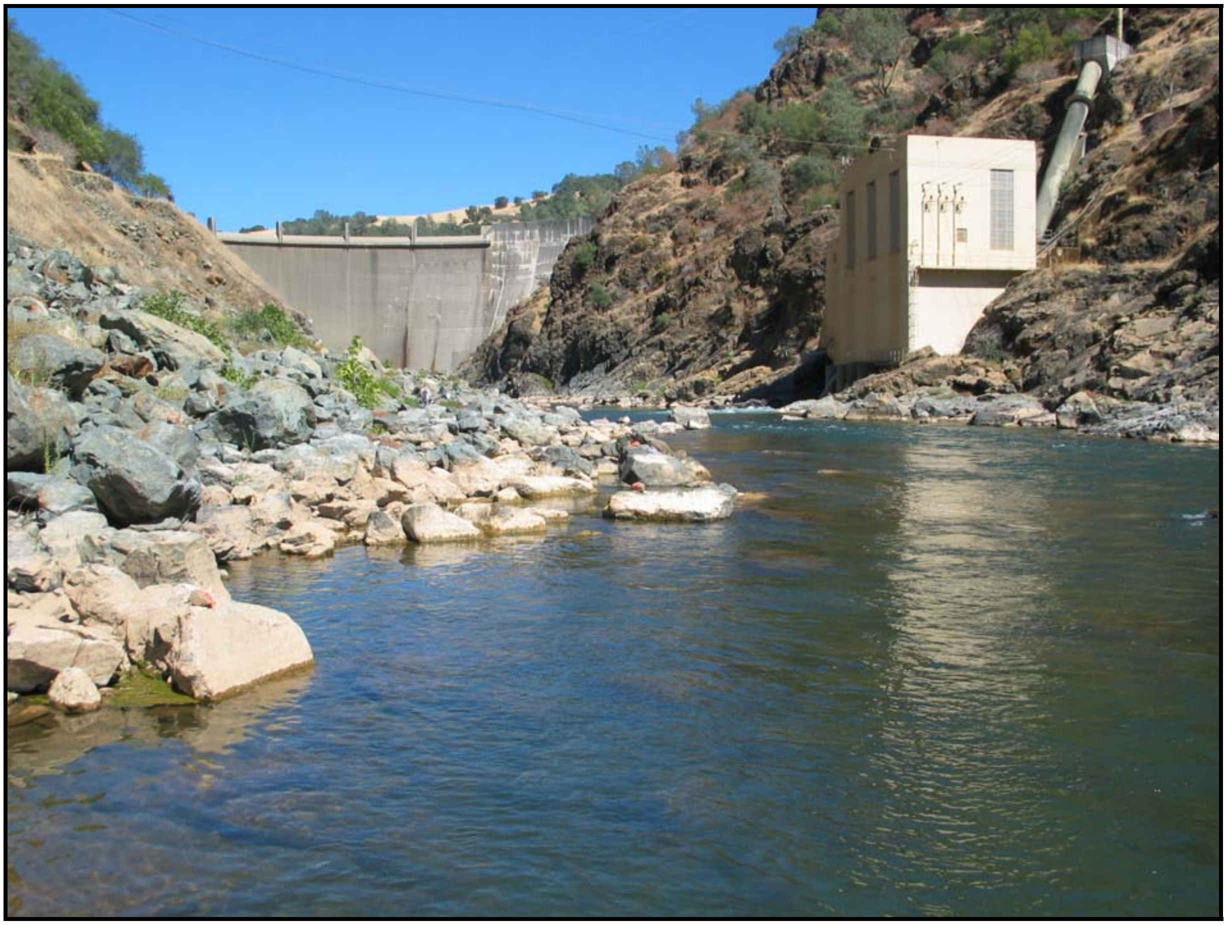
# LOWER YUBA RIVER GRAVEL AUGMENTATION PROJECT

# YUBA AND NEVADA COUNTIES, CALIFORNIA

FINAL ENVIRONMENTAL ASSESSMENT

November 2010



US Army Corps
of Engineers ®
Sacramento District

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, SACRAMENTO
CORPS OF ENGINEERS
1325 J STREET
SACRAMENTO, CALIFORNIA 95814-2922

REPLY TO
ATTENTION OF

NOV 17 2010

Environmental Resources Branch

FINDING OF NO SIGNIFICANT IMPACT
Lower Yuba River Gravel Augmentation Project
Yuba and Nevada Counties, California

The U.S. Army Corps of Engineers, Sacramento District, has determined that implementing the proposed gravel augmentation project on the Lower Yuba River, immediately below Harry L. Englebright Dam and Reservoir, would have no significant effects on the quality of the human environment. The project area is located in the Lower Yuba River canyon off Highway 20, about 23 miles east of Marysville, California. Project activities would include placing 2,000 to 5,000 short tons of a heterogeneous mix of gravel and cobble directly into the Lower Yuba River channel below Englebright Dam using a gravel sluicing method.

The proposed action would partially compensate for the operation of the Englebright Dam. Implementation of a gravel augmentation plan would improve the overall function of the habitat of the Lower Yuba River by providing spawning gravel to key areas that have been designated as critical habitat for the Central Valley spring-run Chinook salmon *(Oncorhynchus tshawytscha)* and the Central Valley steelhead (*O. mykiss*).

An Environmental Assessment (EA) was prepared to evaluate the potential effects to natural and cultural resources in the proposed project area. Based on the evaluation of potential effects described in the EA, I have determined that the proposed gravel augmentation project would have no significant adverse effects on existing resources including special status species, fish and wildlife, vegetation, air and water quality, and cultural resources. No additional environmental documentation is required, and the project activities may proceed as proposed.

17 NOV 2010
Date

William J. Leady, P.E.
Colonel, U.S. Army
District Engineer

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## TABLES



## PLATES



## APPENDICES

## ACRONYMS

| | |
|---|---|
| APE | Area of Potential Effect |
| BLM | Bureau of Land Management |
| BO | Biological Opinion |
| CDFG | California Department of Fish and Game |
| CDOT | California Department of Transportation |
| CDWR | California Department of Water Resources |
| CESA | California Endangered Species Act |
| cfs | Cubic feet per second |
| CNDDB | California Natural Diversity Data Base |
| Corps | U.S. Army Corps of Engineers |
| CRWQCB | California Regional Water Quality Control Board |
| EA | Environmental Assessment |
| EDR | Englebright Dam Reach |
| EFH | Essential Fish Habitat |
| EIS | Environmental Impact Statement |
| EPA | Environmental Protection Agency |
| ESA | Endangered Species Act |
| ESU | Evolutionarily significant unit |
| FONSI | Finding of No Significant Impact |
| GAIP | Gravel/Cobble Augmentation Implementation Plan |
| HTRW | Hazardous, toxic, or radiological waste |
| MBTA | Migratory Bird Treaty Act |
| NAAQS | National Ambient Air Quality Standards |
| NEPA | National Environmental Policy Act |
| NMFS | National Marine Fisheries Service |
| PG&E | Pacific Gas and Electric |
| RMT | Lower Yuba River Management Team |
| SHPO | State Historic Preservation Officer |
| UCD | University of California, Davis |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geological Service |
| VELB | Valley elderberry longhorn beetle |
| YCWA | Yuba County Water Agency |

# 1.0 Purpose and Need for Action

## 1.1 Background

The Lower Yuba River downstream of Harry L. Englebright Dam and Reservoir (Englebright) has experienced extensive sediment deposition as a result of the hydraulic gold mining that occurred in the watershed during the mid- to late 1800's. An estimated 685 million cubic yards of mining debris was washed out of the mountains and into the Yuba River (Hagwood 1981). As the sediment migrated downstream, the river bed rose, causing extensive flooding in the Marysville area. To control this sediment movement, the California Debris Commission constructed Daguerre Point Dam in 1906 and Englebright in 1941.

Since its construction, Englebright has continued to fulfill its primary purpose of debris control with containment of 17,750 acre-feet of sediment (Chiles 2003). The elimination of the upstream supply of sediment, however, has lead to progressive degradation of the downstream channel below Englebright, at least as far downstream as Parks Bar, where the Highway 20 (Plates 1 – 2) bridge footings have been exposed (Musseter Engineering, Inc. 2000). Lack of sediment input and gravel loss within this reach of the Lower Yuba River have greatly reduced the availability of quality spawning gravel for the Central Valley steelhead (*Oncorhynchus mykiss*) and spring-run Chinook salmon (*Oncorhynchus tshawytscha*).

Below Parks Barr, sediment sources from tributary input; gravel entrained from bars, training walls, and hill slopes; and gravel existing in the channel bed continue to provide large areas of suitable spawning habitat (Moir 2006). However, without additional gravel delivery, the existing gravel supply in the bed and usable gravel stored in bars will decrease as it is gradually transported downstream, leading to a net deficit of suitable spawning sediment.

## 1.2 Proposed Action

The U.S. Army Corps of Engineers (Corps) is proposing to implement a gravel augmentation project in the fall of 2010, by placing 2,000 to 5,000 short tons of a heterogeneous mix of gravel and cobble (0.25 to 5.0 inches in diameter) directly into the Lower Yuba River channel below Englebright Dam, as the establishment of a long-term gravel augmentation program. The material would be monitored after the placement, adding to the understanding of the Lower Yuba River geomorphic processes. The information gathered from the monitoring of the gravel placed in 2010 will allow the Corps to verify or revise details of the long-term gravel augmentation plan (Pasternack 2010).

## 1.3 Location

The project area is located on the Lower Yuba River, starting at Englebright (Yuba River mile 23.9) downstream to Daguerre Point Dam (Yuba River mile 11.4), in Yuba and Nevada Counties, California (Plate 1). The proposed gravel placement site is located downstream of

Englebright Dam, approximately 900-feet downstream of the Narrows 2 Powerhouse[i] and 115-feet downstream of the Narrows 1 Powerhouse[ii] This site is less than one-acre and would be confined to the river channel within the Englebright Dam Reach (EDR), a 0.89-mile long bedrock reach starting at Englebright Dam and ending at the junction with Deer Creek, located in the steep Narrows Canyon off Highway 20, approximately 23 miles east of Marysville, California (Plates 2, 3, and 4).

## 1.4 Purpose and Need for the Action

Englebright Dam plays a crucial role in protecting the downstream region from being overwhelmed by sedimentary mining waste debris still being eroded off hillsides and stored in long sections of the channel network upstream (James 2005, Wright and Schoellhamer 2004, Pasternack 2010. Most of the active Lower Yuba River also still has tens of millions of cubic yards of sedimentary mining waste debris in it that pre-date Englebright Dam and are still being re-worked as part of a highly dynamic, meandering gravel-bed river. However, the reach between Englebright Dam and the confluence with Deer Creek is now almost devoid of river-rounded gravel and cobble necessary for salmon spawning. In particular, spring-run Chinook salmon that historically went far upstream would substantially benefit from a gravel augmentation program below Englebright Dam. However, the critical reach is in a narrow canyon that is difficult to access and manage, let alone place thousands of tons of coarse sediment into (Pasternack 2010).

The purpose of the proposed gravel augmentation project is to place suitable-sized spawning gravel within the upper Narrows reach of the Lower Yuba River. The proposed action would satisfy the a term and condition of the incidental take statement included in the November 21, 2007 Biological Opinion (BO) prepared by National Marine Fisheries Service (NMFS) pursuant to Section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.C. 1531 et seq.) Specifically, the BO states: “The Corps shall develop and implement a long-term gravel augmentation program to restore quality spawning habitat below Englebright Dam. The Corps shall utilize the information obtained from the pilot gravel injection project to develop and commence implementation of a long-term gravel augmentation program within three years of the issuance of this biological opinion” (NMFS 2007).

## 1.5 Purpose and Scope of the Environmental Assessment

The purpose of this Environmental Assessment (EA) is to determine whether the proposed action would result in significant effects on the environment, require preparation of an Environmental Impact Statement (EIS), or whether the types and significance of effects of the proposed action would support a Finding of No Significant Impact (FONSI).

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[i] On November 17, 1975, the Corps issued Easement No. DACW05-2-75-716 to the Yuba County Water Agency (YCWA) for the Narrows 2 powerhouse, granting permission for the powerhouse to be constructed, operated, and maintained below Englebright (NMFS 2002).
[ii] Narrows 1 powerhouse (FERC No. 1403), owned, and operated by PG&E is located on the opposite side of the river about 500 ft. downstream of Narrows 2.

This EA examines various alternatives to deliver and place the gravel, describes the environmental resources in the project area, determines the potential effects of the preferred alternative on those resources, and proposes mitigation measures to reduce effects to less than significant. This EA has been prepared in accordance with the National Environmental Policy Act (NEPA) to provide full disclosure of potential environmental effects.

### 1.6 Decision Needed

The District Engineer, the Commander of the Sacramento District of the Corps, must decide whether or not to proceed with the proposed action described in this EA and whether a FONSI is appropriate. This EA provides the basis for a FONSI under NEPA. Comments received will be used in reaching a decision on whether a FONSI is appropriate or if an EIS should be prepared.

### 1.7 Project Authority

Harry L. Englebright Dam and Lake were authorized by the River and Harbor Act of 1935 (49 Stat. 1028) as a unit of the Sacramento River Debris Control Project. Construction of recreation facilities at Englebright Lake and provision of services to the public by concessionaire is in accordance with Section 4 of the Flood Control Act of 1944 (58 Stat. 887) and subsequent amendments.

## 2.0 Alternatives

A Gravel/Cobble Augmentation Implementation Plan (GAIP) for the Englebright Dam Reach of the Lower Yuba River, CA was developed to thoroughly assess the results of the 2007 pilot gravel injection project (Corps 2007), analyze the monitoring data collected post-pilot project, and to assess methods and measures that could be utilized in the proposed gravel augmentation project. The GAIP thoroughly documents a plan for implementing a gravel/cobble augmentation program below Englebright Dam. This plan addresses the biogeomorphic impact of the proposed project on the Lower Yuba River. The GAIP is included in this Final EA (Appendix A).

### 2.1 Alternatives Eliminated from Detailed Discussion

#### 2.1.1 Construct Temporary Access Road

A temporary access road to the proposed gravel placement site would be constructed from the existing Narrows 2 powerhouse access road down to the riverbank. The Narrows 2 access road would be extended about 250 feet to the riverbank beginning roughly 25 feet downstream of the Narrows 2 facility. Several switch backs would descend 40 feet down to the river bank. With the temporary road constructed, gravel transport trucks would deliver gravel in 10- and 20-ton increments to the river bank from a designated commercial source via public and private roads. A front-end loader would be used to place the gravel from the riverbank into the river.

This method would place the gravel and cobble into the Lower Yuba River by hauling material in 10-ton and 20-ton trucks down to the river's edge, pouring it along the edge, and distributing it with front loaders (Pasternack 2010). However, the EDR has not had a road down to the water's edge since the 1997 flood destroyed the previous one there. The elevation of the river's water surface at 855 cubic feet per second (cfs) is approximately 292 feet (NAVD88 datum), whereas the elevation of the end of the existing road at the Narrows 2 facility is approximately 353 feet. The vertical drop of 61 feet takes place over a horizontal distance of just approximately 100 feet, so the slope is 0.5 (50%). As a result, the road would have to be steep with switchbacks. It would be unlikely for 20-ton trucks to negotiate the switchbacks, so delivery would be limited to 10-ton trucks or front loaders. Moreover, to construct a new road would require importing a large quantity of road fill materials. This raised a serious concern about the risk of these materials eroding by rain, landslide, or flood, which would cause harmful mud, sand, and angular crushed rock to enter the river and integrate into the bed material. This method would also be extremely costly, and it would be environmentally harmful to remove a temporary road after gravel/cobble augmentation. It is not possible to remove a road off a steep rocky hillside without causing debris to be left behind risking water quality and river-substrate problems. Further considerations raised the concern over possibly having to excavate the end of the road in the channel, which could cause direct water quality problems. Also, the permitting process for road construction would take a long time, precluding gravel/cobble augmentation in 2010 and possibly 2011 (Pasternack 2010).

This alternative was eliminated from further discussion because of the potential for soil erosion directly into the river channel from excavation and fill placement for the temporary road. To minimize the after-action effects, removal of the temporary road material to a location outside of the 100-year flood zone would be required, which would be extremely costly and environmentally harmful, as it is not possible to remove a road off a steep rocky hillside without causing debris to be left behind risking water quality and river-substrate problems (Pasternack 2010). This remedial measure would be too costly and environmentally degrading for the proposed action to proceed.

### 2.1.2 Helicopter Delivery

A helicopter would be used for the delivery and placement of gravel in this alternative. Past applications of spawning gravel have used helicopters for delivery in difficult to reach locations (Kimball 2003). A radio-controlled hopper would be attached by a cable to the helicopter. The hopper would be filled by a loader on the ground and flown to a designated point on the river. A radio signal would be sent to the hopper, which opens the bottom of the hopper, thereby delivering the gravel to the designated spot. The average rate of delivery for this alternative is 20 tons per hour.

Although this alternative would not require the construction of a temporary access road within the 100-year floodplain, this alternative was eliminated from further discussion because of the hazardous combination of slow flight in close proximity to physical obstructions (Englebright

Dam, steep canyon walls, and suspended electrical transmission conduit associated with the Narrows 2 powerhouse). In addition, this method would have a slow delivery rate, depending on how far the stockpile is from the placement site, and as the contractual cost estimates of between $1,800 to $4,500 per hour for a heavy lift capacity helicopter and operator(s), this method would be much too costly for the proposed action to proceed.

### 2.1.3 Truck-mounted Conveyor Belt

This method was initially used during the 2007 pilot project. A 135-foot conveyor belt, mounted onto a truck, would be fully extended and rotated perpendicular to the truck so that its end was over the river. With an approximately 100 to 120-foot bank width, this length is just sufficient to get material into the Narrows 2 pool. Material would be fed into a hopper using a small 0.5 to 1-ton front loader. A feeder with a conveyor belt would then lift the material up and onto the truck-mounted belt to deliver the gravel out over the water, avoiding particle breakage by delivering the material into a deep pool. This alternative was eliminated from further discussion because of two problems: (1) limitations in placement options along the proposed project location, and (2) the possibility of dewatering in the placement area between the two Narrows powerhouses.

First, given the geometry of the road, hillside, channel, and Narrows 2 powerhouse, the area of the wetted channel suitable for placement that is within the 135' length of the conveyor belt is very limited. Gravel and cobble is not permitted to be placed up against the powerhouse and no pile can be allowed to interfere with the immediate outflow jet issuing from the powerhouse. The Narrows 2 pool is approximately 15 feet deep, but much of it is not reachable with the conveyor belt. Based on visual appearance at the end of the pilot injection in 2007, the gravel/cobble pile was built up approximately 11 feet high off the stream bed (Pasternack 2010). Given some more rotation capability and making the water even shallower, it appeared that a total amount of 1,000 tons of gravel could be stored in the pool by this method. The gravel and cobble deficit for the EDR is one to two orders of magnitude higher than that, making this approach inadequate for the need (Pasternack 2010).

Second, there is a proven concern of gravel placed into the Narrow 2 pool depositing into the shallow area between the Narrows 2 and Narrows 1 powerhouses (Pasternack, 2009). The problem with such deposition is that an unknown amount of this area may be dewatered when maintenance is done on the Narrows 2 powerhouse. A newly constructed bypass tunnel exists to avoid that, but it is still a risk. If gravels were dewatered in September-November for maintenance, then it is possible that salmon embryos would be harmed.

This method did work for the 2007 pilot experiment; Pasternack (2009) observed that the 2009 flood of 15,381 cfs scoured off the top 23% of the 2007 injected gravel pile. None of the eroded material made it past the Narrows 1 powerhouse. Instead, it deposited in the nooks in bedrock fractures and behind boulders and bedrock outcrops in a narrow band down the length of the area between the two powerhouses. In autumn 2009 Chinook salmonids were observed by Yuba River Management Team (RMT) staff to be spawning on that material (Pasternack 2010).

Pasternack (2009) provided a thorough evaluation of what happened after the 2007 pilot project and its consequence. It was concluded that that a placement of a large amount of gravel/cobble into the Narrows 2 pool would certainly yield deposits in the area between the powerhouses that is at risk for annual dewatering in September-November. Given that the entire EDR is lacking in gravel/cobble, there are other areas where gravel could be introduced downstream of Narrows 1, thereby avoiding the problem of channel dewatering.

## 2.2 No Action

The No-Action alternative serves as the environmental baseline against which the proposed action is compared. Under this alternative, the Corps would not implement the gravel augmentation project on the Lower Yuba River immediately downstream of Englebright. If no action is taken, the existing gravel supply in the stream bed and usable gravel stored in current bars would gradually decrease as it is transported downstream, leading to a net deficit of suitable spawning gravels.

There are currently several projects and programs, either in the planning stages or underway on the Lower Yuba River, that involve various efforts to improve conditions for anadromous fisheries. However, the existing geomorphic processes related to recruitment and transport of suitable spawning gravels below Englebright would essentially remain the same. The Corps may be required to reinitiate consultation with NMFS to determine the appropriate actions to be taken in the absence of a gravel augmentation project, to compensate for the interruption of recruitment gravel caused by the operation of Englebright Dam.

## 2.3 Gravel Sluicing (Preferred Alternative)

The preferred alternative consists of placing 2,000 to 5,000 short tons (7,404.41 to 18,518.52 cubic yards) of gravel and cobble directly into the Lower Yuba River channel near the Narrows 1 Powerhouse via gravel sluicing, which involves drawing water up from a source and into a flexible pipe, where gravel and cobble is added from the top to produce a water, sediment slurry that is then piped down to a site for directed placement by one to two operators. Details of staging, gravel sizes, placement, and monitoring for the alternative are provided below. Project features are provided in Plate 4.

The gravel/cobble mixture would be monitored after placement within the EDR. The information gathered from the monitoring of the placed material will allow the Corps to determine if it will be necessary to place additional quantities of gravel, if any, within the Lower Yuba River channel below Englebright (Pasternack 2010).

### 2.3.1 Gravel Placement Process

The sluicing process involves drawing water up from a source (the reservoir) and into an 8-inch diameter “Yelomine” flexible pipe, where gravel and cobble is added from the top to produce a water, sediment slurry that is then piped down to a site for directed placement by one to two operators. The amount of water used to do the sluicing depends on the pipe and pump configurations, and is typically 1,000 to 1,500 gallons per minute, which is 2.23 to 2.34 cubic feet per second (cfs) (Pasternack 2010). One water pump would be located at the reservoir water's edge, to push the water uphill in a 6 to 8 inch pipe. The pump inlet would be screened, according to the NMFS mesh screen criteria for a pump (NMFS 1996). Specifically, screen mesh openings are not to exceed 3/32 inch for woven wire or perforated plate screens, or 0.0689 inch for profile wire screens, with a minimum 27% open area. If fry-sized salmonids are never present at the site, screen mesh openings would not exceed ¼ inch for woven wire, perforated plate screens, or profile wire screens, with a minimum of 40% open area.

This process is normally a five-person operation: one person would operate the water pump at the source, one, in a loader, would bring gravel to the feeder, one person would operate the feeder in order to prevent clogs and coordinate communications, and two at the end nozzle, directing gravel placement and to add pipe as needed to periodically move downstream. This approach would have a minimal construction footprint; Plates 4 and 5 illustrate the project design and layout.

The rate of gravel placement via sluicing is approximately 100 to 300 short tons per day, all dependent upon how frequently the system clogs. This is slow relative to gravel placement by truck-mounted conveyor belt (approximately 500 short tons per day) or truck/front loaders (approximately 1,000 short tons per day) (Pasternack 2010). At an average rate of 150 short tons per day, it would take 33 days to place 5,000 short tons of gravel.

The approach that would be used with gravel sluicing is to start at the water's edge, build across the river, and then work downstream. At the outlet of the system, gravel would go into a rigid pipe supported by floating, air-filled barrels. The outlet would be manually directed to the placement point with the aid of ropes as needed. Using this approach, it is possible to place gravel according to a sophisticated design with few constraints.

The water intake pump system, which includes fish screening, would be positioned right on the water's edge, along the gravel road on the north side of the reservoir that runs close to the dam. From there, the water would be pumped in one or two 6 to 8-inch diameter pipes approximately 1,070-feet up the side of the road to the crest (Plate 4).

The pipes would go over the crest of the hill, and down the side of the paved road, approximately 300-feet towards the Narrows 2 powerhouse, until a point at which there is a noticeable slope break favorable to beginning the gravel addition to the pipe. At that location, a screened hopper on the north side of the road would receive sediment from a front loader, transferring the material the short distance from the stockpile. The loader operator would gently bounce the bucket to trickle the sediment into the hopper as the primary control on the flow rate; a hopper operator would be stationed there to ensure no blockages, clean out finger rocks as needed, and communicate conditions with other operation participants by radio.

Under the hopper, the gravel and water would join in a metal pipe that would then connect to the beginning of the 8-inch diameter, semi-flexible "Yelomine" pipe. This pipe would then run down approximately 1,270-feet down the ditch on the north side of the road to the switchback. From that point, the pipe would go 264-feet straight down the grassy hillside to a terrace level, where an old roadbed and foot-trail are located. From that point, the pipe would make a straight line, 130 feet down to the water's edge near the upstream end of the gravel placement area (Plate 4).

### 2.3.2 Gravel and Cobble

The Anadromous Fish Restoration Program, a U.S. Fish and Wildlife Service program tasked by the Central Valley Project Improvement Act to make "all reasonable efforts to at least double natural production of anadromous fish in California's Central Valley streams on a long-term, sustainable basis" (USFWS 2010) has recommended gravel specifications to ensure that the placed gravel provide some usable spawning habitat and optimal egg survival rates for the salmonids within the Lower Yuba River, as shown in Table 1. This gravel would be obtained from a commercial aggregate source located near the project site, within the Lower Yuba River watershed, and would arrive screened and pre-washed to the placement site.

