BIOLOGICAL EVALUATION
AQUATIC SPECIES, REPTILES, AMPHIBIANS, and FISH

El Dorado Project No. 184

Eldorado National Forest
July 2003

PREPARED BY______________________________________ DATE__________.
FOREST FISHERIES BIOLOGIST

I. INTRODUCTION

This Biological Evaluation (BE) analyzes the potential effects of the proposed Forest Service Terms and Conditions developed in connection with the relicensing for the El Dorado Hydroelectric Project (No. 184) upon Forest Service designated aquatic Sensitive species. This BE is prepared in accordance with direction provided in Forest Service Manual (FSM) 2672.42 and implementing regulations [19 U.S.C. 1536 (c), 50 CFR 402.12 (f) and 402.14 (c)]. The purpose of this document is to ensure that project decisions do not adversely affect species viability or create significant trends towards Federal listing.

The Regional Forester's Sensitive Species list for Region 5 (dated June 10, 1998), identifies the following sensitive aquatic reptile, amphibian, and fish species which may occur on the Eldorado National Forest and Stanislaus National Forest:

Western pond turtle	*Clemmys marmorata*
Foothill yellow-legged frog	*Rana boylii*
Mountain yellow-legged frog*	*Rana muscosa*
Northern leopard frog	*Rana pipiens*
Yosemite Toad*	*Bufo canorus*
Limestone salamander	*Hydromantes brunus*
Relictual slender salamander	*Batrachoseps relictus*
Hardhead	*Mylopharodon conocephalus*

* Also USFWS candidate species, as shown in the most recent quarterly species list for the ENF dated June 12, 2003, last updated June 5, 2003, and obtained from the USFWS website (http://sacramento.fws.gov/es/spp_lists/NFFormPage.htm).

This BE will only address the aquatic species listed above. Terrestrial wildlife species are addressed in a separate BE (Lipton 2003).

II. CONSULTATION TO DATE

The Federal Energy Regulatory Commission (FERC), as the licensing agency, is responsible for consultation in compliance with section 7(c) of the Endangered Species Act. The Sensitive species analyzed in this BE are not on the Federal list of Endangered or Threatened species, nor are they proposed for listing; the Endangered Species Act requirements for Federal agency consultations do not apply to this Biological Evaluation.

III. CURRENT MANAGEMENT DIRECTION

Current management direction for Sensitive species on the ENF can be found in the following documents, filed at the Supervisor's Office:

- Forest Service Manual and Handbooks (FSM/H 2670)

- National Forest Management Act (NFMA)
- National Environmental Policy Act (NEPA)
- Eldorado National Forest Land and Resource Management Plan (LRMP), as amended in January 1993.
- Sierra Nevada Forest Plan Amendment Environmental Impact Statement (EIS) (USDA 2000).

The Sierra Nevada Forest Plan Amendment guides the management of the Sierra Nevada national forests until their forest plans are revised. The aquatic, riparian and meadow conservation strategy in the EIS provides for clean water, functioning aquatic ecosystems, and environmental conditions that contribute to viable populations of associated species.

The Sierra Nevada Forest Plan Amendment Environmental Impact Statement (EIS) provides direction for the management of threatened and endangered species. The Aquatic Management Strategy in the EIS directs that the Forests utilize administrative measures to protect and restore aquatic, riparian, and meadow ecosystems and provide for the viability of native animal species associated with these ecosystems. The following Aquatic Management Strategy goals pertain to aquatic sensitive species:

- To maintain and restore water quality to meet goals of the Clean Water Act and Safe Drinking Water Act, providing water that is fishable, swimmable, and suitable for drinking after normal treatment.
- To maintain and restore habitat to support viable populations of native and desired riparian-dependent species.
- To maintain and restore the species composition and structural diversity of animal communities in riparian areas, wetlands, and meadows to provide desired habitats and ecological functions.
- To maintain and restore the distribution and health of biotic communities in species aquatic habitat to perpetuate their unique functions and biological diversity, and
- To maintain and restore spatial and temporal connectivity for aquatic and riparian species within and between watersheds to provide physically, chemically and biologically unobstructed movement for their survival, migration and reproduction.

According to the EIS, a Riparian Conservation Objectives analysis would need to be performed for projects occurring within Riparian Conservation Areas, and is included in the project file.

IV. DESCRIPTION OF THE PROPOSED PROJECT

The FERC is in the process of deciding if it will issue a new license for the continued operation of the El Dorado Hydroelectric Project, and, if so, what conditions it will impose in any license issued. In connection with this decision, the Forest Service has developed 4(e) conditions based on the Land and Resource Management Plans (as amended) for the Eldorado National Forest and Lake Tahoe Basin Management Unit. The Forest Service's proposed action is to issue the project conditions described in the document entitled *Forest Service Preliminary Terms and*

Conditions Provided Under 18 CFR § 4.34 (b) b(1) In Connection With the Application for Relicensing of the El Dorado Hydroelectric Project (FERC No. 184) (May 1, 2003) which shall be included in any new license the FERC may issue for the continued operation of the El Dorado project. Please see this document for a listing of the Conditions to which this BE is referring.

The El Dorado Hydroelectric Project and its associated facilities are described in the Draft Environmental Impact Statement, El Dorado Hydroelectric Project (FERC No. 184-065), issued in March of 2003. The project occurs within the South Fork of the American River (SFAR) watershed, on both private land and lands administered by the Eldorado National Forest and Lake Tahoe Basin Management Unit. The project boundary includes 1,334 acres of National Forest System land, occurring between about 3,400 and 8,000 feet in elevation. The El Dorado Hydroelectric Project consists of four storage reservoirs (Lake Aloha, Echo Lake, Silver Lake, and Caples Lake), seven diversion dams (occurring on seven tributaries of the SFAR) that provide water to the El Dorado Canal. The El Dorado Canal occupies National Forest System land between the Kyburz Diversion Dam (located on the SFAR just below its confluence with the Silver Fork American River), to the western edge of the Forest boundary at Fresh Pond. Project facilities on National Forest System lands also include a 110 by 40 foot powerhouse on the SFAR, and portions of a 2.8-mile long combination pipeline and penstock conveyance between the El Dorado Forebay and the Akin Powerhouse.

Water is stored in Lake Aloha, Echo Lake, Caples Lake, and Silver Lake for release after the spring runoff. Water from these lakes flows either directly into the SFAR or via tributaries of the SFAR. Seven smaller streams that are tributaries of the SFAR (Alder Creek, Mill Creek, Bull Creek, Carpenter Creek, Ogilby Creek, Esmeralda Creek, No-Name Creek) are each diverted into the El Dorado Canal. At the El Dorado Forebay, flows are divided between Akin Powerhouse and the intake for EID's irrigation canal. Flows that pass through the powerhouse are returned to the SFAR.

Water is drafted from the storage lakes beginning in July from Lake Aloha. Once Lake Aloha has been drawn down, it becomes necessary to draw from Caples Lake. Water is drawn from Caples Lake until after Labor Day, when it becomes necessary to draw from Echo Lake and Silver Lake. Although exceptions have occurred, Silver Lake is maintained as high as possible until after Labor Day. Silver Lake must be fully drawn down, due to state requirements, by October 31 and all spillway flashboards must be removed and the spillway gates fully opened. Echo Lake must be fully drawn down, due to state requirements, by November 15 and all spillway flashboards must be removed and the spillway gates fully opened. The two lakes cannot be used to store water until the flashboards are replaced the following spring on or about April 1.

To protect aquatic habitat, the licensee is required to maintain minimum flows from Lake Aloha and Silver and Caples lakes and the bypassed reach on the SFAR and adhere to ramping rate restrictions for Silver and Caples lakes.

V. SPECIES ACCOUNTS AND EFFECTS

The following table lists those species introduced in Section I, their preferred habitats, and whether, based on the activities the project proposes, the species has the potential of being impacted by any of the proposed activities. Habitat for species that may be impacted by the activities proposed under this project is highlighted.

Table 1. Sensitive species that may be present or affected by activities, and their potential to occur in the El Dorado Project area affected by the proposed issuance of the FERC License.

Species	Elevation Range of Habitat (ft)	Preferred Habitat	Potential for Project to Affect this Species
Western pond turtle	**Below 6,000**	**Ponds and slow moving streams**	**Occupied habitat occurs within the project area.**
Foothill yellow-legged frog	**Below 6,000**	**Perennial streams with cobbles, riffles, and open areas**	**Occupied habitat occurs within the project area.**
Mountain yellow-legged frog	**Above 5,000**	**High elevation ponds, lakes, and low-gradient streams**	**Occupied habitat occurs within the project area.**
Northern leopard frog	**From sea level-7,000**	**Low gradient perennial streams, marshes, bogs, and ponds**	**None. Surveys have not detected this species in the area. It is suspected the one museum specimen collected in 1965 was fish bait or a released individual.**
Yosemite toad	**Above 6,000**	**High elevation wetland areas and meadows**	**None. The project is outside the current known range of this species. A few isolated (possibly hybrid) populations have been detected south of the project area near Blue Lakes.**
Limestone salamander	**1,200-2,500**	**Moist limestone rock outcrops in crevices and talus**	**None. The project is outside the geographic range of this species**
Relictual slender salamander	**4,000-8,200**	**Mixed conifer forests on damp soil of under leaf litter.**	**None. The project is outside the geographic range of this species.**
Hardhead	**Below 4,400**	**Sacramento-San Joaquin river system preferring large, deep pools in clear streams**	**Suitable habitat occurs within the project area and there have been species detections in the South Fork American River.**

Some activities of the project will have no effect on aquatic species considered in this document. The following analysis of effects will concentrate primarily on proposed project streamflows, activities that will affect flows, construction activities that may disturb lake or streamside habitat such as campground and facilities upgrades, and any other standards or activities that could potentially affect any of the above species or their habitats.

Western pond turtle

Existing Environment.

Species and Habitat Account. Information about this species life history and habitat preference used for this analysis is provided in Appendix B. Surveys in 2001 for this project by Ecorp Consulting (2002) for herptiles did not locate any western pond turtles. In July, 1993 a western pond turtle was observed in Silver Fork American River downstream of China Flat. This is the only past sighting in the project area.

This species historically occurred from sea level to 5,000 feet, although turtles are scarce anywhere above 4,500 feet (Holland et al. 1992), but have been observed up to higher elevations in the 6,000 feet range (Holland 2002). They could also occur in most stream gradients (Holland 2002). Fifty-one miles of perennial stream habitat exists below the 6,000 foot elevation in this project.

Effects of the Proposed Action
Direct and Indirect Effects

Any conditions not mentioned below are either outside of the elevation range for western pond turtles or would have no effect on them.

Condition No. 31 – Minimum Streamflows
Condition No. 32 – Ramping Rates
During the development of the proposed conditions, one of the tenets regarding aquatic ecosystems was that the native aquatic biota were best adapted to the natural flow regime. All of the flow related measures incorporated in the conditions were designed to mimic the pattern of the natural hydrograph within the constraints of operating a hydropower project. Proposed streamflows for project-affected stream reaches on the Eldorado National Forest that may provide suitable habitat for western pond turtles are expected to benefit this species where they are present.

Throughout the history of the project, flows have been reduced as the result of diversions with the seasonality of flow variation being altered due to storage. These flow changes have, in many cases, adversely affected the quality and quantity of aquatic habitat and the ecological requirements for the native fauna. Minimum flows in the proposed conditions would mimic the natural hydrograph to the extent possible and, in most cases, provide more flow during times of the year when higher flow would be expected. Although these more natural flows may provide benefits to many aquatic biota, the benefits to western pond turtles are not known but are estimated to be positive.

One deviation from the natural hydrograph in the proposed flows, which may be detrimental to western pond turtles, is the fall flow release out of Silver and Caples Lakes. Generally, these fall flows are fairly close to the natural hydrograph of fall storms, but may be more steady, thus more intense, than would be with natural fall rainstorm flows. It is possible that these highsteady fall flows could displace juvenile turtles downstream in the Silver Fork American or SFAR; however, the magnitude of the flow would probably not be great enough to displace adults. The optimum flows for young western pond turtles have not been scientifically determined. A western pond turtle population would likely be able to survive under these flow conditions, but the overall affect on population capability in these rivers is not known, but is not expected to be a significant factor in their survival. It is estimated that ramping rates should be gradual enough to reduce the shock of cooler water temperatures and higher flows as flows increase, although there is no scientific information to verify whether this is true.

Condition No. 34 – Caples Lake Releases and Flow Limitations
The pulse flows prescribed in this conditions are meant to initiate the transport of bedload material, which would assist in improving habitat conditions for aquatic species through pulse flow releases during the spring runoff period and channel stabilization measures that are meant to prevent channel degradation and encourage the growth and establishment of woody and herbaceous riparian species. These releases would occur during the spring runoff period and are estimated to mimic conditions under which western pond turtles evolved. It is unlikely that these spring flows would affect the adult western pond turtles on Silver Fork American River.

Condition No. 36 - Esmeralda Creek Restoration
Though specific plans have not been developed for this condition, these actions are expected to provide benefits to aquatic species by restoring the creek channel to its original location. Through agency review of the plan, protection measures will be put in place to survey prior to the activity, monitor for western pond turtles during restoration, and ensure suitable nesting locations are avoided.

Condition No. 37 – Monitoring Program
Condition No. 38 – Ecological Resources Adaptive Management
Condition No. 42 – Water Temperature
These conditions require the licensee to complete aquatic species, water temperature and general water quality monitoring for the Project which, through agency review of the monitoring plans, would provide benefits to the species by helping to increase our knowledge of their range and habitat conditions.

The adaptive management program includes monitoring the proposed conditions once the new license is implemented, including flows and water temperatures. If monitoring indicates that resource objectives are not being met, adaptive management measures may be implemented that may provide further protection of sensitive species.

Condition No. 39 – Mitigation for Entrainment
The screening of Carpenter and Alder Creeks for fish entrainment would also provide protection for western pond turtles from being swept into the canal and recruited out of the watershed by going down the canal where there would be less chance of survival.

Condition No. 46 – Implementation Plan
Condition No. 49 – Review of Recreation Developments
Condition No. 50 –Specific Recreation Conditions
Condition No. 51 – Operation and Maintenance of Recreational Facilities
Relicensing of the El Dorado Hydroelectric Project does not involve new construction or development of new recreational facilities within the range of the western pond turtle. Construction activities are limited to upgrading and expansion of recreation facilities, campgrounds, and associated access roads and parking areas. These activities would occur within the boundaries of established recreation facilities. There are a few acres proposed for

ground disturbing activities in association with the Project. The majority of the proposed work in campgrounds and receational areas is intended to minimize the impacts from uncontrolled, dispersed recreational vehicle access. Areas that are proposed for treatment of surface materials have been previously impacted and are currently contributing sediment to water resources. The proposed treatments will have a positive effect on water quality, and it is expected that the treatments will reduce the potential for expansion of impacts to riparian and lake shore areas from undirected vehicular use.

Routine maintenance of access roads and project facilities, including the El Dorado Canal, the existing diversion dams, and fish screening on Alder Creek and Carpenter Creek may necessitate the use of heavy equipment near streamcourses. These are already existing developments where use of heavy equipment could, though it is not likely, crush traveling western pond turtles or their nesting sites, as many of these areas are compacted or have frequent use. As stated in the proposed conditions, the Forest Service must be consulted before commencing any new construction or maintenance activities, and the Forest Service may require that a Biological Evaluation be prepared and that mitigation measures be implemented to protect sensitive species. The only detection of a western pond turtle within the portion of the project on the Eldorado National Forest is on the Silver Fork American River, which is not near any of the routine maintenance locations. Due to the low density of turtles observed nearby, the likelihood that pond turtles are present in association with the above described activities is low, as is the likelihood that adverse direct effects will occur.

Cumulative Effects.
The project will not contribute to adverse cumulative effects upon western pond turtles since direct and indirect impacts of the project are probably minimal and may be beneficial where turtles are present.

Roads are considered the principal cause of accelerated erosion in forests throughout the western United States (USDA 2000), and average road densities are high in the project area. Excessive erosion to streams fill pools, reducing the habitat for western pond turtles. An increase in the density of roads is an increase in the chance for western pond turtles to be run over by vehicles (Gibbs 2002). Work to reduce roads is a step toward reducing cumulative effects. The original construction and existence of roads may have led to western pond turtle habitat degradation through sedimentation and easier access by the public.

Dispersed recreation activities near or in streams could disturb sensitive aquatic species through the accumulation of sediment which fills pools, through collecting or handling species by people, or through disturbance by pets. Indiscriminate planting of bullfrogs in private ponds, and the colonization of bullfrogs to neighboring ponds, affects the western pond turtles in a detrimental way (Holland 2001).The level of use across the forest is expected to continue and increase over time as the human population continues to increase, although one restoration goal of the Riparian Conservation Objectives (USDA 2000) is to reduce the number of roads in RCAs.

Combining all the cumulative effects from other activities in the watersheds of the project area over time may possibly have contributed to the present low population status of the species in localized stream populations. During the gold rush, western pond turtles were collected in large numbers for food. Timber harvest activities can impact nesting and overwintering sites. These areas are beyond the buffers traditionally placed on streams with timber projects and are unprotected by heavy machinery. Roads were probably another significant factor affecting western pond turtles by providing easier access to the public for collecting individuals, and by crushing from vehicles. Bullfrogs introduced into ponds are also a factor affecting quality of habitat for western pond turtles. Historic land treatments caused habitat degradation through sedimentation that may have filled western pond turtle pool habitat, some of which has recovered over time. And lastly, the creation of dams along the SFAR has impeded habitat connectivity and created barriers to dispersal, altered flows, changed pool depths, and fragmented existing populations causing interference of normal movement patterns. Habitat destruction and alteration are threats for this species. It fares poorly in reservoirs created by dams (Holland 1991), partly because water levels fluctuate widely and because such waters are favored by introduced predators such as bullfrogs and bass that prey on young turtles.

Summary
Fall release flows from Caples and Silver Lakes down the Silver Fork American River could be detrimental to young turtles, although this is not expected to occur. There is no known scientific information on flow tolerances for young turtles, and it is expected that they would move to areas of lower velocities. Overall, the flow regime recommended should provide as close to a simulation of the natural hydrograph as was possible, considering that recreation and hydroelectric objectives needed to be addressed as well.

Determination
If the above conditions are implemented, the project may impact individual western pond turtles but is not likely to result in a trend toward Federal listing or a loss of viability.

Foothill yellow-legged frog

Existing Environment.
Species and Habitat Account. Information about this species life history and habitat preference used for this analysis is provided in Appendix B. Surveys in 2001 for this project by Ecorp Consulting (2002) of 29 sites resulted in 11 locations that contained foothill yellow-legged frogs. Seven were sites were on the SFAR between just above Grays Canyon Creek to just above Slab Creek Reservoir. Four locations were tributary sites: Silver Creek, Soldier Creek, Ogilby Canyon Creek, and Grays Canyon Creek. Breeding was observed as occurring or suspected of occurring by the presence of small, recently metamorphosed juveniles at four SFAR sites, at Silver Creek, and at Soldier Creek. In 2003, surveys below Silver Creek found several sites of foothill yellow-legged frogs above Slab Creek Reservoir, one site being downstream of Akins Powerhouse (Stillwater Sciences 2003).

Potentially suitable habitat affected by the project includes 51 miles of perennial streams up to 6,000 feet elevation including SFAR, Silver Fork American River, Esmeralda Creek, Alder Creek, Carpenter Creek, Bull Creek, Mill Creek, Ogilby Canyon Creek, and No-name Creek. However, up to 4,000 feet elevation in the SFARarea is a more realistic upper limit.

Effects of the Proposed Action
Direct and Indirect Effects

Any conditions not mentioned below are either outside of the elevation range for foothill yellow-legged frogs or would have no effect on them.

Condition No. 31 – Minimum Streamflows
Condition No. 32 – Ramping Rates
During the development of the proposed conditions, one of the tenets regarding aquatic ecosystems was that the native aquatic biota were best adapted to the natural flow regime. All of the flow related measures incorporated in the proposed conditions were designed to mimic the pattern of the natural hydrograph within the constraints of operating a hydropower project. Proposed streamflows for project-affected stream reaches on the Eldorado National Forest that may provide suitable habitat for foothill yellow-legged frogs are expected to benefit this species where they are present.

