. Hydrology would be monitored in approximately 10 groundwater wells (2-inch slotted PVC pipe rising approximately 12 inches above-ground) and one stream-level logger (4-inch long x 0.5-inch diameter data loggers secured to a tee-post in the stream channel). The stream-level logger would be associated with a rectangular-notched plywood weir in the creek so that cross-sectional geometry, and therefore water volume, can be measured. These PVC wells, tee-post, and plywood weir would be removed by 10 years after project completion by NPS staff. Vegetation would be monitored non-destructively in unmarked plots associated with the groundwater wells.

A. Wilderness Character:

Does this alternative affect the qualities of wilderness character? *For definitions of wilderness character qualities, see the MRA Instructions.*

Untrammeled: **Yes:** ☒ **No:** ☐

Explain: This alternative would result in short-term trammeling on approximately 5-6 acres, where existing soils would be manipulated to restore the wetland topography, hydrology, and vegetation to its functional state prior to human disturbance by severe grazing. The dewatered portion of the meadow, about 5 acres, would be graded down in elevation and the resultant material used to fill the 0.4 acre gully, creating a level cross-section and sheet-flow hydrologic regime. Plants propagated in a nursery (grown from seed collected at Cahoon Meadow) would be installed. The trammel occurs to a larger spatial area than alternative 2, and over a longer period of time (12 weeks in year 2, 2-3 weeks in year 3).

Two to three years of crew work to repair erosion that would likely occur after large storm events, prior to full establishment of vegetation, would cause some additional trammel. Over the long-term, the restoration is designed to restore natural processes (sheet flow hydrology) so the site is sustainable as a wetland system and does not require further maintenance (or trammeling) past five years.

Undeveloped: **Yes:** ☒ **No:** ☐

Explain: Reconstructing the access trail into the project site is considered a development, though the adverse effect on this quality would be short term as the trail would be rehabilitated and the area restored to natural conditions. There is short-term development because of the use of motorized equipment, motor vehicles, and landing of aircraft. Landing of aircraft is estimated at up to 30 round trips by a Chinook helicopter and 10-20 round trips by a light (AStar) helicopter. Motor vehicles would include up to four pieces of earthmoving equipment in a large area (approximately 5.4 acres) for about 28-35 days. Motorized equipment would include use of chainsaws, water pumps, compressors, generators, and power tools for the construction period of 10 to 12 weeks. In addition, there would be short-term construction installations (water diversion pipes), and short-term scientific installations (2" PVC water monitoring wells, t-post staff gauges, stream-level loggers). Long-term, the meadow would appear natural with no development or human improvement.

Natural: **Yes:** ☒ **No:** ☐

Explain: There would be short-term, adverse impacts to natural during the 12-week earthmoving phase of this alternative. Prior to regrading, trees, woody vegetation, and downed logs would be cleared from the 5-6 acre area to be regraded; wetland vegetation from the gully bottom and topsoil throughout the project would be salvaged, stored, and replaced on the regraded surface at the end of the project. The tree removal would not adversely affect wildlife or ecosystem function. Soil would be disturbed for regrading over a 5-6 acre area (5 acres dewatered meadow and 0.4 acres gully bottom); soils would be exposed for about 6 to 8 weeks before being protected by erosion control blanket, so there is some risk of soil loss and increased downstream turbidity during summer rain events. There would likely be increased downstream turbidity for up to 12 weeks of site work, but earthmoving-related sedimentation would be mitigated and monitored.

There would be long-term, beneficial impacts to the natural quality of wilderness character at Cahoon Meadow. Regrading the dewatered portion of the meadow would eliminate the headcut, providing the most sustainable, reliable, stable protection for the 14.9 acres of intact wetland. In addition, 5.4 acres of dewatered wetland and gully would be restored to a vegetated sheetflow wetland ecosystem. This was the Cahoon Meadow landform that existed for thousands of years prior to human impacts that initiated gully formation.

Opportunities for Solitude or Primitive and Unconfined Recreation:

Yes: ☒ **No:** ☐

Explain: There would be short-term increases in administrative crew presence in the project area with adverse impacts to solitude, but because this is a seldom-visited area of the park, the impacts would be slight. The short-term re-establishment of the trail could provide benefits to hikers wishing to visit Cahoon Meadow, but this benefit would be short term only during the project activities, then the trail would be restored to natural conditions.

Visitors to the Hockett Meadow area, Evelyn Lake, or the Mineral King Road would be adversely affected by distant visual and noise effects of the helicopter. Use of the South Fork Road for staging the helicopter would reduce these effects on the Mineral King Road.