**TABLE 1. Gravel and Cobble Specifications for Salmonid Spawning and Egg Incubation.**

| Gravel Size (inches) | Percent Retained | Target % of Total Mix |
|---|---|---|
| 4 to 5 | 0 to 5 | 2.5 |
| 2 to 4 | 15 to 30 | 20 |
| 1 to 2 | 50 to 60 | 35 |
| 3/4 to 1 | 60 to 75 | 15 |
| 1/2 to 3/4 | 85 to 90 | 15 |
| 1/4 to 1/2 | 95 to 100 | 10 |
| < 1/2 | 100 | 2.5 |

### 2.3.3 Gravel and Cobble Placement Location

The selection of the specific location for focusing gravel and cobble location has been guided by constraints in powerhouse operations, potential benefits to the river, and feasible delivery methods. Powerhouse operations presently preclude gravel augmentation between Englebright Dam and the Narrows 1 powerhouse. To get the most benefit and longevity from adding gravel to the river, the further upstream it is introduced, the better. To avoid having to fill the scour pool adjacent to the Narrows 1 facility, and yield riffle habitat for immediate spawning use with the least amount of initial gravel placement during a gravel sluicing operation, the placement should begin approximately 115-feet downstream of the end of the Narrows 1 powerhouse, where the maximum depth of the pool is under five-feet at 855 cfs of flow (Pasternack 2010).

### 2.3.4 Staging and Stockpiling

There would be one staging area for the project, located at the gravel turnouts along the paved access road to Narrows 2. This area would be used primarily for vehicle parking and temporary storage of truck trailers loaded with gravel. The same turnouts would be used to stock pile the gravel; prior to the start of sluicing operations, the gravel would be stockpiled in the three parking/turnout areas at the overlook on the north side of the dam. This location is behind a locked gate and inaccessible to the public.

The likely truck haul route that would be used to deliver gravel from the commercial source to the project site is would begin at the intersection of State Route 20 and Peoria Road, and end on the Narrows 2 access road, at a bench downstream of, and level with, the top of Narrows 2 (Plate 2).

### 2.3.5 Work Schedule

The proposed work would be conducted over two to six weeks in early November of 2010. Work hours would be limited to normal workdays, from 8:00 a.m. to 5:00 p.m. Any work conducted past the year 2010 would be conducted and completed prior to spring-run Chinook salmon spawning within the Lower Yuba River (01 September), or as approved by the resource agencies.

### 2.3.6 Monitoring Program

Outflow release from the Narrows 2 powerhouse and spill flows over the top of Englebright would aid in transporting the gravel placed downstream within the upper Narrows reach of the Lower Yuba River. Gravel placed within the river would be monitored for salmonid use for at least two seasons via protocol-level redds surveys (Appendix B). Additionally, the injected gravel would be monitored up to two years for entrainment and fate of the material with the aid of low aerial digital photography using a tethered 8-foot blimp system.

Data from the monitoring program would be compared with hypothetical quantitative predictions based on the ecologic, geomorphic, and hydrodynamic conditions present at the placement site. Confirmation of predictions would relate to how much the channel would be affected and how long the effect would persist, coupled with the potential beneficial qualities of the changes induced, would allow optimization of a the long-term gravel augmentation program design with a more accurate cost/benefit analysis.

# 3.0 Affected Environment and Environmental Consequences.

## 3.1 Environmental Resources Not Considered in Detail

Initial evaluation of the potential effects of the alternatives indicated that there would not be any adverse direct, indirect, or cumulative effects on several resources due to the scale, scope, and schedule of the proposed action. These resources are discussed in Sections 3.1.1 through 3.1.7 to add to the overall understanding of the environmental setting.

### 3.1.1 Climate

The project area has a Mediterranean, semi-arid climate characterized by cool, moist winters and warm, dry summers. Summer temperatures average approximately 90 degrees Fahrenheit (°F) during the day and 50 °F at night. Winter daytime temperatures average in the low 50’s, and nighttime temperatures average in the upper 30’s.

The temperature generally decreases and precipitation increases as the elevation rises from 120 feet above mean sea level at Daguerre Point Dam to the crest elevation of Englebright at 527 feet above mean sea level. Precipitation data have been recorded daily at Englebright for the National Weather Service since 1955 (WRCC 2005). Annual precipitation averaged over this 50-year time span is about 34.5 inches, with approximately a 40 percent chance of precipitation occurring on any given day between November 15 and March 1. Heaviest monthly rainfall periods of record include December 1955 at 17.65 inches, March 1995 at 16.60 inches, and January 1969 at 16.11 inches (WRCC 2005).

The proposed project would not result in any changes to climate. There would be minimal generation of greenhouse gasses from the proposed gravel augmentation activity that would cumulatively contribute to climate change. Specifically, there would be no action conducted that would cause a shift in climatologically based resources.

### 3.1.2 Geology and Seismicity

The surface of the Central Valley is composed of unconsolidated Pleistocene (two to three million years ago) and Recent (10,000 year ago) sediments. The valley floor is composed of alluvial fan and channel deposits from the various rivers in the area. Adjacent to the Feather River are the most recent sedimentary rocks that overlie igneous rocks while older sedimentary rocks are located father east. The sedimentary rocks are both marine and continental in origin (Corps 1998).

Yuba County lies in east-central California, an area experiencing relatively low seismic activity. The nearest active fault is the Cleveland Hill Fault, located about 20 miles northeast of Marysville. This fault was the source of the 5.7 magnitude earthquake in the Oroville area in 1975. Federal and State studies after 1975 determined that the Foothills Fault system in Yuba County is a continuation of the Cleveland Hill Fault. However, the studies also determined that seismic activity in the area is estimated to have a very long recurrence interval so special seismic zoning for the Foothills Fault system is not necessary (Corps 1998).

The proposed project would not result in any changes to the geology or the seismicity of the area.

### 3.1.3 Land Use

The Yuba County General Plan identifies the types of land use in the vicinity of the project area as public land, foothill agriculture, extractive industrial, and open space (QUAD Consultants 1994). The Corps holds fee title to approximately 165 acres of land surrounding the dam at Englebright. The proposed augmentation site is located within the southwest component of these fee title lands below the outlet of the Narrows 2 powerhouse. On November 17, 1975, the Corps issued Easement No. DACW05-2-75-716 to the Yuba County Water Agency (YCWA) for the Narrows 2 powerhouse, granting permission for the powerhouse to be constructed, operated, and maintained below Englebright (NMFS 2002).

Further downstream from Englebright and Narrows 2 powerhouse, land ownership in the vicinity of the Lower Yuba River includes Pacific Gas and Electric Company (PG&E) and University of California, respectively, followed by private parcels and several gravel mining operations. The largest gravel extraction operation occurs in the Yuba Goldfields, located south of the Yuba River and downstream of the Highway 20 Bridge (Corps 2001).

The Bureau of Land Management (BLM) owns scattered parcels adjacent to the Corps property on the south bank at Daguerre Point Dam. The BLM has proposed a land exchange in the Yuba Goldfields to provide about six-miles of public access along the Yuba River from the Highway 20 Bridge downstream to Daguerre Point Dam (Corps 2001). A larger portion of these lands that extend downstream to the City of Marysville has been identified as the Yuba River Recreation and Wildlife Enhancement Area in the 1996 Yuba County General Plan. This area is protected from encroachments that are incompatible with recreational and wildlife uses. These uses may include activities such as camping, fishing, hiking, bike riding, equestrian use, and river rafting. The area also serves as a connection between wildlife preserves and parklands (QUAD Consultants 1994).

The proposed project would not result in any changes to land use. Specifically, there would be no encroachments that are incompatible with recreational and wildlife uses.

### 3.1.4 Agriculture, and Prime and Unique Farmland

Agriculture is still the most extensive land use in Yuba County, and the most significant component of the county's economy. Approximately 68 percent of the county is used for agricultural croplands and grazing. In addition, Yuba County does not participate in the Williamson Act (California Land Conservation Act). The gross value of agricultural production in 2006 was $163.1 million (Yuba County 2007). The top five crops were rice, peaches, dried plums, cattle and calves, and walnuts.

The agricultural land in Yuba County is usually located in areas that have the potential to be prime farmland[iii]. The areas of potential prime farmland are generally located along the

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[iii]Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and that is available for these uses.
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historic flood plains of the Yuba and Feather Rivers due to the relatively flat topography, water supply, and soil conditions. In 2006, there were approximately 270,763 acres of land in agricultural crops production in Yuba County (Yuba County 2007). Of this total, there were 41,993 acres of prime farmland, 11,019 acres of farmland of statewide importance, and 32,372 acres of unique farmland recorded in Yuba County (CDC 2007). The type and yield of the crop determine if it is prime or unique[iv]. No prime or unique farmland has been committed to nonagricultural use during the 2004 through 2006 period. There are no soil types in vicinity of the project area that support statewide important farmland.

The proposed project is not located in the vicinity of any land designated as prime or unique farmland. No agricultural lands would be taken out of production due to the proposed project.

### 3.1.5 Socioeconomics and Environmental Justice

Socioeconomics describes the social and economic characteristics of the study area. The socioeconomic conditions of the project area are influenced by water diverted to farmers near Daguerre Point Dam and gravel mining in the Yuba Goldfields (ENTRIX 2004). The YCWA is the largest water rights holder on the Yuba River, with permits or licenses for over two-million acre-feet of water per year (CDFG 1991a). Various water districts, irrigation districts, water companies, and individuals contract with YCWA for delivery of up to 1,550 cfs of water for irrigation and other uses. In addition to providing water for consumptive use, water is released for power generation at the Colgate powerhouse (located approximately 16 miles upstream of Englebright), at YCWA's Narrows 2 powerhouse (located immediately downstream of Englebright), and PG&E's Narrows 1 powerhouse. Hydroelectric power is generated at these locations under authorization from the Federal Energy Regulatory Commission and numerous water rights licenses issued by the State of California.

Within the project area, water diverted under YCWA's water rights permits is delivered to Browns Valley Irrigation District, Brophy Water District, South Yuba Water District, Cordua Irrigation District, Hallwood Irrigation District, Ramirez Water District, and other smaller contractors (YCWA 2002). These water districts divert Yuba River water to supply portions of their irrigation requirements from three diversions located near the downstream boundary of the project area. Browns Valley receives up to 10 cfs of pumped diversion water through the Browns Valley Canal at the Pumpline Diversion Facility located 0.9 mile upstream of Daguerre Point Dam. Cordua, Hallwood, and Ramirez receive gravity-fed water via the Halwood-Cordua Canal (North Canal) from the north side of the Yuba River just upstream of the north abutment of the Daguerre Point Dam. Brophy and South Yuba receive gravity-fed water via the South Yuba Canal (South Canal) from the south side of the Yuba River just upstream of the south abutment of Daguerre Point Dam. Water diversion begins in April and peaks in July in association with the irrigation of rice fields. A total of 63,200 acres of land is irrigated with water from these diversions (ENTRIX 2004).

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[iv] Unique farmland is land, other than prime farmland, that is used for the production of specific high-value food and fiber crops, such as citrus, tree nuts, olives, cranberries, and other fruits and vegetables. It has the special combination of soil quality, growing season, moisture supply, temperature, humidity, air drainage, elevation, and aspect needed for the soil to economically produce sustainable high yields of these crops when properly managed.

The proposed action would not affect the socioeconomic conditions in the area. In the event of full bedload mobility within the proposed gravel placement site, it is highly unlikely that the gravel/cobble mixture would move outside of the EDR. The irrigation diversion points are well downstream of the EDR, and thusly would not be affected. Additionally, no populations live in or around the project area; therefore, the project would have no effects on populations or minority/low income housing.

### 3.1.6 Esthetics

An area's visual character is determined by the variety of the existing visual features, the quality of those features, and the scope and scale of the scene. The visual components of a particular area consist of features such as landforms, vegetation, manmade structures, and land use patterns. The quality of these features depends on the relationship between them and their scale in the overall scene.

The visual character of the Lower Yuba River is quite varied. The presence of a river canyon in an area that is cool and moist in the spring and hot and dry in the summer creates striking visual scenery Rolling hills above the river are covered with green grass and wildflowers in the spring, fading to a golden brown in the summer and fall. Oak trees are seen on the hillsides, and above them, the ever-present turkey vultures glide circles in the sky on the updrafts generated by the sun's interplay on the topography.

Englebright, marking the uppermost boundary of the project area, has its own esthetic values. There could be few manmade works found in the foothills of the Sierras that are as awe-inspiring as Englebright Dam. This is especially true during the spring months when the Yuba River, swollen by melting snows, sends freshets down its canyons to combine and cascade 260-feet over the brink of the dam. The resultant mist from this massive artificial waterfall rises from the canyon through the green oaks and foothill pine to create a breathtaking display (Hagwood 1981).

The gravel would be placed into the Lower Yuba River below the high-water mark, and would be visible to casual observers in the short-term, until natural algal development and sedimentation occurred to blend the newly placed gravel with the surrounding streambed substrate. The proposed action site is located in the vicinity of the Narrows 2 hydropower generating facility. The proposed action would occur over two to six weeks. Although the proposed action would add to a temporary disruption of the visual setting along the Lower Yuba River, it would have no significant or long-term adverse effects on the visual resources in the area.

### 3.1.7 Vegetation and Wildlife

The major vegetation types surrounding the project area include grassland, blue oak woodland, open gray pine woodland, and chaparral. Some of the dominant species include interior live oak, blue oak, gray pine, buttonbrush, blackberry, poison oak, wild oat, foxtail, and ripgut brome. The Lower Yuba River channel within the Narrows Canyon is mostly devoid of vegetation. Small isolated clumps of shining willow, mulefat, and other riparian species are widely scattered along the otherwise barren rocky banks along the proposed gravel placement site and for approximately two miles downstream within the Narrows Reach.

Downstream of the Narrows Reach, past gold and gravel mining operations have left extensive piles of cobble and gravel, significantly reducing the quality and quantity of vegetation types within the Garcia Gravel Pit Reach. The dominant vegetation species along the flood plain consists of narrow strips of Freemont cottonwood, sandbar willow, red willow, and box elder. Individual elderberry plants may attain small tree stature in the vicinity of Daguerre Point Dam.

The riparian and adjacent upland oak/grassland habitat along the Lower Yuba River supports a variety of wildlife species. Mammals that might be found within the project area include the California blacktail deer, western gray squirrel, black-tailed jackrabbit, California ground squirrel, grey fox, mountain lion, bobcat, coyote, spotted skunk, striped skunk, raccoon, long-tailed weasel, beaver, muskrat, river otter, Botta’s pocket gopher, western harvest mouse, and numerous bats.

Reptiles and amphibians that are known to inhabit the project area include the western pond turtle, common garter snake, Pacific gopher snake, western rattlesnake, western fence lizard, western whiptail lizard, western skink, horned lizard, western aquatic garter snake, California kingsnake, Pacific tree frog, and bull frog.

Bird surveys conducted between June and August 1999 by a Corps biologist included observations of California valley quail, mourning dove, scrub jay, mallard, Anna’s hummingbird, American crow, turkey vulture, tree swallow, killdeer, belted kingfisher, and downy woodpecker (Corps 2001). Migratory birds and their habitats are protected under the Migratory Bird Treaty Act (MBTA), as amended (16 U.S.C703 et seq.). Several migratory birds, including waterfowl, shorebirds, song birds, hummingbirds, vultures, and raptors commonly are found along the Lower Yuba River and around Englebright Lake, including red-tailed hawks and bald eagles. Songbirds, in particular, have the potential to utilize habitat located within the project area, including field sparrow, song sparrow, fox sparrow, orange-crowned warbler, tree swallows, and the lesser and American goldfinch.

The proposed action would have no significant adverse effect on vegetation or wildlife due to the limited scope and duration of the action and the lack of riparian vegetation in the vicinity of the proposed gravel placement site. The removal (clearing and grubbing) of potential nesting habitat during the non-nesting season is the most common means to avoid potential take during project construction. The proposed action would not involve removal of any existing riparian or upland oak/grassland habitat. Additionally, in order to avoid any potential effects to migratory bird species or migratory bird habitat, construction of the project would take place outside of nesting season (March-August). Gravel would be placed directly into the river channel. Any wildlife displaced by this action would be expected to return to the area soon after the action is completed.

## 3.2 Soils, Topography, and Geomorphology

### 3.2.1 Existing Conditions

The existing sedmentological and morphological characteristics of the Lower Yuba River within the project area are the direct results of historical hydraulic and dredge mining for gold that continued into the 1940's. Attempts to mitigate the catastrophic sedimentation produced from these activities resulted in the construction of Englebright and Daguerre Point Dams (Mussetter Engineering, Inc. 2000). The project area itself is confined to that portion of the Lower Yuba River between Englebright and Daguerre Point Dam. Based on relatively large differences in geology, topography, gradient, and channel morphology, the project area may be divided into two distinct reaches: Narrows Reach and Garcia Gravel Pit Reach (Beak Consultants, Inc. 1989).

Narrows Reach. The Narrows Reach extends from Englebright to the downstream terminus of a sheer rock gorge called the Narrows (River Mile 23.9 to River Mile 21.9). Within this reach, the first 0.7 mile to the mouth of Deer Creek is characterized by steep rock walls, long deep pools, and short rapids. Outflow from Narrows 1 powerhouse enters the Narrows 2 pool, which is connected to a smaller downstream pool through a deep run. Pool depths are more than 12 feet, and the run's depth is generally more than 4 feet. Major topographical relief on the south bank of the channel causes depths to increase rapidly along the margin, while relief on the north bank is less pronounced with a more gradual character. Below this area, the river cuts 1.3 miles through the Narrows Gorge. The Narrows contains a single large, deep, boulder-strewn pool with an average bed slope of 14.78 feet per mile (ENTRIX 2004).

Englebright has eliminated the upstream supply of sediment and led to some downstream-progressing degradation of the channel, at least as far downstream as Parks Bar (Mussetter Engineering, Inc. 2000). The lack of sediment supply, coupled with the hydraulic capacity of the high flow regime to transport coarse sediment through the steep confined bedrock channel, has effectively flushed pre-dam bed load material farther downstream. The resulting channel substrate found below Englebright is mostly bedrock.

Garcia Gravel Pit Reach. The Garcia Gravel Pit Reach extends from the Narrows Reach downstream to Daguerre Point Dam (River Mile 21.9 to River Mile 11.5). It is here that the Lower Yuba River canyon opens into a wide alluvial floodplain where large volumes of hydraulic mining debris known as the Yuba Goldfields remain from past gold mining operations. The river descends on an average of 9.0 feet per mile to Daguerre Point Dam, the southwestern boundary of the project area.

Daguerre Point Dam was constructed to trap hydraulic mining sediment. Accumulated sediment from in-filling upstream of the dam has formed a sediment wedge that extends about 2.7 miles upstream. The slope of the streambed is nearly zero for one mile upstream of Daguerre Point Dam (ENTRIX 2004). The predominant rock formation in the vicinity consists of meta-volcanic greenstone (Corps 2001). The predominant soil type is the Redding-Corning series, which consists of a reddish-yellow gravelly surface overlying the reddish clay subsoil (Corps 2001).

The current and historic Lower Yuba River channel contains water-worn pebbles, cobbles, and boulders. For about four miles upstream of Daguerre Point Dam, the south bank is composed of dredge spoils from the Yuba Goldfields, and the north bank is predominantly composed of the Riverbank Formation, which is a highly resistant complex of red sand, silt, gravel, and small cobble from the Pleistocene.

Qualitative observations of streambed sediments upstream of Daguerre Point Dam were made by ENTRIX in September 2002. These observations concluded that a tremendous volume of suitable spawning size gravel is stored in steeply-sloped gravel bars on the sides of the channel within this reach (ENTRIX 2004). The Lower Yuba River has incised into many of the gravel bars creating a hydraulically efficient channel with low flow widths, high flow depths, and high flow velocities (ENTRIX 2004). These hydraulic conditions combined with sediment-free water released from the Narrows 2 powerhouse below Englebright enable the river to effectively transport what gravel is available downstream and form a coarse armored substrate. Through selective erosion, coarse sediment remains on the bed and shields the underlying fine sediment from erosion and transport. This layer likely mobilizes during the periodic large floods.

Although the large gravel bars may constrain the available habitat during spawning periods, they also partially serve as a source for gravel recruitment. Recent geomorphological studies by the University of California, Davis (UCD) (Moir 2006) have shown that this reach experiences frequent episodes of morphological adjustment as a consequence of the plentiful local sediment supply and a near-natural flood hydrology[v] that significantly influences patterns of salmonid habitat utilization between spawning seasons. Differencing of the pre- and post-flood site topographies and hydraulic model outputs revealed that scour in the upstream pool-tail section of Garcia Gravel Pit reach study sites resulted in aggradations of the side channel and fining of the downstream channel margins, improving habitat conditions and increasing spawning frequency in these locations.

Both ENTRIX and UCD studies indicate that, although the distribution and frequency of salmonids spawning activity may be positively influenced by flood-induced morphological changes in the Lower Yuba River channel, the process is not presently self-sustainable. The channel will continue to incise and the bed further armor. In addition, without additional gravel delivery to the channel, the existing gravel supply in the bed and usable gravel stored in bars will decrease as it is gradually transported downstream out of the project area, leading to the reduction in spawning habitat (ENTRIX 2004).

### 3.2.2 Effects

<u>Basis of Significance</u>. An alternative would be considered to have a significant effect on soils, topography, and geomorphology if river channel discharge and sediment load rates are substantially altered enough.

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[v] The “near-natural flood hydrology” is a condition resulting from the Yuba Accord, as signed in 2008. The Yuba Accord is unprecedented in that it combines increased instream fisheries flows – for wild, native salmon and steelhead – with increased supplemental water supplies for California cities and farms, while preserving all of the project’s clean, renewable hydropower generation capacity (LYRA 2010a). Pre-Yuba Accord conditions were resulted in a fairly flattened hydrograph and were not a “near-natural hydrology” at all.

No Action. Under this alternative, the soils, topographic, and geomorphologic conditions in the project area would remain the same. The river channel through the Narrows Reach would continue to be deprived of adequate gravel recruitment due to the existence of Englebright Dam.

Proposed Action. Sediment budget provides a record of relative channel stability and thus means of assessing physical habitat change (Merz et al. 2006). There would be no effect to the soils or topography in the area, in response to the gravel placement. However, a potential short-term localized effect to the geomorphologic process would be expected in response to the gravel placement. The geomorphic stability of the river would reach dynamic equilibrium with the redistribution of gravel placed into hydraulically shielded areas that allow coarse sediment deposition (Pasternack 2010). Because the proposed placement site is within a hydraulically efficient stretch of the Lower Yuba River, deposition in the shallower run section would be limited to micro-eddies behind immobile boulders.

SRH-2D model[vi] simulations performed for the EDR indicated that for flows greater than 5,000 cfs there are distinct areas of high and low velocity longitudinally down the river (Pasternack 2010). As discharge increases, the longitudinal variation in velocity decreases and lateral variation increases. This is a common pattern previously reported for other constricted reaches (Pasternack 2010). It is characteristic of the stage-dependent role of multiple scales of channel non-uniformity in controlling flow-habitat relations and fluvial geomorphology. The modeled pattern for Chinook spawning hydraulic habitat shows that regardless of gravel/cobble presence, the canyon presently has almost no suitable microhabitat capability to support salmonid spawning. At 855 cfs there is a small area of suitable hydraulics on the bedrock plateau just downstream of the Narrows 2 pool, a little upstream of the rapid by the gaging station, and a little habitat on the edge of the Landers Bar point bar, located just upstream of the confluence of Deer Creek. At 4,500 cfs there is significantly less hydraulic habitat present (Pasternack 2010).

The pattern of the sediment transport regime for the EDR is highly stage dependent. For flows below 15,400 cfs, the primary area of scour risk is in the narrowest part of the canyon between Narrows 1 and 2 powerhouses. The only other area of high scour potential is in the rapid below the USGS gaging station. At 30,000 cfs, large areas experience full bedload mobility, but there is a small area of lower stress in the pool adjacent to the gaging station. Also, the widest part of the canyon around Landers Bar does not experience full mobility at this flow, so it is highly unlikely that a gravel/cobble mixture would move past that area (Pasternack 2010).

The 2D hydraulic modeling of the EDR found that the river is too deep to provide Chinook spawning habitat right now, necessitating gravel augmentation to fill in the channel and provide opportunities for creating morphological unit complexity (Pasternack 2010). Geomorphically, the river does not exhibit stage-dependent flow convergence, with routing of sediment through pools and deposition on high “riffles” at high discharges. Instead, as discharge increases, depth and velocity simply increase almost everywhere, so the area of scour increases down the river. In terms of the proposed gravel placement project, the indication is that the area in the upper half of the EDR where gravel might be augmented into the river is susceptible to full

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[vi] SRH-2D: Sedimentation and River Hydraulics – Two-Dimensional model, is a two-dimensional (2D) hydraulic, sediment, temperature, and vegetation model for river systems.

mobility at 10,000 cfs (except for the Narrows 2 pool, which is deep enough to require much higher discharge to scour the bottom of it). Meanwhile, augmented gravel would be unlikely to move out of the EDR until a flood of about 95,000 cfs associated with minimal flow out of Deer Creek, such as during a snowmelt period or the later stages of a rain-on-snow event. The reason Deer Creek flow must be minimal, is that at high flow the tributary enters the Yuba nearly perpendicular to it, creating a barrier to sediment transport. Maximum export of sediment out of the EDR is thus expected to occur during the lowest Deer Creek outflow.

### 3.2.3 Mitigation

The purpose of the proposed project is to provide suitable habitat for spawning salmonid species. SRH-2D model simulations performed for the EDR indicated that a condition of full bedload mobility over the majority of the project area would be achieved at 10,000 to 15,400 cfs (Pasternack 2010). That means that at these discharges, and any larger ones, the project will scour. However, gravel scoured from the placement site would not require mitigation, as the gravel/cobble would still be available within the EDR for salmonid use.

As there would be no significant adverse effects to soils or geomorphology, no mitigation would be required.