Throughout the history of the project, flows have been reduced as the result of diversions with the seasonality of flow variation being altered due to storage. These flow changes have, in many cases, adversely affected the quality and quantity of aquatic habitat and the ecological requirements for the native fauna. Minimum flows in the proposed conditions would mimic the natural hydrograph to the extent possible and, in most cases, provide more flow during times of the year when higher flow would be expected. Although these more natural flows may provide benefits to many aquatic biota, the benefits by these prescribed flows are not known, but are estimated to be positive. The long-term monitoring included in the conditions will help determine the status of this species as a result of the prescribed flows.

Ramping rates during this time should be gradual enough to reduce the shock of flow changes by the time the flow reaches down to the SFAR, and it is estimated that there would be insignificant change at this lower end of the project.

Condition No. 37 – Monitoring Program
Condition No. 38 – Ecological Resources Adaptive Management
Condition No. 42 – Water Temperature
One other concern for foothill yellow-legged frogs living along the SFAR could be abrupt flow fluctuations as a result of water diversion into the canal. The water velocity from abrupt flow fluctuations of more or less flow could conceivably dislodge or strand egg masses and tadpoles during reproductive periods. Monitoring after any flow fluctuations of more than 50 cubic feet per second when the flow has receded to less than 100 cfs is included in the proposed conditions. It is unlikely that these flow fluctuations would occur, but this condition helps assure that the egg masses and tadpoles are protected from being dislodged or stranded above water.

These conditions require the licensee to perform water temperature and general water quality monitoring for the Project which, through agency review of monitoring plans, would provide benefits to the species by helping to increase our knowledge of their range and habitat conditions. Water temperature data is important to assure that reproduction of foothill yellow-legged frogs is occurring during the natural period for this species, and their reproductive rate is not being slowed as a result of water being too cool from project operations. An extensive temperature monitoring program along with the use of adaptive streamflow management should provide the capability to mitigate any adverse temperature effects.

The adaptive management program includes monitoring the proposed conditions once the new license is implemented, including flows and water temperatures. If monitoring indicates that resource objectives are not being met, adaptive management measures may be implemented that may provide further protection of sensitive species.

Condition No. 34 – Caples Lake Releases and Flow Limitations
These releases would occur during the spring runoff period and are estimated to mimic conditions under which foothill yellow-legged frogs evolved. It is unlikely that these spring flows would affect the foothill yellow-legged frogs on Silver Fork American River.

Condition No. 36 - Esmeralda Creek Restoration
Though specific plans have not been developed for this condition, these actions are expected to provide benefits to aquatic species by restoring the creek channel to its original location. Through agency review of the plan, protection measures will be put in place to survey prior to the activity to ensure foothill yellow-legged frogs are not being affected.

Condition No. 39 – Mitigation for Entrainment
The screening of Carpenter and Alder Creeks for fish entrainment would also provide protection for amphibians from being swept into the canal and recruited out of the watershed by going down the canal where there would be less chance of survival.

Condition No. 46 – Implementation Plan
Condition No. 49 – Review of Recreation Developments
Condition No. 50 –Specific Recreation Conditions
Condition No. 51 – Operation and Maintenance of Recreational Facilities
Relicensing of the El Dorado Hydroelectric project does not involve new construction or development of new recreational facilities within the range of the foothill yellow-legged frog. Construction activities are limited to upgrading and expansion of recreation facilities, campgrounds, and associated access roads and parking areas. These activities would occur within the boundaries of established recreation facilities and not in the streamcourse where foothill yellow-legged frogs reside. There are a few acres proposed for treatment of surface materials that have been previously impacted and are currently contributing sediment to water resources. The proposed treatments will have a positive effect on water quality, and it is expected that the treatments would reduce the potential for expansion of impacts to riparian and lake shore areas from undirected vehicular use.

Routine maintenance of project facilities, including the El Dorado Canal, the existing diversion dams, weir structures, and the addition of fish screening on Alder Creek and Carpenter Creek may necessitate the use of heavy equipment near streamcourses. These are already existing developments where use of heavy equipment could, but is not likely to, crush foothill yellow-legged frogs, as many of these areas are compacted or have frequent use, and not likely to be a reproductive site. Through agency review of the plan, protection measures will be put in place to survey prior to the activity to ensure foothill yellow-legged frogs are not being affected. As stated in the proposed conditions, the Forest Service must be consulted before commencing any new construction or maintenance activities, and the Forest Service may require that a Biological Evaluation be prepared and that mitigation measures be implemented to protect sensitive species.

The detections of foothill yellow-legged frogs within the portion of the project on the Eldorado National Forest are on or near the SFAR from Ogilby Creek downstream. Due to the low density of foothill yellow-legged frogs observed nearby the locations of the above described maintenance, the likelihood that this species would be present in association with it is low, as is the likelihood that adverse direct effects would occur.

Condition No. 52 – Target Lake Levels and Minimum Pool
One deviation from the natural hydrograph with the proposed flows is the fall flow release out of Silver and Caples Lakes. These are fairly minor flow deviations from the normal rainfall flows for the fall months where foothill yellow-legged frogs reside.The range of the foothill yellow-legged frog in this project lies below the Kyburz Diversion Dam, as determined by 2002 surveys. These fall release flows may cause minor changes below this dam in the fall, a time when it is estimated that foothill yellow-legged frog life stages would not be affected significantly by flow changes. Although it is doubtful that any effects would occur to this species, long-term monitoring would help determine if there are any project effects. Through monitoring it should be ensured that fall release flows from Silver and Caples Lakes do not cool water temperatures too soon and reduce fitness of young metamorph foothill yellow-legged frogs.

Cumulative Effects.
The project will not contribute to adverse cumulative effects upon foothill yellow-legged frogs since direct and indirect impacts of the project are minimal and may be beneficial.

The original creation of hydropower projects on the SFAR have added to the cumulative effects for foothill yellow-legged frogs. The following have most likely occurred. On dammed systems peak flood flows are decreased and year-round flows are typically lower. These flow modifications can cause bar formations of suspended sediments to decrease and bed materials to become more coarse as a result of the decreased peak flows (Ligon et al. 1995, and Williams and Wolman 1984, *in* Lind 1996). This reduces side channel areas with shallow water for reproductive sites. Reservoir creation caused direct habitat loss (Brode and Bury 1984, *in* Lind 1996). Reservoirs impede habitat connectivity creating barriers to dispersal, interference of normal movement patterns, and fragmented populations.

Increased isolation of threatened frog populations may also have substantially reduced the probability of re-colonization of a site where extinction occurred (Wilcox 1980, Hanski and Gilpin 1991). This effect could occur due to the decreased size of potential source populations, the increased distance from source populations, and direct predation on dispersing individuals (Hanski 1989, Sjogren 1991).

Dispersed recreation activities near or in streams could disturb sensitive aquatic species through the accumulation of sediment which fills pools, through collecting or handling species by people, or through disturbance by pets. Indiscriminate planting of bullfrogs in private ponds, and the colonization of bullfrogs to neighboring ponds, affects the western pond turtles in a detrimental way (Holland 2001).The level of use across the forest is expected to continue and increase over time as the human population continues to increase.

Summary

Concerns for future impacts to foothill yellow-legged frog populations have been addressed to the extent possible with the restrictions on flow fluctuations, monitoring, and adaptive management. There remains one other potential concern that was not able to be addressed under the 4(e) conditions and still have a viable hydropower project, the effects of foothill yellow-legged frogs living and reproducing at or below Akins Powerhouse. Once the powerhouse begins to operate, foothill yellow-legged frog habitat may not exist below this point to Slab Creek Reservoir, a distance of under 1/2 mile on the South Fork American River. The populations above this point would remain self-sustaining and would not be affected. There was one known reproducing site existed at the tailrace of the powerhouse in the 2001 surveys, and one site in 2003 below the powerhouse (Stillwater Sciences 2003).

Determination

If the above conditions are implemented, the project may impact individual foothill yellow-legged frogs but is not likely to result in a trend toward Federal listing or a loss of viability.

Mountain yellow-legged frog

Existing Environment.

Species and Habitat Account. Information about this species' life history and habitat preference used for this analysis is provided in Appendix B. Surveys in 2001 for this project by Ecorp Consulting (2002) at 68 sites resulted in 10 locations that contained mountain yellow-legged frogs: a pond upstream from Upper Echo Lake, Silver Lake, three inlet tributaries to Silver Lake, three ponds southeast of Silver Lake, a pond adjacent to Granite Lake, Emigrant Creek, Lake Aloha, Middle Creek, and a pond south of Caples Lake. Breeding was observed as occurring at Middle Creek, a side pool of Lake Aloha, and the pond upstream from Upper Echo Lake. Project affected areas are: Lake Aloha and ponds downstream, and Silver Lake. Potential habitat for mountain yellow-legged frogs is 36 miles of streams, lakes, and ponds above 5, 000 feet elevation. In 1993, two adult mountain yellow-legged frogs were sighted in upper Alder Creek.

Effects of the Proposed Action
Direct and Indirect Effects

Any conditions not mentioned below are either outside of the elevation range for mountain yellow-legged frogs or would have no effect on them.

Condition No. 31 – Minimum Streamflows

Ecosystem matrices were used to relate streamflow (magnitude, timing, and duration) and seasonality to ecosystem attributes, including mountain yellow-legged frogs and the condition of their habitat. This assisted in developing the prescribed regime that would provide the appropriate magnitude, timing, and duration of minimum streamflows and thus, favorable biotic response. Whenever possible the natural hydrograph was used to develop these minimum streamflows.

Condition No. 32 – Ramping Rates
It is estimated that the ramping rates would be gradual enough to reduce the shock of flow changes should mountain yellow-legged frogs be in the outlet streams. It is unlikely that mountain yellow-legged frogs are residing in outlet streams, such as Caples Creek and Oyster Creek, but they could travel through these areas. There have been no studies to determine the appropriate velocity of water in streams for mountain yellow-legged frogs, although it is expected to be a fairly slow velocity. Outlet streams for miles downstream would not be optimum habitat, as water velocities and flow quantities would not permit their reproduction. Mountain yellow-legged frogs would more likely would be living in tributaries to outlet streams, which would not be affected by ramping rates.

Condition No. 33 – Operation and maintenance of Lake Aloha
It has been identified that Lake Aloha spills may be allowing brook trout in Lake Aloha to invade the mountain yellow-legged frog ponds below the dam. Actions in this proposed condition would require these brook trout to be removed from the ponds in a timely manner which would help reduce impacts to these sensitive frog populations. An amphibian monitoring program will be implemented upon initiation of the recommended flow regime.

Condition No. 34 – Caples Lake Releases and Flow Limitations
The intent of introducing pulse flow events to the main channel of Caples Creek is to: (a) more closely mimic the timing and duration of peak flows that would occur under an unimpaired hydrograph; (b) initiate transport of bedload material, which would assist in improving habitat conditions for aquatic species; (c) facilitate flooding of the stream side riparian community at the appropriate time of the year; and (d) aide in control of spills into the spillway channel. These pulse flow events are proposed to occur during the time in the natural hydrograph of spring high flows. Mountain yellow-legged frogs have naturally evolved with these spring high flows and are not expected to be detrimentally affected.

Condition No. 35 – Oyster Creek Stabilization
Mountain yellow-legged frogs have not been observed in Oyster Creek, but the incision of the channel has resulted in siltation, which has affected mountain yellow-legged frog habitat downstream. A plan would be created to stabilize this channel, thus improve habitat downstream.

Condition No. 37 – Monitoring Program
Condition No. 38 – Ecological Resources Adaptive Management
The adaptive management program includes monitoring the proposed conditions once the new license is implemented, including flows and water temperatures. If monitoring indicates that resource objectives are not being met, adaptive management measures may be implemented

that may provide further protection of sensitive species, including mountain yellow-legged frogs.

The presence and distribution of sensitive amphibian species are important in evaluating long-term population trends. Monitoring at the end of each 5-year period provides an index of changes in amphibian populations.

Monitoring would also ensure trout do not exist in the ponds below Lake Aloha as a result of spills over the auxiliary dams. These trout could consume the amphibian living in the ponds. The licensee must operate the project to attempt to prevent spills from overtopping these auxiliary dams in the future, which would help in the recovery of the mountain yellow-legged frog from project effects. At present, telemetry is being investigated to better be able to determine when spills are occurring.

- The following sites would be monitored after implementing the recommended flow regime to ensure that no adverse impacts are occurring. Echo Lake – Camp Harvey Tributary and associated ponds (EID site 440 T/L)
- Silver Lake (EID site 750LB)
- Camp Silverado (EID site 753IT)
- Caples Lake and the natural channel below Caples Lake Dam
- Lake Aloha and associated downstream ponds and habitats

Condition No. 46 – Implementation Plan
Condition No. 49 – Review of Recreation Developments
Condition No. 50 –Specific Recreation Conditions
Condition No. 51 – Operation and Maintenance of Recreational Facilities
Prior to constructing the Caples Lake boat launching ramp, the area should be surveyed for mountain yellow-legged frogs. Frogs have not been sighted at the edge of Caples Lake, although there is a possibility that they could be there, as they do live on the eastern edge of Silver Lake.

All other construction activities are limited to upgrading and expansion of existing recreation facilities, campgrounds, and associated access roads and parking areas. These activities would occur within the boundaries of established recreation facilities and not in the streams, lakes or ponds where mountain yellow-legged frogs reside. The proposed treatments will have a positive effect on water quality, and it is expected that the treatments would reduce the potential for expansion of impacts to riparian and lake shore areas from undirected vehicular use.

As stated in the proposed conditions, the Forest Service must be consulted before commencing any new construction or maintenance activities, and the Forest Service may require a Biological Evaluation that includes mitigation measures to be implemented to protect sensitive species.

Condition No. 52 – Target Lake Levels and Minimum Pool

The target lake levels of Caples and Silver Lakes would provide summer long high lake levels for recreation. Mountain yellow-legged frogs have been known to inhabit the edges of reservoirs, as they have been detected on the edges of Silver Lake and Lake Aloha. Although the high water levels provide more habitat, if frogs and tadpoles cannot escape the trout in the lake, they may be consumed. Only under certain conditions would a higher lake level provide more habitat, that is, if more shallow habitat is being created. In Silver Lake, the high lake levels seem to be providing habitat on the eastern side of the lake for mountain yellow-legged frogs, according to surveys. When Lake Aloha reduces lake levels, starting in mid-summer, isolated pockets of pools are created in shallow areas, creating mountain yellow- legged frog habitat where brook trout cannot swim. The optimum lake level for mountain yellow-legged frogs in reservoirs has not been studied in the scientific community.

Caples and Silver Lakes are releasing large fall flows in order to satisfy summer recreational needs by holding the water during the summer. The water would be released in the fall to comply with dam safety requirements prior to the winter, and to provide hydroelectric generation. Generally, these fall flows are fairly close to the natural hydrograph of fall storms, but may be more steady flowing for a longer duration than would be with natural fall rainstorm flows. If mountain yellow-legged frogs were to inhabit the outlet streams, such as Caples Creek or Oyster Creek, they would need to move to locations up higher on the stream banks during these fall flows, and tadpoles would need to find refuge behind boulders or logs. It is not expected for mountain yellow-legged frog tadpoles to be living in the streams where flows would displace them from rainstorm events in the fall. They have generally evolved to be in smaller streams where displacement would not occur. During the fall the adults are known to use stream corridors for movement from one location to another, especially during the month of September. The fall release flows from Caples and Silver Lakes are an unnatural occurrence in the hydrograph, therefore it is suspected that effects to mountain yellow-legged frogs may have occurred from past operations, but not expected to occur by continuing these flows.

Summary

Effects to mountain yellow-legged frogs are expected to be negligible, if not reduced, by implementing the Conditions above. Brook trout, which may eat frogs and tadpoles, would be removed from the ponds below Lake Aloha if spilling occurs over the saddle dam. As part of Condition 51, surveys along the lake edge should be performed to ensure mountain yellow-legged frogs are not living in the area of construction for the Caples Lake boat launch ramp. It is estimated that the ramping rates would be gradual enough to reduce the shock of flow changes should mountain yellow-legged frogs be in the outlet streams. The fall release flows from Caples and Silver Lakes are an unnatural occurrence in the hydrograph, therefore it is suspected that effects to mountain yellow-legged frogs may have occurred from past operations, but not expected to occur by continuing these flows. Adaptive management and the proposed monitoring plan would ensure that populations are remaining stable and that new scientific information is incorporated into management of mountain yellow-legged frogs in the project area.

Cumulative Effects.

The project is not expected to contribute to adverse cumulative effects upon localized populations of mountain yellow-legged frogs.

The original creation of hydropower projects on the SFAR have added to the cumulative effects for foothill yellow-legged frogs. The following have most likely occurred. On dammed systems peak flood flows are decreased and year-round flows are typically lower. These flow modifications can cause bar formations of suspended sediments to decrease and bed materials to become more coarse as a result of the decreased peak flows (Ligon et al. 1995, and Williams and Wolman 1984, *in* Lind 1996). This reduces side channel areas with shallow water for reproductive sites. Reservoir creation caused direct habitat loss (Erode and Bury 1984, *in* Lind 1996).

Reservoirs impede habitat connectivity creating barriers to dispersal, interference of normal movement patterns, and fragmented populations. Reservoirs and many high mountain lakes have been historically planted with fish. The presence of non-native trout in the project-affected waters probably causes one of the largest impacts to populations of mountain yellow-legged frogs in the Sierras.

Increased isolation of threatened frog populations may also have significantly reduced the probability of re-colonization of a site where extinction occurred (Wilcox 1980, Hanski and Gilpin 1991). This effect could occur due to the decreased size of potential source populations, the increased distance from source populations, and direct predation on dispersing individuals (Hanski 1989, Sjogren 1991).

Dispersed recreation activities near or in streams could disturb TES aquatic species through the accumulation of sediment which fills pools, collected or handled by people, or disturbed by pets. The level of use across the forest is expected to continue and increase over time as the human population continues to increase.

Determination
If the above conditions are implemented, the project may impact individual mountain yellow-legged frogs but is not likely to result in a trend toward Federal listing or a loss of viability.

Hardhead

Existing Environment
Species and Habitat Account
Information about this species' life history and habitat preference used for this analysis is provided in Appendix B. A survey for this project (TRPA 1998) conducted specifically to focus on the range of hardhead in the SFAR SES 2003) have found that hardhead extend between approximately 1.6 miles below Silver Creek confluence down to, and including, Slab Creek Reservoir, and continue downstream from there. Hardhead range is impeded by a 15foot barrier waterfall approximately 0.5 miles downstream from Silver Creek confluence. There appears to be suitable habitat upstream of this barrier, but hardhead have not be detected above the barrier. Therefore, there are 1.6 miles of suitable hardhead habitat in this project area below the barrier.

Effects of the Proposed Action

Direct and Indirect Effects

Any conditions not mentioned are either outside of the elevation range for hardhead or would have no effect on them.

Condition No. 31 – Minimum Streamflows
The flow regimes in the streams affected by this project have been altered in regards to magnitude and timing. Generally, flows have been reduced as the result of diversions and the seasonality of flow variation has been altered due to storage in the headwaters. These flow changes can adversely affect the quality and quantity of aquatic habitat and the ecological requirements for the native fauna. Ecosystem matrices were used to relate streamflow (magnitude, timing, and duration) and seasonality to ecosystem attributes, including hardhead and the condition of their habitat. This assisted in developing the prescribed regime that would provide the appropriate magnitude, timing, and duration of minimum streamflows and thus, favorable biotic response. Whenever possible the natural hydrograph was used to develop these minimum streamflows.

During the development of the proposed conditions, one of the tenets regarding aquatic ecosystems was that the native aquatic biota were best adapted to the natural flow regime. All of the flow related measures incorporated in the proposed conditions were designed to mimic the pattern of the natural hydrograph within the constraints of operating a hydropower project. Proposed streamflows for project-affected stream reaches on the Eldorado National Forest that may provide suitable habitat for hardhead are expected to benefit this species if they are present.

Condition No. 32 – Ramping Rates
Ramping rates during this time should be gradual enough to reduce the shock of flow changes by the time the flow reaches down to the SFAR, and it is estimated that there would be insignificant change at this lower end of the project where hardhead reside.