Other Features of Value (e.g. Cultural Resources):

Yes: ☐ **No:** ☒

Explain: NA

B. Safety:

How does this alternative affect visitor and/or employee safety? Does it present a new or changed situation that threatens visitor safety? If there are adverse effects, what mitigation measures will be taken? Which hazards cannot be mitigated?

Visitor Safety: Minor impacts due to increased truck traffic (equipment-hauling) on either the Mineral King Road or the South Fork Road; low probability, moderate severity).

Employee Safety: This alternative places park crews in the field to construct the trail and cut trees within the grading limits, which slightly increases employee risk compared to usual operational risk levels. However, there is an elevated risk to contractor crews working in remote areas under helicopters and using heavy equipment (low to moderate probability, high severity).

C. Other Criteria

Does this alternative help maintain proficiency in the use of primitive and traditional skills? Does it affect the special provisions (grazing, mining, water developments, access to non-federal land, etc.) identified in Sections 4 and 5 of the Wilderness Act? Are there any timing requirements or cost constraints that need to be considered?

Yes: ☐ **No:** ☒

Explain: NA

Alternative #4

Description of the Alternative:

What are the details of this alternative? When, where, and how frequently will the action occur? What methods and techniques will be used? How long will the activity last? What mitigation measures will be taken?

NOTE: *The positive and negative effects of this alternative should not be included in the description.*

STABILIZE WITH HAND-BUILT LOG STRUCTURES

The goal of Alternative 4 is to stabilize the gully headcuts, preventing further headward erosion, to protect the remaining 14.9 acres of intact wetland upstream of the gully.

Alternative 4 Design

An option to stabilize the gully headcut using hand-built log structures was considered during project planning and was presented during the public scoping process. This option considered hand-building a set of three headwall/stepdown structures, one for each headcut, constructed of logs obtained on-site, and stepped down on the downstream face to disperse cascading-water energy. The structures would be 7-8 feet tall to accommodate the vertical drops from the meadow surface, and keyed into the existing meadow headcut with both at-grade inlet and outlet aprons to discourage water from flowing around or under it. The design for the log headwall and step-down apron was based on decades of work by William Zeedyk treating erosion gullies and headcuts, which include necessary design elements such as wire and geotextile (Zeedyk & Jansens 2006). The design used 12-inch diameter logs, requiring that approximately 130-150 trees be cut from the site. The proposed design would be the largest hand-built log headwall/step-down structures implemented to stabilize an erosion gully. This

design (Zeedyk) is typically applied to erosion gullies 3-4 feet deep and 10-12 feet wide in the semi-arid Southwestern US.

The advantage of log structures is that the bulk of the structure would be built from on-site, native materials, with some imported anchoring materials such as steel posts and wire likely needed. Though very difficult, it should be possible to construct log structures using hand crews, possibly with stock assistance. The disadvantages are that the logs would decompose over time. In large floods, logs may become dislodged and can float away. The three log structures would also be more susceptible to erosion at their lateral edges, as compared to the single large rock chute. Annual monitoring would be needed to check the log structures for damage, and repairs may be needed approximately every 3 to 5 years. The estimated life of the structures is 20-30 years, after which they would need to be replaced to maintain their function of protecting the 14.9 acres of intact wetland from loss.

Alternative 4 Implementation

Alternative 4 would likely be implemented as a three-year project. In year one, the trail from Cahoon Rock to Cahoon Meadow would be reconstructed as described for Alternative 2, but because the crew would be fully supplied by stock (with little to no helicopter use) over a period of 3 years, a more substantial trail would be needed. In August or later, to avoid bird nesting season, this crew would begin cutting trees at least 12 inches in diameter. Trees would be limbed and hauled, by hand, to the headcut area to be staged for installation in year two. Cut limbs would be scattered on site or used in construction to provide additional energy dissipation, if needed. Tree species would be lodgepole pine, white fir, or incense cedar.

Crews would camp at Hockett Meadow or a temporary crew camp closer to Cahoon Rock during the initial part of trail construction and at Cahoon Meadow during later trail construction and tree cutting. Crews would be supplied primarily by stock, by day trip from Hockett Meadow or Atwell Mill, without overnight grazing at Cahoon Meadow. Rare helicopter supply trips may be needed for large tools or supplies. Chainsaws would be used for an estimated two weeks in August to cut and limb trees.

In years two and three, the crew would complete log cutting and hauling to the headcut area. Water would be diverted around the site to maintain water quality and a dry work site; temporary sheet-metal dams, 8 to 12 inch diameter plastic pipe, and sediment control logs would be needed for the water diversion. The crew would clear trees, downed logs, and other debris from the headcut area and use hand-tools (shovels, picks, hoes) to excavate soil so that logs can be placed according to the design. Existing wetland vegetation would be salvaged prior to soil disturbance and replaced following construction. Crews of up to 15 people would camp at Cahoon Meadow for up to 12 weeks each year. Chainsaws would be used to cut logs to necessary lengths. Pulleys and winches may be used to move and position logs. Steel stakes and cables may be needed to anchor logs in place.