## 3.3 Hydrology and Water Quality

### 3.3.1 Existing Conditions

Hydrology. The Yuba River watershed drains approximately 1,300 square miles on the western slope of the Sierra Nevada from a maximum height of 9,100 feet at Mt. Lola to 30 feet at the Yuba River's confluence with the Feather River at Marysville, California. The Lower Yuba River extends approximately 24 miles from Englebright (at elevation 282 feet) to its confluence with the Feather River. Much of the watershed is controlled by several reservoirs that store water and trap sediments to varying degrees. These include Englebright, Daguerre Point Dam, and New Bullards Bar Reservoir, which is located approximately 16 miles upstream of Englebright. The total storage capacity of the watershed is 1,377,000 acre-feet of water.

The flow in the Yuba River is partially controlled by New Bullards Bar Reservoir, the largest reservoir in the watershed, which was constructed by the YCWA in 1969. The YCWA stores water in New Bullards Bar Reservoir for release to provide in-stream flows for flood control, power generation, recreation, environmental protection and enhancement, and to provide irrigation water to member units that have water rights and water service contracts. The YCWA has also supplied water from New Bullards Bar Reservoir for municipal, industrial, and fish and wildlife purposes through a number of temporary transfers lasting less than a year. Except for New Bullards Bar Reservoir, there is only minimal storage for retention of snowmelt within the basin. Hence, much of the spring and early summer flow to the Lower Yuba River is the result of uncontrolled snowmelt within the basin. In the summer and early fall, prior to the precipitation season, most of the flow in the Lower Yuba River is regulated by releases from New Bullards Bar Reservoir.

Englebright Dam, marking the upstream boundary for the project area, is downstream of New Bullards Bar Reservoir. PG&E constructed the Narrows 1 powerhouse approximately ¼-mile below Englebright Dam. The YCWA constructed the Narrows 2 powerhouse immediately below Englebright Dam as part of its Yuba River Development Project. The coupled operation of New Bullards Bar and Englebright includes releases through the New Colgate, Narrows 1, and Narrows 2 powerhouses, thus providing the principal regulation of the Lower Yuba River.

Water that is released from New Bullards Bar Reservoir generally passes through Englebright Reservoir without modifying Englebright Reservoir elevations. Most of the Lower Yuba River flow downstream of Englebright is released as outflow from hydroelectric power generation. Consequently, the 0.2 mile of river between Englebright and the Narrows 2 hydroelectric facility normally has standing water, except when Englebright is spilling (CDFG 1991a).

Yuba River flows are measured at Smartsville near Englebright Dam at the upper end of the Lower Yuba River (Smartsville Gage – U.S. Geological Survey [USGS] Station No. 11418000) and at Marysville, about six miles upstream of the mouth of the Yuba River (Marysville Gage – USGS Station No. 11421500). Data from the Yuba River's Smartsville gaging station indicate that flows average 2,600 cfs annually, with the highest flows in February and March.

In 1986, the Corps developed a 100-year flood simulation model for the Yuba River to evaluate the effects of such an event. This model produced various flow and stage relationships at points along the Yuba River. The flows modeled by the Corps ranged up to a 100-year even of 135,000 cfs (CDWR 1999). The data obtained from the Corps flood model and yearly average flow from the Smartsville gaging stations was also used to estimate flow event probabilities. These estimates are shown below in Table 2.

**TABLE 2. Estimated Flow Event Probabilities**

| Event | Flow CFS |
|---|---|
| 1 in 10 years | 23,000 |
| 1 in 25 years | 51,000 |
| 1 in 50 years | 85,000 |
| 1 in 75 years | 114,000 |
| 1 in 100 years | 135,000 |

The Federal Power Act sets forth minimum in-stream flow requirements on the Lower Yuba River. On March 1, 2006, the YCWA began to provide in-stream flow in accordance to the 2007 Pilot Program Fisheries Agreement. After the successful pilot program, concluded in 2007, the YCWA instilled the protocols, as defined in the Lower Yuba River Accord (YCWA 2010). Except as otherwise stated in the LYRA, YCWA complies with the flow schedule requirements shown in Table 3 during the period of the proposed project, and schedules 1 – 6 specify minimum in-stream flow requirements measured at the Marysville Gage based on the

## TABLE 3. Lower Yuba River Minimum In-stream Flows (cfs) for Schedules 1 through 6, Measured at the Marysville Gage.

| Schedule [a] | Oct 1-31 | Nov 1-30 | Dec 1-31 | Jan 1-31 | Feb 1-29 | Mar 1-31 | Apr 1-15 | Apr 16-30 | May 1-15 | May 16-31 | Jun 1-15 | Jun 16-30 | Jul 1-31 | Aug 1-31 | Sep 1-30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 500 | 500 | 500 | 500 | 500 | 700 | 1,000 | 1,000 | 2,000 | 2,000 | 1,500 | 1500 | 700 | 600 | 500 |
| 2 | 500 | 500 | 500 | 500 | 500 | 700 | 700 | 800 | 1,000 | 1,000 | 800 | 500 | 500 | 500 | 500 |
| 3 | 500 | 500 | 500 | 500 | 500 | 500 | 700 | 700 | 900 | 900 | 500 | 500 | 500 | 500 | 500 |
| 4 | 400 | 500 | 500 | 500 | 500 | 500 | 600 | 900 | 900 | 600 | 400 | 400 | 400 | 400 | 400 |
| 5 | 400 | 500 | 500 | 500 | 500 | 500 | 500 | 600 | 600 | 400 | 400 | 400 | 400 | 400 | 400 |
| 6 [b, c] | 350 | 350 | 350 | 350 | 350 | 350 | 350 | 500 | 500 | 400 | 300 | 150 | 150 | 150 | 350 |

TAF = total acre-feet

cfs = cubic feet per second

[a] Schedule 1 years are years with the North Yuba Index (NYI) ≥ 1,400 TAF, Schedule 2 are years with NYI 1,040 to 1,399 TAF, Schedule 3 are years with NYI 920 to 1,039 TAF, Schedule 4 are years with NYI 820 to 919 TAF, Schedule 5 are years with NYI 693 to 819 TAF, Schedule 6 are years with NYI 500 to 692 TAF, and Conference Years are years with NYI < 500 TAF.

[b] Indicated flows represent the average flow rate at the Marysville Gage for the specified time periods listed above. Actual flows may vary from the indicated flows according to established criteria.

[c] Indicated Schedule 6 flows do not include an additional 30 TAF available from groundwater substitution to be allocated according to the criteria established in the Fisheries Agreement.

Reference: LYRA 2010a – Lower Yuba Accord Documents

## TABLE 4. Lower Yuba River Minimum In-stream Flows (cfs) for Schedules A and B, Measured at the Smartsville Gage.

| Schedule | Oct 1-31 | Nov 1-30 | Dec 1-31 | Jan 1-31 | Feb 1-29 | Mar 1-31 | Apr 1-15 | Apr 16-30 | May 1-15 | May 16-31 | Jun 1-15 | Jun 16-30 | Jul 1-31 | Aug 1-31 | Sep 1-30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A[a] | 700 | 700 | 700 | 700 | 700 | 700 | 700 | [c] | [c] | [c] | [c] | [c] | [c] | [c] | 700 |
| B[b] | 600 | 600 | 550 | 550 | 550 | 550 | 600 | [c] | [c] | [c] | [c] | [c] | [c] | [c] | 500 |

cfs = cubic feet per second

[a] Schedule A flows are to be used concurrently with Schedules 1, 2, 3, and 4 at Marysville.

[b] Schedule B flows are to be used concurrently with Schedules 5 and 6 at Marysville.

[c] During the summer months, flow requirements at the downstream Marysville Gage always will control; thus, Schedule A and Schedule B flows were not developed for the May through August period. Flows at the Smartsville Gage will equal or exceed flows at Marysville.

Reference: LYRA 2010a – Lower Yuba Accord Documents

North Yuba Index (water year hydrologic classification). Schedules A and B shown in Table 4 specify minimum in-stream flow requirements at the Smartsville Gage.

Water Quality. State law defines beneficial uses of California's waters as uses that may be protected against quality degradation. As defined by the Central Valley Region of the California Regional Water Quality Control Board (CRWQCB), waters below Englebright Dam supports numerous beneficial uses including irrigation, power generation, recreation, cold and warm freshwater habitat for resident fishes, and cold and warm freshwater migration and spawning habitat for anadromous fishes (CRWQCB 1998).

The overall water quality of the Lower Yuba River is good and has improved in recent decades due to controls on hydraulic and dredge mining operations, and the establishment of minimum in-stream flows (Beak Consultants, Inc. 1989). Several factors that influence water quality in the river include rainfall and runoff patterns, quality of the irrigation water supply, crop acreages, crop cultural practices (pesticide and herbicide use), water management, and soil characteristics.

Dissolved oxygen concentrations, total dissolved solids, pH, hardness, alkalinity, and turbidity are well within acceptable or preferred ranges for salmonids and other key freshwater organisms. The minimum, maximum, and average levels of pH, turbidity, dissolved oxygen, total organic carbon, nitrogen, phosphorus, and electrical conductivity for the Lower Yuba River are presented in Table 5. The data were collected on the Yuba River near Parks Bar (Yuba Shed 2010.)

**TABLE 5. Water Quality of the Lower Yuba River near Marysville, California.**

| Parameter | Minimum | Maximum | Average |
|---|---|---|---|
| pH (standard units) | 5.83 | 7.97 | 6.89 |
| Turbidity (NTUs) | 0 | 19.63 | 2.45 |
| Dissolved Oxygen (mg/L) | 6.93 | 14.23 | 10.98 |
| Total Organic Carbon (mg/L) | 0.7 | 2.4 | 1.1 |
| Nitrogen (mg/L) | 0.05 | 0.14 | 0.07 |
| Phosphorus (mg/L) | 0.01 | 0.02 | 0.01 |
| Electrical Conductivity (µS/cm) | 40 | 86.67 | 67.31 |
| Water Temperature (°C) | 6.93 | 16.17 | 11.1 |

Notes: mg/L = milligrams per liter. µS/cm = microsiemens per centimeter

As required under CFR 40, Part 230, Section 404(b)(1) of the Clean Water Act, a Section 404(b)(1) analysis was performed to determine the potential for adverse effects on the Lower Yuba River aquatic ecosystem posed by the specific dredged or fill material discharge activities associated with the proposed gravel placement. Under consideration were the potential short- and long-term effects of the proposed gravel placement on the physical, chemical, and biological components of the aquatic environment.

Discharges into waters of the U.S. that require a Federal permit or license also require certification in accordance with Section 401 of the Clean Water Act from the CRWQCB (Appendix C). The certification is necessary to ensure that the discharge would comply with the State's water quality standards that protect the beneficial uses of California's waters against quality degradation.

### 3.3.2 Effects

Basis of Significance. An alternative would be considered to have a significant effect on hydrology if the action would alter local or regional existing flow patterns sufficient to introduce unintended substrate scour or deposition, mobilize local sediments, or substantially increase turbidity levels.

An alternative would be considered to have a significant effect on water quality if it would substantially degrade water quality, contaminate a public water supply, substantially degrade or deplete ground water resources or interfere with groundwater recharge, or expose sensitive species or humans to substantial pollutant concentrations.

No Action. Current operations of water releases at Englebright Dam, via releases through Narrows 1 and Narrows 2 and uncontrolled overtopping of the dam during high-flow events, impairs the timing, frequency, duration, and quantity of water flowing downstream of the dam. Under this alternative, water resources and quality would remain the same at Englebright Lake and the Lower Yuba River. The water quality and hydrology in the Lower Yuba River is expected to remain the same. Fresh water (surface and ground) would continue to be of good quality, and used for agriculture, recreational, and domestic purposes.

Proposed Action.

*Water Quality*. Approximately 2,000 to 5,000 short tons of a heterogeneous mix of gravel and cobble (0.25 to 5.0 inches in diameter) would be placed directly into the Lower Yuba River channel at the proposed placement site (less than one acre) over a maximum period of two to six weeks. No ground-breaking activities are associated with this project. No mechanized equipment would be entering the channel or operating within the 100-year floodplain.

The placement of this gravel within the channel would increase the amount of suspended sediment and thus turbidity in the immediate vicinity of the placement site and for an unknown distance downstream. The proposed placement site is located within a hydraulically efficient stretch of the Lower Yuba River. Therefore the source of any increased turbidity would be attributed to the introduction of sediment particles adhering to the placed gravel and not from sediments disturbed and suspended from the channel bottom and sides. Turbidity associated with the proposed project activities would not exceed the CRWQCB objectives for turbidity in the Sacramento River Basin. The CRWCQB turbidity limits are as follows:

a. Where natural turbidity is less than 1 Nephelometric Turbidity Units (NTUs), controllable factors shall not cause downstream turbidity to exceed 2 NTU;
b. Where natural turbidity is between 1 and 5 NTUs, increase shall not exceed 1 NTU;

c. Where natural turbidity is between 5 and 50 NTUs, increases shall not exceed 20 percent;
d. Where natural turbidity is between 50 and 100 NTUs, increases shall not exceed 10 NTUs;
e. Where natural turbidity is greater than 100 NTUs, increases shall not exceed 10 percent.

Turbidity would not be expected to increase more than 15 percent above naturally occurring background levels during the placement process.

The Smartsville USGS Stream Gage would be adversely affected if high flows flush gravel downstream en mass, causing stream gage inaccuracies as a result of coarse sediment deposition near the gage. This would require stream gage rating work to be performed.

*Hydrology*. The Lower Yuba River hydrologic analysis includes a basic assessment of dams, hydrologic alteration by dams, a characterization of the flow regime, determination of geomorphically significant flows, and flood frequency analysis (Pasternack 2008). The post-placement hydrology, after the 2007 pilot gravel injection project, was gaged in the bedrock canyon roughly half way down (USGS Smartsville Gage #11418000). During the 2007-2008 water years, the maximum flow was 3,500 cfs (Pasternack 2009). The pilot-project had no effect on the hydrology of the Lower Yuba River. Moreover, the currently proposed gravel augmentation would not be expected to have an affect on the hydrology of the Lower Yuba River. The placement of gravel in to the Lower Yuba River is not expected to change the rate or efficiency flow.

### 3.3.3 Mitigation

The findings of the Section 404(b)(1) analysis determined compliance with the requirements of the guidelines specified under CFR 40, Part 230, Section 404(b)(1) of the Clean Water Act, with the inclusion of the appropriate and practicable discharge conditions to minimize pollution or adverse effects to the affect aquatic ecosystem. Given the limited duration and the timing of the activity, as well as minimal area of effects, the appropriate and practicable conditions include the requirements that the gravel arrive screened and pre-washed to the placement site from the commercial aggregate source. The Section 401 Water Quality Certification includes conditions that are required in order for the Corps to proceed with the project. Those conditions are included in this Final EA (Appendix C).

The YCWA and downstream water districts would be notified of potential short-term turbidity increases during the gravel placement activity and potential stream gage inaccuracies until the geomorphic stability of the river is allowed to reach dynamic equilibrium. Standard pollution prevention measures, including the monitoring of turbidity levels during construction, erosion and sediment control measures, proper control of non-stormwater discharges, and hazardous spill prevention and response measures would be implemented, as necessary, by the contractor during the gravel placement.

With the inclusion of the above mitigation measures, no significant adverse effects on hydrology or water quality are anticipated.

## 3.4 Traffic

### 3.4.1 Existing Conditions

Traffic Types and Volume. There are three roads within the project area, from the location of the commercial gravel source (near the intersection of State Route 20 and Peoria Road) to the staging and stockpile location near Englebright dam: Scott Forbes Road, Long Bar Road, and the access road to the Narrows 2 powerhouse facility. Use of the access road is controlled by a locked gate. The access road ends at a bench downstream of and level with the top of Narrows 2. The primary traffic use of the roads within the project area is low-density; mainly rural traffic and Narrows 2 personnel.

### 3.4.2 Effects

Basis of Significance. Effects on traffic would be considered significant if the alternative would:

- Cause an increase in traffic that is substantial in relation to the existing traffic load and capacity of the street system;
- Exceed, either individually or cumulatively, a level of service standard established by the county congestion management agency for designated roads and highways;
- Substantially increase hazards due to a design feature or incompatible uses;
- Result in inadequate emergency access;
- Result in inadequate parking capacity; and/or,
- Conflict with adopted policies, plans, or programs supporting alternative transportation.

No Action. This alternative would have no effects on existing traffic in or near the project area. The types and numbers of traffic would remain the same in the vicinity.

Proposed Action. The gravel transport haul route begins at the intersection of State Route 20 and Peoria Road, about 14 miles east from Marysville, California (Plate 2). Road access to the proposed gravel placement site is via paved rural county roads for about six miles and ending with two miles of paved access road to the Narrows 2 powerhouse facility. Use of the access road is controlled by a locked gate. The access road ends at a bench downstream of and level with the top of Narrows 2.

Haul trucks would transport the gravel from a pre-selected selected commercial site and follow the route along Scott Forbes Road, Long Bar Road, and the access road to the Narrows 2 powerhouse facility. It will take a 20-ton haul truck approximately 250 trips (roughly eight trips per day) to deposit 5,000-short tons of gravel at the staging and stockpile location near Englebright dam. However, traffic is light along the rural roads, and while the access road to the Narrows 2 powerhouse facility is closed to the public, the proposed project would have temporary effects on Narrows 2 personnel traffic near the placement site. These effects would include increased traffic volume due to gravel transport trucks traveling to and from the placement site. However, the project would be designed so that the conveyor or gravel transport trucks would not close or block a roadway, or block emergency vehicle access.

### 3.4.3 Mitigation

Posted construction zones, reduced speed limits, and a flagman would be used to ensure Narrows 2 personnel safety in the vicinity of the placement site. These safety requirements would be included in the gravel placement contract specifications. The gravel placement contractor would also be responsible for obtaining any permits required for transportation of equipment on local highways. A California Department of Transportation (CDOT) encroachment permit would not be required as there is no encroachment within the CDOT right-of-way. As a result, there would be no significant effects on traffic.

## 3.5 Hazardous, Toxic, and Radiological Waste

### 3.5.1 Existing Conditions

The Narrows 2 hydropower facility is located near the proposed gravel placement site. Corps personnel inspected the site on August 21, 2006, and found no indication of existing or past sources of hazardous, toxic, or radiological waste (HTRW) in the vicinity. In additions, NMFS analyzed the effects of a proposal to install a full-flow bypass structure associated with the facility on November 4, 2005; no existing HTRW were identified (NMFS 2005b).

The remainder of the project area is located in a rural setting where adjacent land uses are primarily open space, agriculture, and recreation. As such, very few potential sources of HTRW exist. One known exception is the presence of mercury in sediments above Daguerre Point Dam. Mercury was used in the mining process to assist in gold recovery during the mid- to late 1800's. Hydraulic mining operations released the mercury along with millions of yards of sediment into the Yuba River.

Mercury is transported by erosion and runoff in the elemental form, in the dissolved form, adsorbed to particles, and as metal droplets. When mercury is converted through microbial actions into methylmercury, it is easily adsorbed my microbes, plants, and animals. Methyl mercury is a potent neurotoxin and is one of the most toxic forms of mercury. Human fetuses and young children, as well as piscivorous (fish-eating) wildlife, are most sensitive to methyl mercury exposure (May et al. 2000).

In response to the concerns and potential risks associated with exposure to mercury, numerous investigations have been conducted within the Yuba River watershed. Preliminary assessments of mercury bioaccumulation within northwestern Sierra Nevada watersheds indicated that the Yuba River is among the areas most severely affected by hydraulic mining and mercury contamination (May et al. 2000).

A more recent study reported that all samples collected in the Yuba River watershed both upstream and downstream of Englebright showed consistent, statistically significant increases above natural background concentrations in methylmercury and total mercury (Alpers 2005). Mercury bioaccumulation was found to be significantly lower immediately downstream from

Englebright, although some higher values were noted farther downstream in the vicinity of Daguerre Point Dam.

Although exposure levels of methyl mercury in the Lower Yuba River were below the Total Threshold Limit Concentrations establish in the California Code of Regulation (CFR), the U.S. Food and Drug Administration and the U.S. Environmental Protection Agency (EPA) issues a joint Federal Advisory for mercury concentrations in fish at Englebright. The fish consumption advisory not only suggests a one to two fish per month limit by women of childbearing age and children 17 years of age and younger, but also a four fish per month limit on women beyond childbearing years and men (OEHHA 2010). As of early summer 2010, it was recommended that Englebright Reservoir be added to the Clean Water Act 303(d) list of impaired rivers, lakes, and reservoirs of the United States for which pollution requirements have failed to provide for water quality, in this case the bioaccumulation of mercury in fish. However, this recommendation must be approved by the State Water Resource Control Board (SWRCB) and the EPA, and as of late summer 2010, the approval has not passed (YCWA 2010a).

### 3.5.2 Effects

Basis of Significance. An alternative would be considered to have a significant effect if it would involve any substance indentified as potentially hazardous (for example, by the Comprehensive Environmental Response, Compensation, and Liability act; the Resource, Conservation, and Recovery Act; and/or 40 CFR Parts 260 through 270); and (1) expose workers to hazardous substances in excess of Federal Occupational, Safety, and Health Administration standards, or (2) contaminate the physical environment, thereby posing a hazard to people, animals, or plant populations by exceeding Federal exposure, threshold, or cleanup limits.

No Action. Exposure levels of mercury and methyl mercury in water and sediment within the Yuba River watershed would continue to represent an increased ecological risk to aquatic species. Potential exposure and associated risks to human fetuses and young children, as well as piscivorous wildlife, would also continue to exist within the project area.

Proposed Action. The operation of motorized equipment at the gravel placement site and trucks used for hauling gravel to the site would increase the risk of discharging hazardous substances (oil, diesel fuel, hydraulic fluids) into the environment. Project gravel obtained from a commercial source and placed into the river would cause short-term increases in turbidity of released sediments from the existing river substrate and could potentially release small amounts of mercury from these sediments. Mercury could be ingested by fish and other aquatic organisms or could settle out in sediments farther downstream.

### 3.5.3 Mitigation

Appropriate best management practices would be implemented in order to ensure that the risk of hazardous materials spills is minimized. The gravel placement contractor would be properly trained to use standard spill prevention and cleanup equipment and techniques including rapid deployment of onsite spill absorption and retention materials.

To minimize release of mercury and methylmercury into the Lower Yuba River, gravel would arrive pre-washed from the commercial quarry to remove sediments containing mercury. Any mercury levels remaining in residual gravel sediments would be considered low, and its release would not be expected to pose one any additional environmental or health risk.

As there would be no significant adverse effects with regards to hazardous, toxic, and radiological waste, no additional mitigation would be required.

## 3.6 Aquatic Fauna

### 3.6.1 Existing Conditions

Fisheries. Twenty-eight species are known to inhabit the Lower Yuba River downstream of Englebright Dam (CDFG 1991a). Of these, eight are anadromous and spend a part of their life cycle in the Lower Yuba River. The fish species that inhabit the Lower Yuba River are shown in Table 6.

Descriptions of key species supported by the Lower Yuba River are provided below. In addition, the Lower Yuba River supports three species that are Federally listed threatened: Central Valley steelhead, Central Valley spring-run Chinook (also State listed as threatened), and green sturgeon. This river also supports one Federal candidate species: Central Valley fall/late fall-run Chinook salmon. Descriptions of these species can be found in Section 3.7, Special-Status Species.

*Sacramento Sucker*. The Sacramento sucker is widely distributed through the Sacramento and Feather River systems. Sacramento suckers occupy waters from cold, high-velocity streams to warm, nearly stagnant sloughs. They are common at moderate elevations (600 to 2,000 feet). Sacramento suckers feed on algae, detritus, and benthic macroinvertebrates. They usually spawn for the first time in their fourth or fifth years. When they cannot move upstream and end up spawning in the lake habitat, they typically orient themselves near areas where spring freshets flow into the lake. They typically spawn in stream habitat on gravel riffles from late February to early June. The eggs hatch in three to four weeks, and they young typically live in the natal system for a couple of years before moving downstream to a reservoir or large river (Moyle 2002).

*Sacramento Pikeminnow***.** Sacramento pikeminnows occupy rivers and streams throughout the Sacramento–San Joaquin River system, including the Lower Yuba River. Sacramento pikeminnows spawn in April and May, with eggs hatching in less than a week. Within a week of hatching, the fry are free swimming and schooling.

Adult pikeminnows may feed on other fish, including juvenile pikeminnow, Chinook salmon, and steelhead, but according to Moyle (2002), are overrated as predators on salmonid species in natural environments. They can, however, be major predators on juvenile salmon and steelhead in riverine environments modified by dams and fish ladders. Pikeminnows tend to remain in well-shaded, deep pools with sand or rock substrate and are less likely to be found in areas where

**TABLE 6. Fish Species that Inhabit the Lower Yuba River**

| **Species Common Name** *Scientific Name* | **Location** | | | **Native or Nonnative** | | **Salmonid** |
|---|---|---|---|---|---|---|
| | **Downstream of Daguerre** | **Upstream of Daguerre** | **Unknown** | **Native** | **Non-native** | **Predator** |
| **Anadromous Fish** | | | | | | |
| **Fall-run chinook salmon** *Oncorhynchus tshawytscha* | X | X | | X | | |
| **Spring-run chinook salmon** *Oncorhynchus tshawytscha* | X | X | | X | | |
| **Central Valley steelhead** *Oncorhynchus mykiss* | X | X | | X | | X |
| **Green sturgeon** *Acipenser medirostris* | X | | | X | | |
| **White sturgeon** *Acipenser transmontanus* | X | | | X | | |
| **Pacific lamprey** *Lampetra tridentate* | X | X | | X | | |
| **Striped bass** *Morone saxatilus* | X | X | | | X | X |
| **American shad** *Alosa sapidissima* | X | X | | | X | X |
| **Resident Fish** | | | | | | |
| **Rainbow trout** *Oncorhynchus mykiss* | X | X | | X | | X |
| **Hardhead** *Mylopharodon conocephalus* | X | X | | X | | X |
| **Speckled dace** *Rhinichthys osculus* | X | X | | X | | |
| **California roach** *Lavinia symmetricus* | | | X | X | | |
| **Sacramento sucker** *Catostomus occidentalis* | X | X | | X | | |
| **Sacramento pikeminnow** *Ptychocheilus grandis* | X | X | | X | | X |
| **Mosquitofish** *Gambusia affinis* | | | X | | X | |
| **Largemouth bass** *Micropterus salmoides* | X | | | | X | X |

| Species Common Name *Scientific Name* | Location | | | Native or Nonnative | | Salmonid |
|---|---|---|---|---|---|---|
| | Downstream of Daguerre | Upstream of Daguerre | Unknown | Native | Non-native | Predator |
| **Smallmouth bass** *Micropterus dolomieui* | X | | | | X | X |
| **Green sunfish** *Lepomis cyanellus* | | | X | | X | |
| **Bluegill** *Lepomis macrochirus* | | | X | | X | |
| **Redear sunfish** *Lepomis microlophus* | | | X | | X | |
| **Tule perch** *Hysterocarpus traski* | X | X | | X | | |
| **Riffle sculpin** *Cottus gulosus* | X | X | | X | | |
| **Common Carp** *Cyprinus carpio* | | | X | | X | |
| **Brown Bullhead** *Ameiurus nebulosus* | | | X | | X | |
| **White Catfish** *Ameiurus catus* | | | X | | X | |
| **Channel Catfish** *Ictalurus punctatus* | | | X | | X | |
| **Threespine stickleback** *Gasterosteus aculeatus* | | | X | X | | |

there are higher numbers of introduced predator species such as largemouth bass and other centrarchid species.