Condition No. 37 – Monitoring Program
Condition No. 38 – Ecological Resources Adaptive Management
Condition No. 42 – Water Temperature
These conditions require the licensee to perform water temperature and general water quality monitoring for the Project which, through agency review of the monitoring plans, would provide benefits to the species by helping to increase our knowledge of their range and habitat conditions. Water temperature data, along with species population data, will help determine if temperature is affecting hardhead life stages. Hardhead prefer warmer water temperatures. Most streams occupied by hardhead have summer temperatures in excess of 20 degrees C, and they select an optimal range between 24-28 degrees C (Knight 1985 as cited in Moyle 2002). Therefore cooler temperatures than occurred under natural flow regimes in summer and fall times of the year can reduce habitat quality. Since the range of hardhead in this project lies below Silver Creek on the South Fork American River, the Upper American River Project's flows from Silver Creek are actually much more of an influence on water temperatures than the flows from the El Dorado Hydroelectric Project. Water coming down the SFAR from reservoirs on this project would be attentuated by the time the flows reached the area of hardhead habitat and not likely to be a cooling factor. During the months of reservoir releases

in the fall, water temperatures are much cooler during these fall months, thus would not cause a cooling effect in the lower SFAR.

The adaptive management program includes monitoring the proposed conditions once the new license is implemented, including flows and water temperatures. An extensive temperature monitoring program along with the use of adaptive streamflow management should provide the capability to mitigate any adverse temperature effects. This would ensure that aquatic species would be protected by monitoring the response of the hardhead populations.

Condition No. 46 – Implementation Plan
Condition No. 49 – Review of Recreation Developments
Condition No. 50 –Specific Recreation Conditions
Condition No. 51 – Operation and Maintenance of Recreational Facilities
Routine maintenance of project facilities, including the El Dorado Canal, the existing diversion dams, weir structures, and the addition of fish screening on Alder Creek and Carpenter Creek may necessitate the use of heavy equipment near streamcourses. Through agency review of the plans, protection measures will be put in place to survey prior to the activity to ensure water quality is protected and hardhead and their habitat are not adversely affected.

Cumulative Effects
This project is not expected to contribute to the cumulative effects addressed below.

The original creation of hydropower projects on the SFAR has added to the cumulative effects for hardhead. The creation of dams isolated populations, impeding connectivity. Peak flood flows have been decreased causing pool filling, and year-round flows have been typically lower, reducing habitat. These flow modifications can cause bar formations of suspended sediments to decrease and bed materials to become more coarse as a result of the decreased peak flows (Ligon et al. 1995, and Williams and Wolman 1984, *in* Lind 1996). Young hardhead in the SFAR have been observed to congregate on the edges of the river and key in on sedge roots and overhanging sedge vegetation (TRPA date unknown). These appeared to be both as a source for food and cover from predators. *Carex* sedges may have decreased as a result of more coarse bed materials, although this is speculation and needs to be studied. Flow modifications may also reduce spawning gravel recruitment for hardhead. Water level fluctuations in reservoirs can cause a decease in hardhead populations, such as Slab Creek Reservoir.

Water temperatures coming out of the bottom of reservoirs on the Upper American River Project and flowing down Silver Creek may be affecting hardhead in the SFAR from water being too cool during the summer. This concern will be investigated and addressed during the relicensing of that project.

Recreational fishing has probably reduced the older age class of hardhead in some areas on the SFAR.

Summary

Concerns for future impacts to hardhead have been addressed to the extent possible with water temperature monitoring and adaptive management. The minimum flows are expected to be suitable for hardhead, but adaptive management could be an avenue if there are future habitat concerns related to these prescribed minimums. There remains one other potential concern that was not able to be addressed in the proposed conditions and still have a viable hydropower project: the effects of the Akin Powerhouse flows and water temperatures on hardhead. Any impacts to this species from the flows and water temperatures are unknown, and it is estimated that monitoring will examine these impacts and adaptive management is available to improve any habitat effects.

Determination.
If the above conditions are implemented, the project may impact hardhead individuals but is not likely to result in a trend toward Federal listing or a loss of viability.

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Appendix A
Project Area Map

Appendix B
Species Accounts

Western Pond Turtle

Management Status and Direction: The northwestern (Clemmys marmorata marmorata) and southwestern (Clemmys marmorata palida) pond turtles are designated as sensitive species in Region 5 of the Forest Service. The USDI Fish and Wildlife Service was petitioned to list the western pond turtle in 1992 under the Endangered Species Act, but determined there was insufficient information to warrant listing.

Habitat account: The western pond turtle (Clemmys marmorata) is found from northwestern Baja California, Mexico, north to the Columbia River, Washington. This species is primarily found to the west of the Sierra-Cascade divide. The northwestern subspecies (C. m. marmorata) occupies the northern portion of the species range south to San Francisco Bay on the coast and the Mokelumne River in the Sierra Nevada (Holland 1991). The portion of the Eldorado National Forest south of the American River and continuing south into the San Joaquin Valley and southern Sierra foothills is considered an intergrade zone between the northwestern and southwestern pond turtle subspecies (C. m. pallida). The Mokelumne River is in this intergrade zone and any populations in this drainage will be considered as western pond turtles for the purpose of this evaluation as subspecific identification has not been attempted for intergrades. This species historically occurred from sea level to 5,000 feet, although turtles are scarce anywhere above 4,500 feet (Holland et al. 1992), but have been observed up to higher elevations in the 6,000 feet range (Holland 2002).

Western pond turtles are habitat generalists, occurring in a wide variety of permanent and intermittent aquatic habitats including rivers, streams, lakes, ponds, vernal pools, and other seasonal and permanent wetlands. They could occur in most stream gradients (Holland 2002). Turtles still exist in small numbers in most large river systems in the central and northern parts of the range, although most populations currently exist in smaller streams, usually in montane areas. Turtles are also known to occupy artificial aquatic habitats such as small reservoirs, canals, farm ponds, and sewage treatment plants (Holland 1991).

Hatchling and small juvenile pond turtles require specialized microhabitats characterized by shallow water (usually < 30 cm deep), presence of emergent vegetation, and clusters of small branches in the water. These microhabitat features probably function as sheltered basking sites, shelter from predators, foraging sites with large numbers of invertebrate prey, and abundant hauling out sites. In rocky streams with little or no emergent vegetation, hatchlings and small juveniles are usually found in shallow, quiet, rocky pools off the main stream course (Holland 1991).

Age and size at first reproduction varies geographically (Holland 1991). In northern California, the smallest known gravid female was 130 mm and probably 10-12 years old (Holland 1991). Most females oviposit in alternate years producing single clutches of 1-13 eggs. Incubation time has been documented ranging from 73-80 days in captivity (Feldman 1982) and from 95-106 days for naturally incubated nests along the Columbia River in Washington (Holland 1991). Oviposition occurs during May through July, with one record in the San Joaquin drainage occuring on June 7. Hatchlings vary in size from 23-31 mm in carapace length and most are thought to overwinter in the nest. Suvivorship in hatchlings and small juveniles is low, with approximately 8-12% of the first year cohort surviving to the second year. Males appear to have a higher probability of survivorship than females, probably due to a lower exposure to predators than females during nesting efforts. Known longevity from marked individuals has been estimated at 39-40 years, and the potential lifespan may be more in the order of 50-70 years (Holland 1991).

Most females nest within 100 meters from water, although may nest up to 150 meters (Holland 2001). At one site in the San Joaquin River drainage, nest sites ranged from 19.5 to 65 m from water. The majority of nest sites have been found on dry, well drained soils with significant clay/silt content and low (<15 degree) slope. Most have been in open areas dominated by grasses or herbaceous annuals, with few shrubs or trees in the immediate vicinity. Exposure varies, but most are found on south or southwest facing slopes (Holland 1991).

The western pond turtle is a dietary generalist and opportunist, and seasonal or periodic shifts in diet occur in response to prey availability (Holland 1991). The majority of the diet in most areas consists of small to moderate sized invertebrates (Holland 1991). Vertebrates have also been documented as prey, including small fish, amphibian larvae and small juvenile frogs (Bury 1986). Plant material has been documented in the diet of pond turtles but is uncommon. Carrion is often a major item in the diet of turtles, including carcasses of a variety of invertebrates and all classes of vertebrates (Evenden 1948, Holland 1985, Bury 1986).

Foraging occurs throughout the water column and prey are swallowed under water. Although turtles occasionally take prey out of water (Carr 1952) there is no evidence that they are able to swallow in air. Most foraging occurs in the early morning and late afternoon during the summer, and may extend into the early evening. In stream habitats, turtles have often been observed foraging below riffles, possibly waiting for drifting prey (Holland 1991).

Western pond turtles may engage in overland movements that are not reproductive in nature or in apparent response to flooding. Turtles have been found crushed on roads adjacent to watercourses for distances up to 200 m. Animals of both sexes have been observed moving overland at distances of 0.5 km from the nearest watercourse. The majority of these movements have been observed during early spring and late fall and may represent movements from and to upland overwintering sites. Overwintering is a poorly understood aspect of turtle behavior. It is uncertain whether pond turtles hibernate in the physiological sense. In montane areas, at least a portion of turtle populations have been observed moving into adjacent upland areas during the winter. They have been found under logs and buried in leaf litter (Holland 1991).

<u>Existing surveys and sightings</u>: Although surveys specifically for western pond turtles have not been conducted on the Eldorado National Forest, they have been observed at 16 locations on the Eldorado NF since 1990. They have been found in the Rubicon, South Fork American, Cosumnes, and Mokelumne River drainages. All observations have been incidental to other activities including fish habitat and amphibian surveys. Five of the sightings have been individuals observed crossing roads, usually within 200 feet of perennial streams, except for one individual observed approximately 3,700 feet from the nearest perennial water source. All sightings associated with streams have been individual juvenile and adult turtles. A maximum of three turtles have been observed at one site involving two small artificial ponds. Pond turtles

have also been reported from a variety of aquatic habitats at lower elevations immediately to the west of the forest. Sightings ranged in elevation from 1,600 to 4,640 feet in stream, pond, reservoir, and upland habitat.

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Foothill Yellow-Legged Frog

Management Status and Direction: The foothill yellow-legged frog (Rana boylii) is designated as a sensitive species in Region 5 of the Forest Service.

Habitat account: On the Eldorado National Forest, potential habitat for foothill yellow-legged frogs (Rana boylii) is considered to be all perennial streams and intermittent streams with persistent pools below 6,000 feet elevation (Stebbins 1985). The foothill yellow-legged frog is a highly aquatic amphibian that is primarily restricted to riverine habitats (Zweifel 1955, Stebbins 1972), and is rarely seen far from streamside habitats (Nussbaum et al 1983, Stebbins 1972). Unlike most other ranid frogs in California, this species is rarely encountered (even on rainy nights) far from permanent water (CDFG 2001). When frightened, it dives to the bottom and takes refuge among stones, silt, or vegetation. During periods of inactivity, especially during cold weather, individuals seek cover under rocks in the streams or on shore within a few meters of water (CDFG 2001).

Habitat variables among those considered necessary to support populations of this species include: stream flow and relative size; stream substrate type; availability of sunny basking sites; and absence of introduced aquatic amphibian predators. Stream size typical of foothill yellow-legged frog habitat is small to moderate, with surface water usually persistent at least in plunge pools, although larger rivers are also utilized. The streambed always includes some percentage of 75-300 mm diameter substrate (cobble), and may also be comprised of bedrock, boulders, and gravel or sand. This species is usually detected in streams that have open, sunny banks (of all substrate types) which are used as basking sites (Fellers and Freel 1996). Adults congregate around breeding pools in April, May and June, and may disperse in the summer months moving into riparian vegetation, moving up tributaries, or reducing diurnal activity (Ashton et al. 1998).

Breeding and egg-laying usually occur from mid-March to early June, after high water of streams subsides (Stebbins 1985). Egg masses are usually laid in the stream margin, at a depth of less than half a meter, and with flow velocities of 0.0 to 0.21 m/second (Ashton et al. 1998). Fuller and Lind (1993) found breeding sites were exposed to significantly greater solar radiation than otherwise suitable sites which met established criteria based on water depth, velocity, substrate size, and distance from the streambank. Cobble/pebbles are the preferred substrate for egg mass attachment, but they have also been found attached to aquatic vegetation, woody debris, and gravel (Fuller and Lind 1993). Eggs hatch in 5 to 30 or more days (Zweifel 1955), probably depending on water temperature (Ashton et al. 1998). Larvae metamorphose by late summer or early fall in 3 to 4 months (Nussbaum et al. 1983). Frogs reach maturity 1 to 3 years after metamorphosis. The life span may be 12 years or more, based on studies of other ranids (Duellman and Trueb 1986).

Primary threats to these frogs are the construction of dams (Lind et al. 1996). and predation by bullfrogs (Rana catesbeiana) in the Sierra (Moyle 1973). Garter snakes feed heavily on tadpoles and adults (Fitch 1941). Centrachid fishes readily eat Rana eggs (Werschkul and Christensen 1977), and, where introduced into foothill streams, may also contribute to the eliminiation of foothill yellow-legged frogs.

On a worldwide basis, acid precipitation, ultraviolet radiation, viruses, pesticides, habitat destruction, and global climate change have all been suggested as causes for the decline of amphibians (Carey 1993). Increased isolation caused by these many causes may have contributed to the extinction of some foothill yellow-legged frog populations because smaller populations of organisms are generally more susceptible to extinction via stochastic events than are larger ones (Wilcox 1980, Hanski 1989, Hanski and Gilpin 1991). This effect may be pronounced in temperate anurans such as foothill and mountain yellow-legged frogs because they often show wide swings in population size in response to environmental factors (Pechmann et al. 1991, Sjogren 1991). Increased isolation of these populations may also have significantly reduced the probability of recolonization of a site where extinction occurred (Wilcox 1980, Hanski and Gilpin 1991). This effect may occur due to the decreased size of potential source populations, the increased distance from source populations, and direct predation on dispersing individuals (Hanski 1989, Sjogren 1991).

On the Eldorado National Forest, potential habitat for foothill yellow-legged frogs is considered to be all perennial streams and intermittent streams with persistent pools below 6,000 feet elevation. Adjacent riparian and terrestrial areas may provide dispersal and sheltering habitat during the wet season, from October 1 through March 31. This dispersal and sheltering habitat is defined by the following streamside management zone (SMZ) widths (also called Riparian Conservation Areas in Sierra Nevada Framework) on each side of the stream channels:

Perennial streams - 300 feet
Seasonally flowing streams - 150 feet

Existing surveys and sightings: Amphibian surveys that included foothill yellow-legged frogs as target species have been conducted on the Eldorado National Forest. Surveys of eight stream reaches in the elevational range of this species were conducted by a contractor during 1992 and 1993 (Martin 1993, Martin, in litt., 1995) , four stream reaches in 1995 (Fellers and Freel 1996), and one stream reach in 1997 (Jones and Stokes 1997) documenting occurrence at 2 of the locations. The occurrences at the remaining locations were documented during fish stream surveys beginning in 1992 and incidental to various other field activities and surveys on the forest. They have been found in the Rubicon, South Fork American, Cosumnes, and North Fork Mokelumne River drainages.

Foothill yellow-legged frogs have been reported at 11 locations on the Eldorado National Forest since 1992: Bark Shanty Canyon Creek, Upper Camp Creek near Pilliken, Lower Camp Creek near Jenkinson Lake, Snow Creek, Sopiago Creek, Soldier Creek, Rubicon River from its mouth upstream for 6.2 miles (5 locations), Rubicon River near Ellicott Bridge, unnamed tributary to North Fork Wallace Canyon Creek, and South Fork American River at the upper limit of Slab Creek Reservoir. Mountain yellow-legged frogs (Rana muscosa) have also been reported at the Bark Shanty Canyon and Upper Camp Creek localities indicating sympatry or possible misidentification. These two localities are within the elevational range of overlap between these two species as is the North Fork Wallace Canyon tributary location. The elevational range for these 11 locations are 1320 to 4580 feet.

During 1973 through 1776, unidentified frogs were noted in several fish stream survey reports that were most probably foothill yellow-legged frogs based on their their use of stream habitat and elevation. These locations are: Rubicon River near the confluence of Big Grizzly Canyon Creek, Otter Creek upstream from Missouri Canyon Creek, North Steely Creek, Middle Dry Creek, and Sopiago Creek.

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Mountain yellow-legged frog

Management Status and Direction: The mountain yellow-legged frog (Rana muscosa) is designated as a sensitive species in Region 5 of the Forest Service. The USDI Fish and Wildlife Service was petitioned to list the mountain yellow-legged frog as endangered on February 8, 2000. USFWS announced a 90 day finding that the petition presents substantial information indicating listing the species may be warranted, and initiated a status review (Federal Register/Vol 65, No. 198/Thursday, October 12, 2000/pages 60603-60605).

Habitat Account: In the Sierra Nevada, the mountain yellow-legged frog (Rana muscosa) is found from around 4,500 feet to over 12,000 feet elevation (Zweifel 1955, Mullally and Cunningham 1956, Stebbins 1985). The historic range extends from Plumas County to Tulare

County (Jennings and Hayes 1994). This species inhabits high elevation lakes, ponds, tarns, and perennial and intermittent streams. This frog is seldom far from water and prefers well illuminated, sloping banks of meadow streams, river banks, isolated pools, and lake borders with vegetation that are continuous to the water's edge (Martin 1992, Zeiner et al. 1988). They have also been observed using a variety of habitats, including grassy streambanks, large boulders adjacent to deep stream pools, fallen trees extending into lakes, and along rocky lake shorelines adjacent to deeper water (Elliott pers. comm. 2000). Shallows along stream and lake margins are used by tadpoles to absorb heat to enhance metabolic rate (Jennings and Hayes 1994). At high elevations, breeding and egg-laying occurs from May through August, as soon as meadows and lakes are free of snow and ice (Stebbins 1985). At lower elevations, breeding occurs from March through June when high water in streams subsides (Stebbins 1985). Larvae are reported to overwinter at least once and often twice before metamorphosis (Cory 1962, Bradford 1983). Time to sexual maturity, and adult life span are unknown (Jennings and Hayes 1994).

Adults and larvae of this species overwinter in deep pools with undercut banks that provide cover (Martin 1994). In high elevation lakes frogs over-winter in nearshore crevices in water depths ranging from 0.4 to 1.2 meters in both shallow lakes and shallow portions of deep lakes (Matthews and Pope 1999). Adults and second year tadpoles have also been observed in small, high elevation, meadow streams with pools less than three feet maximum depth and no lakes within one mile (Elliott pers. comm. 2000). It is believed the limiting factor in winter for frogs is low dissolved oxygen in the water and not low temperature (Bradford 1982, 1983).

The most mobile month for frogs was found to be in September by Matthews and Pope (1999), when surveying between the months of August to October. In their study at 11,000 feet elevation in Kings Canyon National Park, mountain yellow-legged frogs were observed moving during daytime approximately 200 feet over dry land on granite rock from one lake to another. Movements following streamcourses for up to 3000 feet have been documented for PIT-tagged individuals (Fellers pers. comm. 1998). Studies have not confirmed travel overland on forested soils at the lower elevations, or between streamcourses.

The mountain yellow-legged frog has been eliminated from 50% of its historic range in the Sierra Nevada (Jennings 1993). As populations are lost, remaining populations become more isolated, which can indirectly result in extinctions of additional populations and reduce opportunities for recolonization of these sites (Bradford et al. 1993). Additional reasons for the mountain yellow-legged frog's disappearance that have been offered include: loss of habitat, altered habitat, grazing, and other environmental problems such as increased ultraviolet radiation, pesticides, viral and fungal infections, and acid rain. There is scientific documentation that introduced fish populations in the Sierra Nevada in the last century have affected mountain yellow-legged frog population sizes (Matthews and Knapp 1999). Due to the adults overwintering underwater and the long metamorphosis of the tadpoles, this species is very vulnerable to introduced fish (Knapp 1994). Garter snakes also prey upon mountain yellow-legged frog tadpoles (Zeiner et al. 1988).

On the Eldorado National Forest, potential habitat for mountain yellow-legged frogs is considered to be all perennial streams, ponds, and lakes above 5,000 feet elevation. Riparian and terrestrial areas adjacent to perennial streams may provide dispersal and sheltering habitat after the breeding season, from June 1 through September 30. This dispersal and sheltering habitat is defined by the following streamside management zone (SMZ) widths (also called Riparian Conservation Areas in Sierra Nevada Framework) on each side of the stream channels:

Perennial streams - 300 feet
Seasonally flowing streams - 150 feet

Above 7,000 feet, terrestrial areas within 300 feet of ponds and lakes may be utilized for dispersal or migration between waterbodies.