Project Follow-up and Maintenance

Follow-up repair may be needed in year four (one year after construction), after the structure has sustained a season of flooding and spring runoff. We estimate that regular maintenance repairs and minor replacement of logs would be needed every five years, with major repairs and reconstruction needed every 25 years as logs decompose or wash away in large flood events. Five-year maintenance events are estimated to require two to four weeks of large crew time, with 25 year maintenance events requiring up to 12 weeks of crew time and

additional cutting of trees, at numbers similar to or less than initial construction, for structural log replacement. The trail from Cahoon Rock would continue to be cleared and maintained to allow crew and stock access for maintenance repairs.

This alternative was eliminated from further consideration due to the safety concerns of using hand crews to construct these structures. The risk exposure to crews digging 8 foot-deep trenches in wet and unstable soil conditions was considered too severe to make this a feasible and safe alternative. The design was also the least likely to provide a successful long-term solution for stabilizing the headcut. For these reasons, the option to stabilize the gully with hand-built log structures was dismissed from further evaluation. However, because this alternative was designed to require minimal section 4(C) prohibited activity, it is fully analyzed in this MRA.

Monitoring

The key monitoring need for alternative 4 is to track the function and integrity of the log structures so that repairs can be made promptly, if needed. Since the site will be very difficult to access during the winter months when flood events might occur, a solar-powered camera that takes daily pictures and uploads remotely, via satellite if available, would aid in this monitoring.

A. Wilderness Character:

Does this alternative affect the qualities of wilderness character? *For definitions of wilderness character qualities, see the MRA Instructions.*

Untrammeled: **Yes:** ☒ **No:** ☐

Explain: Trammeling is similar to alternative 2: there is short-term trammeling of 0.5-1 acre, because the headcut area is being reshaped and manipulated so that the change in grade from the top of the headcut to the bottom of the gully is hardened, in order to prevent further headward erosion of the vertical face of the headcut. Trees to supply logs for the structures would be gathered from within 0.5 mile from the headcuts. The meadow in this area is being manipulated into a novel condition uncharacteristic of natural meadows, but the quality of being engineered is minimized by the use of on-site log materials. The duration of the trammel for initial construction is estimated at 12 weeks a year over 3 years.

Because the log structures are expected to be vulnerable to storm damage and erosion, they would require frequent repair (estimated every 5 years) and complete reconstruction (estimated every 25 years). This is supported by SEKI Soil and Moisture crew records suggesting frequent (often annual) maintenance of log check dams in the 1940s-60s. Thus this alternative has the highest level of long-term trammeling when compared with the other action alternatives.

Undeveloped: **Yes:** ☒ **No:** ☐

Explain: There is short-term development because of the use of mechanized equipment (chainsaws to cut 130-150 trees). In addition, there would be short-term construction installations (water diversion pipes), and long-term scientific installations

(mounted camera). Long-term, the log structures would remain evident as human constructions, though softened by vegetation growth.

Natural: **Yes:** ☒ **No:** ☐

Explain: There would be beneficial impacts to the natural quality of wilderness character at Cahoon Meadow compared to no action, with duration dependent on how long maintenance and rebuilding could be supported. While functional, the log structures would prevent further headward erosion of the vertical faces of the headcuts and protect the 14.9 acres of intact wetland from potential complete loss. However, the application of this type of design to the gully widths and depths of Cahoon Meadow are well outside the bounds of successful application in other locations, so feasibility of construction and probability of successful headcut stabilization are low. The three log structures would be more susceptible to erosion at their lateral edges, as compared to the single large rock chute. In addition, the logs would decompose over time. In large floods, logs may become dislodged and can float away. To remain effective, the structures would require frequent maintenance, repair, and complete rebuilding. Annual monitoring would be needed to check the log structures for damage, and repairs would likely be needed every 3 to 5 years. The estimated life of the structures is 20-30 years, after which they would need to be replaced to maintain their function of protecting the 14.9 acres of intact wetland from loss.

Opportunities for Solitude or Primitive and Unconfined Recreation:

Yes: ☒ **No:** ☐

Explain: There would be short-term increases in administrative crew presence in the project area with adverse impacts to solitude, but because this is a seldom-visited area of the park, the impacts are slight. The longer-term re-establishment of the trail could provide benefits to hikers wishing to visit Cahoon Meadow, but this benefit is slight. Visitors to the area could be adversely affected by the noise of chainsaws (affecting opportunities for solitude).