*Striped Bass*. Striped bass are anadromous fish that have been an important part of the sport-fishing industry in the Delta. They were introduced into the Sacramento–San Joaquin estuary between 1879 and 1882 (Moyle 2002). Their range in the Lower Yuba River is limited to the reach of the rivers below the dams. Striped bass may move into the lower reaches of the rivers year round but probably most often between April and June, when they spawn. The species tends to remain in deep, slow-moving water, where it has access to prey without having to expend a great deal of energy.

*American Shad*. American shad are anadromous fish that have been introduced into the Central Valley and have become established as a popular sport fish. The main American shad runs in California are in the Sacramento River up to Red Bluff and in the lower reaches of the river's major tributaries (American, Feather, and Yuba Rivers), as well as the Mokelumne and Stanislaus Rivers. American shad enter the Lower Yuba River to spawn during the spring (primarily May and June) and support a seasonal fishery downstream of Daguerre Point Dam.

Shad abundance increases at higher Yuba River flows relative to flows in the Feather and Sacramento Rivers.

Aquatic Macroinvertebrates. Qualitative aquatic macroinvertebrate sampling conducted by Corps biologists within the EDR reach of the Lower Yuba River indicated that the aquatic macroinvertebrate community contains a high density of individuals, but low diversity in the numbers of invertebrate taxonomic orders and families represented. Table 7 indicates the aquatic macroinvertebrates that were field identified within the project site.

**TABLE 7. Occurrence of Aquatic Macroinvertebrates within the Englebright Dam Reach of the Lower Yuba River.**

| | TRANSECT | | |
|---|---|---|---|
| | **Upstream reach** | **Mid-reach** | **Downstream Reach** |
| **Arthropoda** | | | |
| Insecta | | | |
| Diptera | | | |
| Chironomidae | X | X | X |
| Simulidae | X | | X |
| Empididae | | X | |
| Ceratopogonidae | X | X | |
| Ephydridae | | X | X |
| Unknown | | | X |
| Ephemeroptera | | | |
| Baetidae | X | X | X |
| Caenidae | X | | |
| Leptophlebiidae | X | | |
| Unknown | X | X | X |
| Crustacea | | | |
| Amphipoda | X | X | X |
| Chelicerata | | | |
| Arachnida | | X | X |
| **Annelida** | X | | |
| **Nematoda** | X | | |
| **Coelenterate** | | | |
| Hydridae | X | X | X |
| **Mollusca** | | | |
| Gastropoda | | | |
| Physidae | X | X | |
| Planorbidae | | | X |
| Platyhelminthes | X | | |

### 3.6.2 Effects

Basis of Significance. An alternative would be considered to have a significant effect on fisheries resources if it would result in a reduction in fish populations or substantially degrade the water quality of fish habitat by increasing the concentrations and total amounts of suspended solids or toxic substances.

No Action. Without additional gravel delivery to the channel immediately below Englebright, the existing gravel supply in the bed and usable gravel stored in downstream bars would decrease as it is gradually transported downstream and out of the project reaches. A continued degradation to physical habitat structure and ecological function of the Lower Yuba River would be expected. In the long-term, the gradual transportation of sediment and gravel downstream, out of the Englebright Dam Reach, would continue the current degradation of fish and aquatic macroinvertebrate habitat.

Proposed Action. Gravel placed into the river would cause short-term increases in turbidity and temporarily disturb aquatic fauna in the stream channel. Increases in turbidity (suspended sediments) could effect redds or fish that may be present during injection, disrupt feeding activities of common fish species or result in temporary displacement from preferred habitats. Gravel placed into the river bed could also bury stream substrates that provide habitat for aquatic invertebrates, an important food source for fishes. Consequently, growth rates of fish could be reduced if turbidity levels or sediments substantially exceed ambient levels for prolonged periods. However, because of the limited amount of gravel, as well as the movement and settling of the gravel and sediments, the elevated turbidity levels would be short term, localized, and less than significant. There would be no long-term adverse effects on fish. There would, however, be long-term beneficial effects, as the new gravel becomes available to salmonids for spawning and in the increased habitat diversity available to the benthic macroinvertebrate community within the EDR.

### 3.6.3 Mitigation

As there would be no significant effects on fish, no mitigation would be required. However, to minimize the effects of the proposed action, gravel would arrive pre-washed from the commercial quarry.

## 3.7 Special Status Species

### 3.7.1 Existing Conditions

Special-status species that have the potential to occur in the vicinity of the project area were determined through a review of various sources including USFWS species lists (updated September 13, 2010, Appendix D), California Natural Diversity Database (CNDDB), Rarefind electronic database (CDFG 2010), and California Native Plant Society Inventory of Rare and Endangered Plants, 7th edition (online) (CNPS 2010). The special-status wildlife, fish, and plant species obtained through these sources were consolidated and listed in Appendix D.

Each species on the list was evaluated for its potential to occur within the project area. Species that are not found in land cover types present in the project area, or whose known range falls outside of the project area, were eliminated from further consideration. Those special-status species that are known to occur or have the potential to occur within the project area are further evaluated in the following sections.

*Wildlife Species*. Eight special-status wildlife species were identified as having the potential to occur in the project area or are known to occur in the project area. These wildlife species include:

- long-eared owl (*Asio otus*)
- Swainson's hawk (*Buteo swainsoni*)
- tricolored blackbird (*Agelaius tricolor*)
- western burrowing owl (*Athene cunicularia hypugea*)
- western yellow-billed cuckoo (*Coccyzus americanus occidentalis*)
- giant garter snake (*Thamnophis gigas*)
- northwestern pond turtle (*Clemmys marmorata marmorata*)
- valley elderberry longhorn beetle (*Democerus californicus dimorphus*)

Long-eared Owl. The long-eared owl is designated as a California species of concern. The long-eared owl requires wooded areas for daytime roosting with adjacent open areas to forage. Their habitat requirements do not change between breeding and wintering although during breeding season the owls become very territorial and subsequently dispersed, whereas during the winter months they roost communally in groups of 7 to 50 birds. In the west and southwest, long-eared owls are found in deciduous woods near lakes and streams where growth of climbing vines provide dense roosting cover during winter. The long-eared owl does not build its own nest and instead will use old crow, magpie, squirrel, or other large abandoned stick nests. Irregularly, it will also use a natural cavity in a tree, cliff, or on the ground.

A CNDDB records search did not identify occurrences of long-eared owls within the project area. However, a nest tree is located several miles south of the project area in the Spenceville Wildlife Area operated by the California Department of Fish and Game (CDFG) (CDFG 2010). Formal surveys have not been performed to determine whether this species is currently present and nesting within the project area.

Swainson's Hawk. The Swainson's hawk is designated as a California threatened species. In the Central Valley, the Swainson's hawk nests primarily in riparian areas adjacent to agricultural fields or pastures, although it sometimes uses isolated trees or roadside trees. The Swainson's hawk nests in mature trees; preferred tree species are valley oak, cottonwood, willow, sycamore, and walnut. Nest sites typically are located near suitable foraging areas. The primary foraging areas for Swainson's hawk include open agricultural lands and pastures.

The riparian forest in the vicinity of Daguerre Point Dam is dominated by native woody riparian tree species that provide potential nest sites for Swainson's hawk. A CNDDB records search identified one occurrence of a breeding pair in the vicinity of the project area (CDFG 2010). This occurrence was east of Yuba City off Hammonton-Smartsville Road. The

Swainson's hawk is also a permanent resident downstream of the project area near the confluence of the Yuba River with the Feather River. Formal surveys have not been performed to determine whether this species is currently present and nesting within the project area. However, Swainson's hawk is expected to forage in the lower portion of the project area. There is no suitable habitat for this species in the vicinity of the proposed gravel placement site.

Western Burrowing Owl. The western burrowing owl is designated as a California species of concern. It is a permanent resident in the Central Valley. Suitable habitat for burrowing owl occurs in ruderal habitats and near agricultural lands throughout the study area. The western burrowing owl nests and roosts in abandoned ground squirrel and other small-mammal burrows, as well as artificial burrows (culverts, concrete slabs, and debris piles). The owl's breeding season is from March to August and peaks in April and May.

A CNDDB records search identified one historical occurrence of a breeding pair in the vicinity of the project area (CDFG 2010). This 1906 occurrence was in the area now known as the Goldfields adjacent to Daguerre Point Dam. Formal surveys have not been performed to determine whether this species is present and nesting in the project area.

Tricolored Blackbird. The tricolored blackbird is designated as a California species of concern. The tricolored blackbird inhabits open valleys and foothills, and may be found in streamside forests, alfalfa and rice fields, marshes, and along reservoirs. This blackbird usually nests in marshes, but may also nest in willow and blackberry thickets and on the ground in clumps of nettles. They forage in wet meadows, rice and alfalfa fields, and in rangelands. They commonly roost in trees or marshes. Whether they are roosting, foraging, or nesting, these birds are always found in very large flocks. The tricolored blackbird both nests and winters in interior valleys from southern Oregon (east of the Cascades) to northwest Baja California. Once abundant in Yuba County, the tricolored blackbird has been possibly eliminated from the county and breeds only in a few scattered areas in California and Oregon.

A CNDDB records search identified a historical tricolored blackbird colony site near the confluence of Dry Creek and the Yuba River. This site has since been developed as an RV Park. The last tricolored blackbird sighting in this area was April 23, 1994 (CDFG 2010). There is no suitable habitat for this species in the vicinity of the proposed gravel placement site.

Western Yellow-Billed Cuckoo. The Western yellow-billed cuckoo is State listed as an endangered species and is a candidate for Federal listing. This species requires large patches (25 acres or larger) of mixed old-growth riparian forests composed of willow and cottonwood trees with dense understory. Dense cottonwood riparian forest is present in the vicinity of Daguerre Point Dam. However, the riparian forest exists as narrow patches found upstream and downstream of Daguerre Point Dam. A CNDDB records search did not identify occurrences of western yellow-billed cuckoos within the project area (CDFG 2010). In addition, statewide surveys conducted in 1999/2000 by USGS and USFWS documented no individuals nesting downstream within the Feather River channel.

Giant Garter Snake. The giant garter snake is Federally and State listed as threatened. The giant garter snake is endemic to emergent wetlands in the Central Valley. Within the project vicinity, the giant garter snake is still presumed to occur in the rice production zones of Yuba, Sutter, Butte, Colusa, and Glenn Counties. The species' habitat includes marshes, sloughs, ponds, small lakes, and low-gradient waterways such as small streams, irrigation and drainage canals, and rice fields (58 FR 54053, October 20, 1993). The giant garter snake is active from approximately May through October and hibernates during the remainder of the year.

The giant garter snake requires adequate water with herbaceous, emergent vegetation for protective cover and foraging habitat. All three habitat components (cover and foraging habitat, basking areas, and protected hibernation sites) are needed. Riparian woodlands and large rivers typically do not support giant garter snakes because these habitats lack emergent vegetative cover, basking areas, and prey populations.

A CNDDB records search did not identify occurrences of giant garter snake within the project area (CDFG 2010). Formal surveys have not been performed to determine whether this species is currently present within the project area. However, there is no suitable habitat for this species in the vicinity of the propose gravel placement site.

<u>Northwestern Pond Turtle</u>. The northwestern pond turtle is designated as a California species of concern. The northwestern pond turtles inhabit permanent or nearly permanent waters with little or no current. The channel banks of inhabited waters usually have thick vegetation, but basking sites such as logs, rocks, or open banks must also be present. Eggs are laid in nests along sandy banks of large slow-moving streams or in upland areas, including grasslands, woodlands, and savannas. Nest sites are typically found on a slope that is unshaded, has a high clay or silt composition, and soil at least 4 inches deep.

Ponded water bodies and some agricultural ditches and canals in the vicinity of the project area provide suitable habitat for this species. A CNDDB records search identified three occurrences of northwestern pond turtles in the vicinity of the project area (CDFG 2010). Two occurrences were associated with natural stream courses and agricultural ditches adjacent to the proposed gravel haul route on Peoria and Scott Forbes Roads. There is no suitable habitat for this species in the vicinity of the proposed gravel placement site.

<u>Valley Elderberry Longhorn Beetle.</u> Elderberry shrubs are the host plant of the valley elderberry longhorn beetle (VELB), which is Federally listed as threatened. Current information on the habitat of the beetle indicates that it is found only with its host plant, the elderberry. Adult VELB feed on foliage and are active from early March through early June. The beetles mate in May, and females lay eggs on living elderberry shrubs. The larvae after hatching burrow in the stems of the shrubs within which they pupate. Before they pupate and metamorphose into an adult, the larva creates a circular exit hole, through which it emerges as an adult.

Elderberry shrubs in the Central Valley are commonly associated with riparian habitat, but also occur in oak woodlands and savannas and in disturbed areas. There are several CNDDB records of VELB occurrences in vicinity of Daguerre Point Dam (CDFG 2010). However, there is no suitable habitat for this species in the vicinity of the proposed gravel placement site.

*<u>Fish Species and Designated Critical Habitat</u>*. The following special-status fish species and designated critical habitats were identified as having the potential to occur or are known to occur in the project area. These fish species and designated critical habitats include:

- Central Valley fall/late fall-run Chinook salmon (*Oncorhynchus tshawytscha*)
- Central Valley spring-run Chinook salmon (*Oncorhynchus tshawytscha*)
- Central Valley spring-run Chinook salmon critical habitat
- Central Valley steelhead (*Oncorhynchus mykiss*)
- Central Valley steelhead critical habitat
- Green sturgeon (*Acipenser medirostris*)

During the early to mid-1900's, anadromous fish species were adversely affected to upstream migration by ineffective fish ladders existing at Daguerre Point Dam (Corps 2001). Low stream flows and high water temperatures in the Yuba River also affected the species. Measures were implemented to address these problems, including reconstruction of the Daguerre Point Dam fish ladders in 1950, establishing flow fluctuation regulations (500 cfs/hour) below Englebright in 1955, and reducing fish entrainment at water diversion facilities beginning in 1984. The commencement of operations at New Bullards Bar Dam in 1970 improved conditions for salmonids in the Lower Yuba River by providing cooler water temperatures and more reliable flows in the summer and fall (NMFS 2005b).

<u>Fall/Late Fall-run Chinook Salmon</u>. On March 9, 1998 (63 FR 11481), NMFS issued a proposed rule to list fall-run Chinook salmon as threatened, but on September 16, 1999 (64 FR 50393), NMFS determined that fall-run Chinook salmon did not warrant being listed as threatened and downgraded it to candidate status. NMFS indicated that the Central Valley fall-run and late fall–run Chinook salmon are a single evolutionarily significant unit (ESU); they are discussed together in this section, even though there are some differences in the life histories of the two runs. There is no State protection for fall-run or late fall–run Chinook salmon.

Fall-run Chinook salmon are the most abundant anadromous fish in the Central Valley. The CDFG began making annual estimates of fall-run Chinook salmon spawning escapement in the Lower Yuba River in 1953 (CDFG 1991a). From 1953 to 2003, escapement estimates ranged from 1,000 fish in 1957 to 39,367 fish in 1982, with an average population of 14,855 fish for the survey period. The 2003 population was 28,897 fish (CDWR 2005a). The total fall-run Chinook salmon population during the November 2007 to April 2008 period, as derived from escapement surveys, was 10,222 fish (CDFG 2010a).

Adult fall-run Chinook salmon migration and holding generally occurs in the Lower Yuba River in the fall, a few days, or weeks before spawning, with numbers peaking in November. By the end of November, typically greater than 90 percent of the run has entered the river. Timing of the adult Chinook salmon spawning activity is strongly influenced by water temperatures (YCWA 2006). Optimal water temperatures for egg incubation are 44 to 54°F (Rich 1997). Newly emerged fry remain in shallow, lower velocity edgewaters, particularly where debris collects and makes the fish less visible to predators (CDFG 1998). The duration of egg incubation and time of fry emergence depend largely on water temperature. In general, eggs hatch after a three to five month incubation period, and alevins remain in the gravel until their yolk-sacs are absorbed.

Juvenile Chinook salmon move out of upstream spawning areas into downstream habitats in response to many factors, including inherited behavior, habitat availability, flow, competition for space and food, and water temperature. The numbers of juveniles that move, and the timing of movement, are highly variable. Storm events and the resulting high flows appear to trigger movement of substantial numbers of juvenile Chinook salmon to downstream habitats. In general, juvenile abundance in the Sacramento–San Joaquin River Delta (Delta) increases as flow increases (USFWS 1993). Fall-run Chinook salmon emigrate as fry and sub-yearlings, and remain off the California coast during their ocean migration.

Spring-Run Chinook Salmon. NMFS designated the Central Valley spring-run Chinook as threatened on September 16, 1999 (64 FR 50393). On February 5, 1999, the California Fish and Game Commission listed spring-run Chinook salmon as threatened under CESA. Critical habitat for this ESU, which includes the Lower Yuba River, was designated on September 2, 2005. The rule became effective on January 2, 2006.

Historically, spring-run Chinook salmon were the most abundant run of Central Valley Chinook salmon (CDFG 2010b). They occupied the headwaters of all major river systems in the Central Valley where there were no natural barriers. Spring-run Chinook salmon, like steelhead, migrated farther into headwater streams where cool, well-oxygenated water is available year round. It is estimated that there were 6,000 miles of salmon habitat in the Central Valley Basin, much of it high elevation spring-run Chinook salmon habitat. By 1928, however, 80 percent of this habitat had been lost (Clark 1929). Major in-basin factors contributing to the habitat decline were migration barriers, hydraulic mining, and water diversions. The total spring-run Chinook salmon population during the November 2007 to April 2008 period, as derived from escapement surveys, was 6,158 fish (CDFG 2010a).

The Feather River Fish Hatchery sustains the spring-run population on the Feather River, but the genetic integrity of that run is questionable (CDWR 1997). Estimates since 1953 on the Feather River indicate numbers of spring-run returning to the hatchery average around 2,115, although the estimates have increased dramatically since 1990. As of 2008, the population had dropped significantly to 1,418 Feather River fish (CDFG 2010a). Part of the significance of the Yuba River fishery is that the river supports natural reproduction that is not augmented with hatchery transplants, although CDFG did conduct a one-time stocking of a small number of juvenile spring-run fish from the Feather River Hatchery into the Lower Yuba River in 1980 (CDFG 1991a). However, there are "Feather River Fish Hatchery effects" on the Yuba River populations of the spring-run chinook. During escapement surveys conducted on the Yuba River, several of the collected spring-run Chinook salmon recoveries were from the Feather River Hatchery (LYRA 2010a). This out-of-basin straying of the Feather River Hatchery fish could potentially have an effect on the continued genetic integrity of the Yuba River's spring-run chinook.

Spawning surveys and adult monitoring at the fish ladders on Daguerre Point Dam conducted by CDFG have detected the continued presence of a small population of spring-run

Chinook salmon migrating into the Lower Yuba River. A total of 108 adult Chinook salmon were estimated to have passed the dam during a study conducted from March 1, 2001, through July 31, 2001, the primary historical migration period for spring-run Chinook salmon (CDFG 2002). The installation of a VAKI River Watcher fish imaging system in the North and South Fish Ladders at Daguerre Point Dam in 2003 contributed substantially to the current understanding of the number and timing of migration of spring-run Chinook salmon. In the spring of 2004 (the first spring that this equipment was fully operational) at total of 413 adult Chinook salmon were detected migrating up past Daguerre Point Dam from April through June (NMFS 2005b). The migration timing and location of these fish indicate that they were all Central valley spring-run Chinook salmon. During 2005, the year in which the VAKI operated continuously during the primary historical migration period, 1,021 Chinook salmon (including grilse) were observed (YCWA 2006). During the 2008 period, a total of 2,268 Chinook salmon were observed (LYRA 2010).

Spawning occurs in the Lower Yuba River from September through November (CDFG 1991a). Approximately 60 percent of the Chinook salmon populations in the Lower Yuba River spawn above Daguerre Point Dam (SWRCB 2003). Chinook salmon redds have been observed in the Garcia Gravel Pit Reach (primarily above Parks Bar) by mid-September (CDFG 2000). Water depth and velocity are directly related to the characteristics of spawning habitats. Emergence takes place in March and April. Spring-run Chinook salmon appear to migrate at two different life stages: fry or yearlings. Fry move between February and June, and yearlings migrate October to March, peaking in November (Cramer and Demko 1997).

During the 2009 to 2010 redd survey conducted by the Lower Yuba River Accord River Management Team, a total of 2,221 redds were observed from Daguerre Point Dam to Englebright Dam. According to Pasternack (2008), the Englebright Dam Reach was found to be wanting of habitat for spring-run Chinook salmon spawning, even though this is where many such fish come and attempt to spawn on the bedrock. The upper half of this reach lacks self-sustainable conditions and is purely governed by bedrock canyon geometry (Pasternack 2008). Thus, only 79 of those observed 2,221 redds were located directly within the Englebright Dam Reach, due to the lack of available spawning habitat. Of those 2,221 redds observed in the Lower Yuba River above Daguerre Point Dam, 1,189 of those redds were located from the point that Highway 20 crosses the Lower Yuba River down to Daguerre Point Dam (LYRA 2010a), where the available salmonid spawning habitat is of much higher quality.

Juveniles display considerable variation in stream residence and migratory behavior. Juvenile spring- and fall-run Chinook salmon may leave their natal streams as fry soon after emergence or rear for several months to a year before migrating as smolts or yearlings (Yoshiyama et al. 1998). Triggers for downstream movement are similar to those described for fall-run Chinook salmon above. Recent fish trapping operations in the Lower Yuba River indicate that large numbers of Chinook salmon fry leave the river in December to March (CDFG unpublished data). Movement of juvenile spring-run Chinook salmon in the Feather River is similar to the Yuba River. A second, smaller peak of smolt-sized fish emigrates in April to June. Most of these observations apply to fall-run Chinook salmon, but may also apply, to an unknown degree, to spring-run Chinook salmon.

Central Valley spring-run Chinook salmon critical habitat. On September 2, 2005, NMFS designated critical habitat for the Central Valley spring-run Chinook salmon ESU (70 FR 52488) (NMFS 2010). Critical habitat consists of water, substrate, and adjacent riparian zone of accessible estuarine and riverine reaches. Accessible reaches are those within the historical range of the Central Valley spring-run Chinook salmon ESU that can still be occupied by any life stage of Chinook salmon. Inaccessible reaches are those above long-standing, naturally impassable barriers (natural waterfalls in existence for at least several hundred years) and specific dams within the historical range of each ESU. Adjacent riparian zones are defined as the area adjacent to a stream that provides the following functions: shade, sediment transport, nutrient or chemical regulation, streambank stability, and input of large woody debris or organic matter.

Critical habitat for Central Valley spring-run Chinook is designated to include all river reaches accessible to Chinook salmon in the Sacramento River and its tributaries in California (NMFS 2002). Also included are river reaches and estuarine areas of the Sacramento-San Joaquin Delta; all waters from Chipps Island westward to Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait; all waters of San Pablo Bay westward of the Carquinez Bridge; and all waters of San Francisco Bay (north of the San Francisco/Oakland Bay Bridge) from San Pablo Bay to the Golden Gate Bridge. Excluded are areas above specific dams or above longstanding naturally impassable barriers.

Central Valley Steelhead. NMFS completed a status review of steelhead populations in Washington, Oregon, Idaho, and California and identified 10 distinct population segments (DPS) in this range. On August 9, 1996, NMFS issued a proposed rule to list five of these DPS (including the Central Valley steelhead) as endangered and five as threatened under the ESA (61 FR 155). The Central Valley steelhead DPS was later listed as threatened (downgraded from its proposed status of endangered) (63 FR 13347). The threatened status was reaffirmed on January 5, 2006, to include all naturally spawned Central Valley steelhead populations below natural and manmade impassable barriers in the Sacramento and San Joaquin Rivers and their tributaries, as well as two artificial propagation programs: the Coleman National Fish Hatchery and Feather River Hatchery steelhead hatchery programs. The critical habitat final designation was published on September 2, 2005 (70 FR 52488), with an effective date of January 2, 2006.

Historically, steelhead spawned and reared in most of the accessible upstream reaches of Central Valley rivers, including the Yuba, Feather, and Sacramento Rivers and their perennial tributaries. Compared with Chinook salmon, steelhead generally migrated farther into tributaries and headwater streams where cool, well-oxygenated water was available year-round. Declines in steelhead abundance have been attributed largely to dams that eliminated access to most of their historic spawning and rearing habitat, and restricted steelhead to less suitable habitat below the dams. Other factors that have contributed to the decline of steelhead and other salmonids include habitat modification, over-fishing, disease and predation, inadequate regulatory mechanisms, climate variation, and artificial propagation (NMFS 2006).