Existing surveys and sightings: Amphibian surveys that included mountain yellow-legged frogs as target species have been conducted on the Eldorado National Forest. Surveys of eight stream reaches in the elevational range of this species were conducted by a contractor during 1992 and 1993 (Martin 1993, Martin, in litt., 1995). Joint Forest Service-California Department of Fish and Game visual shoreline surveys of numerous lakes, ponds, and streams have been conducted during 1993 through 1997. Amphibian occurrence on the Eldorado National Forest has also been documented during fish stream surveys and incidental to various field project activities. Mountain yellow-legged frogs have been reported from over 70 ponds, lakes, and streams over 7,000 feet elevation, mostly in the Desolation and Mokelumne Wilderness Areas. Outside of Wilderness Areas they have been reported in 15 streams and one artificial pond between 5,200 and 7,800 feet elevation. These streams are Cole Creek, Deer Creek drainage streams, unnamed tributary to Caples Creek, Middle Creek, Forni Creek, Little Bear River, Camp Creek, Alder Creek, Bark Shanty Creek, two inlet streams to Silver Lake, Tragedy Creek, Bassi Fork, Lyons Creek (upper), unnamed tributary to Rubicon River, and Dufrene Pond.

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Hardhead

Population status

Historically, hardhead (Mylopharodon conocephalus) have been regarded as a widespread and locally abundant species (Ayres 1854, Jordan and Evermann 1896, Evermann 1905, Rutter 1908, Murphy 1947, Soule 1951, Reeves 1964). Hardhead are still widespread in the foothill streams, but their specialized habitat requirements, combined with widespread alteration of downstream habitats, has resulted in the isolation of populations. These conditions increase the chance for localized extinctions. Hence, hardhead are less abundant than they once were, especially in the southern half of their range.

Hardhead are widely distributed in low to mid-elevation streams in the main Sacramento-San Joaquin drainage as well as the Russian River drainage. Their range extends from the Kern River, Kern County, in the south to the Pitt River, Modoc County, in the north. Populations are scattered in the tributary streams of the San Joaquin drainage, but have not been found in the valley reaches of the San Joaquin River (Moyle and Nichols 1973, Saiki 1984, Brown and Moyle 1987). In the Sacramento River drainage, hardhead are present in most of the larger tributary streams as well as the Sacramento River. They are widely distributed in the Pit River drainage (Cooper 1983, Moyle and Daniels 1982), including the main Pit River and its series of hydroelectric reservoirs. On the Eldorado National Forest, hardhead have been reported in the South Fork American River, in Slab Creek Reservoir and upstream for about two miles to a barrier falls (Jordan and Brown 1993, TRPA 1998), as well as in the Middle Fork American River (CDFG 1979).

Life History and Habitat Information

Hardhead are primarily bottom feeders, foraging for benthic invertebrates and aquatic plant material in quiet water. They will occasionally feed on plankton and surface insects. Smaller fish (<20 cm SL) feed primarily on mayfly nymphs, caddisfly larvae, and small snails, whereas larger fish feed mainly on aquatic plants (especially filamenous algae), as well as crayfish and other large invertebrates (Reeves 1964). The ontogenetic changes in teeth structure seems to fit the dietary switch. Reeves (1964) found no remains of fish in the stomachs of large hardhead.

Hardhead mature after their second year and most likely spawn in the spring (Reeves 1964), judging by upstream migrations of adults into smaller tributary streams during this time of year (Wales 1946, Murphy 1947, Bell and Kimsey 1955, Rowley 1955). Estimates based on juvenile recruitment suggest that hardhead spawn by May-June in Central Valley streams and that spawning season may extend into August in the foothill streams of the Sacramento-San Joaquin drainage (Wang 1986).

Hardhead reach 7-8 cm by their first year, but growth slows in subsequent years. In the American River, hardhead reach 30 cm SL in four years, whereas in the Pitt and Feather Rivers, it takes six years to reach that length (Moyle et al. 1983, PG&E 1985).

Hardhead are typically found in undisturbed areas of larger middle and low-elevation streams (Moyle and Nichols 1973, Moyle and Daniels 1982). Elevational range is 10 – 1450m (Reeves 1964). Most streams occupied by hardhead have summer temperatures in excess of 20 degrees C, selecting an optimal range between 24-28 degrees C (Knight 1985). Hardhead are relatively intolerant of low oxygen levels, especially at higher temperatures, a factor which may limit their distribution to well oxygenated streams and the surface water of reservoirs (Cech et al. 1990). They prefer clear, deep (>1m) pools with sand-gravel-boulder substrates and slow velocities (<25cm/sec) (Moyle and Nichols 1973, Knight 1985, Moyle and Baltz 1985). In streams, adult hardhead tend to remain in the lower half of the water column, rarely moving into the upper levels (Knight 1985), while juveniles concentrate in shallow water close to the stream edges (Moyle and Baltz 1985). Hardhead are always found in association with Sacramento squawfish and usually with Sacramento suckers. They tend to be absent from streams with introduced exotics, especially centrarchids (Moyle and Nichols 1973, Moyle and Daniels 1982), or streams that have been severely altered by human activity (Baltz and Moyle 1993).

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APPENDIX A

Foothill Yellow-Legged Frog (*Rana boylii*)

Life History and Habitat Information

Status:	*Federal*	Species of Concern
	State	California Species of Special Concern/Protected
	Forest Service	Sensitive

Species Description

Juveniles and Adults – The foothill yellow-legged frog (FYLF) is a moderate-sized frog, with juveniles ranging from 22 to 40 mm snout to vent length (SVL), and adults measuring from 40 to 65 mm SVL (Nussbaum et al. 1983). When they reach their maximum adult size, females are larger than males, and may measure up to 20 – 25 mm longer in SVL. The dorsal coloration of FYLFs is highly variable and in many situations blends closely with the predominant color of the surrounding substrate, making the frogs cryptic and difficult to spot. Dorsal color also appears to reflect the amount of sun exposure, with uniform dark gray or olive colored individuals typically observed in heavily shaded streams, and lighter gray, brown, tan, and yellow frogs with varying amounts of spotting found in areas that lack heavy shading (personal observations). Both juveniles and adults may have dark red coloration, often along the poorly developed dorsal lateral folds.

Many juvenile and adult FYLFs are spotted, and their skin may appear rough due to the presence of small tubercles. The tympanum is relatively small, about half the size of the eye, and is colored and roughened like the surrounding skin, often making it difficult to see (Leonard et al. 1993; Nussbaum et al. 1983). The dorsal surfaces of the rear legs are often distinctly barred, and the ventral surfaces are pale to brilliant yellow; however, the yellow coloration may be faint or lacking in younger frogs. The posterior portion of the abdomen may also be yellow or light orange in color with the remainder of the abdomen white. Dark mottling on the chin and throat is common but not always present. The webbing of the hind toes is full, slightly concave, and extends to the tip of the longest toe (Leonard et al. 1993).

During the breeding period, males may be identified by their enlarged forearms, without the need to capture them. In addition, they develop enlarged nuptial pads on the medial surfaces of the thumbs for gripping the female during amplexus, but this characteristic can only be observed if the frog is captured. Male frogs may be found in small groups in areas used for breeding, and young males may be observed in amplexus with each other. On the North Fork Feather River, male frogs have been observed on exposed substrates at mid-day calling from known oviposition sites (personal observations). The call consists of short coarse or guttural sounds with a slightly descending or ascending tone at the end of the call. These low volume calls are repeated in succession separated by silence of various lengths (personal observations). Because FYLFs are known to call primarily underwater (MacTeague and Northern 1993), this type of vocalization would presumably generate vibrations necessary to carry underwater, particularly in stream habitats. This call was also heard in early September on the Middle Fork Stanislaus River (personal observations).

Egg Masses – In coastal streams, Lind et al. (1996) found that egg masses are laid along stream margins in shallow water that is usually <1.0 m deep and in flows less than 21 cm/sec. In the Sierra Nevada Mountains, recent studies have indicated that FYLFs typically deposit egg masses in shallow edgewater habitat <40 cm deep with velocities <10 cm/sec (Pacific Gas and Electric Company 2001, 2002a, 200b). FYLF egg masses are generally deposited in open, sunny areas and typically have a dark bluish tint for several days following oviposition (Ashton et al. 1998; personal observations). When first deposited, the egg mass is compact and expands as it absorbs water into a medium to large fist-sized cluster (Ashton et al. 1998), although smaller egg masses have been observed at some locations on the Middle Fork Stanislaus River (personal observations). Females normally deposit eggs in clusters of 200-300, but clusters may range from 100 to 1,000 eggs (Storer 1925; Nussbaum et al. 1983; Zeiner et al. 1988). After absorbing water, the egg mass loses its bluish color and resembles a bunch of small grapes. Individual eggs are distinctly black and are encased by clear gelatinous envelopes (Ashton et al. 1998), and as the ova develop, they can be seen elongating within the envelope (personal observations). Eggs on the outside of the mass that receive the most sunlight have been observed developing and hatching first, with the interior eggs hatching at a later date (personal observations). Depending on stream water quality and water velocity at the location of the egg mass, sediment and algae may accumulate on the mass making it very difficult to find. Within a week or two after eggs have hatched, the egg mass breaks down and the tadpoles begin to disperse (Ashton et al. 1998). This may be highly dependent on the location of the egg mass and stream conditions, such as water temperature, water depth, cover, and flows.

Tadpoles – When tadpoles emerge, they are totally black and measure less than 8 mm total length (Nussbaum et al. 1983). As tadpoles grow, they begin to turn light brown, tan, or olive, with gold flecks or dark spots scattered on the dorsal surface and tail musculature. At this stage, their cryptic coloration blends with the algae and flocculent material in shallow edgewater habitat, making them very difficult to find. Depending on the stage of development, their eyes may appear on the top of the head or slightly inset from the outline of the head when viewed from above (personal observations). Rear legs begin to develop first and become fully developed before front legs start to appear. Tadpoles retain their tail during metamorphosis, providing them with excellent propulsion and making them difficult to capture when combined with the cryptic coloration (personal observations). Tadpoles reach a maximum total length of around 55 mm, and once metamorphosed into young frogs, they measure between 22 and 27 mm total length (Nussbaum et al. 1983; Zeiner et al. 1988), with the majority of newly metamorphosed frogs measuring from 22 to 24 mm (Pacific Gas and Electric Company 2001, 2002a, 2002b).

Distribution

Historically, FYLFs were found in the Coast Ranges from the Santiam River drainage in Oregon (Mehama and Marion counties) to the San Gabriel River drainage in California (Los Angeles County), and along the west slopes of the Sierra Nevada/Cascade crest in most of central and northern California (Storer 1925; Fitch 1938; Zweifel 1955). The elevational range of the FYLF extends from near sea level to about 5,000 ft. However, specimens catalogued at the University of California Museum of Vertebrate Zoology (MVZ 35914-18) show that this species has been recorded at elevations as high as 6,000 ft in Plumas County (Zweifel 1955). Jennings and Hayes (1994) indicate that FYLFs have disappeared from about 45% of their historic range in California and 66% of their historic range in the Sierra Nevada Mountains. Based on the results of recent surveys conducted on the Pit, North Fork Feather, North Fork Mokelumne, and Middle Fork Stanislaus rivers, breeding populations of FYLFs documented on these regulated rivers have all been below 3,000 ft in elevation, with the majority of the frogs occurring at elevations below 2,500 ft. (Pacific Gas and Electric Company 2001, 2002a, 2002b; Spring Rivers 2001; Ibis Environmental, Inc. 2002).

General Life History

FYLFs are a highly aquatic amphibian, spending most or all of their life in or near streams, though frogs have been documented underground and beneath surface objects more than 50 m from water (Nussbaum et al. 1983). Adult FYLFs are primarily diurnal with high site fidelity and typically occupy small home ranges. However, from April through June, adults and subadults may move several hundred meters or more, to congregate at breeding sites. FYLFs may be active all year in the warmest localities, but may become inactive or hibernate in colder areas.

Seasonal movements of adult and recently metamorphosed FYLFs indicate a preference for different habitat types depending on seasonal requirements. Adult frogs, primarily males, will congregate along main stem rivers during spring to breed. However, adults do not typically remain in these areas during summer, returning instead to basking and foraging sites on tributaries, or retreating to cooler microhabitats along shaded river sections. They may also decrease diurnal activity during the hottest part of the summer. Zweifel (1955) noted that younger individuals typically remained by the stream until late fall and appeared earlier in the spring than adults. Observations of juvenile FYLFs have shown a strong tendency to initiate upstream migrations in late summer and early fall (Ashton et al. 1998; Twitty et al. 1967) similar to the compensating mechanism displayed by stream insects subject to downstream drift (Jennings and Hayes 1994). These movements are often correlated with the presence of upstream tributaries containing suitable habitat for FYLFs, and it is speculated that this may be an evolutionarily mechanism this species has developed to repatriate larvae that may have been washed downstream (Ashton et al. 1998).

Egg laying normally follows the period of high-flow discharge associated with winter rainfall and snowmelt, usually between late March and early June (Storer 1925; Grinnell et al. 1930; Wright and Wright 1949). Prior to the onset of breeding, adult frogs begin to appear along stream margins, especially on warm sunny days. As flows diminish and water temperatures begin to increase, males are usually the first to begin moving back to breeding areas to establish calling stations. Females arrive later when average air temperatures increase, stream flows decrease, and water temperatures reach 12 to 15°C. Breeding tends to take place in the same general area each year, unless stream conditions change and the habitat is no longer suitable for breeding. FYLF oviposition has previously been thought to be completed within a two week period (Storer 1925; Zweifel 1955; Nussbaum et al. 1983; Stebbins 1985; Jennings 1988); however, studies on Coastal streams (Kupferberg 1996; Lind et al. 1996) and Sierra Nevada streams (Pacific Gas and Electric Company 2001, 2002a, 2002b) have revealed that breeding may extend over a longer period of time. Kupferberg (1996) suggested this might be the result of late season rains or drought conditions.

Females may deposit from 100 to 1,000 eggs (Storer 1925), but more typically deposit 200 to 300 eggs in clusters attached to the sides or undersides of cobbles and boulders, or less commonly to gravel, vegetation, or submerged logs or root wads. Egg masses (clusters) are most often deposited in shallow edgewater areas <40 cm deep with little or no water flow (<10 cm/sec), and eggs generally hatch in about 15 to 30 days depending on water temperature. Nussbaum et al. (1983) reported eggs hatching in about 5 days at a temperature of 20° C. FYLF tadpoles metamorphose into juvenile frogs in 3 to 4 months. During the early stages of development, tadpoles are herbivorous, feeding on diatoms and other algae (Kupferberg 1996), and as they mature will opportunistically feed on the necrotic tissue of dead tadpoles or macrofauna, if available (Ashton et al. 1998).

After metamorphosis, the diet of juvenile frogs is similar to that of adults and includes terrestrial and aquatic invertebrates such as spiders, moths, flies, beetles, water striders, snails, and grasshoppers, as well as crustaceans and molluscs. Two years are thought to be required to reach adult size (Storer 1925), with sexual maturity at 1-2 years for males and two years for females (Zweifel 1955; Nussbaum et al. 1983), although some individuals may reproduce as early as six months after metamorphosis (Jennings 1988). During studies on a tributary to the Yuba River, Van Wagner (1996) documented one-year-old males with enlarged forearms and nuptial pads that had a strong clasping reflex. He also noted that larger young-of-the-year males displayed these breeding characteristics during the fall, when both male and female adult frogs displayed breeding readiness. Of particular note, some of the larger females displayed distended abdomens and appeared gravid. Although little data are available regarding longevity of FYLFs in the wild, Van Wagner (1996) reported a female at least three years old, and based on studies of other ranids, the life span of FYLFs may be more than three years (Duellman and Trueb 1986).

Garter snakes (*Thamnophis* spp) are the principal natural predator of tadpoles, and juvenile and adult frogs. Other natural predators that FYLFs evolved with may include aquatic insects, various fish species, birds, and mammals (Ashton et al. 1998). Moyle (1973) implicated introduced bullfrogs (*Rana catesbeiana*) in the observed reduction of FYLF populations in the Central Valley and Sierra foothills. The introduction of non-native fishes, including centrarchids (bass, sunfish, etc.), known to readily eat Rana eggs (Werschkul and Chrsitensen 1977), and stocking of salmonids (trout) in streams where they historically did not exist, may also contribute to the disappearance or reduction of FYLF populations in Sierra streams. Additional human caused impacts to FYLFs and their habitat include, but are not limited to, construction and maintenance of dams and reservoirs, controlled stream flows, recreation, mining, logging, and livestock grazing (Jennings and Hayes 1994; Lind et al. 1996). In addition to these factors, there is increasing evidence reported by The Declining Amphibian Population Task Force (DAPTF) that the occurrence of disease, specifically the chytrid fungus, is increasing in the Sierra Nevada (Speare et al. 1998). With the increasing number of amphibian surveys in the Sierra Nevada Mountains, there is a high risk of surveyors spreading diseases among and between amphibian populations. The DAPTF has compiled procedures to minimize the spread of disease agents and parasites between study sites, which can be found in the DAPTF Fieldwork Code of Practice (http://www.mpm.edu/collect/vertzo/herp/Daptf/fcode_e.html).

Habitat Preferences

FYLFs are characteristically found close to water in association with perennial streams and ephemeral creeks that retain perennial pools through the end of summer. In general, FYLFs appear to prefer low to moderate gradient (0 to 4%) streams, particularly for breeding; however, juvenile and adult frogs may also utilize moderate to steep gradient (4 to ≥10%) creeks during the summer and early fall (personal observations). FYLFs utilize or are associated with a variety of aquatic habitat types, including: pools, riffles, runs, cascade pools, and step-pools, depending on life stage and the time of year. In California, specific habitat preferences for each life stage have been documented for streams in the Coast Ranges (Kupferberg 1996; Lind et al. 1996), and in several large river systems in the Sierra Nevada (Pacific Gas and Electric Company 2001, 2002a, 2002b; Spring Rivers 2001; Ibis Environmental, Inc. 2002). Adults preferentially utilize shallow edgewater areas with low water velocities (<10 cm/sec) for breeding and egg laying, and juvenile and adult frogs may be found adjacent to riffles, cascades, main channel pools, and plunge-pools that provide escape cover.

FYLFs are found in or near streams associated with a variety of upland habitats including foothill hardwood, foothill hardwood-conifer, mixed conifer, chaparral, and coastal scrub. FYLFs have been documented on streams with both low and moderate amounts of riparian and overhanging canopy cover. Occurrence and distribution relative to stream canopy or shade may be somewhat tied to life stage (Ashton et al. 1998), but there is an observed preference for streams that offer a combination of exposed basking sites and shade (personal observations).

Little is known of the habits or habitat preferences of FYLFs during winter months at higher elevations (elevations where freezing conditions are common). FYLFs likely hibernate in nearby burrows or under cover objects such as woody debris and vegetation, or they may remain in the water where they have been found in streams with water temperatures as low as 7.5° C (personal observations).

Breeding and Egg-Laying Habitats – In rivers, breeding areas are often located within relatively close proximity to the confluences of tributary streams (Kupferberg 1996), both perennial and ephemeral streams with permanent pools (personal observations). Macro- and microhabitats utilized by FYLFs for breeding and oviposition depend largely on the availability of suitable habitat. Breeding areas are typically located in shallow edgewater areas along low gradient cobble and small boulder dominated point or lateral bars, in side channels, pool tail-outs, and side pools along river margins. In many streams, FYLF breeding habitat is often associated with main channel pools, runs, glides, or very low gradient riffles in areas with predominantly cobble, boulder, and gravel substrates.