Other Features of Value (e.g. Cultural Resources):

Yes: ☐ **No:** ☒

Explain: NA

B. Safety:

How does this alternative affect visitor and/or employee safety? Does it present a new or changed situation that threatens visitor safety? If there are adverse effects, what mitigation measures will be taken? Which hazards cannot be mitigated?

Visitor Safety: No effect.

Employee Safety: This alternative would place park crews in a sustained high-risk situation (excavating 8-9 foot trenches to place logs in saturated soil) that would have to be repeated when significant repairs or replacement of the log structures are needed. The need for repairs

and replacement would likely be frequent, approximately every 3 to 5 years with total replacement needed every 20 to 30 years.

C. Other Criteria

Does this alternative help maintain proficiency in the use of primitive and traditional skills? Does it affect the special provisions (grazing, mining, water developments, access to non-federal land, etc.) identified in Sections 4 and 5 of the Wilderness Act? Are there any timing requirements or cost constraints that need to be considered?

Yes: ☐ **No:** ☒

Explain: NA

Additional Alternatives

Are there any alternatives that were considered but dismissed?

Yes: ☒ **No:** ☐

If yes, list alternatives and explain reason for dismissal:

CONSTRUCT CHECK DAMS ALONG THE LENGTH OF THE CHANNEL

One common technique used to treat gullies has been the construction of check dams along the length of the channel. The check dams provide three functions: they function to slow the flow and disperse energy by creating pools of water, they encourage the deposition of sediment that slowly fills the gully, and they can raise the water table in the adjacent meadow. The SEKI Soil and Moisture Conservation Crew (SMCC) installed and maintained hundreds of check dams in the backcountry of SEKI in the 1940s through 1970s. In low gradient meadows with small dimension channels, these structures may be effective in stabilizing gullies and accumulating sediment. Another setting where small check dams have been effective is in narrow, ~5 foot deep gullies in peat. Near Manchester, UK, restoration teams have successfully deployed sheet metal dams in narrow peat gullies, raising the water table high enough to have ecological importance to the plants on the peat surface.

The steep gradient and deep, wide gully in Cahoon Meadow make large check dam structures likely to fail. The dimensions of check dams that would be needed to span the width and height of the gully in Cahoon Meadow are outside the range of the check dams installed by the SMCC or in other Sierra Nevada locations that we are aware of. Placing flow obstructions in such a steep, confined channel is likely to force flow around the obstruction, causing channel widening by collapsing the banks and eroding more of the meadow. Stable check dams cannot be built by hand more than 3 or 4 feet high, and this would still leave the water table 10 or more feet below the meadow surface in most places. This would have little ecological benefit for the impacted wetland. The amount of time required to accumulate sediment behind these dams is difficult to estimate because each site's watershed sediment yield is different. The meadow sediments themselves suggest that several thousand years is required to accumulate ~20 feet of sediment in a sheetflow environment. At most, this is a rate of 1 foot per 100 years, which is far too slow to be considered as a management alternative. Application of prescribed fire to the surrounding watershed, in order to increase

sediment yield and subsequent accumulation behind check dams, was also considered. However, it would be difficult to direct the sediment deposition where it is desired, and sediments could be deposited on the surface of the intact meadow rather than in the gully, to the detriment of those wetlands. Finally, nearly annual repair would be needed to maintain check dams so that they result in improvement rather than worsening of gully conditions, requiring a multi-century commitment.

Techniques such as cross-vanes and other hardened in-stream structures designed to keep flow in a central channel, reduce channel migration and bank erosion, and provide grade control were considered, but dismissed because they do not address the primary problem of the headcut instability. In addition, the gully already contains a vegetated inset floodplain within the larger confined, eroded gully. This vegetation is providing more stabilization, sediment trapping, and flow dispersal than small hardened cross-vanes would. In fact, cross-vanes are specifically designed to pass sediment in a stabilized high-velocity central channel, which would be counter to the goal of accumulating sediment through time to slowly fill in the gully.

REINTRODUCE BEAVERS

There is considerable interest across North America in using beaver reintroduction to maintain instream dams. Although there are significant stands of willow in the upper portion of Cahoon Meadow, beaver conduct 90% of their foraging within 100 feet of their dams (Hall 1960), and there are very few willows within 100 feet of the gully in Cahoon Meadow. In addition, beavers tend to require connected habitat up and/or downstream to disperse to. Cahoon Meadow is near the top of its watershed and the channel below the meadow is steep and confined with little or no willow for miles. Finally, beaver colonies form and disappear annually across a broad landscape, meaning that even if a colony could be established at this particular site, it would be unlikely to be continuously occupied. In order to ensure a sustainable beaver meta-population over the long-term, restoration efforts would have to occur over a broad spatial scale with likely hundreds of animals. Such a project is outside the scope of planning for Cahoon Meadow restoration, at it would have substantial impacts that extend far beyond Cahoon Meadow.