The CDFG estimated that only approximately 200 steelhead spawned annually in the Lower Yuba River prior to 1969. During the 1970’s, CDFG annually stocked hatchery steelhead from the Coleman National Fish Hatchery into the Lower Yuba River, and by 1975 estimated a run size of about 2,000 fish (CDFG 1991a). Since 1975, the run size has not been estimated, but is believed to be “stable” and supports a significant recreational fishery (McEwan and Jackson 1996). CDFG stopped stocking steelhead into the Lower Yuba River in 1979, and currently manages the river to protect the natural steelhead production through strict “catch-and-release” fishing regulations. During the 2008 period, 424 steelhead were observed passing through the VAKI system at Daguerre Point Dam (LYRA 2010).

The upstream migration of adult steelhead in the mainstem Sacramento River historically started in July, peaked in September, and continued through February or March (McEwan and Jackson 1996). Currently, upstream migration in the Lower Yuba River occurs from August through March and peaks in October and February (CDFG 1991a). Central Valley steelhead spawning generally occurs from January through April in the Lower Yuba River (CDFG 1991a). However, redds have been observed as late as August. Many of the late-spawning fish appear to be resident rainbow trout.

Egg incubation time in the gravel is determined by water temperature, with optimal egg incubation temperatures reported to range from 48°F to 52°F (CDFG 1991b). Steelhead fry usually emerge from the gravel two to eight weeks after hatching, usually between February and May, but sometimes into June (CDFG 1991b). Newly emerged steelhead fry move to shallow, protected areas along streambanks and then move to faster, deeper areas of the river as they grow. Juvenile steelhead feed on a variety of aquatic and terrestrial insects and other small invertebrates.

Juvenile steelhead rear throughout the year and may spend from one to three years in freshwater before migrating to the ocean; juvenile steelhead rear in the Lower Feather and Bear Rivers throughout the year (CDFG 1991b). Smoltification is the physiological adaptation that juvenile salmonids undergo to tolerate saline waters. This process occurs in juveniles as they begin their downstream migration. Smolts generally migrate from March to June (CDFG 1991b).

Central Valley Steelhead Designated Critical Habitat. Critical habitat for Central Valley steelhead is designated to include all river reaches accessible to listed steelhead in the Sacramento River and San Joaquin Rivers and their tributaries in California (NMFS 2002). Also included are river reaches and estuarine areas of the Sacramento-San Joaquin Delta; all waters from Chipps Island westward to Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait; all waters of San Pablo Bay westward of the Carquinez Bridge; and all waters of San Francisco Bay (north of the San Francisco/Oakland Bay Bridge) from San Pablo Bay to the Golden Gate Bridge. Excluded are areas of the Merced River confluence and areas above specific dams or above longstanding naturally impassable barriers.

Green Sturgeon. The Sacramento River currently hosts the only known spawning population of Southern distinct population segment (DPS) green sturgeon, *Acipenser medirostris* (Poytress et al. 2010). This genetically distinct population (Israel et al. 2004) was listed as threatened under the Federal Endangered Species Act on April 7, 2006 (NMFS 2006).

According to Poytress et al. (2010), green sturgeon successfully spawn in the Sacramento River, including the upper Sacramento River beyond the Red Bluff Diversion Dam. Spawning events occurred several river kilometers upstream and downstream of the Red Bluff Diversion Dam prior to, and subsequent to, the June 15 seasonal dam gate closure, and occurred directly below the dam within two weeks after the gate closure. The temporal distribution pattern suggested by this second year of study indicates spawning of Sacramento River green sturgeon occurs from early April through late June (Poytress et al. 2010).

There are confirmed observations of both white sturgeon (*Acipenser transmontanus*) (CDWR 2005b) and green sturgeon (*Acipenser medirostris*) (NMFS 2005a) in the Feather River near the mouth of the Yuba River, and unconfirmed species observations of sturgeon in the Yuba River below Daguerre Point Dam (NMFS 2005b). It is believed that adult sturgeon are unable to ascend the fish ladder structures existing at Daguerre Point Dam (NMFS 2005b). Therefore, Daguerre Point Dam may be considered a barrier to the upstream migration of green sturgeon in the Lower Yuba River.

*Essential Fish Habitat*. The Magnuson-Stevens Fishery Conservation and Management Act (MSA) of 1996 govern the conservation and management of ocean fisheries. The purpose of the Act is to take immediate action to conserve and manage fishery resources off the U.S. coasts and U.S. anadromous species, and promote the protection of Essential Fish Habitat (EFH).

EFH is the aquatic habitat (water and substrate) necessary for fish to spawn, breed, feed, or grow to maturity (NMFS 2002) that will allow a level of production needed to support a long-term, sustainable commercial fishery and contribute to a healthy ecosystem. For the Yuba River, the EFH for Chinook salmon are within the USGS hydrologic unit codes[vii] 18020107 (Lower Yuba River) and 18020125 (Upper Yuba River). Englebright Dam is not considered to be an impassible barrier (NMFS 2007).

*Plant Species*. Only one special-status plant species, Brandegee's Clarkia (*Clarkia biloba* ssp. *brandegee*), was identified as having the potential to occur in the project area, or is known to occur in the project area. The California Native Plant Society lists the plant with a status of 1B.2, meaning that the taxon is "rare, threatened, or endangered in California and elsewhere; seriously threatened in California" (CDFG 2010). This plant species is discussed below.

*Clarkia* are showy California native annuals and their colors add to the beauty of the Sierra spring landscape. Some species used in commercial flower seed mixes have names like "fare-well-to-spring," "fairy fans," "red ribbons," and "summer's darling." There are about 40 species of *Clarkia*, almost all in western North America.

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[vii] To clearly identify watersheds that contain EFH, NMFS uses fourth field hydrologic unit codes (HUCs) developed by the USGS (defined in the Department of the Interior, USGS publication; Hydrologic Unit Maps, Water Supply Paper 2294, 1987). The geographic extent of HUCs range from first field (largest geographic extent) to sixth field (smallest geographic extent). Fourth field HUCs divide the landscape into distinct geographic areas that are identified by eight numbers unique to that hydrologic unit.

Brandegee's Clarkia is found in dry habitats below 2,500 feet elevation in six counties of the northern Sierra. It typically grows on gravelly slopes above creeks and rivers and along roadsides. Brandegee's Clarkia may bloom from May to July depending on weather conditions and location. A CNDDB records search identified one occurrence of Brandegee's Clarkia in the vicinity of the project area (CDFG 2010). This occurrence (recorded in 1971) was located east of the Sierra Foothill Research and Extension Center near Scott Forbes Road. This road is the proposed haul route for gravel delivery to the proposed gravel placement site.

### 3.7.2 Effects

Basis of Significance. An alternative would be considered to have a significant effect on special status species, critical habitat, or EFH if it would result in the "take" of a Federally or State-listed threatened or endangered species, adversely affect designated critical habitat, or substantially affect any other special status species, including degradation of its habitat.

No Action. Without additional gravel delivery to the channel immediately below Englebright, the existing gravel supply in the bed and usable gravel stored in downstream bars would decrease as it is gradually transported downstream and out of the project reaches. A continued degradation to physical habitat structure and ecological function of the Lower Yuba River would be expected.

Proposed Action. As there is no suitable habitat for any listed wildlife or plant species in or near the gravel placement site, the proposed action would have no adverse effects on any of these species. However, the gravel placement is not likely to adversely affect Federally listed species or their designated critical habitat, including the threatened Central Valley spring-run Chinook salmon *(Oncorhynchus tshawytscha),* threatened Central Valley steelhead (*O. mykiss),* the respective designated critical habitats for these salmonid species, and the threatened Southern DPS of North American green sturgeon *(Acipenser medirostris).*

The proposed gravel placement may include minimal short-term effects such as localized and temporary disturbance, displacement, or impairment of feeding, migration, or other behaviors by adult and juvenile salmon and steelhead from noise, suspended sediment, turbidity, and sediment deposition generated during gravel placement activities. Gravel placed into the river would cause short-term increases in turbidity and temporarily disturb salmonids within the stream channel. Short-term increases in turbidity and suspended sediment may disrupt feeding activities of salmonids or result in temporary displacement from preferred habitats. Gravel placed into the river bed could also bury stream substrates that provide habitat for aquatic invertebrates, an important food source for salmonids. Consequently, growth rates of salmonids could be reduced if suspended sediment and turbidity levels substantially exceed ambient levels for prolonged periods. The proposed project site is mostly devoid any river-rounded gravel/cobble (Pasternack 2010), this material is the basic building block of alluvial morphological units necessary for salmonid spawning. Additionally, none of the gravel from the 2007 pilot project has migrated as far downstream as to the currently proposed gravel placement site. Thusly, there is no chance of salmonid redds or embryos to occur within the proposed placement site.

Long-term effects of the proposed gravel placement on the critical habitat of salmonids include alteration of river hydraulics and substrate conditions within the river channel. The total aquatic volume of the pool at the placement site may be initially decreased by deposition of the gravel. However, it is expected that a substantial portion of the introduced substrate would eventually be transported downstream to hydraulically shielded areas during periods of greater discharge.

Whether the modified channel offers more favorable habitat for spawning and rearing, and whether more favorable fish habitat translates to increased biological production remains uncertain. The proposed gravel placement site within the Narrows reach may have primarily served as a pathway for fish traveling to and from spawning habitat farther upstream in the drainage network. With upstream migration blocked by Englebright, this mainstream channel becomes the upstream-most available location to create alluvial habitat.

The key challenge is to balance the need for reduced gravel mobility with the biological requirement of preferred substrate, depth, and flow velocity for spawning and redd survival. Achieving this balance is particularly difficult because of the wide range of flow magnitudes that must be accounted for. Implementation of the proposed gravel placement project would improve the understanding of how gravel resources (spawning habitat) respond to changes in flow, and continue to allow better identification of channel reaches where the long-term gravel augmentation program would be most beneficial.

### 3.8 Mitigation

To avoid or minimize potential effects on these listed species, the proposed placement of gravel would be scheduled for a late-fall timeframe. The timing of the action was determined by both coordination with NMFS, and by the natural history of the salmonids. By then, Central Valley spring-run Chinook salmon would have moved downstream and away from the placement site to seek more favorable spawning gravels (Table 8). It is expected that any remaining fish would temporarily avoid the gravel placement site by moving out of the affected area. Gravel would also arrive pre-washed from the commercial quarry. Any elevated turbidity resulting from residual gravel sediments would be temporary and localized, and would not have long-term, permanent effects.

As a result, the Corps has determined that implementation of the gravel placement project immediately below Englebright Dam (in order to satisfy the Terms and Conditions of the incidental take statement included in the BO dated November 21, 2007) would have no significant adverse effects on the listed Fall/Late Fall-run Chinook salmon, Central Valley spring-run Chinook salmon and Central Valley steelhead, nor would it likely destroy or adversely modify the designated critical habitat for these species, or impact EFH within the Yuba River. USFWS and NMFS coordination and concurrence are included in this Final EA (Appendices F and G).

## TABLE 8. Life Stage Timing of Selected Fish Species that Inhabit the Lower Yuba River

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Fall-Run Chinook Salmon** | | | | | | | | | | | | |
| Adult Migration | ▒ | | | | | | | ▒ | ■ | ■ | ■ | ■ |
| Spawning | ▒ | | | | | | | | | ■ | ■ | ■ |
| Egg Incubation | ■ | ■ | | | | | | | | ■ | ■ | ■ |
| Emergence | ■ | ■ | ■ | | | | | | | | | ▒ |
| Fry Rearing & Emigration | ■ | ■ | ■ | | | | | | | | | ▒ |
| Juvenile Rearing & Emigration | | | ▒ | ■ | ■ | ■ | | | | | | |
| **Spring-Run Chinook Salmon** | | | | | | | | | | | | |
| Adult Migration | | ▒ | ■ | ■ | ■ | ■ | ■ | ■ | | | | |
| Summer Holding (Adults) | | | | | | ■ | ■ | ■ | ■ | | | |
| Spawning | | | | | | | | ▒ | ■ | ■ | ■ | ▒ |
| Egg Incubation | ■ | | | | | | | ▒ | ■ | ■ | ■ | ■ |
| Emergence | ■ | ▒ | | | | | | | ■ | ■ | ■ | ■ |
| Fry Rearing & Emigration | ■ | ■ | ■ | ▒ | | | | | | | ■ | ■ |
| Juvenile Rearing and Emigration | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| **Steelhead** | | | | | | | | | | | | |
| Adult Migration | ■ | ■ | ■ | ▒ | | | | ▒ | ■ | ■ | ■ | ■ |
| Spawning | ■ | ■ | ■ | ■ | ▒ | | | | | | | ▒ |
| Incubation | ■ | ■ | ■ | ■ | ■ | ▒ | | | | | | ■ |
| Emergence | ▒ | ■ | ■ | ■ | ■ | ■ | | | | | | |
| Juvenile Emigration | | ▒ | ■ | ■ | ■ | ■ | ▒ | | | | | |
| Adult Emigration | ▒ | ■ | ■ | ■ | ■ | ■ | | | | | | |
| Juvenile Rearing | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |

▒ Low probability of occurrence; not included in the assessment of the project effects.

■ Primary occurrence included in the assessment of project effects.

Source: Table modified from CDFG (1991a) and ENTRIX (2004).

## 3.9 Air Quality

### 3.9.1 Existing Conditions

Regulatory Background. The Federal Clean Air Act establishes National Ambient Air Quality Standards (NAAQS) and delegates enforcement to the states, with direct oversight by the Environmental Protection Agency (EPA). In California, the Air Resources Board is the responsible agency for air quality regulation.

The California Clean Air Act established California Ambient Air Quality Standards, which are more stringent than the Federal standards and include pollutants not listed in the Federal standards. All Federal projects in California must comply with the stricter California air quality standards.

On November 3, 1993, the EPA issued the General Conformity Rule stating that Federal actions must not cause or contribute to any violation of a NAAQS or delay timely attainment of air quality standards. A conformity determination is required for each pollutant where the total of direct and indirect emissions caused by a Federal action in a nonattainment area exceeds *de minimus* threshold levels listed in the rule (40 CFR 93.153).

Sources of Pollution. The project area is located in the Sacramento Valley Air Basin, which is composed of Butte, Colusa, Glenn, Placer, Sacramento, Shasta, Solano, Sutter, Tehama, Yolo, and Yuba Counties (CARB 2007). The topographic boundaries of the basin, coupled with light winds and atmospheric stability, make the basin susceptible to the accumulation of air pollutants. On many summer days, a "delta breeze" blows in from the ocean towards Sacramento. These winds can transport air pollution from the Bay Area to the Sacramento Air Basin. The delta breeze turns northward and moves Sacramento's air pollution up toward the north end of the Sacramento Valley and to the east into the Sierra Nevada foothills and project area. When the wind blows out of the north, Sacramento air pollution can be transported into the San Joaquin Valley Air Basin to the south.

The Sacramento Valley Air Basin is designated for ozone, nitrogen dioxide, particulate matter greater than 10 microns ($PM_{10}$), sulfates, and visibility reducing particles. The major air pollution problems in the basin are high concentrations of oxidants and suspended particulates. Both pollutants frequently exceed air quality standards. The largest source of oxidants in the basin is motor vehicles, and the major source of suspended particulates is agriculture.

Local Air Quality Management. Management of Federal and State air quality standards in the project area is the responsibility of the Feather River Air Quality Management District in Yuba County. The pollutants that are monitored by Yuba County include carbon monoxide, sulfur dioxide, lead, and hydrogen sulfide. An air quality monitoring station is located in Yuba City, California. Yuba County is designated as "unclassified" or "in attainment" for carbon monoxide, nitrogen dioxide, and sulfur dioxide. Yuba County is in "non-attainment" for ozone and $PM_{10}$ (FRAQMD 2004, 2010).

Sensitive Receptors. Sensitive receptors include sensitive land uses and those individuals and/or wildlife that could be affected by changes in air quality due to construction of the project. Examples of sensitive land uses include residences, schools, playgrounds and parks, and hospitals. There are no sensitive land uses in the project area. The only sensitive receptors would be nearby recreationists and wildlife.

### 3.9.2 Effects

Basis of Significance. An alternative would be considered to have a significant effect on air quality if it would violate any ambient air quality standard, contribute on a long-term basis to an existing or projected air quality violation, expose sensitive species or humans to substantial pollutant concentrations, or not conform to applicable Federal standards.

No Action. Under this alternative, the air quality conditions in the vicinity of the project area would remain the same. Air quality would continue to be influenced by climatic conditions, and local and regional emissions from vehicles and agricultural activities.

Proposed Action. The proposed gravel placement would have short-term effects on air quality in the area. Operation of the conveyor equipment, a loading dozer, and gravel transport vehicles would produce emissions and $PM_{10}$, as well as increase fugitive dust from gravel placement activities.

The placement of approximately 2,000 to 5,000 short tons of gravel would be expected to take place over two to six weeks. It would take a 20-ton haul truck 250 trips to haul 5,000 short tons of gravel from the commercial source. Over the course of six weeks that would equal approximately eight haul trips a day. Table 9 denotes the estimated emissions for the proposed action. Based on the equipment needed and estimated hours of operation for each piece of equipment, the estimated emissions and $PM_{10}$ would not be expected to exceed Federal, State, or Local standards or *de minimus* thresholds (Appendix E). No conformity determination would be required.

**TABLE 9. Emissions for the 2010 Proposed Lower Yuba River Gravel Augmentation**

| **Emission Estimates for:** | Gravel Augmentation | | | **Total** | **Exhaust** | **Fugitive Dust** | **Total** | **Exhaust** | **Fugitive Dust** | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Project Phases (English Units)** | **ROG** | **CO** | **NOx** | **$PM_{10}$** | **$PM_{10}$** | **$PM_{10}$** | **$PM_{2.5}$** | **$PM_{2.5}$** | **$PM_{2.5}$** | **$CO_2$** |
| ***De minimus* Thresholds (tons/year)** | 50 | 100 | 50 | 100 | - | - | 100 | - | - | - |
| **Maximum (pounds/day)** | 10.1 | 40.3 | 51.1 | 18.1 | 3.1 | 15 | 6 | 2.9 | 3.1 | 4,977.90 |
| **Total (tons/construction project)** | 0.2 | 0.5 | 0.7 | 0.3 | 0 | 0.2 | 0.1 | 0 | 0 | 68.6 |

### 3.9.3 Mitigation

Although there would be no significant effects on air quality, the following best management practices would be implemented to reduce equipment emissions, $PM_{10}$, and fugitive dust:

Equipment Emissions

- The selected contractor would be responsible to ensure that all heavy-duty equipment is properly tuned and maintained, in accordance with manufacturers' specifications.
- Gravel transport vehicles and conveyor equipment would be shut down when not in use.

Particulate Matter

- Conveyor loading operations would be suspended when winds exceed 20 miles per hour.
- All trucks hauling gravel into the project area would be operated in accordance with the requirements of California Vehicle Code Section 23114. If necessary, all materials transported onsite would be adequately watered or covered.
- The gravel staging area would be watered as needed to control fugitive dust generated by equipment and activities.
- Construction equipment and vehicular traffic on unpaved roads would be restricted to a 15-mile per hour speed limit.

## 3.10 Recreation

### 3.10.1 Existing Conditions

The primary recreation activities within the project area are fishing, boating, recreational exercise, and wildlife viewing. Other activities may include hunting, swimming, and gold panning. These activities occur mostly upstream of the Highway 20 bridge, although some do occur between Daguerre Point Dam and Highway 20. Public access upstream of the Highway 20 bridge is limited due to private ownership of nearby lands.

Englebright Reservoir at the upstream project boundary is unique in that it offers boat-in camping. The lake itself has provided pleasant days of sightseeing, fishing, and swimming, waterskiing, and picnicking for thousands of visitors for over 60 summers.

The Sycamore Ranch RV Park and Campground is a developed recreation area located near the confluence of Dry Creek and the Yuba River. This facility offers tent and RV camping, fishing access to the Yuba River and Dry Creek, and swimming in the Yuba River.

Special fishing regulations are in effect on the Lower Yuba River within the project area. From Daguerre Point Dam upstream to the Highway 20 (Parks Bar) Bridge, one hatchery trout, or one hatchery steelhead (rainbow trout greater than 16 inches) may be taken. Any salmon caught must be immediately released. Open season lasts all year. No fishing is allowed above the Highway 20 Bridge to Englebright after August 31; therefore, no anglers should be in the vicinity of the gravel placement site while project activities are conducted.

CDFG, in cooperation with the University of California Sierra Foothill Research and Extension Center, provides a limited number of anglers with fishing access to a remote section of the Lower Yuba River on Extension Center property. This angling opportunity is available to a limited number of anglers through a random draw offered by CDFG. The Lower Yuba River angling access program terminates at the end of open season (August 31) for trout and salmon in this area.

### 3.10.2 Effects

Basis of Significance. An alternative would be considered to have a significant effect on recreation if it would result in loss of recreational facilities, cause a substantial disruption in a recreational activity or opportunity, or substantially diminish the quality of the recreational experience.

No Action. Under this alternative, the recreation areas, activities, and use at the restoration would remain the same.

Proposed Action. The proposed action could temporarily diminish the recreational experience of visitors due to the noise, dust, and in-water activities caused by the gravel sluicing equipment. The project would have no significant adverse effects on recreation in the project area. Public access to the proposed gravel placement site is limited with access through a locked gate. The Lower Yuba River angling access program would not be operating while gravel placement activities are conducted.

### 3.10.3 Mitigation

The Englebright Dam recreational areas would remain open and available for the existing levels and types of recreational activities during construction and implementation of the proposed action. Any short-term adverse effects to recreation would be minimized by restricted public access to the proposed gravel placement site. As there would be no significant adverse effects on recreation, no mitigation would be required.

## 3.11 Noise

### 3.11.1 Existing Conditions

Noise is unwanted or undesirable stationary, transient, intermittent, or continuous sound produced by any activity or device. Noise can cause a disruption of normal activities or cause the quality of physical and emotional health and the over-all quality of life to diminish. The most frequent standard of measuring sound is the “A-weighted” decibel scale, which measures frequencies that can be heard by the human ear. Noise level recorded with the unit measure of dB $L_{eq}$ is the average noise level over a 24-hour time period. Noise level recorded with unit measure of dB $L_{dn}$ is the average noise over one-hour period. The Yuba County noise regulations establish 65 dBA maximum Day-Night $L_{dn}$ as being considered compatible with residential uses or development.

Noise Sources. The primary sources of noise in the area are associated with motor vehicles, human activities, natural sounds such as wind, and turbine and water discharges associated with the Narrows 1 and Narrows 2 hydroelectric facilities, and recreational activities such as boating at Englebright.

Sensitive Receptors. Sensitive receptors include those individuals and/or wildlife that could be affected by changes in noise types or levels due to construction activity. The nearest sensitive receptor (residence) is more than ½-mile from the proposed action area, and those people who recreate at or on the reservoir. Noise levels are relatively low during the late night and early morning hours when ambient noise levels from recreational activities at Englebright are at a minimum. Noise levels are higher during summer daytime hours due to increased recreational boating.

### 3.11.2 Effects

Basis of Significance. An alternative would be considered to have a significant effect if it would substantially increase the ambient noise levels for adjoining areas. The significance of short-term noise effects is evaluated with reference to existing noise levels, the duration of the noise, and the number of sensitive receptors affected by construction.

No Action. This alternative would not have any adverse effects on existing noise in the project area. Current noise sources and levels would be expected to remain the same.

Proposed Action. Construction activities from the proposed action, such as the running of the water pump, and loading the travel into the sluicing system, would temporarily increase the noise levels near the action area. Daytime recreational users within the Englebright Dam recreational areas would likely experience increased noise levels. However, temporary construction activities are not expected to significantly adversely affect sensitive receptors in the action area.

### 3.11.3 Mitigation

The contractor would follow the Yuba and Nevada County noise control ordinances and regulations and ensure that the noise level does not go over the established 65 dBA maximum Day-Night average noise level. The duration of construction would be a maximum of two to six weeks. The work hours would be 8:00 a.m. to 5:00 p.m. during the regular work week. Occasional visitors and residents near Englebright could be aware of a temporary increase in noise levels, but any effects would not be considered to be significant. The proposed project also would not conflict with the Yuba County General Plan Noise Element, the Yuba County Municipal Code Chapter 8.20 Noise Ordinance, or the general plan or specific plan noise elements or noise ordinances for Nevada County adjacent to the project area. Therefore, the proposed project would have no long-term adverse effects on noise levels in the project area.

## 3.12 Cultural Resources

### 3.12.1 Existing Conditions

The project area lies within the traditional boundaries of the Nisenan, or Southern Maidu people. The Nisenan language is part of the Penutian linguistic stock, a linguistic stock composed of Wintuan, Maiduan, Yokutsan, and Utian language families that constituted a continuous belt throughout Central California and the Sierra Nevada. The boundaries of the Nisenan territory were the Yuba, Bear, and American Rivers and the lower Feather River. On the west, the Nisenan territory was roughly bounded by the Sacramento River between the Feather and the American Rivers. To date, no archaeological surveys have located prehistoric sites within the project area.

The arrival of Euro-Americans in the 1820's began with the fur trapping expeditions. In the mid-1800's came the arrival of the Gold Rush miners, and agricultural pursuits developed shortly thereafter. Hydraulic mining for gold in the region was extensive and quickly degraded agricultural resources when massive amounts of sediment from mine tailings were washed downstream. Eventually, hydraulic mining was halted, and debris dams such as Englebright and Daguerre Point Dam were constructed to control the continual downstream washing of sediment.

The Hallwood-Cordua Canal, located near the right abutment of Daguerre Point Dam, was constructed after WWI for agricultural irrigation (Corps 2001). The canal is unlined except for the concrete outlet near the dam. The outlet structure was reconstructed in 1964. Neither Daguerre Point Dam nor the Hallwood-Cordua Canal appears to meet the criteria for inclusion in the National Register of Historic Places due to numerous reconstructions. The Corps evaluated the historic status of Daguerre Point Dam and found that it did not meet the requirements for listing. However, a final determination by the State Historic Preservation Officer (SHPO) has not been made.