FYLF egg masses are often attached to the sides or undersides of large cobble and boulders, although they may also be attached to small cobble, gravel/pebble substrates, vegetation, or underwater woody debris. In rivers, egg masses are typically located in relatively shallow, calm edgewater areas within 3 m of shore, and are more commonly found closer to the bottom than the water surface. Data obtained during studies conducted on the Pit, North Fork Feather, North Fork Mokelumne, and Middle Fork Stanislaus rivers (Pacific Gas and Electric Company 2001, 2002a, 2002b; Spring Rivers 2001; Ibis Environmental, Inc. 2002) indicate that these shallow breeding areas are typically <40 cm deep with velocities <10 cm/sec. However, depending on the habitat type and presence of aquatic predators, oviposition may also occur in deeper water and in slightly faster currents up to 20 cm/sec. Several studies have documented partial scouring of egg masses at velocities ≥20 cm/sec (Kupferberg 1996; Pacific Gas and Electric Company 2002a). Egg masses are usually located in open sunny areas with little shade from riparian vegetation. Field observations have documented that eggs exposed to the sun mature more quickly than those in shade or partial shade, regardless of water temperature. In addition, eggs on the perimeter of the mass have been found to develop and hatch first, with eggs located in the center hatching several days later (personal observations).

Tadpole Habitats – Tadpoles generally occur in the same locations and habitat as that used for breeding and egg deposition, and young tadpoles appear to have some fidelity to the original egg mass site (Ashton et al. 1998). In the absence of disturbance (e.g., substantial increase in water velocity, significant drop in water level, recreation, etc.), tadpoles usually remain in the vicinity of the egg mass for several days, slowly dispersing into adjacent areas as they grow. Young tadpoles forage on diatoms or other algae on the surface of the surrounding substrate (Kupferberg 1996; Ashton et al. 1998). However, as they develop, tadpoles lose the black coloration and become more camouflaged, blending with the background. From this stage of development (approximately four weeks after hatching) until they reach metamorphosis, tadpoles are cryptic and often match the color of bottom substrates and detritus. FYLF tadpoles appear to prefer edgewater habitat where water temperatures are generally warmer (usually by at least 2 - 4° C) than the mainstream temperature. Tadpoles appear to prefer calm shallow water and will utilize substrate interstices, detritus, and aquatic vegetation for cover.

Juvenile Habitats – Following metamorphosis, juvenile frogs may be observed in groups and where numerous, may be conspicuous along rocky stream margins (personal observations). Juveniles typically remain in the vicinity of breeding locations for the remainder of the summer and fall. However, juvenile frogs have been observed on the Middle Fork Stanislaus River migrating upriver or up nearby tributaries in September (personal observations). When associated with river cobble bars, some juveniles may disperse to nearby isolated pools or side channels (personal observations). By November or December, and through the remainder of winter, juvenile frogs are typically absent from stream margins. However, depending on elevation and local weather conditions, juvenile and adult frogs may be occasionally observed on warmer winter days along streams, even when water temperatures are as low as 7.5° C (personal observations). In some streams, adult frogs may remain close to the water all winter, spending a portion of the time underwater (Van Wagner 1996).

As with adult FYLFs, juveniles are strongly associated with cobble bars and slow moving portions of streams. On the South Yuba River, Yarnell (2000) found juvenile FYLFs in wider portions of stream channels with low-relief banks. These stream sections provided protected overflow areas during winter and spring months. Second-year juveniles begin to depend upon streamside shading (shading >20%) and the cover afforded by overhanging streamside vegetation (Ashton et al. 1998), much the same as adults.

Adult Habitats – During the summer and fall, adult FYLFs appear to prefer stream channels that provide exposed basking sites and cool shady areas immediately adjacent to the water's edge. When disturbed, they typically dive into the water and take refuge on the bottom in cobble, boulder, gravel, silt, or vegetation (Stebbins 1985). Recent observations (Kupferberg 1996; Lind et al. 1996; Pacific Gas and Electric Company 2001, 2002a, 2002b) have corroborated information from Moyle (1973) that adults tend to prefer channel margins that provide some vegetative shading, either from the riparian canopy or occasionally understory vegetation bordering the water's edge. In contrast, studies on the South Yuba River found that adults appear to prefer deep, channelized stream types and pool-type habitats on a year-round basis (Yarnell 2000). These differences are likely due to the availability of preferred habitat types on different river systems. FYLFs appear to be very adaptable to varying conditions and may utilize alternate habitat types when necessary. Recent studies conducted on several river drainages in the Sierra Nevada have documented significant differences in habitat types between drainages occupied by FYLFs (personal observations).

Recent investigations into the presence and distribution of FYLFs on the North Fork Feather, North Fork Mokelumne, Middle Fork Stanislaus (Pacific Gas and Electric Company 2001, 2002a, 2002b; Ibis Environmental, Inc. 2002), and Trinity (Lind et al. 1996) rivers have noted that, except during the breeding season, adults are seldom found in stream reaches that do not provide at least a moderate amount of riparian or margin vegetative shading. Though potentially abundant during the breeding season, adults are typically observed at a reduced frequency on main stem rivers areas during the remainder of the year. Ashton et al. (1998) speculated that adults are either dispersing into streamside vegetation or adjacent tributaries, or possibly reducing diurnal activity. During the summer, some adults may remain in the vicinity of breeding sites on main stem rivers if there are cool, partly shady areas with adequate cover (Pacific Gas and Electric Company 2002a, 2002b; personal observations). However, adults seem to prefer nearby tributary streams, where overhead riparian canopy provides areas of partial sun and shade throughout the day, and air temperatures are cooler than on the main river. Perennial streams appear to be the preferred summer habitat of adults; however, ephemeral streams with perennial pools also provide suitable habitat (Pacific Gas and Electric Company 2002a, 2002b; Ibis Environmental, Inc. 2002). Adult frogs are not usually found in sections of creek that have moderately high to high amounts of low overhanging cover (shade).

As with juvenile FYLFs, adults are typically absent from stream margins by November or December through the remainder of winter. However, depending on elevation and local weather conditions, adult frogs may occasionally be observed on warmer winter days along streams (personal observations). In some streams, adult frogs may remain close to the water all winter, spending a portion of the time underwater (Van Wagner 1996).

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Appendix B

Foothill Yellow-Legged Frog

Standard Operating Procedures for River and Creek Visual Encounter Surveys

The following standard operating procedures (SOPs) describe the parameters and data collection methods for completing river and creek visual encounter surveys (VESs) for foothill yellow-legged frogs (FYLFs). Depending on the level of information required, all or a portion of the parameters described in these SOPs may be used during the VESs.

General Parameters and Methods

1. All measurements should be recorded in metric units unless otherwise indicated.
2. Many of the data sheet parameters will be recorded as a numerical code. A guide for these codes is included in the following SOPs, and most of the frequently used codes are also provided at the bottom of each VES data sheet.
3. For consistency in data collection, surveys will be started and completed by the same crew members.
4. Where practicable, surveyors will initiate the VES at the bottom of the site and work upstream.
5. All observations and comments on amphibians and aquatic habitat will be recorded on the VES data sheets. Each crew member will have a field notebook. Notebooks will be identified with the crew member's name and initials (a three letter code from the first letter of the first, middle, and last name of the crew member) and numbered sequentially in the order used. The notebook will be used to record observations and comments on habitat conditions not included on the data sheet. Entries on all pages should be dated.
6. Right bank and left bank will be designated facing in a downstream direction.
7. Time entries should be recorded in military format (e.g., 4:00 PM is 1600).
8. Distance and length measurements should be taken with a hip chain, metric tape, or range finder.
9. Velocity measurements should be made with a Marsh-McBurney (or similar) flow meter. Record velocity measurements to the nearest cm/sec.
10. Weather conditions: VESs should generally be conducted on warm, sunny days with light winds ($\leq$ 20 mph) when the probability of observing frogs out in the open is greatest. Surveys should be avoided on cold or very windy days (> 20 mph, depending on the exposure of the habitat). On extremely hot days, surveys should be conducted during the cooler portion of the day (i.e., morning and late afternoon to evening).
11. Poor weather conditions may preclude conducting VESs during all or a portion of the day. If field conditions are safe, site habitat assessments may still be completed.

12. Amphibian surveys should be performed at the time of day the target species is most likely to be observed. In general, surveys should be conducted between about 0900 and 1900. However, this is dependent on the time of year and local weather conditions. If significant changes in weather occur during the survey (e.g., significant drop in temperature or increase in wind speed), the survey should be discontinued.

13. Polarized sunglasses are highly recommended to reduce glare and increase visibility at aquatic sites.

14. Photographs of FYLF microhabitats, egg masses, tadpoles, etc. should follow the methods outlined in Section 6.2 of the main text. Photographs should be logged on field data sheets and additional notes kept in the field notebook.

15. If available, copies of aerial photographs should be used to denote site boundaries, area surveyed, search pattern, transect locations, and prominent habitat features. If not available, a site drawing should be included on the back of the site habitat assessment data sheet. The location of egg masses, tadpoles, and the general location of frogs should also be indicated on the aerial photograph or drawing.

16. Care should always be exercised not to disturb amphibian habitat or amphibians any more than is necessary to conduct the surveys. Cover objects (e.g., bark, logs, rocks, vegetation) should be carefully lifted or tipped up and replaced in their original positions before replacing amphibians.

17. When capturing and handling amphibians, the surveyor's hands should be clean (no sun protection products, insect repellent, or other lotions). In addition, the use of surgical gloves for handling frogs will reduce the likelihood of transmitting diseases. Surveyors should limit the time that amphibians are handled, and should release animals at the point of capture. If handling amphibians for an extended period is necessary for identification purposes or to take photographs, a clean plastic bag or jar partially filled with ambient water may be used for holding animals for a short period of time (< 5 min.). When conducting a formal VES, any time expended identifying or capturing animals should not be included as part of the total time spent surveying.

18. To decrease the possibility of transmission of infectious agents (chytrid fungus, or other fungal or bacterial infections) from handling potentially infected frogs, the following procedures developed by Speare, et al. (1998) and the Declining Amphibian Populations Task Force should be utilized during all field surveys. The following protocols are also the accepted procedures being used by the U. S. Forest Service.

    With increasing focus on amphibians and field surveys to; identify and document the presence and distribution of special-status species (e.g., FYLF) and determine utilization of habitats, there is a high risk that field crews could spread disease among other amphibian populations. There is growing evidence that the occurrence of the chytrid fungus is increasing in the Sierra Nevada. Consequently, it is essential that field crews follow a standard protocol for cleaning equipment before conducting surveys in other drainages. It is not necessary to clean equipment between sites within drainages.

    In tadpoles, the chytrid fungus attacks the keratin tooth rows and horny beak. In frogs, the fungus is associated with the keratinized layers of the skin. In the field, signs of infection may be observed by examining the mouths of tadpoles. Infected individuals will typically have: tooth rows that are mostly or entirely missing; beaks that lack black pigment; and occasionally slight deformities in the soft, fleshy parts of the mouth in addition to the above conditions.

    When conducting surveys for FYLFs (or other amphibians), there are two methods for handling frogs that will significantly reduce the potential for transmitting infectious agents between frogs. These are: 1) the use of disposable gloves (e.g., Surgigloves), changing gloves after handling each animal; and 2) the capture and handling of frogs using new plastic bags for each animal. In both cases, the frogs do not come in contact with the surveyor's skin or clothing. When frogs are difficult to catch, the surveyor's skin or clothing may come in contact with the frog. If this occurs, all contact surfaces should be cleaned with an antiseptic solution. Used gloves, plastic bags, nets, and/or jars used to capture or hold frogs should not come in contact with clean equipment. Several nets, plastic bags, and gloves should be available for each site. When the survey is completed, dispose of all gloves and plastic bags, and clean other equipment, hands, and clothing with hospital grade disinfectant or 70% ethanol.

To reduce the risk of spreading infections to other areas, clean hands, clothes, boots, and potentially vehicle tires if contact with aquatic habitats occurs. Bleach can be used to clean and disinfect equipment, but it looses effectiveness over time and should be replaced after a month or two. Before leaving a site, remove mud, organisms, algae, and other debris from nets, boots, vehicle tires, and other gear. Do not clean equipment in the immediate vicinity of aquatic habitats. Be sure to rinse all gear thoroughly with fresh water after cleaning. Refer to Speare, et al. (1998) for more information: www.jcu.edu.au/school/phtm/PHTM/frogs/ampdis.htm or www.mpm.edu/collect/vertzo/herp/Daptf/code_e.html.

19. Voucher specimens may be collected if positive identification cannot be made in the field. Collect only as many specimens as needed to complete the identification. If fewer than four FYLFs are found at a site, they should not be collected, and no more than two specimens should be taken at any site. The specimens should be placed in a glass or Nalgene container with 10% isopropyl alcohol (or 10% ethanol) for temporary storage. The final storage solution should be 70% ethanol.

20. Field data sheets will be QA/QC checked as each sheet is completed. The reviewer's initials and the review date will be recorded at the bottom of the data sheet.

Upper Portion of Data Sheet

Below are instructions for completing the river and creek VES data sheets, beginning with the upper left corner. Specific differences between rivers and creeks are so noted. Using the criteria provided in the main text for determining stream type, circle either River or Creek in the title of all data sheets completed for the site. There are specific data sheets for each major life stage: one for egg masses, one for tadpoles, and one for juveniles/subadults and adults. The instructions for each version are included below.

Date – Record the date of the survey in the following format: month / day / year (e.g., 07/02/01).

Site # – Record the site number designated during the preliminary habitat assessment (e.g., 1, 2, 3).

Subsite # – The river and creek SOPs differ, as follows.

For rivers: Subsites should be designated at river locations where more than one suitable habitat type is present, or where there are discontinuous sections of the same habitat type (e.g., lateral bars separated by bedrock outcrops). (Example: *Within the site, there are two lateral cobble bars with suitable habitat located along the right bank of the river that are separated by a section of steep bedrock. FYLF are observed at the upper bar, but not at the lower one. The two bars should be designated as separate subsites and separate data sheets should be completed for each one.*). Ideally, subsites should be based upon the occurrence of FYLFs. However, if monitoring is a project objective, suitable habitat in close proximity to known locations should be designated as subsites, and VESs should be conducted at each subsite. Site/subsite notations will be numeric/alpha (e.g., 1a, 1b) and should be assigned beginning with the downstream subsite and sequentially working upstream.

For creeks: Since FYLFs are typically dispersed along creeks during the summer and may occupy several different habitats, the designation of subsites may not be necessary. However, subsites should be designated at creek locations where FYLFs and breeding habitat is present, or at locations where aggregations of frogs occur. Separate VESs should be conducted at each subsite. These habitat areas may be discontinuous and separated by other types of habitat (e.g., cascade/pool and riffle areas separated by steep bedrock cascades). Site/subsite notations will be numeric/alpha (e.g., 1a, 1b) and should be assigned beginning with the downstream subsite sequentially working upstream.

River or Creek Name/Location – Record the river or creek name, if available, and describe the location of the site/subsite or use other identifying information (such as a local landmark or relative position). For creeks, also provide approximate survey location along the creek. Include a landmark or other indicator provided on the USGS topographic map.

Observers – For tandem VESs, the initials of both team members should appear on the data sheet. The initials of the team member filling out the data sheet should be noted first. For a separate/individual VES, record only the initials of the biologist conducting the survey.

Survey Method – Indicate the search method used for the VES – tandem or separate/individual.

Start Time – Record the time the VES is started.

End Time – Record the time the VES is completed.

Actual VES Time – Record the time actually spent conducting the VES. This represents the time spent between the start and end time that is exclusively expended searching for FYLFs. Time spent filling out VES data sheets, and capturing or identifying animals is included within the start and end times, but is not included in the actual VES time.

Air Temp. – Measure and record starting and ending air temperatures. Readings should be taken in the shade at chest height and should be recorded in degrees Celsius.

Water Temp. – Water temperatures should be recorded in degrees Celsius. River and creek water temperatures should be obtained along the shoreline in edgewater areas, and at a location further from shore that is representative of the main stream temperature. In lentic habitats (side pools, scour pools, etc.), water temperatures should be representative of the habitat.

Discharge – Estimate the flow in cubic feet per second (cfs). Where available, use stream gage data.

Total Site Length – Record the total length of the site. If subsites have been designated, this measurement should include all subsites, including the areas between subsites (e.g., steep bedrock walls, sand beaches, areas with dense overhanging vegetation, etc.) that are not considered suitable habitat. For rivers, include both banks if subsites have been designated on both sides of the river. For creeks, both banks are always included in the total site length.

Subsite Length – The river and creek SOPs differ, as follows.

For rivers: After finishing the VES, measure and record the subsite length on all completed VES data sheets. If the subsite includes both banks of the river, they should be measured separately and combined for the subsite length.

For creeks: After completing the VES, measure and record the length of each subsite (both banks are included) on all VES data sheets, if applicable.

Search Area Length – The river and creek SOPs differ, as follows:

For rivers: Indicate the overall length of the area searched (survey area) for the site or subsite. If a site or subsite includes both sides of the river, the search area length will include both transect lengths.

For creeks: Record the total length of the creek that is included in the VES.

Search Area Width – The river and creek SOPs differ, as follows.

For rivers: Record the average width of the area that is surveyed (amphibian habitat only). This should be measured from the river bank and extend into habitats that were included in the VES (e.g., edgewater, riffles, pools, etc.). This may be measured with a hip chain or tape.

For creeks: Record the average width of the area that is surveyed. This should be an estimate of the average creek width that was included in the VES.

Total Area Searched – This represents the survey area length times the average survey area width. Total area should be recorded in square meters.

Site Visit – Indicate if this is the first, second, third, or fourth site visit during the course of the year.

Weather – Indicate current weather, including sky conditions and wind conditions, experienced during the VES. Use the following general guidelines:

Sky conditions:

Overcast: > 60% cloud cover
Partly overcast: 20% –60% cloud cover
Clear: < 20% cloud cover

Wind conditions:

Inclement: winds > 20 mph
Fair: winds 10–20 mph
Ideal: calm to winds < 10 mph

Example: weather that is Overcast/Fair = greater than 60% cloud cover and winds between 10 and 20 mph.

Weather Past 24 Hours – Indicate what the weather conditions were over the last 24-hour period, per the criteria specified above.

Photograph # – Record the photograph number, so it can be indexed to the notes and description recorded in the field notebook. For detailed methods refer to Section 6.2 in the main text.

Roll/Disc/Card # – Record the film roll number or digital disc/card number. This should be a sequential number with the photographer or crew leader's initials as a prefix (e.g., CWH1, CWH2, and so on). The roll number should be recorded on each film canister with indelible pen. Digital discs should be labeled as directed above for 35 mm film. Digital cards should be placed in small sealed envelopes, and the envelopes labeled with the same information.

Middle Portion of Data Sheet

Data Sheet Parameters Specific to Egg Masses

On the data sheet for egg masses, use the following instructions for recording data in the 15 columns that appear in the center of the data sheet. For those data sheet parameters that have several potential categories from which to choose, record the number in parenthesis (#) that corresponds to the most appropriate answer.

Egg Mass Letter – A letter should be assigned to each specific egg mass, or group of egg masses, that is observed at the site or subsite. These letters should be sequential from the downstream end of the site to the upstream end. If more than 26 egg masses or groups of egg masses are observed at a given site, continue to assign Egg Mass Letters as follows: egg mass 26 = Z, 27 = AA, 28 = BB, etc.

Distance – Record the distance from the bottom of the site or subsite to the location of the egg mass or egg mass group.

Number of Egg Masses – Record the number of egg masses at a given location. For a group of egg masses, indicate which egg mass pertains to the data being collected. For example: If three egg masses are found for "Group A", record the number as 1 of 3, 2 of 3, and 3 of 3, starting at the downstream end of the egg mass group and continuing upstream.

Egg Mass Attachment Substrate – Record the specific substrate category to which the egg mass is attached. Size classifications for substrate categories follow the modified Wentworth (1922) scale, and information on woody debris was obtained from CDFG (1994).

Substrate Type	Size Range (mm)
(1) Sand	0.06 – 1
(2) Gravel/Pebble	2 – 63
(3) Cobble	64 – 256
(4) Boulder	> 256
(5) Bedrock	–
(6) Small Woody Debris	< 307 diameter
(7) Large Woody Debris	> 307 diameter
(8) Other	–

Distance From Shore – Measure the distance of each egg mass from the water's edge. The distance should be measured with a metric tape or ruler.

Depth of Egg Mass – Record the water depth from the surface to the center of each egg mass. The water depth should be measured with a metric stick or ruler.