MITIGATION MEASURES TO REDUCE EFFECTS ON WILDERNESS CHARACTER

In addition to the mitigations to protect the natural quality of wilderness character included in the environmental assessment, the following mitigations will be included to protect the untrammeled, undeveloped, and OSPUR qualities of wilderness character:

Untrammeled

- Within each alternative, the extent of manipulation will be strictly maintained within the work limits.
- Within each alternative, the duration of manipulation will be maintained within the limits described.

Undeveloped

- Within each alternative, limit the types of quantities of mechanized equipment to those listed.
- Stage the helicopter from a close frontcountry location, such as the Wolverton Helispot on the Mineral King Road or from the South Fork road, to minimize wilderness overflights by helicopter.
- Plan helicopter loads and flights carefully to maximize loads and minimize flights.
- Materials that are small and light enough to be transported by pack stock, and that are needed outside the window of time when helicopter transport is necessary for large and heavy items, will be transported by pack stock.
- No motorized equipment would be used in camps. Propane/white gas or battery-powered lanterns would be used to light the cooking/camp areas.

Opportunities for Solitude or Primitive and Unconfined Recreation

- Use of earthmoving equipment, motorized tools, and helicopter flights would be limited to between 7:00 a.m. and 6:00 p.m. The helicopter would follow the same flight path to and from the project site.
- During construction periods, wilderness visitor would be informed of construction activities. This would occur through the permit issuance process, wilderness rangers on the trail, and other educational contacts. Where possible, visitors would be told of alternate routes and times to avoid helicopter noise intrusion.
- When possible, conduct helicopter flights outside the peak visitation periods of July-August. However, on-site work for this project must be conducted during July through early September, when Cahoon Meadow is in its driest condition, and completed in September before substantial rainfall is expected. Therefore there is little latitude to limit helicopter flights to the shoulder season.

Comparison of Alternatives

Rate each alternative on a scale of +3 to -3.

-3	-2	-1	0	+1	+2	+3
High Negative Impact	Moderate Negative Impact	Low Negative Impact	No Impact/ Undeterminable	Low Positive Impact	Moderate Positive Impact	High Positive Impact

WILDERNESS CHARACTER	short-term Alternative 1 No Action	long-term Alternative 1 No Action	short-term Alternative 2	long-term Alternative 2	short-term Alternative 3	long-term Alternative 3	short-term Alternative 4	long-term Alternative 4
Untrammeled	0	0	-2	-1	-3	0	-1	-2
Undeveloped	0	0	-2	-1	-3	0	-1	-2
Natural	-2	-3	-1	2	-2	3	-1	-1
Solitude or Primitive and Unconfined Recreation	0	0	0	0	0	0	0	0
Unique / Other Features								
TOTAL	-2	-3	-5	0	-8	3	-3	-5

SAFETY	short-term Alternative 1 No Action	long-term Alternative 1 No Action	short-term Alternative 2	long-term Alternative 2	short-term Alternative 3	long-term Alternative 3	short-term Alternative 4	long-term Alternative 4
VISITOR	0	0	-1	0	-1	0	0	0
EMPLOYEE	0	0	-1	-1	-1	0	-3	-3
TOTAL	0	0	-2	-1	-2	0	-3	-3

OTHER CRITERIA SUMMARY	short-term Alternative 1 No Action	long-term Alternative 1 No Action	short-term Alternative 2	long-term Alternative 2	short-term Alternative 3	long-term Alternative 3	short-term Alternative 4	long-term Alternative 4
TOTAL								

Decision:
What is the <u>minimum</u> activity?

Select an alternative. Usually, the alternative that has the least overall adverse effect on wilderness character is preferred. However, there may be other considerations.

Note: When selecting the preferred alternative the potential disruption to wilderness character and resources will be considered before, and given significantly more weight than, economic efficiency and convenience. If a compromise of wilderness character or resources is unavoidable, only those actions that preserve wilderness character and/or have localized, short-term acceptable adverse impacts will be allowed.

Selected alternative:
Alternative 3: Regrade with Machinery to Restore Wetland Topography, Hydrology, and Vegetation**,** if funding resources become available.

Otherwise, Alternative 1: No Action.

Rationale (include safety criterion, if appropriate):

Alternatives 1, 2, and 3 affect different aspects of wilderness character to varying degrees, and meet the mandates and policies of the NPS to varying degrees. Alternative 3 provides the highest long-term improvement to wilderness character at the expense of the highest short-term impacts. Alternative 4 results in long-term, adverse impacts to wilderness character.