Archival research was conducted in 2004 by ENTRIX, a Corps consultant, at the California Historical Resources Information System, North Central Information Center, Sacramento, to locate all previously recorded sites situated within a 1/8-mile radius of the project area. This information was used to anticipate the type, quality, and number of archaeological sites that might be present in the area. In addition, a review of all previously conducted archaeological surveys for the area with 1/8-mile of the project area also was undertaken. This background review was conducted to bolster current research efforts and to address all potential effects to historical properties prior to initiation of the gravel placement action.

This review resulted in the identification of four previously recorded archaeological sites (CA-YUB-144-H, CA-YUB-626-H, CA-YUB-669-H, and CA-YUB-736-H) located within 1/8-mile radius of the project area. Of these, site CA-YUB-669-H is situated adjacent to the project area. All of the remaining sites are within 500 feet of the project area (ENTRIX 2004).

The four previously identified sites are historic sites probably associated with Gold Rush Era placer mining in the area. In fact, CA-YUB-669-H is described by site recorders as a "site of small mining bar 1850-1860"; presumably Parks Bar (ENTRIX 2004). Site CA-YUB-144-H is a historic cemetery identified in an early historical account dated 1879; a tombstone within the cemetery can reportedly be dated to 1849 (ENTRIX 2004). CA-YUB-626-H is the site of two medium sized water conveyance ditches measuring at least one-half mile in length, likely related to mining activities in area (ENTRIX 2004). The remaining site, CA-YUB-736-H, is another river placer site near Parks Bar designated as Fillmore Hill (ENTRIX 2004). None of the four sites are listed on or have been determined to be eligible for listing on the National Register of Historic Places. In addition, none of the sites are listed on the California Register of Historic Resources. No testing or further archaeological investigation has occurred at any of the sites.

At least four in-field reconnaissance level archaeological surveys have been conducted within and adjacent to the project area. Two of the surveys were conducted in the 1970's for the Corps, Sacramento District, under contract with the California State University, Sacramento. The first, entitled "A Reconnaissance Archeological and Historical Site Survey of Selected Portions of the Parks Bar Lake Project Alternative, Marysville Lake Project," was reported in November 1974 and covered the entire project area. This survey initially located the four sites referred to in this section. The second survey, entitled "Cultural Resources of the Marysville Lake, California Project (Parks Bar Site), Yuba and Nevada Counties, California," was completed in August 1978. This survey covered the entire project area and re-visited the previously recorded sites. The third survey was conducted in 2002 by YCWA to analyze the effects of a proposal to install a full-flow bypass structure on the Narrows 2 hydropower facility adjacent to the 2007 gravel pilot placement site. The survey included the exterior of the power plant, the immediate surrounding area, and the locations that would be used for staging and spoils disposal. No cultural resources were identified at that time. It was determined that the steep slopes of the canyon made this location unsuitable for early historic or prehistoric occupation despite the area's proximity to the Yuba River (YCWA 2006).

On March 19, 2007, a fourth in-field reconnaissance level archaeological survey was conducted by a Corps' archaeologist within and adjacent to the project area for the pilot gravel injection project (Corps 2007). The area of potential effect (APE) was determined to be the Lower Yuba River channel and the paved haul roads from the commercial gravel site to the base of Englebright Dam.

### 3.12.2 Effects

Basis of Significance. An alternative would be considered to have a significant adverse effect on cultural resources if it would diminish the integrity of the resource's location, design, setting, materials, workmanship, feeling, or association. Types of effects include physical destruction, damage, or alteration; isolation or alteration of the character of the setting; introduction of elements that are out of character with the property; neglect; and transfer, lease, or sale of the property.

No Action. Under this alternative, there could be some effects to cultural resources. Natural processes such as erosion, root and rodent intrusion, and flooding could affect sites by exposing them to the elements and vandals.

Proposed Action. In accordance with 36 CFR 800.3(a)(1), the Corps determined that the proposed project action has no potential to cause effects to cultural or historic properties within the APE. The haul roads are not historically significant, and there are no historic properties present in the Lower Yuba River channel. Additionally, there are no cultural resources or historic properties identified within the APE. As the proposed project is taking place in a highly disturbed context, any cultural resources would have long since been obliterated. Consequently, if there were any historic properties that were present at one time, they would have become highly disturbed and lost any attributes that would have contributed to their status as an historic property. Since this undertaking does not have the potential to cause effects on historic properties, the Corps has no further obligations under Section 106 of the National Historic Preservation Act of 1966. Should any prehistoric (arrowheads, mortar, or human bones) or historic artifacts (glass, ceramics, metal, or nails) be discovered during implementation of the proposed action, work activities would be stopped until mitigation is determined in consultation with the SHPO and Native American representatives. The proposed gravel placement site would not affect any of the three water diversion canals.

### 3.12.3 Mitigation

As the gravel placement would have no adverse effects on cultural resources or historic properties, no mitigation would be required. The Corps is currently in communication with the SHPO, seeking concurrence of this no effect determination.

## 4.0 Growth-Inducing Effects

An action agency must consider the indirect effects of a proposed action when preparing an EA. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate (40 CFR 1508.8[b]). The proposed gravel placement would have no effect on population growth or densities. Growth in the project area would proceed as projected in the Yuba County general plans.

## 5.0 Cumulative Effects

NEPA requires that an EA discuss project effects which, when combined with the effects of other projects, could result in significant cumulative effects. NEPA defines a cumulative effect as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions” (40 CFR 1508.7).

Currently, there are multiple planned and ongoing resource restoration projects within the Yuba River watershed with the goal of increasing and stabilizing anadromous fish populations. These projects include improved sediment management, fish screening alternatives at diversions, habitat improvement and restoration, and improved fish passage. The California Department of Water Resources, the Lower Yuba River Technical Working Group, and the Lower Yuba River Accord River Management Team are all also supporting development of long-term restoration planning to assist in prioritizing actions to complete restoration and enhancement of salmonid habitat. Additionally, the results of local studies by UCD indicate that specific restoration approaches must also consider the geomorphic regime of the system (Pasternack 2008, 2009, 2010).

The proposed action could contribute to the cumulative environmental effects of these planned and ongoing resource-restoration projects within the Yuba River watershed. However, it is assumed that these projects have been or would be conducted in compliance with all applicable environmental laws and regulations, including implementation of mitigation measures. The proposed action, in combination with past, present, and potential future actions, would likely contribute to the overall health and vigor of the watershed.

The proposed actions habitat restoration efforts (gravel augmentation) within the EDR downstream from Englebright Dam, where there is a net deficit of spawning sediment, may provide disproportionately important spawning habitat, would result in a benefit to production of the system (Moir 2006, Corps 2007).

## 6.0 Compliance with Environmental Laws and Regulations

**Bald Eagle Protection Act of 1940, as amended,** 16 U.S.C. 668-668d, 54 Stat. 250. *Full Compliance*. This law provides for the protection of the bald eagle and the golden eagle by prohibiting, except under certain specified conditions, the taking, possession, and commerce of such birds. The proposed action would have no adverse effects on bald or golden eagles.

**Clean Air Act of 1972, as amended, 42 U.S.C. 7401, et seq.** *Full Compliance*. The Corps completed an analysis of air quality effects from the proposed action and determined that the estimated emissions and $PM_{10}$ would not exceed Federal *de minimus* thresholds. The Corps has also determined that the proposed action would have no adverse effect on the future air quality of the project area. Therefore, no conformity determination would be required.

**Clean Water Act of 1972, as amended, 33 U.S.C. 1251, et seq.** *Full Compliance*. The proposed action includes placement of materials in the waters of the U.S. Gravel placement may result in the temporary suspension of sediments at and immediately downstream of the proposed gravel placement site. A Section 404(b) (1) evaluation for the project determined that in order to minimize pollution or adverse effects to the affected aquatic ecosystem include the requirement that the gravel arrive screened and pre-washed to the placement site from the commercial aggregate source. The Section 401 Certification, as issued by CRWQCB with required water quality conditions per the certification is included in this Final EA (Appendix C).

**Endangered Species Act of 1973, as amended, 16 U.S.C. 1531, et seq.** *Full Compliance*. A list of threatened and endangered species that may be affected by the project was obtained from the USFWS on September 13, 2010 (Appendix D**).** The Corps has determined that implementation of a gravel placement project immediately below Englebright Dam (in order to satisfy the Terms and Conditions of the incidental take statement included in the BO dated November 21, 2007) would have no significant adverse effects on the listed Central Valley spring-run Chinook salmon and Central Valley steelhead, nor would it likely destroy or adversely modify the designated critical habitat for these species. NMFS concurs with the Corps determination that the proposed project will not likely adversely affect Federally listed threatened Central Valley steelhead, threatened Central Valley spring-run Chinook salmon, and the threatened Southern distinct population segment of North American green sturgeon, or their respective designated critical/essential habitats. The Corps has closely coordinated with USFWS and NMFS regarding the proposed action. The communication and coordination with USFWS and NMFS have been included in the Final EA (Appendices F and G).

**Executive Order 12989, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations**. *Full Compliance*. This Executive Order states that Federal agencies are responsible to conduct their programs, policies, and activities that substantially affect human health of the environment in a manner that ensures that such programs, policies, and activities do not have the effect of excluding persons from participation in, denying persons the benefits of, or subjecting persons to discrimination under such programs, policies, and activities because of their race, color, or national origin. The proposed action is in compliance with this Executive Order and would not affect any minority or low-income communities.

**Executive Order 13112, Invasive Species.** *Full Compliance.* This order directs federal agencies to: prevent the introduction of invasive species; detect and respond rapidly to and control such species; not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species unless the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions. The proposed action would not result in the introduction or spread of any new invasive or noxious plant species.

**Farmland Protection Policy Act, 7 U.S.C. 4201 et seq.** *Full Compliance*. This Act requires a Federal agency to consider the effects of its actions and programs on the Nation's farmlands. The proposed action would not result in the loss of any farmland.

**Fish and Wildlife Coordination Act of 1958, as amended, 16 U.S.C. 661, et seq.** *Full Compliance*. The USFWS has participated as an active member of the Yuba River Technical Working Group in evaluating the proposed gravel placement project and the Corps has coordinated with USFWS as required under this Act. The USFWS concurred that the proposed project would have minimal impacts and would immediately create beneficial habitat for the Central Valley spring-run Chinook salmon and the Central Valley steelhead. The USFWS Coordination Act Report is included in the Final EA (Appendix F).

**Magnuson-Stevens Fishery Conservation and Management Act.** *Full Compliance*. Salmonid species that may be affected by the proposed action are evaluated in this EA. The Corps has determined that the proposed gravel placement project would have no significant adverse effects on these species, nor would it likely destroy or adversely modify the designated critical habitat for these species. This EA serves as the Corps EFH Assessment for Chinook salmon. The Corps has closely coordinated with NMFS during bi-monthly meetings regarding the proposed action. NMFS has concurs that because the proposed action has been designed to avoid adverse impacts to the aquatic and riparian habitat within the Yuba River and has incorporated conservation measures to ensure that EFH features will not be diminished, EFH Conservation Recommendations are not required at this time. The communication and coordination with NMFS have been included in the Final EA.

**Migratory Bird Treaty Act of 1936, as amended, 16 U.S.C. 703 et seq**. *Full Compliance*. The Migratory Bird Treaty Act implements various treaties and conventions between the United States, Canada, Japan, Mexico, and Russia, providing protection for migratory birds as defined in 16 U.S.C. 715j. The proposed action is in compliance with provisions of this Act.

**National Environmental Policy Act of 1969, as amended, 42 U.S.C. 4321, et seq.** *Full Compliance*. This EA is in full compliance with this act. Public comments received during the public review period have been included and incorporated into this Final EA. The submittal of the Final EA and the signed Finding of No Significant Impact (FONSI) complete the NEPA process and fully comply with this act.

**National Historic Preservation Act of 1966, as amended**. *Full Compliance*. Section 106 of this act requires the head of a Federal agency to consider the effects of Federal undertakings on properties that are listed in, or are eligible for listing in the National Register of Historic Places. The implementing regulation for Section 106 is 36 CFR Part 800, "Protection of Historic Properties," requires Federal agencies to initiate Section 106 consultation with the SHPO. Cultural resources surveys of the APE in 2007 were negative. In accordance with 36 CFR 800.3(a)(1)No potential to cause effects, the Corps determined that the proposed undertaking meets the requirements for compliance with the regulation. Consequently, the Corps has no further obligations under Section 106 of the National Historic Preservation Act of 1966. .

**Wild and Scenic Rivers Act, 16 U.S.C. 1271 et seq.** *Full Compliance*. The purpose of the ‘Wild and Scenic Rivers Act is to preserve and protect wild and scenic rivers and immediate environments for the benefit of present and future generations. The Lower Yuba River has not been designated as a component of either the Federal or State Wild and Scenic Rivers systems.

## 7.0 Agencies and Persons Consulted.

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## 8.0 Coordination and Review of the Draft EA

The draft EA was circulated for 15 days to interested Federal, State, and local agencies; organizations; and the public. All comments received were considered and incorporated into the Final EA, as appropriate (Appendix H).

## 9.0 Conclusions

Based on this EA and agency coordination, the proposed gravel placement project would not have a significant adverse effect on the environmental resources in the project area, including threatened and endangered species, and other wildlife and vegetation. Therefore, the proposed action would require no mitigation avoidance, implementation of BMPs, and additional measures proposed in this EA. This project has met the requirements for actions as described in 40 CFR 1508.13. A signed FONSI accompanies this final EA.

## 10.0 List of Preparers

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**PLATE 1**
**PROJECT AREA VICINITY MAP**

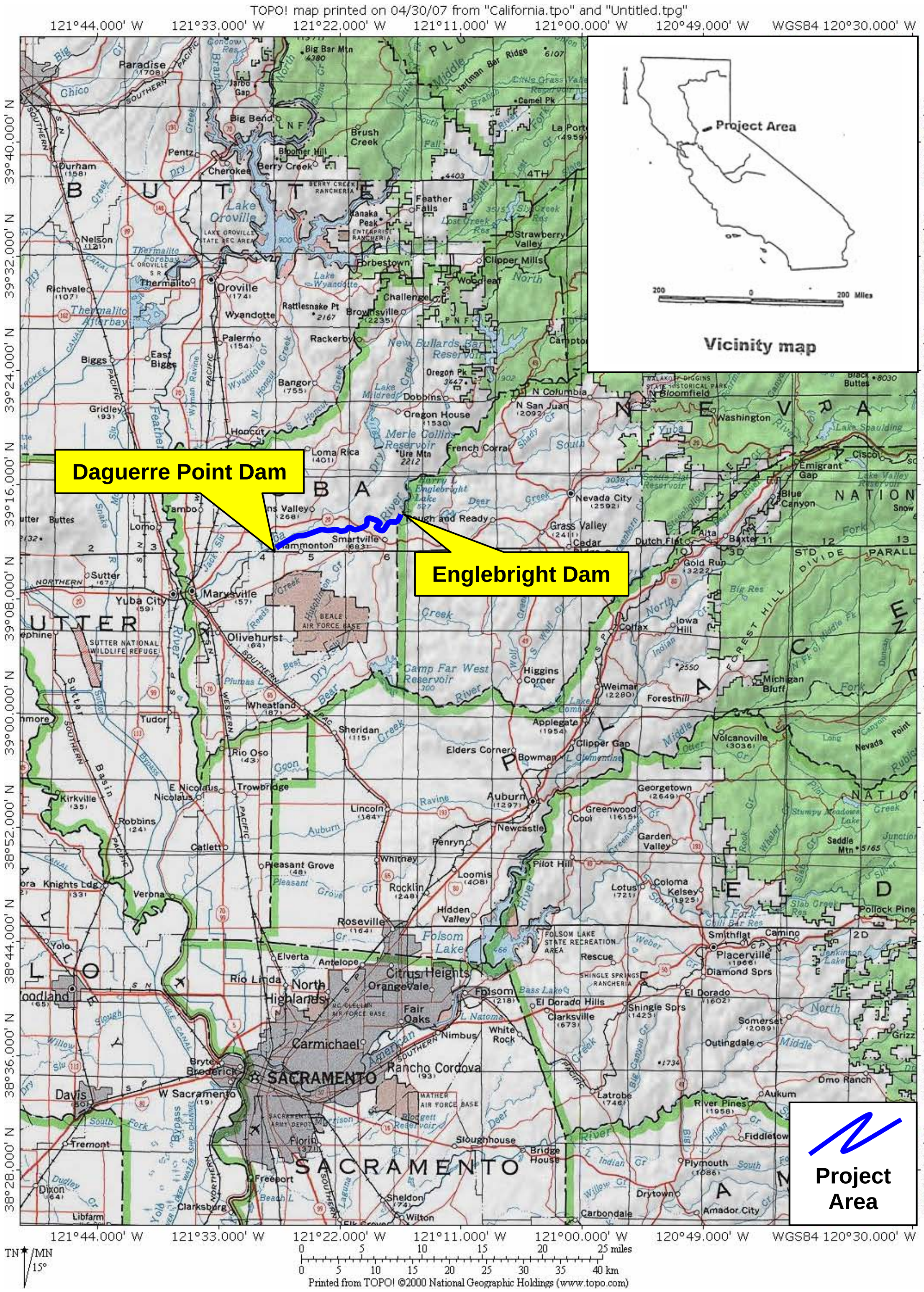



**Plate 1. Project Area Vicinity Map**

**PLATE 2**
**PROJECT AREA MAP**

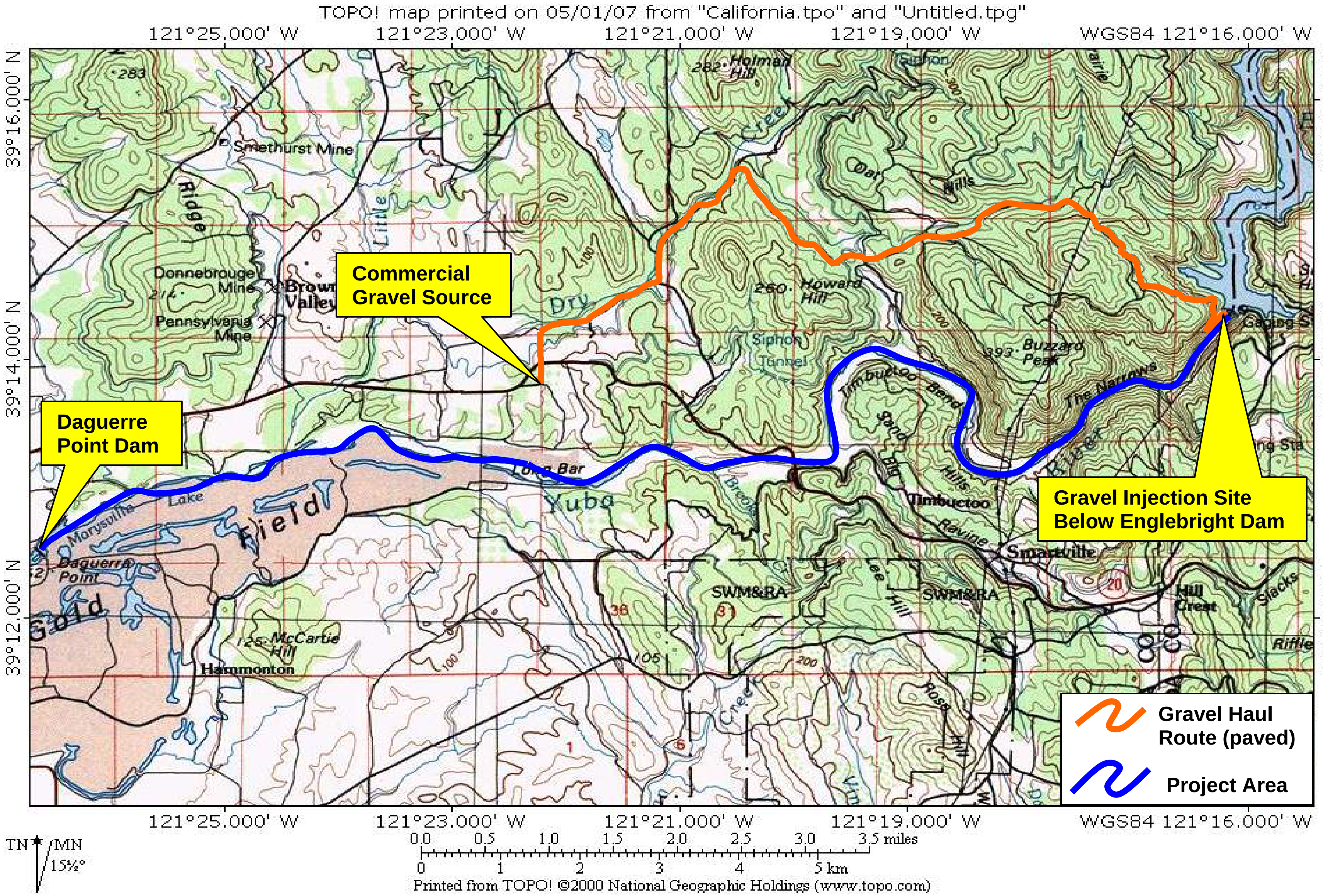



**Plate 2. Project Area Map**

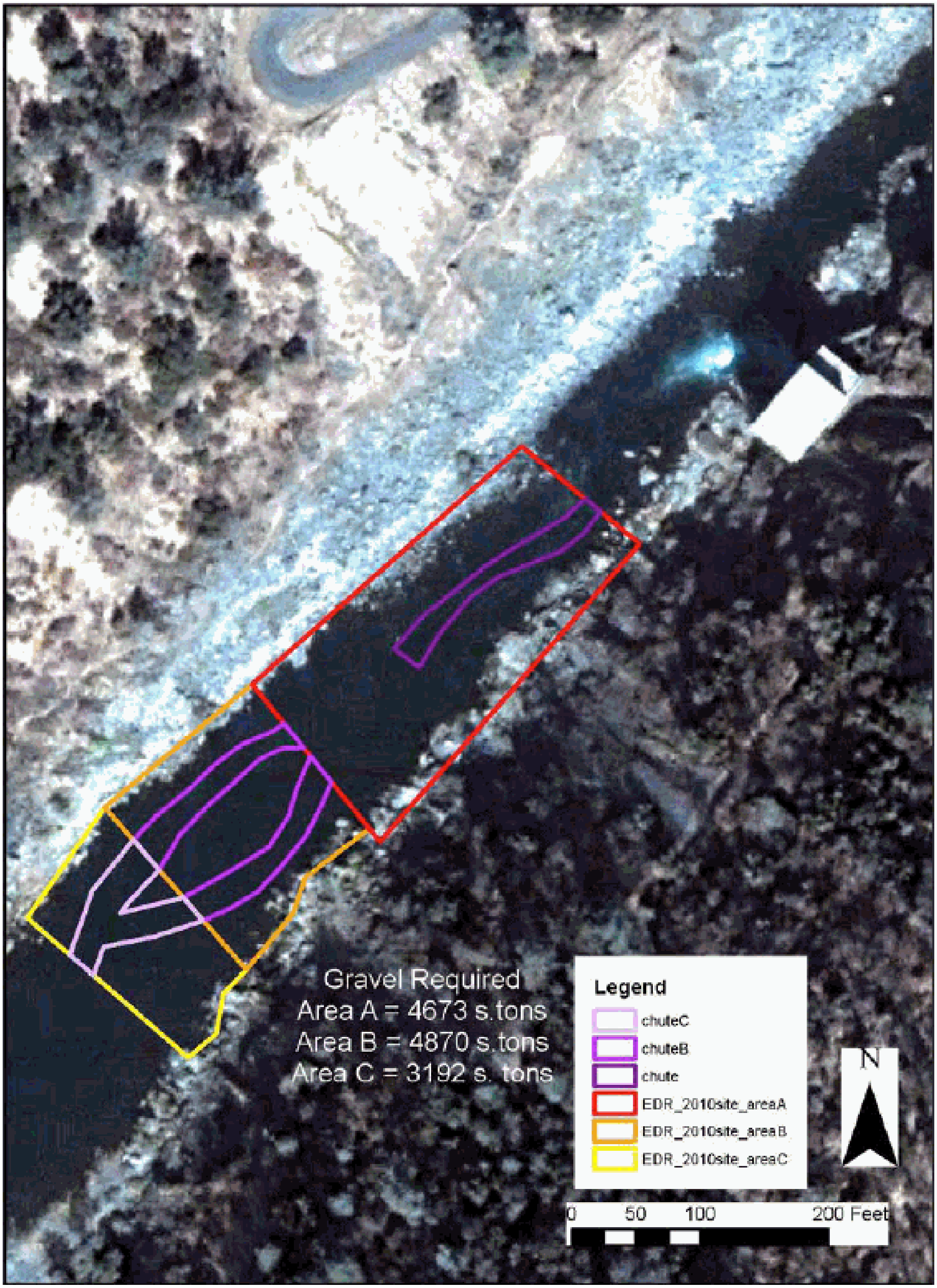
**PLATE 3**
**LOWER YUBA RIVER**


Harry L. Englebright Dam
Englebright Dam Reach
Timbuctoo Reach
Narrows Reach
Deer Creek
Highway 20 Crossing

**PLATE 4**
**LOCATION OF PROJECT FEATURES AND SCHEMATIC OF THE GRAVEL/COBBLE DELIVERY SYSTEM**


Screened water pump(s)
Uphill water push
Gravel Staging Area
habitat builder
Englebright Dam
Gravel sluice pipe in drainage ditch
Narrows II Powerhouse
Narrows I Powerhouse

**PLATE 5.**
**DESIGN CONCEPT FOR USING GRAVEL AUGMENTATION IN THE ENGLEBRIGHT DAM REACH, TO POSSIBLY OBTAIN A SALMON-SPAWNING RIFFLE WITH DIVERSE MICROHABITAT FEATURES**
(Pasternack 2010).