% Silt on Egg Mass – Estimate the percentage of the egg mass surface area that is covered by silt as follows:

(1) None
(2) < 25%
(3) 25 – 50%
(4) 51 – 75%
(5) > 75%

Egg Mass Orientation – Record the stream orientation of the egg mass on the attachment substrate, as follows:

(1) Upstream side
(2) Downstream side
(3) Shore side
(4) Stream side
(5) On top of substrate
(6) Underneath substrate

Flow Orientation – Record the direction of streamflow relative to the location of the egg mass, as follows:

(1) Oriented into flow (e.g., egg mass on upstream side of attachment substrate facing into the current)
(2) Sheltered from flow by attachment substrate
(3) Flow along side of egg mass (shear flow)
(4) Located in eddy current from sheltering substrate
(5) Flow over the top
(6) No flow (egg mass in standing or still water)

Velocity – Measure the water velocity (in cm/sec) in the water column as close to the egg mass as possible. The reading should be taken adjacent to the center of the egg mass. This measurement should represent the average flow velocity at the location of the egg mass at the time of the VES.

River and Creek Habitat – Record the appropriate habitat types from the following choices: Habitat types were extracted from Rosgen (1996).

(1) *Low gradient riffle* (little or no whitewater, moderate velocities 20-50 cm/s, substrate of gravel and cobble - totally to partially submerged, <4% slope)
(2) *High gradient riffle* (considerable whitewater, fast velocities >50 cm/s, substrate of cobble and boulder - exposed, 4-7% slope)
(3) *Run* (no water turbulence; swift velocity; substrate of gravel, cobble, and boulder; low slope; occurs over a definite thalweg)
(4) *Glide* (no water turbulence; low to moderate even velocity; substrate of sand, gravel and cobble; 0-1% slope; occurs over a wide channel lacking a definite thalweg)
(5) *Main channel pool* (low velocities, usually large and deep and fills most of the channel, substrate - variable, no slope)
(6) *Step-pool* (varying velocities, boulder substrate, high-gradient, pools separated by short riffles or cascades)
(7) *Other*

Microhabitat – Record the microhabitat type that characterizes the location where the egg mass is found, using the habitat categories provided below:

(1) *Isolated Side Pool* – An isolated side pool is hydraulically isolated from the main channel or creek channel and receives little or no surface flow. This type of pool may be fed by a seep or spring that discharges to the river or creek.

(2) *Connected Side Pool* – A connected side pool is located adjacent to and hydraulically connected with the main river or creek. In rivers, these pools are often located along cobble/boulder bars or in boulder/sedge habitat.
(3) *Scour Pool* – A scour pool is an isolated pool formed at higher flows, and is normally filled during high flows. Scour pools are often located on bars or in bedrock areas.
(4) *Backwater Pool* – Backwater pools occur along the margins of rivers or creeks at the edge of the main flow, and are usually characterized by reverse currents. Backwater pools may occur at river or creek bends, at the bottom of main channel pools, below channel obstructions, etc.
(5) *Side Channel* – A side channel is smaller than the main channel, and generally only receives a portion of the streamflow, and may dry up at lower flows. Side channels are usually close to the main channel in wider sections of the river or creek.
(6) *Boulder/Sedge* – Boulder and sedge habitat occurs in low relief areas along the margin of the river or creek. It is characterized by exposed and submerged boulders and cobble with interspersed sedge clumps, with slow-moving water and small pools (isolated and/or connected).
(7) *Edgewater* – Edgewater habitat generally occurs in shallow, slow moving or calm water areas along margins of river bars or margins of creeks. Appropriate substrates consist primarily of cobble and boulders, often with some gravel.
(8) *Pool Tail-Out* – Pool tail-outs normally occur at the downstream end of main channel pools adjacent to the main outflow. These areas are typically shallow with slow moving water. In rivers, pool tail-outs typically have cobble and/or boulder substrates.
(9) *Riffle* – Riffles (both high and low gradient) normally occur in areas with cobble and boulder substrates, and are usually associated with changes in stream gradient. Riffles may occur in side channels as well as the main channel.
(10) *Other* – This category includes any habitat type that is not described above. Provide a description of the area in the Comments portion of the data sheet.

Note: if more than one microhabitat occurs where egg masses are observed (e.g., a riffle in a side channel or edgewater in a pool tail-out), indicate all such microhabitat types by recording the appropriate codes.

Substrate at Egg Mass – Indicate the dominant substrate types in a 1-m^2 area surrounding the egg mass. Size classifications for substrate categories follow the modified Wentworth (1922) scale, and information on woody debris was obtained from CDFG (1994).

Substrate Type	Size Range (mm)
(1) Silt/Clay/Mud	≤ 0.059
(2) Sand	0.06 – 1
(3) Gravel/Pebble	2 – 63
(4) Cobble	64 – 256
(5) Boulder	> 256
(6) Bedrock	–
(7) Small woody debris	<307 Diameter
(8) Large woody debris	>307 Diameter

Max. Water Depth – Record the total water depth where the egg mass is located. The water depth should be measured with a metric stick or ruler.

Water Temperature – Record the water temperature in degrees Celsius where each egg mass is located.

Data Sheet Parameters Specific to Tadpoles

On the data sheet for tadpoles, use the following instructions for recording data in the 14 columns that appear in the center of the data sheet. For those data sheet parameters that have several potential categories from which to choose, record the number in parenthesis (#) that corresponds to the most appropriate answer.

Group Letter – A letter should be assigned to groups of tadpoles that are observed at a site or subsite. These letters should be sequential from the downstream end of the site or subsite to the upstream end. If several aggregations of tadpoles are observed together, they should be recorded as one group. If more than 26 groups of tadpoles are observed at a site or subsite, continue to assign Group Letters as follows: 26 = Z, 27 = AA, 28 = BB, etc.

Distance – Record the distance from the bottom of the survey site or subsite to the location of the tadpoles.

Approximate Number of Tadpoles – If the site is small, search the entire area and estimate the total number of tadpoles present. If the site is large, estimate the number of tadpoles per m^2 based on several random counts ($\#/m^2$) obtained within representative areas where tadpoles are observed. Use these data to estimate the total number of tadpoles for the site.

Distance from Shore – Measure the distance the tadpoles are from the water's edge. For an aggregation of tadpoles take a measurement at the center of the group. If tadpoles are dispersed along the shoreline, record an average distance from the water's edge. The distance should be measured with a metric tape or ruler.

Velocity – Measure the water velocity (in cm/sec) where tadpoles are located.

Tadpole Stage – Record the tadpole developmental stage based upon the following choices. Tadpoles include all tadpole stages (completely aquatic) from the day of hatching, through metamorphosis to the point where they move to terrestrial habitats (no vestiges of their tadpole form remain). The developmental stage should represent the dominant stage of tadpoles present, as individuals or in groups.

(1) No legs
(2) Rear legs
(3) Rear legs and front nubs
(4) Legs fully grown, but with tail
(5) Mixed; use this code only if the group consists of tadpoles at various stages of development.

Average TL (Total Length) – Estimate the average TL of the tadpoles, including those observed in groups. Estimates should periodically be verified by actual measurements of representative individuals.

River and Creek Habitat – Record the appropriate habitat types from the following choices. Habitat types were extracted from Rosgen (1996):

(1) *low gradient riffle* (little or no whitewater, moderate velocities 20-50 cm/s, substrate of gravel and cobble - totally to partially submerged, <4% slope)
(2) *high gradient riffle* (considerable whitewater, fast velocities >50 cm/s, substrate of cobble and boulder - exposed, 4-7% slope)

(3) *run* (no water turbulence; swift velocity; substrate of gravel, cobble and boulder; low gradient slope; occurs over a definite thalweg)
(4) *glide* (no water turbulence; low to moderate even velocity; substrate of sand, gravel and cobble; 0-1% slope; occurs over a wide channel lacking a definite thalweg)
(5) *main channel pool* (low velocities, usually large and deep and fills most of the channel, substrate - variable, no slope)
(6) *step-pool* (varying velocities, boulder substrate, high-gradient, pools separated by short riffles or cascades)
(7) *other*

Note: if more than one habitat type occurs within a site or subsite, record all appropriate habitat types.

Microhabitat – Record the microhabitat type (from the habitat types provided below) that characterizes the location where the tadpoles are observed.

(1) *Isolated Side Pool* – An isolated side pool is hydraulically isolated from the main channel or creek channel and receives little or no surface flow. This type of pool may be fed by a seep or spring that discharges to the river or creek.
(2) *Connected Side Pool* – A connected side pool is located adjacent to and hydraulically connected with the main river or creek. In rivers, these pools are often located along cobble/boulder bars or in boulder/sedge habitat.
(3) *Scour Pool* – A scour pool is an isolated pool formed at higher flows, and is normally filled during high flows. Scour pools are often located on bars or in bedrock areas.
(4) *Backwater Pool* – Backwater pools occur along the margins of rivers or creeks at the edge of the main flow, and are usually characterized by reverse currents. Backwater pools may occur at river or creek bends, at the bottom of main channel pools, below channel obstructions, etc.
(5) *Side Channel* – A side channel is smaller than the main channel, and generally only receives a portion of the streamflow, and may dry up at lower flows. Side channels are usually close to the main channel in wider sections of the river or creek.
(6) *Boulder/Sedge* – Boulder and sedge habitat occurs in low relief areas along the margin of the river or creek. It is characterized by exposed and submerged boulders and cobble with interspersed sedge clumps, with slow-moving water and small pools (isolated and/or connected).
(7) *Edgewater* – Edgewater habitat generally occurs in shallow, slow moving or calm water areas along margins of river bars or margins of creeks. Appropriate substrates consist primarily of cobble and boulders, often with some gravel.
(8) *Pool Tail-Out* – Pool tail-outs normally occur at the downstream end of main channel pools adjacent to the main outflow. These areas are typically shallow with slow moving water. In rivers, pool tail-outs typically have cobble and/or boulder substrates.
(9) *Riffle* – Riffles (both high and low gradient) normally occur in areas with cobble and boulder substrates, and are usually associated with changes in stream gradient. Riffles may occur in side channels as well as the main channel.
(10) *Other* – This category includes any habitat type that is not described above. Provide a description of the area in the Comments portion of the data sheet.

Note: If more than one microhabitat occurs where tadpoles are observed (e.g., edgewater in a pool tail-out), indicate all such microhabitat types by recording the appropriate codes.

Dominant Substrate – Record the dominant substrate types in a 1-2 m^2 area where tadpoles are observed. If tadpoles are distributed along the shoreline, indicate the dominant substrate types for the area where tadpoles are observed. Size classifications for substrate types follow the modified Wentworth (1922) scale, and information on woody debris was obtained from CDFG (1994).

Substrate Type	Size Range (mm)
(1) Silt/Clay/Mud	< 0.059
(2) Sand	0.06 – 1
(3) Gravel/Pebble	2 – 63

Substrate Type	Size Range (mm)
(4) Cobble	64 – 256
(5) Boulder	> 256
(6) Bedrock	–
(7) Small Woody Debris	< 307 diameter
(8) Large Woody Debris	> 307 diameter
(9) Aquatic Vegetation	–

% Algae – Estimate to the nearest 10% the amount of algae present where tadpoles are observed.

% Detritus – Estimate to the nearest 10% the amount of detritus present on substrates where tadpoles are observed.

Max. Water Depth – Record the maximum water depth where tadpoles are found. The water depth should be measured with a metric stick or ruler.

Water Temp. – Record the water temperature in degrees Celsius where tadpoles occur.

Data Sheet Parameters Specific to Juveniles/Subadults and Adults

On a data sheet for juveniles/subadults and adults, use the following instructions for recording data in the 10 columns that appear in the center of the data sheet. For data sheet parameters that have several potential categories from which to choose, record the number in parenthesis (#) that corresponds to the most appropriate answer.

Number of Frogs – Indicate the number of individuals observed within the site or subsite. If a large number of juveniles/subadults or adults is encountered, an estimate of the total number present may have to be sufficient.

Distance – Record the distance from the bottom of the site or subsite to the location of the frog or aggregation of frogs.

Sex (M/F) – When possible, determine the sex of captured frogs, and for those frogs that can usually be sexed without handling (e.g., during the breeding period, most males typically have enlarged forearms and thumb pads for grasping females). Do not record sex if a positive determination cannot be made.

Age (J, A) – Indicate the approximate age of the frogs observed (when possible) using the following categories: *Juvenile/Subadult* – includes recently metamorphosed individuals that have no vestiges of their tadpole form, up to about 1 1/2 to two years old (generally 39 mm or less snout-vent length); *Adult* – includes all sexually mature frogs (generally two years old or older, with a 40 mm or greater snout-vent length). Note: Adult males are typically smaller (snout-vent length) than adult females for individuals from the same year-class.

Snout-Vent Length – This represents the distance from the tip of the frog's snout to the vent, and should be recorded in millimeters.

Activity – Record the individual's activity from the following choices: (1) sitting in shade, (2) basking, (3) hiding, (4) calling, (5) swimming, (6) foraging, (7) amplexus, (8) floating, (9) underwater, or (10) other.

River and Creek Habitat – Record the appropriate habitat types from the following choices. River habitat types were extracted from Rosgen (1996).

(1) *low gradient riffle* (little or no whitewater, moderate velocities 20-50 cm/s, substrate of gravel and cobble - totally to partially submerged, <4% slope)
(2) *high gradient riffle* (considerable whitewater, fast velocities >50 cm/s, substrate of cobble and boulder - exposed, 4-7% slope)
(3) *run* (no water turbulence; swift velocity; substrate of gravel, cobble and boulder; low gradient slope; occurs over a definite thalweg)
(4) *glide* (no water turbulence; low to moderate even velocity; substrate of sand, gravel and cobble; 0-1% slope; occurs over a wide channel lacking a definite thalweg)
(5) *main channel pool* (low velocities, usually large and deep and fills most of the channel, substrate - variable, no slope)
(6) *step-pool* (varying velocities, boulder substrate, high-gradient, pools separated by short riffles or cascades)
(7) *other*

Note: if more than one habitat type occurs within a site or subsite, record all appropriate habitat types.

Microhabitat – Record the microhabitat type that characterizes the location where frogs are observed from the habitat types provided below.

(1) *Isolated Side Pool* – An isolated side pool is hydraulically isolated from the main channel or creek channel and receives little or no surface flow. This type of pool may be fed by a seep or spring that discharges to the river or creek.
(2) *Connected Side Pool* – A connected side pool is located adjacent to and hydraulically connected with the main river or creek. In rivers, these pools are often located along cobble/boulder bars or in boulder/sedge habitat.
(3) *Scour Pool* – A scour pool is an isolated pool formed at higher flows, and is normally filled during high flows. Scour pools are often located on bars or in bedrock areas.
(4) *Backwater Pool* – Backwater pools occur along the margins of rivers or creeks at the edge of the main flow, and are usually characterized by reverse currents. Backwater pools may occur at river or creek bends, at the bottom of main channel pools, below channel obstructions, etc.
(5) *Side Channel* – A side channel is smaller than the main channel, and generally only receives a portion of the streamflow, and may dry up at lower flows. Side channels are usually close to the main channel in wider sections of the river or creek.
(6) *Boulder/Sedge* – Boulder and sedge habitat occurs in low relief areas along the margin of the river or creek. It is characterized by exposed and submerged boulders and cobble with interspersed sedge clumps, with slow-moving water and small pools (isolated and/or connected).
(7) *Edgewater* – Edgewater habitat generally occurs in shallow, slow moving or calm water areas along margins of river bars or margins of creeks. Appropriate substrates consist primarily of cobble and boulders, often with some gravel.
(8) *Pool Tail-Out* – Pool tail-outs normally occur at the downstream end of main channel pools adjacent to the main outflow. These areas are typically shallow with slow moving water. In rivers, pool tail-outs typically have cobble and/or boulder substrates.
(9) *Riffle* – Riffles (both high and low gradient) normally occur in areas with cobble and boulder substrates, and are usually associated with changes in stream gradient. Riffles may occur in side channels as well as the main channel.
(10) *Exposed Bank* – Exposed locations along the river margin (e.g., boulders, bedrock, sand or mud bank, etc.)
(11) *Protected Bank* – Protected locations along the river margin (e.g., under an overhanging bank or boulder, large cracks between boulders, etc.)

(12) *Other* – This category includes any habitat type that is not described above. Provide a description of the area in the Comments portion of the data sheet.

Note: if more than one microhabitat characterizes the area where frogs are observed (e.g., riffle in a side channel), indicate both microhabitat types using the codes provided above.

Dominant Substrate – Record the dominant substrate types that are being utilized by frogs at the time of the observation. Size classifications for substrate types follow the modified Wentworth (1922) scale, and information on woody debris was obtained from CDFG (1994).

Substrate Type	Size Range (mm)
(1) Silt/Clay/Mud	< 0.059
(2) Sand	0.06 – 1
(3) Gravel/Pebble	2 – 63
(4) Cobble	64 – 256
(5) Boulder	> 256
(6) Bedrock	–
(7) Small Woody Debris	< 307 diameter
(8) Large Woody Debris	> 307 diameter
(9) Aquatic Vegetation	–
(10) Margin vegetation	–
(11) Other	–

Comments – Enter any comments about the foregoing data.

Lower Portion of Data Sheet

Fish Present – Indicate if fish are observed or otherwise known to occur in the river or creek.

Type – Circle or write in the fish species group(s) present. Following are representative classifications:

- Salmonids – *trout and salmon*
- Centrarchids – *bass and sunfish*
- Cyprinids – *minnows*

Herpetofauna & Life Stage – Record all amphibians or reptiles, other than the target species, that were observed during the VESs. Include the approximate number and the life stage(s) present (A – adult, J – juvenile/subadult, T – tadpole, E – egg).

Other Species Observed – Record other species observed at the site/subsite during the VES.

Comments – Additional comments will be noted at the bottom of the VES data sheet. Comments should include observations of conditions affecting amphibians that are not listed on the main data sheet such as road construction/maintenance, recreation, and other related issues that are notable or are relatively uncommon. Additional comments may include: observations of the average size of egg masses or evidence of fungus or predation; health of tadpoles, juveniles/subadults, and adults; or direct or suspected predation on FYLFs. If extra space is required for comments, the reverse side of the data sheet should be used.

QA/QC – Record the initials of the person who reviews the data sheet, and indicate the date it was reviewed. The reviewer should not be the person who completes the data sheet.

References

CDFG (California Department of Fish and Game). 1994. California salmonid stream habitat restoration manual. Third Edition. State of California Resources Agency, Department of Fish and Game, Inland Fisheries Division, Sacramento, CA.

Rosgen, D. 1996. Applied river morphology. Wildland Hydrology, Pagosa Springs, CO.

Speare, R., L. Berger, and H. Hines. 1998. How to reduce the risks of you transmitting an infectious agent between frogs and between sites. James Town University, Townsville, Australia. 9 pp.

Wentworth, C.K. 1922. A scale of grade and class for elastic sediments. *Journal of Geology* 30: 377-392.