Alternative 1 (no action) best preserves the untrammeled and undeveloped qualities of wilderness character, but at the expense of the natural quality. The loss of 5.4 acres of wetland habitat and function due to past human activities would remain unabated, and additional losses of up to 14.9 acres of wetland habitat and function would almost certainly occur. NPS policy (4.1.5) is not entirely prescriptive of taking action, using such language as (italics added): "The Service will *seek* to return such disturbed areas to the natural conditions and processes characteristic of the ecological zone in which the damaged resources are situated. The Service will use the best available technology, *within available resources*, to restore the biological and physical components of these systems" (4.1.5); and "When natural wetland characteristics or functions have been degraded or lost due to previous or ongoing human actions, the Service will, *to the extent practicable*, restore them to predisturbance conditions" (4.6.5).

Alternative 2 (stabilize headcut with machine-built rock structure) preserves the existing natural quality of wilderness character over the long term (protects 14.9 acres of intact wetland from erosion) at the expense of limited short-term and long-term trammeling (on 0.5-1 acre during 3-5 weeks, moving 1060 CY of sediments, maintained every 25 years and after floods), substantial short-term development (105 helicopter flights, use of 1 item of earthmoving equipment and power tools for up to 5 weeks), and limited long-term development (construction of a 160-foot wide rock chute using 520 CY imported rock). Because this alternative mitigates the erosive energy of the headcuts by creating a sloped and hardened drop-down structure, but does not solve the underlying problem caused by the rapid change in elevation between the wetland surface and the gully bottom, it requires a permanent, maintained construction. It does not restore wetland integrity, so is not a fully sustainable solution. NPS policy allows this type of action, stating (italics added): "Biological or physical processes altered in the past by human activities may need to be actively managed to restore them to a natural condition *or to maintain the closest*

approximation of the natural condition when a truly natural system is no longer attainable" (4.1).

Alternative 3 (regrade with machinery to restore wetland topography, hydrology, and vegetation) preserves and improves the long-term natural quality of wilderness character (protects 14.9 acres of intact wetland from erosion and restores wetland function to 5.4 acres of dewatered wetland and gully bottom) at the expense of more intensive, widespread, short-term trammeling (on 5-6 acres during 15 weeks, moving 12,500 CY of sediment), and more substantial short-term development (use of 4 items of earthmoving equipment and power tools for up to 12 weeks, though fewer helicopter flights, 40-50, than alternative 2). However, there is no long-term trammeling or long-term development with this alternative. Because this alternative solves the underlying problem caused by the rapid change in elevation between the wetland surface and the gully bottom by filling the gully and recreating the level landform, sheet-flow hydrology, and wetland vegetation that existed prior to livestock grazing, the action restores wetland integrity and is a fully sustainable solution. NPS policy is prescriptive of taking action when practicable, when resources are available, and when the action will not harm other resources: "When natural wetland characteristics or functions have been degraded or lost due to previous or ongoing human actions, the Service will, to the extent practicable, restore them to predisturbance conditions" (4.6.5). This alternative is also supported by the "Revisiting Leopold Report" (2012) which urges that parks be managed to preserve ecological integrity, which "describes the quality of ecosystems that are largely self-sustaining and self-regulating. Such ecosystems may possess complete food webs, a full complement of native animal and plant species maintaining their populations, and naturally functioning ecological processes such as predation, nutrient cycling, disturbance and recovery, succession, and energy flow." The NPS Director's Memo "Applying National Park Service Management Policies in the Context of Climate Change" (2012) reinforces that restoring ecological integrity is an important strategy to adapt to climate change: "restoring naturally functioning ecosystems. . .and continuing other actions that build and support system resilience – remain as viable management strategies that are also consistent with our need to adapt to climate change."

Alternative 4 (stabilize with hand-built log structures) minimizes the short-term impacts to wilderness character at the expense of long-term impacts to untrammeled and undeveloped and a low probability of long-term improvements to the natural quality. In addition, the impacts to employee safety risk over the long-term were assessed to be unacceptable. Short-term trammeling (on 0.5 to 1 acre) is minimized by constructing three log structures localized at the headcuts, but 2.5 summer seasons of crew hand work are needed for construction rather than one season in the other alternatives. Because the log check dams are likely to fail in flood events, they would need frequent repair (estimated every 3 to 5 years) and long-term replacement (estimated every 25 years) as logs decompose and wash downstream, requiring multiple long-term trammeling actions. Short-term development is minimized by using only chainsaws, hand-tools, and stock support (with minimal helicopter support) rather than earthmoving equipment and large helicopters. On-site materials are used and the footprint of the constructed log structures is smaller than the rock chute in alternative 2. However, there are long-term impacts to the undeveloped character because recurrent actions to repair (every 3-5 years) and rebuild (every 25 years) the log structures would require use of chainsaws, including cutting 130-150 new trees to supply logs every 25 years. These impacts would "buy" only a low probability of long-term improvement to the natural quality for the following reasons: the log structures are susceptible to erosion at their lateral edges; long-term maintenance at this remote location is difficult to support consistently; and the necessary size of the log structures substantially exceeds

the size of successful application in other areas. Long-term, the overall impact to the natural quality would be negative because soils would need to be redisturbed and more trees cut to rebuild the log structures. Because of the risk and safety concerns associated for this alternative, in addition to the low probability that the log structures would successfully stabilize the headcuts (as detailed in the assessment of the natural quality), this alternative was dismissed from further analysis in the environmental assessment.