Gravel Required
Area A = 4673 s.tons
Area B = 4870 s.tons
Area C = 3192 s. tons
Legend
chuteC
chuteB
chute
EDR_2010site_areaA
EDR_2010site_areaB
EDR_2010site_areaC
N
0 50 100 200 Feet

# APPENDIX A
# FINAL GRAVEL/COBBLE AUGMENTATION IMPLEMENTATION PLAN

# Gravel/Cobble Augmentation Implementation Plan (GAIP) for the Englebright Dam Reach of the Lower Yuba River, CA

(photo of proposed gravel augmentation location)

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September 30, 2010

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**OVERVIEW**

The purpose of this report is to thoroughly document a plan for implementing a gravel/cobble augmentation program below Englebright Dam and to address its biogeomorphic impact on the lower Yuba River. As described below, Englebright Dam plays a crucial role in protecting the downstream region from being overwhelmed by sedimentary mining waste debris still being eroded off hillsides and stored in long sections of the channel network upstream. Most of the active lower Yuba River also still has tens of millions of cubic yards of sedimentary mining waste debris in it that pre-date Englebright Dam and are still being re-worked as part of a highly dynamic, meandering gravel-bed river. However, the reach between Englebright Dam and the confluence with Deer Creek is now almost devoid of river-rounded gravel and cobble necessary for salmon spawning. In particular, spring-run Chinook salmon that historically went far upstream would substantially benefit from a gravel/cobble augmentation program below Englebright Dam. Yet the critical reach is in a narrow canyon that is difficult to access and manage, let alone place thousands of tons of coarse sediment into. Numerous issues have to be considered and addressed. That effort is facilitated by the existence of many studies of the river in recent years that form the basis for understanding the status and challenges ahead for the river.

This report covers topics related to preliminary planning efforts, pre-project characterization of the reach in question, design development for the specific 2010 next-phase pilot project, and long-term planning. Section 1 is an overview of the literature that describes what is already known about the river leading to a geomorphic and biological nexus for the action necessary to rehabilitate the river with respect to the impact of Englebright Dam. Section 2 explains what gravel/cobble augmentation is and how it may be implemented. Specific constraints and opportunities associated with the possible use of each method below Englebright Dam are described, including how specific methods affect site selection and project goals. Section 3 presents the pre-project characterization of the Englebright Dam Reach. That includes a summary of available data and information, a new estimation of the gravel/cobble deficit for the reach, 2D hydrodynamic modeling and analysis of results, and a conception of how the reach works in its baseline condition. Section 4 presents the details of the concept for how to get gravel to the river bed in the remote canyon. The recommended method involves sluicing gravel and cobble to the river. Section 5 explains and tests design concepts, objectives, and methods for the opportunity to place gravel in 2010 to yield immediate, preferred salmon spawning physical habitat. Section 6 describes a long-term plan for monitoring the outcome of the 2010 pilot project and then what actions should be taken thereafter to continue to rehabilitate gravel/cobble storage and enhance salmonid spawning habitat in the reach with additional augmentations over time.

# 1. LOWER YUBA RIVER BACKGROUND

The 3,490-km$^2$ Yuba River basin has hot, dry summers and cool, wet winters. Relative to other Sierra basins, the Yuba has among the highest mean annual precipitation (>1,500 mm), so it has been used for hydropower, water supply, flood regulation, gold mining and sediment control (James 2005). During the Gold Rush (mid- to late 1800's), hillsides were hydraulically mined until several court decisions first outlawed the practice, then reinstated it with restrictions and taxes instituted to construct and pay for dams such as Daguerre Point Dam and Englebright Dam. These dams were designed to prevent the transport of hydraulic mining debris to the valley, thus lowering the risk of flooding. However, hydraulic mining never returned to the levels of the 1800's (Gilbert, 1917). Englebright Dam is located at 39°14'23.37"N, 121°16'8.75"W (Yuba River mile 23.9 upstream from confluence with the Feather River) in a narrow bedrock canyon on the Yuba River in northern California. Streamflow is recorded at the United States Geological Survey Smartville gage (#11418000) 0.5 km downstream of Englebright Dam. The gage's statistical bankful discharge 1971-2004 was 5620 cfs (159.2 $m^3 s^{-1}$), which matches field indicators (tops of active medial bars and positioning of bank vegetation) for the bankful discharge in Timbuctoo Bend. Given that the Middle and South Yuba tributaries lack large reservoirs, winter storms and spring snowmelt produce floods that overtop Englebright Dam. The Lower Yuba River (LYR) is ~38 km (24 mi) long from Englebright to the junction with the Feather. The Englebright Dam Reach (EDR) extends from Englebright down to the confluence with Deer Creek (Fig. 1.1).

## 1.1. LYR Geomorphic History

No records are known to exist describing river conditions in the canyon that Englebright sits in prior to placer gold mining in the mid-Nineteenth century. During the era of placer gold mining, Malay Camp on the northern bank of the Yuba close to the confluence of Deer Creek served as a base of operations for miners working Landers Bar, an alluvial deposit in the canyon nearby. The historical records of the existence of this camp and placer-mining site proves that coarse sediment was stored in the canyon prior to hydraulic mining in a large enough quantity to produce emergent alluvial bars.

During the period of hydraulic gold mining, vast quantities of sand, gravel, and cobble entered the Yuba River (Gilbert, 1917) and deposited throughout the system (Fig. 1.2). This human impact completely transformed the river. Historical photos from 1909 and 1937 document that the canyon was filled with alluvial sediment with an assemblage of river features including riffles (Pasternack et al., 2010). Conditions downstream of the canyon during that period were described by James et al., (2009). Even though Daguerre Point Dam was built on the valley floor in 1906 (at Yuba River mile 11.4 upstream from confluence with the Feather River) to prevent the transport of hydraulic mining debris, it is too small to block sediment migration during floods.

Englebright Dam (capacity of just 82.6 million $m^3$) was constructed in 1941 to serve as an additional, highly effective barrier to the hydraulic-mining waste material continuing to move down to the Central Valley. Thereafter, photos show that the amount of alluvium in the entire lower Yuba River, including the canyon, decreased (Pasternack et al., 2010). At the Marysville gaging station, the river incised ~20' from 1905-1979, while 0.5 mi downstream of the Highway 20 bridge it incised ~35' over the same period (Beak Consultants, Inc., 1989). These landform adjustments are still on-going. For example, Pasternack (2008) estimated that ~605,000 $yds^3$ of sediment (primarily gravel and cobble) were exported out of Timbuctoo Bend from 1999 to 2006. Further investigations of landform and sediment-storage changes are on-going, and the early indications are that they will show significant dynamism well beyond what was presumed by Beak Consultants, Inc (1989).

The reported changes conform with the expected, natural response of a river to blockage of downstream sediment passage (e.g. Williams and Wolman, 1984). For most rivers, such geomorphic changes represent a harmful human impact on a river, but in this case of pre-existing, unnatural snuffing of the river corridor by mining debris, the dam is actually *restoring* the river toward its historical geomorphic condition, in the truest meaning of the term- to go back to the pre-existing state prior to hydraulic gold mining. Hydraulic mining is the primary disturbance to the Yuba River. Going back in this case means evacuating much of the waste debris associated with that historic practice. Abatement of the downstream effects of sediment derived from uplands through the use of dams is an accepted practice for watershed rehabilitation (Shields, in press). On the LYR, there is strong evidence that Englebright Dam has helped to evacuate sediment without hurting important channel processes. For example, despite the evidence that Timbuctoo Bend is undergoing significant sediment export and river-corridor incision, White et al. (2010) reported that eight riffles persisted in the same locations over the last 26 years (likely back much further). Most of these persistent riffles are positioned in the locally wide areas in the valley, while intervening pools are located at valley constrictions. Thus, incision and sediment export do not necessary translate into harmful degradation of fluvial landforms. In Timbuctoo Bend, the existence of undular valley walls preserves riffle-pool morphology in the face of on-going geomorphic change. Given the vast quantity of waste material still present in the upper system and the ability of many unhealed hillsides to generate more, Englebright Dam continues to serve as an important protection for the environment of the LYR.

Confounding the natural response of the river to the restorative impact of Englebright, the Yuba River has been subjected to harmful in-channel human activities that further altered it. The greatest impact came from dredgers processing and re-processing most of the alluvium in the river valley in the search for residual gold and to control the river (James et al., 2009). First, there was the formation of the ~10,000 acre Yuba Goldfields in the ancestral migration belt. Then there was the relocation of the river to the valley's northern edge and its isolation from the Goldfields by large "training berms" of piled-up dredger spoils. Dredger-spoil training berms also exist further upstream in Timbuctoo Bend away from the Goldfields (Fig. 1.3); these berms provide no flood-control benefit.

Although no training berms exist in the canyon downstream of Englebright Dam, mechanized gold mining facilitated by a bulldozer beginning ~1960 (Fig. 1.4) completely reworked the alluvial deposits in the vicinity of the confluence with Deer Creek, changing the river's form there (Pasternack et al., 2010). Prior to mechanized mining, glide-riffle transitions were gradual, enabling fish to select among a diverse range of local hydraulic conditions. Bulldozer debris constricted the channel significantly, induced abrupt hydraulic transitioning, and caused the main riffle at the apex of the bar to degrade into a chute. In addition, mining operations evacuated the majority of alluvium at the mouth of Deer Creek. On top of these impacts, the 1997 flood caused angular hillside rocks and “shot rock” debris from the canyon bottom to be deposited on top of the hydraulic-mining alluvium in the canyon.

At present, the Yuba River downstream of Englebright Dam continues to change in response to the complex assemblage of natural processes and human impacts. The legacy of hydraulic mining is the first and foremost impact to the system, relative to the pre-existing condition. Englebright Dam blocks further impacts from upstream mining waste and is directing the river on a trajectory toward restoration of the pre-existing landform. Daguerre Point Dam serves as a stabilizer in the system, providing a base level for how far incision can go between it and Englebright Dam. Mechanized re-working of alluvium and associated channelization have dictated the lateral bounds of what the river can do now and also impact the diversity and distribution of river-corridor landforms.

In summary, the fluvial geomorphology of the Yuba River is so unique that it is crucial to evaluate it on its own terms and not apply simple generations and concepts from other rivers with dams. Hydraulic mining, dredger re-processing of the valley floor, mechanized in-channel mining, upstream watershed management choices, and dams all combine to yield a system that requires careful investigation before making conclusions about how the fluvial geomorphology works and what restoration opportunities exist. Recent studies have helped clarify the current status of the river and more investigations are on-going.

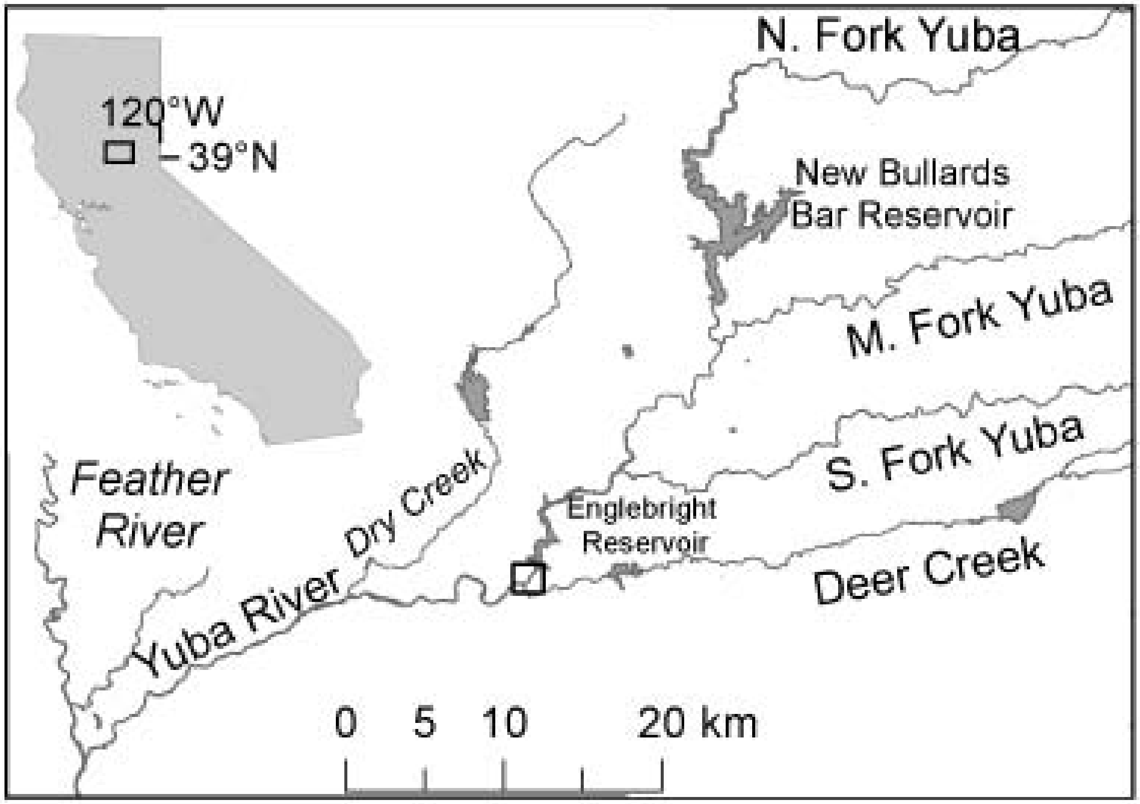


**Figure 1.1.** Location map of the Englebright Dam Reach (black box) in the Yuba catchment.

**Figure 1.2.** 1905 photo of the LYR near Parks Bar taken by G.K. Bilbert (http://libraryphoto.cr.usgs.gov/photo_all.htm).

**Figure 1.3.** Dredger forming high tailings berm out of a mining-waste point bar at Rose Bar on 10/21/1937. (Photo from the California Transportation State Archive).

**Figure 1.4.** Photo of a gold mining operation on Sinoro Bar circa 1960. (Photo courtest of Ralph Mullican).

## 1.2. LYR Salmonids History

### 1.2.1. Historical Population Accounts

The spring run of Chinook salmon (SRCS) is a federally threatened species that is differentiated by the time at which adults migrate from the ocean to freshwater systems (Yoshiyama et al. 1996). There are no quantitative estimates for pristine, historic salmonid populations on the Yuba River prior to hydraulic gold mining, let alone isolating just SRCS, but Yoshiyama et al. (1996) reported historic accounts suggesting a large population, possibly in the hundreds of thousands. For example, they cite Chamberlain and Wells (1879) as stating that the Yuba was so full of salmon that Indians speared them "by the hundred". However, during hydraulic gold mining much water was diverted away and the river valley was allowed to fill 20-80' high with mine tailings. A first-hand account of a miner at Long Bar in the valley stated that the miner's diet primarily consisted of pancakes and there is no mention of fish at all (Lecouvreur, 1906). Yoshiyama et al. (1996) reported accounts of the construction of Bullards Bar Dam in 1921-1924 in which it was stated that so many salmon were blocked at the construction location that their carcasses had to be burned. SRCS and steelhead both were known to migrate far up into the North and Middle Yuba Rivers and several miles up into the South Yuba before reaching potentially impassable waterfalls. However, much of the spawning habitat in the upper watershed was badly degraded by mining debris, sand, and turbidity. If the SRCS population was in the hundreds of thousands of fish, then the riffles in the canyon where Englebright Dam is located would likely have been used by part of that large population during the mining era and early 20th century. However, relative to the total abundance, this number of fish spawning in the canyon may not have drawn the attention of naturalists at the time, especially given the difficulty of getting to that area.

During the latter half of the 20th century, Yuba River salmonid populations were estimated quantitatively (Fig. 1.5), but it is still difficult to isolate SRCS numbers. Yoshiyama et al. (1996) cite several estimates of the fall-run Chinook salmon population, but provide no enumeration of SRCS. They cite John Nelson as reporting that fall- and spring-run populations are mixed and that these mixed fish are now present in "minimal numbers". CDFG (1991) enumerates the annual estimate of fall-run Chinook salmon, with a range of 1000 in 1957 to 39,000 in 1982. For SRCS, CDFG (1991) states that a remnant population exists and that it is composed of some in-river natural reproduction, strays from the Feather River, and restocked, hatchery-reared fish. Restocking of fingerlings and yearlings was done in 1980. CDFG (1991) reported that 20 pairs of Chinook salmon were observed to spawn at the Narrows powerhouse in autumn 1986 and due to passage barriers in the autumn, it was decided that these were SRCS that migrated during high spring flows. CDFG stopped conducting annual escapement surveys in 1989. No survey was done in 1990. The Yuba County Water Agency (YCWA) sponsored Jones and Stokes, Inc. to perform escapement surveys using the CDFG methodology for 1991-2004.

For 2005-2007 CDFG took over the effort again, but beginning in 2008 the responsibility shifted to the Yuba Accord River Management Team (RMT) as part of its new Monitoring and Evaluation Plan. The RMT's 2008 escapement and redd reports used temporal modalities associated with fresh carcass observations and frequencies of redd observations to try to differentiate spring- and fall-run Chinook salmon. However, it was not possible to obtain a clear distinction and all data were analyzed together. In all of these modern enumerations, abundance estimates did not isolate SRCS or the subpopulation of all Chinook in the EDR; carcass counts were not made in the EDR due to challenging accessibility.

For March 2007 through February 2008, the RMT operated a Vaki RiverWatcher video monitoring system on both fish ladders at Daguerre Point Dam (~12 miles downstream of the EDR). This system scans the side-view projected area of each fish and takes a color photo of each fish. From these data, staff counts the number of fish that pass and use characteristic morphometrics to identify the species of each fish (for ~70% of individuals). Of the 1,324 Chinook that were observed, 336 (25%) passed in March-August, which is the period that SRCS likely migrate.

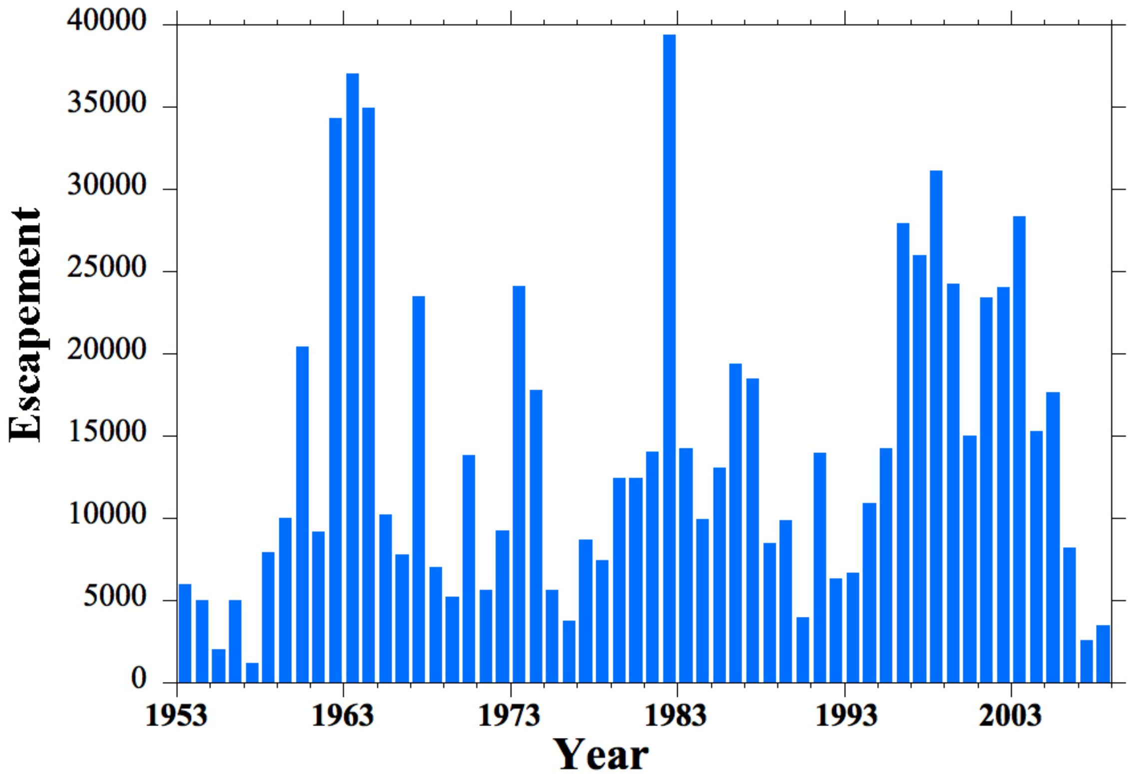


**Figure 1.5.** Adult Chinook salmon abundance for the LYR based on carcass surveys and coded-wire tagging.

### 1.2.2. Physical Habitat Conditions

Physical habitat units in rivers are defined as zones with characteristic attributes where organisms perform ecological functions, which are the ways in which organisms interact with each other and their surroundings. Common attributes of physical habitat include substrate type, water depth, water velocity, water temperature, cover objects, and shading. The quantity and quality of physical habitat are critical factors that can limit the size of fish populations. The assemblage of these attributes stem from the interaction among hydrologic, hydraulic, and geomorphic processes. As a result, when processes are altered or degraded by human intervention, then physical habitat will likely be degraded too. In turn, that decreases the size of fish populations.

Physical habitat conditions related to salmonids downstream of Englebright Dam have been studied over the years. With respect to the spawning life stage, Fulton (2008) investigated salmon spawning habitat conditions in the canyon below Englebright Dam and found the conditions to be very poor to nonexistent. No rounded river gravels/cobbles are present in the canyon between Englebright Dam and Sinoro Bar by the confluence with Deer Creek other than a small amount injected artificially in November 2007. For the whole lower Yuba River, Beak Consultants, Inc (1989) states:

> "The spawning gravel resources in the river are considered to be excellent based on the abundance of suitable gravels, particularly in the Garcia Gravel Pit and Daguerre Point Dam reaches. The tremendous volumes of gravel remaining in the river as a result of hydraulic mining make it unlikely that spawning gravel will be in short supply in the foreseeable future. Armoring of the channel bed is possible, but has not developed to date, probably due to periodic flushing by floods comparable to the 1986 event."

Similarly, Pasternack (2008) reported that:

> In Timbuctoo Bend "…there is adequate physical habitat to support spawning of Chinook salmon and steelhead trout in their present population size. Furthermore, all of the preferred morphological units in the *[Timbuctoo Bend Reach]* TBR have a lot of unutilized area and adequate substrates to serve larger populations."

With respect to rearing life stages, Beak Consultants, Inc (1989) states that:

> "The Daguerre Point Dam and Garcia Gravel Pit reaches contribute most of the *[Weighted Usable Area]* WUA, and substantially more than the Simpson Lane Reach; The Narrows Reach contributes little fry habitat… Total WUA for juveniles is highest in the Daguerre Point Darn and Garcia Gravel Pit reaches… The Simpson Lane Reach contributes a small amount of WUA, while The Narrows Reach provides virtually no juvenile habitat."

Adult migration is presently under study by the RMT, but there are some pre-existing observations. Adult SRCS are commonly observed holding in pools in the canyon below Englebright Dam, in the pools in Timbuctoo Bend, and in the pool below Daguerre Point Dam. In September 2007, UC Davis graduate student Aaron Fulton observed SRCS attempting to dig redds and spawn on bedrock covered with a thin veneer of angular gravel, causing them injury. Acoustic tracking of adult SRCS in 2009 by the RMT showed that some individuals migrate into and out of the canyon until September at which point they stop migrating and attempt to spawn between Englebright Dam and the highway 20 bridge.

### 1.3. LYR Geomorphology-Salmonids Nexus

Two key conclusions from this review of previous knowledge are that most of the lower Yuba River is still geomorphically dynamic and that the river possesses a diversity of in-channel physical habitats, even if some types are not as abundant as would be optimal for restoring the size of fish populations that likely existed in the Yuba River prior to the onset of hydraulic gold mining. Hydraulic mining snuffed the river and its floodplain with a vast, homogenous mix of mining waste. Since Englebright Dam blocked that, channel complexity and habitat diversity has been re-emerging, and that process continues. The extent to which it can continue is impacted by the role of the training berms and the degraded state of the entire Yuba Goldfields, both of which are beyond the scope of actions related specifically to the impact of Englebright Dam, which is the focus of this report. The glaring problem in the system associated with this dam is the status of SRCS spawning in the EDR.

The dramatic decline in SRCS in California has been attributed to dams, as they block up to ~80% of historic spawning habitat. Based on life history, impassable high dams have hurt the spawning life stage of adult SRCS the most, because spawning is the purpose behind the migration of SRCS to Sierran headwaters. Under a regulated flow regime, SRCS migrate to bedrock reaches at the base of large dams and hold in pools supplied with cold sub-thermocline water releases. On the Yuba holding occurs below Daguerre Point Dam and to a lesser extent below Englebright Dam (Fig. 1.6), but once it is time to spawn, SRCS move upstream into the canyon. Therefore, whether they provided historically preferred physical spawning habitat or not (and for the Yuba the evidence is that they did), bedrock reaches at the base of large dams play a key role in SRCS viability under the current regime of impassable dams.

If SRCS cannot spawn in sufficient numbers, then physical habitats supporting their subsequent life stages downstream are irrelevant. There is no question that Englebright Dam is a complete barrier to fish migration upstream and gravel/cobble transport downstream. Any effort to reinstate SRCS presence upstream of Englebright Dam would take significant time to figure out, implement, and evaluate its effectiveness. If such an effort were undertaken, it would still be critical to sustain existing populations below the dam using well-proven methods until passage efforts were equally well demonstrated in the watershed. To achieve usable, preferred SRCS spawning habitat in the canyon, it is necessary to resolve the lack of river-rounded gravels/cobbles there. At this time and for the foreseeable future, only the canyon is in need of a gravel/cobble supply to offset the impact of Englebright Dam.

**Figure 1.6. Photo of SRCS holding in bedrock/boulder section of the LYR near the mouth of Deer Creek (photo courtesy of Ralph Mullican).**

## 2. GRAVEL/COBBLE AUGMENTATION

The key negative impact of Englebright Dam on the lower Yuba River is the loss of a mixture of gravel- and cobble-sized river-rounded rocks in the canyon between Englebright Dam and the confluence with Deer Creek, which is necessary to support SRCS spawning there. This reach is known as the Englebright Dam Reach (EDR). Fulton (2008) investigated physical habitat in the uppermost third of the EDR and found that suitable hydraulics for salmon spawning were present there, but needed substrates were absent (Fig. 2.1). Subsequent modeling of the entire EDR showed that the same holds true for the entire reach- there are areas of good hydraulics, but they lack the needed river-rounded gravel and cobble mixture (Pasternack, 2008a). Thus, the solution to this problem is to implement a procedure known as gravel/cobble augmentation (Wheaton et al. 2004a; Pasternack, 2008b).