Foothill Yellow-Legged Frog
River and Creek Visual Encounter Survey Data Sheet
Egg Masses

Date: mm____ dd____ yy____ Site #: ______ Subsite #: ______ River Name/Location: ______________________ Observers: _______ _______
Survey Method: tandem separate Start Time: ________ End Time: _________ Actual VES Time: _________ Start Air Temp: _______ End Air Temp: _______
Water Temp: (edgewater) _______ (main channel) _______ (pool) ________ Discharge: _______ cfs Total Site Length: ________ Subsite Length: _______
Search Area Length: _______ Search Area Width: ________ Total Area Searched: (m^2): ________ Site Visit: 1 2 3 4
Weather: *Sky*: Overcast Partly Overcast Clear *Wind:* Inclement Fair Ideal Past 24 hrs: *Sky*: Overcast Partly Overcast Clear *Wind:* Inclement Fair Ideal
Photograph # (index to notebook): ______ ______ ______ ______ ______ ______ ______ ______ ______ ______ Roll/Disc/Card #: _________

Egg Mass Letter[1]	Distance[2] (m)	No. of Egg Masses	Egg Mass Attachment Substrate[3]	Distance from Shore (m)	Depth of Egg Mass (cm)	% Silt on Egg Mass[4]	Egg Mass Orientation[5]	Flow Orien-tation[6]	Velocity[7] (cm/sec)	River and Creek Habitat[8]	Micro-habitat[9]	Substrate at Egg Mass[10]	Max. Water Depth[11] (cm)	Water Temp (°C)

[1] Egg Mass Letter – for individual egg masses or groups of egg masses
[2] Distance – distance from bottom of site/subsite to egg mass
[3] Egg Mass Attachment Substrate – (1) sand, (2) gravel/pebble (3) cobble, (4) boulder, (5) bedrock, (6) small woody debris, (7) large woody debris, (8) other
[4] % Silt on Egg Mass – (1) none, (2) < 25%, (3) 25 – 50%, (4) 51 – 75%, (5) > 75%
[5] Egg Mass Orientation – (1) upstream side, (2) downstream side, (3) shore side, (4) stream side, (5) on top of substrate, (6) underneath substrate
[6] Flow Orientation – (1) oriented into flow, (2) sheltered from flow, (3) flow along side of egg mass, (4) egg mass in eddy current, (5) flow over the top, (6) no flow
[7] Velocity – flow taken in water column as close to egg mass as possible
[8] River and Creek Habitat – (1) low gradient riffle, (2) high gradient riffle, (3) run, (4) glide, (5) main channel pool (6) step-pool, (7) other
[9] Microhabitat – (1) isolated side pool, (2) connected side pool, (3) scour pool, (4) backwater pool, (5) side channel, (6) boulder/sedge, (7) edgewater, (8) pool tail-out (9), riffle, (10) other
[10] Substrate at Egg Mass – (1) silt/clay/mud, (2) sand, (3) gravel/pebble, (4) cobble, (5) boulder, (6) bedrock, (7) small woody debris, (8) large woody debris
[11] Max. Water Depth – total depth at egg mass location
Note: On return visits note condition of egg masses – hatched, detached partially or entirely from substrate, attacked by fungus, predated upon, etc.

Fish Present: Yes No Type: Salmonid Centrarchid Cyprinid Other: ______________________
Herpetofauna & Life Stage (A J T E) tree frog ______ bullfrog ______ western pond turtle ______ garter snake ______ Other ______________
Other Species Observed: ______________________________
Comments: ______________________________

QA/QC (initials): ________ Date: _________

Foothill Yellow-Legged Frog

River and Creek Visual Encounter Survey Data Sheet

Tadpoles

Date: mm____ dd____ yy____ Site #: ________ Subsite #: ________ River Name/Location: ______________________________ Observers: _______ _______
Survey Method: tandem separate Start Time: ________ End Time: _________ Actual VES Time: _________ Start Air Temp: _______ End Air Temp: ________
Water Temp: (edgewater) ______ (main channel) ______ (pool) _______ Discharge: ______ cfs Total Site Length: ________ Subsite Length: ________
Search Area Length: ________ Search Area Width: ________ Total Area Searched: (m^2): ________ Site Visit: 1 2 3 4
Weather: *Sky*: Overcast Partly Overcast Clear *Wind: Inclement Fair Ideal* Past 24 hrs: *Sky*: Overcast Partly Overcast Clear *Wind: Inclement Fair Ideal*
Photograph # (index to notebook): _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ Roll/Disc/Card #: _________

Group Letter[1]	Distance[2] (m)	Approx. No. of Tadpoles[3]	Distance From Shore[4]	Velocity[5] (cm/sec)	Tadpole Stage[6]	Avg. TL[7] (mm)	River or Creek Habitat[8]	Micro-Habitat[9]	Dominant Substrate[10]	% Algae	% Detritus	Max. Water Depth[11] (cm)	Water Temp. (°C)

1 Group Letter – if multiple groups of tadpoles at a site/subsite
2 Distance – distance from bottom of site/subsite
3 No. of Tadpoles – Estimate the total number of tadpoles for the area. If tadpole counts are determined by number/meter^2, convert number of tadpoles/m^2 to number of tadpoles/site/subsite
4 Distance From Shore – For an aggregation of tadpoles, measure to the center of the group. If tadpoles are dispersed along the shoreline, record an average distance from the water's edge.
5 Velocity – measure where tadpoles are located
6 Tadpole Stage – (1) no legs, (2) rear legs, (3) rear legs and front nubs, (4) legs fully grown, but with tail, (5) mixed
7 Avg. TL – average total length of tadpoles
8 River or Creek Habitat (1) low gradient riffle, (2) high gradient riffle, (3) run, (4) glide, (5) main channel pool, (6) step-pool, (7) other
9 Microhabitat – (1) isolated side pool, (2) connected side pool, (3) scour pool, (4) backwater pool, (5) side channel, (6) boulder/sedge, (7) edgewater, (8) pool tail-out, (9) riffle, (10) other
10 Dominant Substrate – (1) silt/clay/mud, (2) sand, (3) gravel/pebble, (4) cobble, (5) boulder, (6) bedrock, (7) small woody debris, (8) large woody debris (9) aquatic vegetation
11 Max. Water Depth – Max. depth at tadpole location

Fish Present Yes No Type: Salmonid Centrarchid Cyprinid Other: ______________________________
Herpetofauna & Lifestage (A J T E) tree frog ______ bullfrog ______ western pond turtle ______ garter snake ______ Other ___________
Other Species Observed: ____
Comments: ____

QA/QC (initials): _________ Date: _________

Foothill Yellow-Legged Frog
River and Creek Visual Encounter Survey Data Sheet
Juveniles/Subadults and Adults

Date: mm____ dd____ yy____ Site #: ________ Subsite #: ________ River Name/Location:________________________________ Observers: _______ _______
Survey Method: tandem separate Start Time: ________ End Time: _________ Actual VES Time: _________ Start Air Temp: _______ End Air Temp: _______
Water Temp: (edgewater) ______ (main channel) ______ (pool) _______ Discharge: _______ cfs Total Site Length: _______ Subsite Length: _______
Search Area Length: ________ Search Area Width: ________ Total Area Searched: (m^2): ________ Site Visit: 1 2 3 4
Weather: *Sky*: Overcast Partly Overcast Clear *Wind: Inclement Fair Ideal* Past 24 hrs: *Sky*: Overcast Partly Overcast Clear *Wind: Inclement Fair Ideal*
Photograph # (index to notebook): _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ Roll/Disc/Card #: _________

Number of Frogs	Distance[1]	Sex (M/F)	Age[2] (J, A)	Snout-Vent Length (mm)	Activity[3]	River or Creek Habitat[4]	Microhabitat Type[5]	Dominant Substrate[6]	Comments

[1] Distance – distance from bottom of site/subsite to frogs
[2] Age – J = Juvenile/Subadult (<= 39 mm), A = Adult (>= 40 mm), snout-vent length
[3] Activity – (1) sitting in shade, (2) basking, (3) hiding, (4) calling, (5) swimming, (6) foraging, (7) amplexus, (8) floating, (9) underwater, (10) other
[4] River or Creek Habitat – (1) low gradient riffle, (2) high gradient riffle, (3) run, (4) glide, (5) main channel pool, (6) step-pool, (7) other
[5] Microhabitat – (1) isolated side pool, (2) connected side pool, (3) scour pool, (4) backwater pool, (5) side channel, (6) boulder/sedge, (7) edgewater, (8) pool tail-out, (9) riffle, (10) exposed bank, (11) protected bank, (12) other
[6] Dominant Substrate – (1) silt/clay/mud, (2) sand, (3) gravel/pebble, (4) cobble, (5) boulder, (6) bedrock, (7) small woody debris, (8) large woody debris, (9) aquatic vegetation, (10) margin vegetation, (11) other

Fish Present Yes No Type: Salmonid Centrarchid Cyprinid Other: ________________________
Herpetofauna & Lifestage (A J T E) tree frog ______ bullfrog ______ western pond turtle ______ garter snake ______ Other __________________________
Other Species Observed: ____
Comments: ____

QA/QC (initials): ________ Date: _________

APPENDIX C

Foothill Yellow-Legged Frog

Standard Operating Procedures for River and Creek Site Habitat Assessments

The following standard operating procedures (SOPs) describe the parameters and data collection methods for completing river and creek site habitat assessments for foothill yellow-legged frogs (FYLFs). Site habitat assessments should be conducted at all sites with suitable habitat for FYLFs, regardless of the visual encounter survey (VES) results.

General Habitat Parameters and Assessment Methods

1. All measurements should be recorded in metric units unless otherwise indicated.
2. For consistency, habitat assessments will be started and completed by the same crew members.
3. Where practicable, habitat assessments will start at the bottom of the site and work upstream.
4. If subsites were designated during the VES, a separate site habitat assessment data sheet should be completed for each subsite.
5. All observations and comments pertaining to amphibian habitat will be recorded on the site habitat assessment data sheet. A field notebook should be used to record additional observations and comments on amphibian habitat not included in the data sheet.
6. Right bank and left bank will be designated facing in a downstream direction.
7. Time entries should be recorded in military format (e.g., 4:00 PM is 1600).
8. Distance and length measurements should be taken with a hip chain, metric tape, or range finder.
9. Velocity measurements should be measured with a Marsh-McBurney (or similar) flow meter. Record velocity measurements to the nearest cm/sec.
10. Field data sheets will be QA/QC checked as each sheet is completed. The reviewer's initials and the review date will be recorded at the bottom of the data sheet.
11. Weather conditions: Habitat assessments can generally be conducted on most days throughout the spring, summer, and fall.
12. Photographs of the site and subsites (if applicable) should include all amphibian habitats present, following the procedures outlined in Section 6.2 of the main text. For river sites and subsites, and creek subsites, photo documentation will include pictures from the bottom looking upstream, from the top looking downstream, and from the middle looking both upstream and downstream. If subsites are not designated on a creek, photographs should be representative of the types of habitat present (both macro- and microhabitats) within the survey area. Photographs should be logged on field data sheets and additional notes recorded in the field notebook.

13. If available, copies of aerial photographs should be used to denote site and subsite boundaries, area surveyed, transect locations, and prominent habitat features. If not available, a site drawing should be included on the back of the habitat assessment data sheet. The general location of egg masses, tadpoles or groups of tadpoles, and the general location of frogs should be included on the aerial photograph or site drawing.
14. Site/subsite habitat assessments are conducted on the initial site visit following the VES. On subsequent site visits, a site habitat assessment data sheet should be completed only if there are significant changes in the overall quality of the habitat (e.g., noticeable changes in the extent and/or distribution of amphibian habitat, the amount of vegetation, water depth and velocity).

Upper Portion of Data Sheet

Below are instructions for completing the river and creek site habitat assessment data sheets, beginning with the upper left corner. These two data sheets are similar, and any differences between them are noted. The instructions for each version of the data sheet are included below.

Date – Record the date of the survey in the following format: month / day / year.

Site # – Record the site number designated during the preliminary habitat assessment (e.g., 1, 2).

Subsite # – If applicable, record the subsite number designated during the VES (e.g., 1a, 1b).

River or Creek Name/Location – Record the river or creek name, if available, and describe the location of the site/subsite or use other identifying information (such as a local landmark or relative position). Provide the approximate survey location along the river or creek, and include a landmark or other indicator provided on the USGS topographic map. If site/subsite VESs have been conducted, use the same river or creek names and locations on the site habitat assessment data sheet.

USGS Quad – Indicate the name(s) of the USGS 7.5' topographic map(s) that cover(s) the location of the site/subsite.

Township/Range – As indicated on the USGS topographic map, indicate the township and range that encompasses all or the largest portion of the site/subsite.

Section – Refer to the USGS topographic map for the Section number containing the site/subsite.

¼ Section – Indicate the ¼ section(s) that contain(s) the site/subsite (e.g., NE ¼, SW ¼, etc.).

Elevation – Record the elevation of the site/subsite as determined by a USGS topographic map or by GPS reading.

GPS File Name – If a GPS point can be obtained, record the GPS file name for the site/subsite. Location data collected by GPS should be post-processed, and compatible for display in ArcView or other GIS format.

Weather – Indicate current weather, including sky conditions and wind conditions, experienced during the VES. Use the following general guidelines:

Sky conditions:

- Overcast: > *60% cloud cover*
- Partly overcast: *20% – 60% cloud cover*
- Clear: *< 20% cloud cover*

Wind conditions:

- Inclement: *winds > 20 mph*
- Fair: *winds 10 – 20 mph*
- Ideal: *calm to winds < 10 mph*

Example: Weather that is Overcast/Fair = greater than 60% cloud cover and winds between 10 and 20 mph.

Total Site Length – Record the total length of the site. If subsites have been designated, this measurement should include all subsites, including the areas between subsites (i.e., steep bedrock reaches, sand beaches, areas with dense overhanging vegetation, etc.) that are not considered suitable habitat. For rivers, include both banks if subsites have been designated on both sides of the river. For creeks, both banks are included as part of the total site length.

River or Creek Aspect – Indicate the orientation of the river or creek drainage at the site/subsite as follows: Southerly, Northerly, Westerly, or Easterly. Example: *A south flowing river or creek would have a "southerly" aspect.*

Discharge – Estimate the river or creek flow in cubic feet per second (cfs). Where available, use stream gage data.

Water Temperature – Water temperatures should be recorded in degrees Celsius (°C). In small lentic habitats (side pools, scour pools, etc.), water temperatures should be representative of the habitat. River and creek water temperatures should be obtained along the shoreline in edgewater areas, and at a location further from shore that is representative of the main stream temperature.

Observers – The initials of both crew members should appear in this space. The initials of the crew member filling out the data sheet should appear in the first space.

Initial Site Visit – Check this box if this is the first site visit during the field season.

Follow-up Visit – Check this box if the site has been visited previously during the field season. The site habitat assessment data sheet only needs to be completed during a return visit if there are significant changes in habitat features.

Photograph # – Record the photograph number so that it can be indexed to the notes and description recorded in the field notebook. For detailed methods, refer to Section 6.2 of the main text.

Roll/Disc/Card # – Record the film roll number or digital disc/card number. This should be a sequential number with the photographer or crew leader's initials as a prefix (e.g., CWH1, CWH2, and so on). The roll number should be recorded on each film canister with indelible pen. Digital discs and cards should be labeled (if not too small) as directed above for 35 mm film. Digital cards should be placed in small sealed envelopes labeled with the same information.

Amphibian Habitat Types – The river and creek SOPs differ, as follows.

For rivers: Circle the habitat type(s) from the list provided on the data sheet that best characterize(s) the site/subsite. If more than one habitat type is present at a site/subsite, circle all that are applicable (i.e., side channel with a low gradient riffle).

- *Boulder/Sedge Margin* – Boulder and sedge habitat occurs in low relief areas along the margin of the river. It is characterized by exposed and submerged boulders with interspersed sedge clumps, slow-moving water, and small pools that may be isolated or connected to the river.
- *Side Channel* – A side channel is smaller than the main channel, and generally only receives a portion of the streamflow, and may dry up at low flows. Side channels may be separated from the main channel in locations where center islands or low gradient cobble/boulder bars (often with vegetation) occur, and are usually relatively close to the main river channel. Side channels may totally or partially dry out at lower summer flows.
- *Main Channel Pool* – Main channel pools typically occur in low gradient sections of rivers and characteristically occupy most of the wetted channel. Main channel pools are generally relatively deep with low velocities and variable substrates.
- *Isolated/Scour Pool* – An isolated or scour pool is typically a pool formed at higher flows, and normally receives surface flow only during higher outflow periods. Isolated pools and scour pools may be located in bedrock areas, river bars, or in side channels that have been disconnected from the main river flow. These types of pools may be maintained by subsurface feed from the river, or seeps/springs along the river channel.
- *Pool Tail-Out/Pool Backwater* – Pool tail-outs occur at the downstream end of main channel pools adjacent to the main outflow. These areas are often shallow with slow moving or still water, and cobble or boulder substrates. Backwater pools occur along the margins of rivers at the edge of the main flow, and are typically characterized by reverse flows. Backwater pools may occur at river bends, at the bottom of main channel pools, below channel obstructions, etc.
- *Low Gradient Riffle* –Low gradient riffles are characterized by moderate velocities (20 – 50 cm/sec) with little or no whitewater, and partially or totally submerged substrates.
- *Run/Glide* – Run habitats occur in low gradient sections of rivers, have swift water velocities but no water turbulence, with cobble and boulder substrates. Glides also occur in low gradient sections of rivers, have swift water velocities and substrates consisting of gravel and cobble. Runs occur over a definite thalweg; glides do not.
- *Lateral Bar or Point Bar* – Lateral bars are located along a relatively straight section of river, and point bars are located on the inside of a river bend. Both lateral and point bars may have side channels at higher flows that often become disconnected from the main river during the summer or early fall possibly forming isolated pools. These bars may also have isolated or scour pools. For these habitat types, visually estimate the overall bar gradient from the river channel margin to the edge of the upland habitat as follows:

    Low: $< 10°$ slope
    Moderate: $10 – 20°$ slope
    High: $> 20°$ slope
- Cobble/Boulder Island – Cobble/boulder islands tend to occur in wider reaches of the river where small substrates (cobble, boulders, and gravel) dominate the channel. Vegetation is typically present to some degree on these islands, which are generally relatively stable habitats.
- *Other* – This category includes any habitat type that is not described above. Provide a description of the area.

For creeks: Circle the habitat type(s) from the list provided on the data sheet, that best characterize(s) the site/subsite. For a habitat type that is not listed on the data sheet, describe it in the space provided.

- *Pool* – Pools typically occur in lower gradient sections of the creek and characteristically occupy most of the wetted channel. Pools may be deep or shallow with low velocities.

- *Cascade/Pool* – Cascade/pool habitat usually occurs in higher gradient sections of creeks and is dominated by a series of small falls or steps with pools. The substrate generally consists of boulders or bedrock, or a combination of the two.
- *Isolated/Scour Pool* – An isolated or scour pool is typically a pool formed at higher flows, and normally receives surface flow only during higher outflow periods. Isolated pools and scour pools may be located in bedrock areas, in side channels that have been disconnected from the main creek flow, or in wide low gradient areas with small substrates. These types of pools may be maintained by subsurface flow from the creek, or seeps and springs along the creek channel.
- *Pool Tail-Out/Pool Backwater* – Pool tail-outs normally occur at the downstream end of main channel pools. These areas are typically shallow, with slow moving water and cobble or boulder substrates. Backwater pools usually occur along the margins of creeks at the edge of the main flow, and often have reverse currents. Backwater pools may occur at creek bends, at the bottom of main channel pools, below channel obstructions, etc.
- *Side Pool* – Side pools are hydraulically isolated from the main creek channel and receive little or no surface flow. This type of pool may be fed by a seep or spring that discharges to the creek
- *Bedrock Pool* – Bedrock pools occur along moderate gradient stream channels consisting primarily of bedrock shelves, with depressions and scoured areas. These pools may be filled at different streamflow levels, and may become dry as summer progresses, or are sustained by normal creek flows or by seeps and springs.
- *Side/Split Channel* – A side channel is smaller than the main channel and generally receives only a portion of the creek flow. Split channels are usually similar in size and receive similar flows. Side or split channels are usually located in wider, lower gradient sections of creeks with cobble and smaller substrates. As the summer progresses and flows decrease, side channels often become isolated from the main creek flow and dry up, unless fed by subsurface flow or a seep or spring.
- *Low Gradient Riffle* – Low gradient riffles are characterized by moderate velocities (20 – 50 cm/sec), with little or no whitewater, and totally or partially submerged substrates.
- *Run* – Runs occur in low gradient sections of the creek. They have little water turbulence, swift velocities, and substrate compositions of gravel, cobble, and boulder.
- *Other* – This category includes any habitat type that is not described above. Provide a description of the area.

Site/Subsite Location – For rivers, record on which bank the site/subsite occurs (bank designations are made facing downstream). Both banks are always included in creek VESs.

Site/Subsite Length and Width – Record the length and average width of the surveyed amphibian habitat (e.g., lateral bar, boulder/sedge margin). The location of the top and bottom of the site/subsite should be marked with flagging (or other marker), and indicated on an aerial photograph, site drawing, or topographic map.

Approximate Area of Site/Subsite – This is an indication of the amount of habitat available, which may be greater than the actual area surveyed. This is determined using the length and width measurements above. The area should also be delineated on an aerial photograph or site drawing. Area should be recorded in square meters.

Habitat Features

% Margin Vegetation – Indicate to the nearest 10% the length of stream bank with vegetation at the edge of the wetted channel within the site/subsite. Circle or write in all types present and indicate the dominant (Dom) vegetation type(s), by checking one or more boxes on the data sheet. This parameter is specific to vegetation along the stream margin that may be used for cover by juvenile/subadult and adult frogs. For creeks without subsites, estimate the percent margin vegetation within the survey area; if this feature is not consistent within the site, record a range in percent.