Alternative 3, if funding resources became available, best meets NPS policy to "seek to return such disturbed areas to the natural conditions and processes characteristic of the ecological zone in which the damaged resources are situated. The Service will use the best available technology, within available resources, to restore the biological and physical components of these systems." Alternative 3 is also consistent with improving the long-term natural quality of wilderness character by re-establishing wetland integrity at Cahoon Meadow in a sustainable way, without requiring long-term maintenance/trammeling and without the human construction of a rock chute or log structure. However, these long-term improvements to wetland integrity come at the cost of substantial short-term trammeling. Alternative 1, if no funding resources become available, is also consistent with NPS policy because restoration is only required if resources are available and if action is practicable. Taking no action best maintains the untrammeled quality of wilderness character, at the cost of wetland integrity and the natural quality of wilderness character.

Cumulative Effects:
Do you know of any other projects in the vicinity of your project location(s) (past, present, or future) that have the potential to impact wilderness character?

Yes: ☒ **No:** ☐

If yes, please describe.

Cumulative use of helicopters in Sequoia and Kings Canyon National Parks wilderness.

The Sequoia and Kings Canyon National Park Wilderness Character Assessment (2012) summarizes wilderness helicopter use as the following:

> Helicopters are frequently used to bring supplies and tools to ranger stations, trail crews, and resource-management crews. Helicopters are also used to maintain the six radio repeaters. Four dams and 15 snow-survey locations in wilderness are often accessed and maintained using helicopters. Helicopters are used to respond to fires, search and rescue (SAR) missions, and medical emergencies (EMS) in wilderness. Approximately one-third of the 100 or so SAR and EMS incidents each year involve evacuation of a park visitor from the wilderness by helicopter (Browne 2010). In years when large search operations occur, emergency helicopter landings may increase dramatically. Over the ten-year period from 2003 through 2012, there was an annual average of 573 hours of helicopter flight time in the parks; note that this includes flights within and outside wilderness and may not involve landings (National Park Service 2012a). Non-emergency helicopter landings (defined as any air delivery or removal of people or material, or when aircraft skids touch ground) in the park's wilderness number around 175-250 per year.

The most substantial, project-based recent helicopter use from the last five years supported the replacement of three wilderness ranger stations at Rae Lakes, LeConte Canyon, and Crabtree. In 2011, 53 flights supported the replacement of the Rae Lakes ranger station; in 2012, 42 flights supported the replacement of the LeConte Canyon ranger station; and in 2013, 97 flights supported the replacement of the Crabtree ranger station. These flights were by a small helicopter (AStar) that has much lower sound and outwash impacts than those of a Chinook.

Other projects that are considered in the cumulative effects analysis:

Action or Project	**Status**	**Brief Description**	**Impact Topics**
Meadow Restoration Efforts Related to Past Grazing by Cattle and Sheep	Past, ongoing, and future	Prior to designation, there was grazing by sheep and cattle in several areas of the wilderness. Most of the cattle grazing leases in Kings Canyon National Park were surrendered or expired in the 1950s. In 1948, the NPS Soil & Moisture Conservation Crew (SMCC) began actively restoring the most damaged meadows, focusing on sites in the Evolution Creek, Roaring River, Crabtree Creek, and Rock Creek watersheds. Efforts also targeted impacts from recreation trails. Restoration efforts by the SMCC ended in the 1970s and included actions in an estimated 50 named meadows. In SMCC-treated sites where gully erosion has stabilized but wetland function has not been fully restored, additional, small-scale (hand-crew focused) restoration efforts may occur in the future to improve wetland function and increase resilience to climate change.	Wilderness Character Natural Resources (wetlands, water quality/ quantity)
Recreational and Administrative Pack Stock Grazing	Past and ongoing	Recreational and administrative pack stock grazing has occurred and continues to occur in the parks. The 2015 Wilderness Stewardship Plan Final Environmental Impact Statement (WSP/FEIS) identifies those areas where grazing will be allowed. Grazing will continue to be managed and informed by results of the Stock Use and Meadow Monitoring and Management Strategy. Estimated grazing capacities for wilderness meadows will continue to be used to inform grazing management, and will be refined as additional information is acquired. See appendix D of the WSP/FEIS for more information.	Wilderness Character Natural Resources (wetlands)
Halstead Meadow Restoration	Past, ongoing, and future	Halstead Meadow, a portion of which is in wilderness, was the most severely damaged meadow in Sequoia National Park. Two phases of restoration have been completed, with earthmoving in 2007 and 2012. Project goals include restoring the meadow landforms,	Wilderness Character Natural Resources (wetlands, water

Action or Project	Status	Brief Description	Impact Topics
		hydrologic processes, wetlands vegetation, and functions. To date, approximately 15 acres have been restored and an additional 6 acres would be evaluated for potential restoration in the final phase. Planning for the final phase of meadow restoration will occur in 2016-2017 with anticipated implementation in 2020 or later.	quality/ quantity)
Ecological Restoration Program at SEKI	Past and ongoing	This program restores landscapes disturbed by human impacts or development to more natural conditions. Abandoned non-historic human development may be removed (asphalt, marijuana grow-site materials, etc.); altered landforms recontoured to their predisturbance condition to restore natural drainage patterns; and, erosion-control measures installed. Projects that may occur in wilderness include restoration of illegal marijuana cultivation sites, abandoned wilderness trails, and campsite restoration.	Wilderness Character Natural Resources (wetlands, water quality/ quantity)
High Elevation Aquatic Ecosystem Restoration Program	Past, ongoing, and future	SEKI has an ongoing habitat restoration program that includes eradication of nonnative fish in wilderness. Thus far, SEKI has restored or is in the process of restoring 26 lakes by eradicating nonnative trout. Similar work is also occurring in Yosemite National Park. A draft Environmental Impact Statement to expand the program was released for public review and comment and the NPS is currently reviewing and addressing comments before a final decision is made. If the program is approved for expansion, nonnative trout eradication activities will continue to occur for the next 25-30 years within the parks' wilderness.	Wilderness Character Natural Resources (water quality/ quantity)
Administrative Mechanical Transport and Motorized Equipment Use	Past, ongoing, and future	The parks, in administering wilderness, will on occasion use mechanical transport and motorized equipment, land aircraft (helicopters), and erect installations. Administrative activities, such as wilderness trail and facility operations (e.g. transporting supplies and equipment, use of rock drills or chainsaws, etc.) and ranger activities (e.g., providing emergency services, fire management, search and rescue, etc.), may require one of the above listed activities. All actions that require mechanical transport, motorized equipment, landing of aircraft, or installations, with the exception of emergencies, are analyzed through a	Wilderness Character

Action or Project	Status	Brief Description	Impact Topics
		Minimum Requirements Analysis process prior to implementation.	
Existing Dams and Related Infrastructure	Past and ongoing	In the East Fork Kaweah watershed, there are four storage dams in 112 acres of designated potential wilderness additions. Their purpose is to hold and regulate water flow for downstream hydroelectric generation. The dams receive periodic maintenance.	Wilderness Character Natural Resources (water quality/ quantity)

Provide details on Wilderness Act Section 4(c) uses proposed in this alternative:

4(c) Prohibition	Frequency and/or Quantity	Duration
mechanical transport	Wheelbarrows, carts	Total duration of construction: 12 weeks.
motorized equipment	Chainsaw Compressor Generator Water pump Power tools	Total duration of construction: 12 weeks.
motor vehicles	Tracked bulldozer Two wheel tractor-scrapers Skid-steer loader	Approximately 35 days
motorboats		
landing of aircraft	Chinook helicopter, estimated 30 flights Light helicopter, estimated 10-20 flights Light helicopter, estimated 5 flights	Estimated 1 day July, 1 day August in year 2 July-Sep, year 2 1 day June, year 3
structure(s)/installation(s)	10 2-inch PVC groundwater wells 3-5 rebar survey monuments 1 stream-level logger (attached to tee-post in stream channel) 1 plywood weir in creek	10 years
temporary road		

Additional mitigation, monitoring and reporting requirements *(Reviewers provide input)*:

Follow-Up Form Required: **Yes:** ☒ **No:** ☐

STEP 4:
Signatures and Reporting

Prepared by:

Athena Demetry Name	Restoration Ecologist Position	12/16/2015 Date

Review and Comments

Name/Position	Comments	Date
Wilderness Coordinator	G. Fauth. Reviewed and provided comments.	10/15/15
Environmental Protection Specialist	N. Hendricks	01/05/2016
Other reviewer as appropriate		

Approvals	Print Name	Signature	Date
Recommended:	Division Chief		
Approved:	Superintendent		

Return to Office of Compliance and Planning for administrative record once document has been approved by the Superintendent.