% Emergent Vegetation – Indicate to the nearest 10% the total area of aquatic habitat within the site/subsite with emergent vegetation. Circle or write in all types present and indicate the dominant (Dom) vegetation type(s), by checking one or more boxes on the data sheet. For creeks without subsites, estimate the percent emergent vegetation within the surveyed area; if this feature is not consistent within the site, record a range in percent.

% Submerged Vegetation – Indicate to the nearest 10 % the area of aquatic habitat within the site/subsite that has submerged vegetation. Circle or write in all types present and indicate the dominant (Dom) vegetation type(s), by checking one or more boxes on the data sheet. For creeks without subsites, estimate percent submerged vegetation within the surveyed area; if this feature is not consistent within the site, record a range in percent.

% Cover Aquatic – Indicate to the nearest 10% the total area of aquatic habitat within the site/subsite that provides cover for all life stages of FYLF. Circle or write in all types present and indicate the dominant (Dom) cover type(s), by checking one or more boxes on the data sheet. For creeks without subsites, estimate the percent aquatic cover within the surveyed area; if this feature is not consistent within the site, record a range in percent.

% Cover Terrestrial –Indicate to the nearest 10% the total amount of terrestrial habitat between the river margin and upland habitat within the site/subsite that provides cover for amphibians. Circle or write in all types present and indicate the dominant (Dom) cover type(s), by checking one or more boxes on the data sheet. For creeks without subsites, estimate the percent terrestrial habitat between the creek and upland habitat within the surveyed area that provides cover for amphibians; if this feature is not consistent within the site, record a range in percent.

% Overhanging Vegetation – Indicate to the nearest 10% the length of stream within the site/subsite with overhanging vegetation. Circle or write in all types present and indicate the dominant (Dom) vegetation type(s), by checking one or more boxes on the data sheet. For creeks without subsites, estimate the percent overhanging vegetation within the surveyed area; if this feature is not consistent within the site, record a range in percent. This parameter should only include vegetation that is directly overhanging river or creek habitats within 2 m of the water surface. Upper canopy vegetation should be included under % Riparian Canopy.

% Riparian Canopy – Indicate to the nearest 10% the amount of riparian canopy within the site/subsite. Circle or write in all types of vegetation that provide shade along the margin of the stream, and indicate the dominant (Dom) type(s). For creeks without subsites, estimate the percent riparian canopy within the surveyed area; if this feature is not consistent within the site, record a range in percent. This measurement does not include overhanging vegetation (i.e., within 2 m of the water surface).

Aquatic Substrate – Indicate to the nearest 10% the aquatic substrate types present in the site/subsite. Size classifications for substrate types follow the modified Wentworth (1922) scale.

Substrate Type	Size Range (mm)
Silt/Clay/Mud	< 0.059
Sand	0.06 – 1
Gravel/Pebble	2 – 63

Substrate Type	Size Range (mm)
Cobble	64 - 256
Boulder	> 256
Bedrock	–

Substrate Embeddedness – Circle the category that best represents the embeddedness of the aquatic substrate in the site/subsite. Embeddedness is defined as the degree to which larger particles (large gravel, pebble, cobble, and boulder) are surrounded or covered by fine sediment such as sand, silt, or clay. Embeddedness categories for stream channel materials (Platts et al. 1983) are provided below. These categories identify fine sediment as material less than 2 mm in diameter.

Level of Embeddedness	Percent of Gravel, Pebble, Cobble, and Boulder Surfaces Surrounded by Fine Sediment
Low	< 25%
Moderate	25-50%
High	> 50%

Dominant Substrate Shape – Indicate the dominant shape of the substrates at the site/subsite. Classification of substrate shape includes: angular, sub-angular, and rounded. This parameter is relative to other substrate within the drainage.

River or Creek Habitat – Indicate to the nearest 10% the river or creek habitats within the site/subsite. Descriptions of aquatic habitat features (Rosgen 1996) are provided below and should be used as a general guide when classifying aquatic habitat.

Aquatic Habitat	General Characteristics
Riffle	Little to considerable whitewater, moderate to fast velocities >20 cm/s, substrate of gravel and cobble to cobble and boulder - totally submerged to exposed, shallow to moderately deep, < 4% - 7% slope (low gradient to high gradient riffles)
Run	No water turbulence; swift velocity; substrate of gravel, cobble and boulder; low gradient; occurs over a definite thalweg
Glide	No water turbulence; low to moderate even velocity; substrate of sand, gravel and cobble; 0-1% gradient; occurs over a wide channel lacking a definite thalweg
Pool	Low velocity, usually large and deep occupying much of the channel, substrate variable, little or no gradient
Cascade/Pool	Varying velocities, bedrock and boulder substrates, high gradient, pools separated by short cascades
Step-Pool	Varying velocities, boulder substrate, high gradient, pools separated by short riffles or cascades
Pocket Water	Sections of a swift flowing stream containing numerous boulders or other large obstructions that create eddies or scour holes (pockets) behind the obstructions

River or Creek Gradient – Record the average stream gradient within the site/subsite. Stream gradient should be visually estimated as follows:

- Low: < 2 %
- Moderate: 2 – 4 %
- High: > 4 – 10+ %

River or Creek Gradient Change – Indicate if there is a significant change in gradient (e.g., *low* = riffle to *high* = bedrock cascade/pool) upstream of the site or between adjacent subsites. If there are several significant gradient breaks associated with adjacent subsites, describe them sequentially in the Comments section at the bottom of the data sheet. Use the categories provided under River or Creek Gradient above. Circle whether the gradient upstream of the site, or the adjacent upstream subsite, is **higher** or **lower** relative to the site/subsite being evaluated.

Change in River or Creek Habitat – Describe the alteration in aquatic habitat associated with a change in gradient, using the habitat types listed above under River or Creek Habitat (*e.g., the lower portion of the site is a slow glide that changes to a high gradient riffle upstream due to an increase in stream gradient).*

Rosgen Channel Type – Circle the appropriate channel type for the site/subsite, using the letter designations provided on the data sheet. Descriptions of the channel types (Rosgen 1996) are provided below:

- **A:** *Cascading channels in a steeply sloped, 'V-shaped' drainage with a 4 – 10% gradient.*
- **B:** *Stream types that occur primarily on moderately steep to gently sloped terrain, with the predominant landform as a narrow and moderately sloping valley. "B" streams are moderately entrenched, moderate gradient (2 – 4%), riffle dominated channels, with infrequently spaced pools*
- **C:** *Stream types that are located in narrow to wide alluvial valleys with a well developed, slightly entrenched floodplain. "C" stream types are low gradient (< 2%), meandering, alluvial channels dominated by riffle/pool habitat and point bars.*
- **D:** *Stream types that are located in broad valleys with alluvial and colluvial fans. "D" stream types are low gradient (< 2%), braided channels with longitudinal and transverse bars, and are characteristically wide channels with eroding banks.*
- **DA:** *Stream types that are located in broad, low-gradient valleys with fine alluvium and/or lacustrine soils, multiple channels, with an expansive well-vegetated floodplain and associated wetlands. "DA" stream types are riffle/pool, similar to stream types "C" and "E", with well-vegetated, laterally stable bars, and very stable stream banks.*
- **E:** *Stream types that occur in broad valleys or floodplains with meadows and are composed of alluvial materials. "E" types are low gradient (< 2%), meandering riffle/pool channels with stable well-vegetated banks.*
- **F:** *Stream types that occur in meadows or other low gradient areas composed of unconsolidated materials. "F" types are entrenched meandering riffle/pool channels on low gradients (< 2%) with a high width/depth ratio typically associated with high bank erosion rates (meadow streams).*
- **G:** *Stream types that are entrenched "gully" step-pool channels with low to moderate gradient (2 – 4%), and high bank erosion rates.*

Wetted Channel Width – Measure and record the wetted channel width (that portion of channel with water) in meters, within a representative section of the site/subsite.

Bankfull Width – Record the bankfull width (upper limit of high flows) of the channel in meters within a representative section of the site/subsite. This measurement should be based on indicators such as staining on rocks, and scour and debris lines. Many hydrologically controlled streams do not display good indicators, and bankfull widths may be approximations based upon available features.

Water Turbidity – Visually estimate turbidity and circle **Low**, **Medium**, or **High**. Estimates should be based upon the following general guidelines:

- Low - *able to see submerged substrate (including small gravels) clearly in 0.6 m (2 ft) of water*
- Medium - *unable to distinguish small gravels in 0.6 m (2 ft) of water*
- High - *unable to readily distinguish large gravels in 0.6 m (2 ft) of water*

Note: turbidity estimates should take into account lighting conditions (shading may affect ratings).

Water Color – Circle **Clear** or **Discolored** (e.g., tannin staining).

Bank Gradient – Circle the appropriate gradient and applicable stream bank (L/R). Record the average bank gradient within the site/subsite; if this feature is not relatively consistent within the surveyed area, indicate a range. For both rivers and creeks, use the categories below.

- Low: < 15°
- Moderate: 15 – 40°
- High: > 40°

Active Bank Erosion – Indicate whether active erosion is occurring within or adjacent to the site/subsite.

Inundated River Bar – For river sites/subsites only, indicate whether inundated bars are present, and record the **Approximate Area** (m^2) of the river bar that is inundated at the existing flow level. This area should include all potentially suitable habitats from the water line out to the point where there is a noticeable change either in slope or in substrate characteristics, or both. The inundated portion of the bar represents an extension of the existing shoreline amphibian habitat that would likely remain amphibian habitat at lower flows. **Average Depth** of the inundated area should be recorded to the nearest 5 cm. Estimate the **Velocity Range** (e.g., 0–5 cm/sec) within a representative portion of the inundated area using a flow meter, or if experienced, visually estimate.

Edgewater – For river sites/subsites only, indicate if there are shallow water areas (typically < 45 cm deep) along the margin of the river with calm or slow moving water and primarily cobble and boulder substrates. Record the **Average Depth** (cm), **Approximate Area** (m^2), and the **Location in Site/Subsite** of the edgewater habitat.

Tributary Nearby – Indicate if there is a tributary confluence at or in close proximity to the site/subsite. Record the tributary **Location** in reference to the site (upstream **(U/S)** or downstream **(D/S)**, and left bank (**LB**) or right bank (**RB**) facing downstream), the approximate **Distance** (m) from the site/subsite, and whether it is **Perennial** or **Ephemeral**. Note: if a tributary is not visible from the top or bottom of the site, consult a USGS 7.5' topographic map and estimate the distance from the site/subsite to the nearest tributary.

Upland Habitat Type – Circle the appropriate upland habitat type adjacent to the site/subsite from the list provided or add an alternative habitat type if necessary.

Fish Present – Record fish that are observed within or adjacent to the site/subsite. Indicate if fish are either suspected or known to occur, but were not observed. For **Type**, circle or write in the species groups that are present. The following are representative classifications:

- Salmonids – *trout and salmon*
- Centrarchids – *bass and sunfish*
- Cyprinids – *minnows*

Herpetofauna and Life Stage – Circle or write in all that apply. Indicate the approximate number and the life stages present (A = adult, J = juvenile/subadult, T = tadpole, E = egg).

Other Species Observed – Record other species observed at the site/subsite.

Impacts to Amphibian Habitat – Indicate if there are existing activities within or adjacent to the site/subsite that could impact amphibians or their habitat. If possible, assess the potential level of impact (low, moderate, or high).

Comments – Comments will be noted at the bottom of the site habitat assessment data sheet. Comments should include observations of conditions potentially affecting amphibians or their habitat that are not included on the data sheets. Such observations might include: a discharge entering the stream, logging and construction activities, recreation activities, notes on particularly good or particularly poor habitat, and other conditions that stand out or are relatively uncommon.

QA/QC – Record the initials of the person who reviews the data sheet for completeness and the date it is reviewed. The reviewer should not be the person who completes the data sheet. The reviewer should complete the QA/QC review before leaving the site.

References

Platts, W.S., W.F. Megahan, and G.W. Minshall. 1983. Methods for evaluating stream, riparian, and biotic conditions. U.S. Forest Service. In: Bain, M.B., and N.J. Stevenson, editors. 1999. Aquatic habitat assessment: common methods. American Fisheries Society, Bethesda, Maryland.

Rosgen, D. 1996. Applied river morphology. Wildland Hydrology, Pagosa Springs, CO.

Wentworth, C.K. 1922. A scale of grade and class for elastic sediments. *Journal of Geology* 30: 377-392.

Foothill Yellow-Legged Frog

River Site Habitat Assessment

Date: mm____dd____yy____ Site #:______ Subsite #:______ River Name/Location:________________________________
USGS Quad: ________________________ Township: ______ Range:______ Section:______ ¼ Section:______ Elevation:_______
GPS File Name: ________________ Weather: *Sky*: Overcast Partly Overcast Clear *Wind:* Inclement Fair Ideal
Total Site Length: _________ River Aspect: _______ Discharge (cfs) ______ Water Temp: (edgewater) ______ (main channel) ______
Observers: ________ ________ Initial Site Visit ☐ Follow-up Site Visit ☐
Photograph # (index to notebook): _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ Roll/Disc/Card #:_____

AMPHIBIAN HABITAT TYPES:

- Boulder/Sedge Margin
- Side Channel
- Main Channel Pool
- Isolated/Scour Pool
- Pool Tail-Out/Pool Backwater
- Low Gradient Riffle
- Run/Glide
- Lateral Bar or Point Bar — Bar gradient: low (<10°) moderate (10–20°) high (>20°)
- Cobble/Boulder Island
- Other: ________________________________

Site/Subsite: Location: right bank left bank Length: _________ Width: __________ Approximate Area (m^2): __________

HABITAT FEATURES:

% Margin Vegetation: ______ Type: forbs grass sedge rush blackberry other: ____________________
Dom.: ☐ ☐ ☐ ☐ ☐ ☐

% Emergent Vegetation: ______ Type: grass sedge rush pondweed other: ____________________
Dom.: ☐ ☐ ☐ ☐ ☐

% Submerged Vegetation: ______ Type: algae rooted aquatic veg other: ____________________
Dom.: ☐ ☐ ☐

% Cover Aquatic: ______ Type: rootwad aquatic veg. woody debris gaps between substrate other : ____________
Dom.: ☐ ☐ ☐ ☐ ☐

% Cover Terrestrial: ______ Type: duff/leaf litter burrows woody debris undercut bank other: ______________
Dom.: ☐ ☐ ☐ ☐ ☐

% Overhanging Vegetation: ______ Type: willow blackberry alder dogwood other: ____________________
Dom.: ☐ ☐ ☐ ☐ ☐

% Riparian Canopy: ______ Type: willow ash alder maple oak conifer other: ____________________
Dom.: ☐ ☐ ☐ ☐ ☐ ☐ ☐

Aquatic Substrate (%): silt/clay _____ sand _____ gravel/pebble _____ cobble _____ boulder _____ bedrock _____
Substrate Embeddedness: low (<25%) moderate (25-50%) high (>50%)
Dominant Substrate Shape: angular sub-angular rounded
River Habitat: riffle _____ run _____ glide _____ pool _____ cascade/pool _____ step-pool _____ pocket water _____
River Gradient: low (0-2%) moderate (2-4%) high (4-10+%) Wetted Channel Width: ______ Bankfull Width: ______
River Gradient Change: No Yes higher lower Change in River Habitat: ____________________
Rosgen Channel Type: A B C D DA E F G
Water Turbidity: low moderate high Water Color: clear discolored (tannins, etc.)
Bank Gradient: low (<15°) R / L mod (15-40°) R / L high (>40°) R / L Active Bank Erosion: Yes No
Inundated River Bar: present absent Approximate Area (m^2) _______ Avg. Depth: _______ Velocity Range: _______
Edgewater: Yes No Average Depth: _______ Approximate Area: ________ Location in Site/Subsite: ____________
Tributary Nearby: Yes No Location: U/S D/S LB RB Distance: ____________ Perennial Ephemeral

Upland Habitat Type: mixed conifer foothill hardwood/conifer foothill hardwood scrub/shrub other:_______________
Fish Present: Yes No Type: salmonid centrarchid cyprinid other: ____________________
Herpetofauna & Life Stage (A J T E) tree frog ______ bullfrog ______ western pond turtle ______ garter snake ______ other_______
Other Species Observed: ________________________________
Impacts to Amphibian Habitat (circle): grazing recreation industrial other: ____________________ low mod high
Comments: ________________________________

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QA/QC (initials): _______ Date: _______

Foothill Yellow-Legged Frog

Creek Site Habitat Assessment

Date: mm____dd____yy____ Site #:______ Subsite #: ______ Creek Name/Location:______________________________
USGS Quad: ________________________ Township: ______ Range:______ Section:______ ¼ Section:______ Elevation: ______
GPS File Name: _________________ Weather: *Sky*: *Overcast* *Partly Overcast* *Clear* *Wind*: *Inclement* *Fair* *Ideal*
Total Site Length: ________ Creek Aspect: _______ Discharge (cfs) _______ Water Temp: (edgewater) ______ (main channel) ______
Observers: ________ ________ Initial Site Visit ☐ Follow-up Site Visit ☐
Photograph # (index to notebook): _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ Roll/Disc/Card #:_____

AMPHIBIAN HABITAT TYPES

- Pool
- Cascade/Pool
- Isolated/Scour Pool
- Pool Tail-Out/Pool Backwater
- Side Pool
- Bedrock Pool
- Side/Split Channel
- Low Gradient Riffle
- Run
- Other ____

Site/Subsite: Length: ________ Width: _________ Approximate Area (m^2): _________

HABITAT FEATURES

% Margin Vegetation: ______ Type: forbs grass sedge rush blackberry other: ____________________
Dom.: ☐ ☐ ☐ ☐ ☐ ☐

% Emergent Vegetation: ______ Type: grass sedge rush pondweed other: ____________________
Dom.: ☐ ☐ ☐ ☐ ☐

% Submerged Vegetation: ______ Type: algae rooted aquatic veg other: ____________________
Dom.: ☐ ☐ ☐

% Cover Aquatic: ______ Type: rootwad aquatic veg. woody debris gaps between substrate other: __________
Dom.: ☐ ☐ ☐ ☐ ☐

% Cover Terrestrial: ______ Type: duff/leaf litter burrows woody debris undercut bank other: __________
Dom.: ☐ ☐ ☐ ☐ ☐

% Overhanging Vegetation: ______ Type: willow blackberry alder dogwood other: ____________________
Dom.: ☐ ☐ ☐ ☐ ☐

% Riparian Canopy: _______ Type: willow ash alder maple oak conifer other: ____________________
Dom.: ☐ ☐ ☐ ☐ ☐ ☐ ☐

Aquatic Substrate (%): silt/clay ____ sand _____ gravel/pebble _____ cobble _____ boulder _____ bedrock _____
Substrate Embeddedness: low (< 25%) moderate (25-50%) high (> 50%)
Dominant Substrate Shape: angular sub-angular rounded
Creek Habitat: riffle: ____ run: ____ glide: ____ pool: ____ cascade/pool: ____ step-pool: ____ pocket water: ____
Creek Gradient: low (0-2%) moderate (2-4%) high (4-10+%)
Creek Gradient Change: No Yes higher lower Change in Creek Habitat: ____________________
Rosgen Channel Type: A B C D DA E F G
Wetted Channel Width: _________ Bankfull Width: _________
Water Turbidity: low moderate high Water Color: clear discolored (tannins, etc.)
Bank Gradient: low (<15°) R / L mod (15-40°) R / L high (>40°) R / L Active Bank Erosion: Yes No
Tributary Nearby: Yes No Location: U/S D/S LB RB Distance: __________ Perennial Ephemeral

Upland Habitat Type: mixed conifer foothill hardwood/conifer foothill hardwood scrub/shrub other: ______________
Fish Present: Yes No Type: salmonid centrarchid cyprinid other: ____________________
Herpetofauna & Life Stage (A J T E) tree frog _____ bullfrog _____ w. pond turtle _____ garter snake _____ other: ________
Other Species Observed: ____
Impacts to Amphibian Habitat: grazing recreation industrial other: ____________________ low mod high
Comments: ____
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QA/QC (initials): ________ Date: ________