**Figure 2.1.** Photo of the EDR below Narrows 1 showing the dominance of shot rock on the banks. The wetted channel is devoid of river-rounded gravel and cobble in this area.

**2.1. Gravel/Cobble Augmentation Defined**

Gravel/cobble augmentation (aka gravel/cobble injection) is defined as the piling up of coarse sediment (usually a mixture of gravel and cobble ranging in size from 0.3-4 inches (8-100 mm) in diameter) within or along a river (Wheaton et al., 2004a).

*The **geomorphic goal** of gravel/cobble augmentation is to reinstate interdecadal, sustainable sediment transport downstream of a dam during floods, which is necessary to support and maintain diverse morphological units, such as riffles, pools, point bars, and backwaters* (Pasternack, 2008b).

*The **ecological goal** of gravel/cobble augmentation that yields self-sustainable morphological units is to have the associated assemblages of physical attributes that are preferred for each of the freshwater life stages of salmonids* (Pasternack, 2008b).

Pasternack (2008b) explains the pros and cons of gravel/cobble augmentation relative to other methods of river rehabilitation in support of salmon spawning. It is important to understand that achieving the geomorphic goal does not mean that the ecological goal will be achieved too. It has frequently been observed that when gravel is injected into a river, it just settles into the bottom of a deep in-channel pit or pool, never to be re-entrained. Unless a reach is investigated for its hydrogeomorphic mechanisms of fluvial landform maintenance, then there is no basis to an assumption that ecological benefits will necessary be achieved from successful redistribution of injected coarse sediment. This is the concept of “process-based” river restoration (Beechie et al., 2010). Any action may or may not work, depending on whether its usage has been placed into the context of the fluvial mechanisms at work in the system. Augmentation of flow or gravel/cobble in the absence of an understanding of processes and impacts is a gamble of unknown value or harm (Pasternack, 2008b).

When performing gravel/cobble augmentation it is often possible to place the material into the wetted channel according a specific design capable of yielding immediate salmon spawning habitat (Wheaton et al., 2004b; Elkins et al., 2007). It can be beneficial to add large wood and boulders during construction to form hydraulic structures in symphony with the gravel/cobble placement (Wheaton et al., 2004c). Together, these diverse elements are shaped (but not hard-wired) to provide adult holding habitat proximal to high-quality spawning habitat, further enhance spawning habitat with complex gravel oxygenation and shading conditions, and furnish early rearing habitat before fish migrate or are flushed downstream. Depending on site history and the specific goals and methods of such efforts, this approach of blending gravel/cobble placement and hydraulic structure construction can dramatically enhance or rehabilitate morphological units and sub-unit hydraulic complexity for a reach below a dam (Elkins et al., 2007). By coupling that with a long-term gravel/cobble injection program at the base of a dam and evaluation of the flow regime, a comprehensive framework for rehabilitating and managing a regulated river can be achieved (Pasternack 2008b). Such a framework for river rehabilitation is hierarchical, because it incorporates a) microhabitat diversity to provide preferred local conditions to support different life stages of existing populations, b) geomorphically sound mesohabitats that provides more and larger organized areas to grow populations, and c) flow variability and injections of gravel to provide the physical inputs necessary for geomorphic dynamics that renew and sustain a gravel-bed river.

### 2.2. LYR Pilot Gravel/Cobble Augmentation

The United States Army Corps of Engineers (The Corps), UC Davis, and USFWS collaborated on an experimental gravel/cobble injection below Englebright Dam (in the pool below the Narrows II powerhouse) in November 2007. The purpose of this experiment was to find out if and where gravel/cobble would deposit in the EDR and thus gain insight into the efficacy of gravel/cobble injection as a habitat enhancement tool for spring-run Chinook salmon in the EDR. The basic study design involved injecting gravel/cobble during low flow in autumn of 2007 and then waiting for high flows in subsequent water years to move it. Then it would be possible to track where those materials went.

Five hundred short tons of triple washed river gravel/cobble was purchased from a nearby quarry downstream. Based on bucket tests in a quarry, Merz et al. (2006) reported a dry bulk density of gravel/cobble to be ~0.722 $yds^3$ per short ton for a Mokelumne River quarry. Using this estimate, a total of 361 $yds^3$ of gravel/cobble was available to be injected in the EDR. The material was trucked in ahead of time and piled on top of the gravel parking lot at the Narrows II powerhouse (Fig. 2.2). Gravel/cobble injection took place on November 29, 2007 beginning at 9:30 am and finishing by 3:00 pm (Fig. 2.3). A TB 135 truck-mounted gravel conveyor was used to reach out over the river and inject gravel into the Narrows II pool. A single small loader was used to transfer piled gravel/cobble into the hopper, but it turned out that not all the gravel/cobble could be fully injected during the single allotted day using that one loader. Consequently, a small amount ended up being incorporated into the parking lot, instead of going into the river (Fig. 2.4). Using a tape measure, the volume of gravel/cobble left behind on the parking lot, in between boulders on the edge of the lot, and spilled over the side was estimated to be ~34 $yds^3$. Thus, ~327 $yds^3$ of gravel and cobble was placed into the river.

As the material was being placed into the river, ~400 painted, magnetized tracer stones were put into the hopper with the gravel/cobble to facilitate tracking. Those tracers are thus integrated all throughout the in-river gravel/cobble pile. Those stones are traceable using a magnetic locator, but any rounded gravel that is found downstream in the EDR must be coming from this source, because there is virtually no other such material in this reach.

Pasternack (2009) investigated the status of the injected gravel/cobble after two winters, and some interesting lessons were evident. Although the two intervening winters were relatively dry (Fig. 2.5), some transport did take place. Of the 327 $yds^3$ that was successfully injected to the river, only ~3 $yds^3$ moved during the period when flow was ≤ 8014 cfs. After a flood with a peak flow of 15381 cfs, a total of ~75 $yds^3$ moved. That amount includes the ~3 $yds^3$ that was moved prior to that, so that means that ~252 $yds^3$ remained in the gravel/cobble injection pile in the Narrows II pool as of July 1, 2009. For the 2010 water year, the peak discharge occurred in June 5, 2010 and it was only 6928 cfs.

Preliminary observations of Chinook salmon redds in 2009-2010 by the RMT found that 120 redds were located in the EDR between September 7, 2009 and February

22, 2010. This response to limited gravel injection indicates that if more gravel was present, a population of SRCS could be accommodated.

**Figure 2.2.** 500 short tons of gravel/cobble prior to injection into the Narrows II pool.

**Figure 2.3.** Gravel injection on November 29, 2007. Gravel pile is located in zone of aeration downstream of the Narrows II powerhouse.

**Figure 2.4.** Photo of stockpiled gravel/cobble left on the parking area and hillside after the 2007 pilot injection.

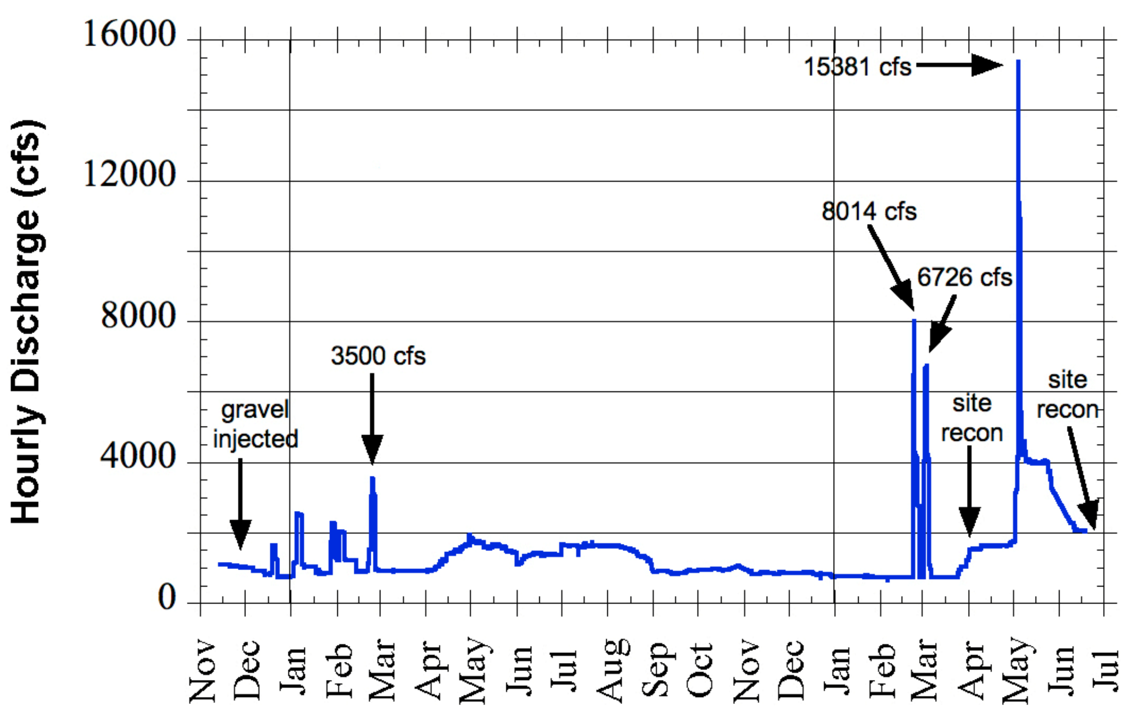


**Figure 2.5.** EDR Hydrograph of 2008-2009 water years showing flow peaks and the timing of key activities.

## 2.3. Methods for Gravel/Cobble Augmentation

Once a decision is made to perform gravel/cobble augmentation relative to other possible actions (Pasternack, 2008b), then it is necessary to determine how to implement it. Several reports have analyzed different methods for implementing gravel/cobble augmentation downstream of dams on rivers. Kimball (2003) described methods, limitations, horizontal placement distance, discharge rate, and the price per ton for 1,000 tons of gravel/cobble placed using helicopters, cable ways, and various conveyor belt systems (portable, truck-mounted, crane mounted and attached to dump truck). Bunte (2004) took a different approach and focused on the diverse river forms made with gravel/cobble-augmentation deposits through active construction and "passive" injection. Those included hydraulic structures, big flat plateaus of gravel, supplementation and lengthening of existing riffles (either upstream or downstream of crest), long riffles with 1-3 crests, artificial spawning channels, complex river patterns, filling of pools, bar shaping, spot fixing. She also covered placement of emergent deposits for future flood redistribution, including dumping along the streambank and construction of ephemeral wing dams directing flow into irrigation diversion canals (Bunte, 2004). Sawyer et al. (2009) reported a thorough analysis of the opportunities and constraints of using front loaders to place gravel/cobble according to a detailed design.

The environmental assessment report for the 2007 pilot gravel/cobble injection analyzed three methods of gravel/cobble augmentation (USACE, 2007). For the remote canyon downstream of Englebright Dam, there is a tremendous challenge to get down to the water's edge in the section where gravel is needed most. The alternatives considered were road construction, helicopter, and truck-mounted conveyor belt.

### 2.3.1. Road Construction and Gravel Placement

The first method assessed by USACE (2007) was gravel/cobble placement by hauling material in 10-ton and 20-ton trucks down to the river's edge, pouring it along the edge, and distributing it with front loaders. However, the EDR has not had a road down to the water's edge since the 1997 flood destroyed the previous one there. The elevation of the river's water surface at 855 cfs is ~292' (NAVD88 datum), whereas the elevation of the end of the existing road at the Narrows II facility is ~353'. The vertical drop of 61' takes place over a horizontal distance of just ~100', so the slope is 0.5 (50%). As a result, the road would have to be steep with switchbacks. It would be unlikely for 20-ton trucks to negotiate the switchbacks, so delivery would be limited to 10-ton trucks or front loaders. Moreover, to construct a new road would require importing a large quantity of road fill materials. USACE (2007) raised a serious concern about the risk of these materials eroding by rain, landslide, or flood, which would cause harmful mud, sand, and angular crushed rock to enter the river and integrate into the bed material. USACE (2007) also indicated that it would be extremely costly and environmentally harmful to remove a temporary road after gravel/cobble augmentation. It is not possible to remove a road off a steep rocky hillside without causing debris to be left behind risking water quality and river-substrate problems. Further considerations in 2010 raised the concern over possibly having to excavate the end of the road in the channel, which could cause water quality problems. Also, the permitting process for road construction would take a long time, precluding gravel/cobble augmentation in 2010 and possibly 2011.

Assuming that a road was constructed and gravel/cobble were to be placed by front loaders, then a suite of concerns related to these machines come into consideration (Sawyer et al., 2009). Extra care would be necessary to avoid oil or gas leaks out of the machinery (a problem known from other efforts). There is also a limitation in matching grading plans in that front loaders cannot go into water deeper than ~2-2.5' or else the transmission can be flooded, ruining the machine (another problem known to have happened in the past on another river). Finally, front loaders cause a high level of turbidity as they drive over the river bed, which can be a water quality problem. For all the above reasons, the method of direct gravel/cobble placement commonly used on the American, Mokelumne, and Trinity Rivers in California is not preferable.

#### 2.3.2. Helicopter Delivery

The second method assessed by USACE (2007) was helicopter delivery. This can be the only means possible for extremely remote locations. However, this approach is the most expensive method, it has a slow delivery rate (depending on how far the stockpile is from the placement site), and it involves highly risky helicopter flying in the presence of power lines and in a narrow canyon with variable winds.

### 2.3.3. Truck-Mounted Conveyor Belt

The third method assessed by USACE (2007), which was ultimately used in the 2007 pilot project, was a truck-mounted conveyor belt. For this approach, a 135' long conveyor belt mounted onto a truck is fully extended and rotated perpendicular to the truck so that its end is over the river. With a ~100-120' bank width, this length is just sufficient to get material into the Narrows II pool. Material is fed into a hopper using a small 0.5- to 1-ton front loader, and then a feeder with a conveyor belt lifts the material up and onto the truck-mounted belt that delivers it out over the water. By pouring the gravel/cobble into a deep pool, particle breakage is avoided. The experience with using this method in 2007 was highly positive. The only lesson learned from the 2007 pilot project that would enhance future usage of this method was that gravel/cobble injection would have been faster if two loaders had been used instead of one.

Unfortunately, there are two serious problems with using the truck-mounted conveyor belt approach in 2010 and beyond below Englebright Dam. First, given the geometry of the road, hillside, channel, and Narrows II powerhouse, the area of the wetted channel suitable for injection that is within the 135' length of the conveyor belt is very limited. Gravel/cobble is not permitted to be injected up against the powerhouse and any pile cannot interfere with the immediate outflow jet issuing from the powerhouse. The Narrows II pool is ~15' deep, but much of it is not reachable with the conveyor belt. Based on visual appearance at the end of the injection in 2007, the gravel/cobble pile was ~ 11' high off the bed. Given some more rotation capability and making the water even shallower, it looked like a total amount of <1000 tons could be stored in the pool by this method. The gravel/cobble deficit for the EDR (to be enumerated below in section 3) is one to two orders of magnitude higher than that, making this approach inadequate for the need.

Second, there is a proven concern of gravel/cobble injected into the Narrow II pool depositing into the shallow area between the Narrows II and Narrows I powerhouses (Pasternack, 2009). The gravel/cobble injected in 2007 fractionated by size during transport in 2008-2010, such that coarser material deposited on the first bedrock plateau and finer material deposited further downstream. Spawning has been observed on the shallow coarser material on the bedrock plateau. A potential exists in emergency situations where gravel may be de-watered.

When Fulton (2008) and Pasternack (2008a) evaluated the scour potential in the Narrows II pool for different sized floods, they assumed that the gravel/cobble would be in a blanket at the bottom of the pool, not standing ~11' high in a loose conical pile. They had no knowledge at the time of their efforts in 2005-2006 how gravel/cobble augmentation might be done at remote Englebright Dam, so they made a basic assumption about it. As a result, they studied a very different situation from what ended up happening. For the case of a blanket fill on the bed, they predicted that any flood capable of scouring the bottom of this deep pool would easily transport the material beyond the Narrows I powerhouse. The reason is that the intervening channel area consists of a bedrock plateau that is narrower and shallower over the whole flow range, so that focuses flow into the fastest, most scouring jet of water possible for the EDR. Based on 2D modeling, it was demonstrated that any flow that could scour gravel/cobble off the bed of the deep pool would definitely be able to transport it beyond the Narrows I facility.

In fact, the actual conditions associated with the 2007 pilot (and any such gravel/cobble augmentation using the truck-mounted conveyor belt) as well as the flow regime that occurred in 2009 were quite different from what had been investigated. Not only was the gravel/cobble piled high unlike in the model simulations, but another important factor not considered was that the Narrows I powerhouse was releasing 500 cfs perpendicular to the channel during the 2009 peak flow overtopping Englebright Dam. Fulton (2008) did not have a topographic map all the way down to Narrows I for his model study and did not investigate the impact of a flow jetting across the riverbed at that location. Conceptually, such a jet would be expected to dramatically reduce bedload transport past that location.

Thanks to the use of a real-world pilot experiment, Pasternack (2009) observed that the 2009 flood of 15381 cfs scoured off the top ~23% of the 2007 pile. None of the eroded material made it past the Narrows I powerhouse. Instead, it deposited in the nooks in bedrock fractures and behind boulders and bedrock outcrops in a narrow band down the length of the area between the two powerhouses. In autumn 2009 Chinook salmonids were observed by RMT staff to be spawning on that material.

Pasternack (2009) provides a thorough evaluation of what happened and the consequence is that injection of a large amount of gravel/cobble into the Narrows II pool would certainly yield deposits in the area between the powerhouses that is at risk for annual dewatering in September-November. Given that the entire EDR is lacking in gravel/cobble, there are other areas where gravel could be introduced downstream of Narrows I, thereby avoiding the problem if channel dewatering. At a later time it might be worthwhile to revisit the issues related to gravel augmentation upstream of the Narrows I powerhouse to determine any conditions under which gravel/cobble could be added there to expand total habitat capacity and gravel/cobble storage in the reach.

#### 2.3.4. Dumping Gravel/Cobble off Roadside

Although not discussed in USACE (2007), another option is that gravel/cobble may be added to a stream by dumping it off a truck down a hillside to the stream bank or into a stream (Bunte, 2004). This approach has been used on Clear Creek, Trinity River, and the upper Sacramento River. It is very inexpensive and fast. However, this approach only serves geomorphic and ecologic goals if the material avoids breakage and actually becomes entrained into the river. Normally that requires a flood to achieve, which could be years to decades before it happens, precluding ecological benefits. For the hillside below Englebright Dam, the only section accessible by truck is between Narrows I and II powerhouses raising the potential problem of material depositing on the bed at risk of dewatering. Also, the hillside is composed of large boulders, shot rock, and bedrock, so dumping material there would cause a lot of breakage. Angular gravel/cobble harms adult spawners. Finally, there are so many nooks in the material on the hillside that it is most likely that the material would be absorbed into those recesses and locked away. Dramatically more material would have to be placed to offset that problem, and even then it is unclear that the material would ever deposit where desired. A thorough, process-based analysis would be required, but the technical challenges of such an assessment yield high uncertainty.

#### 2.3.5. Cableway Delivery

For steep canyons it is possible to build a cableway high across the canyon and drop gravel down into the river. By having one end of the cableway at a higher elevation than the other, it is possible for the weight of gravel/cobble to carry the load down over the river. After dumping to out, then one winches the container back up. Kimball (2003) reported details and costs. For the canyon below Englebright Dam, the problem is that the only place to stockpile gravel and install/operate a cable way would be in the area between Narrows I and II facilities. As discussed before, this area has a risk of gravel/cobble dewatering in September and October making it unsuitable for gravel/cobble augmentation at this time. Also, gravel/cobble placement is limited to a single cross-section, and for that cross-section there is little control over how and where gravel is place in the river. These factors make this method unsuitable for the EDR for 2010 and likely beyond.

#### 2.3.6. Gravel/Cobble Sluicing

According to Pittman and Matthews (2007) and Kimball (2003), gravel/cobble sluicing involves drawing water up from a source and into an 8" diameter "Yelomine" flexible pipe where gravel/cobble is added from the top to produce a water-sediment slurry that is then piped down to a site for directed placement by 1-2 operators. The amount of water used to do the sluicing depends on the pipe and pump configuration, and is typically 1000-1500 gallons per minutes, which is 2.23-3.34 cfs. The best way to get the water is to locate the water pump(s) at the source-water's edge and then push the water uphill in a 6-8" pipe. The pump cannot draw water vertically up to it more than 30', but if the pump is placed at the water's edge it can push the water vertically much farther as needed to get to the top of the a hill where the gravel/cobble is added.

Normally, it takes five people to operate the system- one person operating the water pump at the water source, one person in a loader bringing gravel to the feeder, one person operating the feeder to prevent clogs and coordinate communications, and two people at the nozzle directing gravel placement and adding pipe as needed to move downstream periodically. This approach is particularly notable for its minimal construction footprint. The main cost is in the upfront purchase of expensive piping, so it largely depends on how far water and the water/sediment slurry has to be pumped. Once the pipes are purchased, they may be used for several years, and the more sediment that is injected, the lower the cost per ton. Also, it may be possible to permanently fix the pipes for annual injections, thereby reducing the labor cost of setting up and taking down the system each year.

Using the sluicing method, the rate of gravel/cobble injection is ~100-300 tons per day, all depending on how frequently the system clogs. This is slow relative to gravel placement by truck-mounted conveyor (~500 tons per day) or truck/front loaders (~1000 tons per day). Indeed, clogs at pipe joints are a likely occurrence and are factored into operations. The primary factors that cause them are 1) low local head, 2) dense packing of 4-6" clasts, and 3) long, flat "finger" shaped rocks that fit through 5-6" sieve openings, but are much longer than that. Once in the pipe finger rocks can turn perpendicular and jam in a coupling. When a jam happens, operations stop, the location of the jam is determined (usually in a coupling), the coupling is broken to release the jam, a new coupling installed, and then operations continue. The steeper the descent (speeding flux), the more continuous the slurry flow (preventing deposition in the pipe), and the finer the sediment mixture (reducing the size of finger rocks), the less clogging will occur. Grain breakage in the pipe has not been evident in any noticeable amount, but the sediment does abrade the pipe, especially at bends. The typical lifetime of a pipe section at a bend has not been reported. Having extra pipe segments on hand is important for long-duration sluicing operations.

In terms of the gravel/cobble placement into the river, the approach with sluicing is to start at the water's edge, build across the river, and then work downstream. At the outlet of the system, gravel/cobble goes into a rigid pipe supported by floating, air-filled barrels. The outlet is manually directed to the placement spot with the aid of ropes as needed. Using this approach, it is possible to place gravel/cobble according to a sophisticated design with a few constraints. As the operators work their way out into the channel, they must add additional pipe to reach new areas. Pipe in the river lies on the bed. Given the weight of the pipe sections and the need to manually couple them, the pipes have to be placed in shallow water. That limits the depth of water that pipes may be placed into to depths of < ~2-2.5'. As a result, front slopes up to the riffle crest have to be relatively steep. Back slopes can be lower, because ambient river velocity aids distribution of the sediment slurry in a blanket downstream. This approach has been used on the lower Stanislaus River and Clear Creek, with favorable reports in both cases. Given its remoteness and steepness, the canyon below Englebright Dam is a strong candidate for gravel/cobble sluicing.

## 3. PRE-PROJECT CHARACTERIZATION OF THE EDR

The spatial focus of this gravel/cobble augmentation implementation plan is the Englebright Dam Reach (EDR) of the lower Yuba River, which has been identified to be the area of the river below Englebright Dam that has been impacted by the dam requiring action (Beak Consultants, 1989; Pasternack, 2008a; Pasternack et al., 2010). The next step is to perform a pre-project characterization that documents the baseline conditions of the EDR. This involves reviewing the available data and information for the reach to yield a conceptual model that captures the processes playing central roles in shaping fluvial landforms in the EDR. Broad based information related to the entire watershed helps guide an understanding of the processes relevant to the focal reach, but ultimately what is needed is an understanding of the mechanistic physical process active in the reach today and potentially active through rehabilitation actions. Thus, the effort involves a process-based approach to the problem by nesting different spatial and temporal scales of investigation.

### 3.1. EDR Literature Summary

Because the EDR is remote, it has not been nearly as well studied as the rest of the lower Yuba River, but it has received some investigation. As described earlier, Beak Consultants, Inc (1989) performed studies in the EDR, including fish habitat mapping, fish community characterization, and implementation of the Instream Flow Incremental Methodology (IFIM) for evaluating stage-dependent physical habitat (using 6 cross-sections in “The Narrows”, which includes the EDR and the subsequent 1.8-km long gorge). In 1999, the terrestrial land in the EDR was topographically mapped by contractors working for The Corps by aerial photogrammetry, but the river’s bathymetry in the reach was not mapped. From 2003-2008 the U.S. Fish and Wildlife Service collaborated with the Watershed Hydrology and Geomorphology Lab at UC Davis to compare and contrast conditions in the EDR and those in Timbuctoo Bend. The reports that presented data and information on EDR were Fulton (2008), Pasternack (2008a), and Pasternack et al. (2010).

### 3.2. EDR Existing Data and Analyses

There does exist some data for the EDR. Key data include a bathymetric survey and digital elevation model of the reach (Fig. 3.1), substrate pebble counts, water surface elevation observations for flows ranging from 800-91400 cfs, georeferenced historical aerial photos, and observations of Chinook salmon attempting to spawn on bedrock. At the time that Fulton (2008) performed his 2D modeling analysis in 2005-2006 to assess flow-habitat relations, sediment entrainment, and geomorphic processes, available data were limited to just the reach between the Narrows II pool and the Narrows I powerhouse. Subsequently, Pasternack (2008a) did do a few 2D model simulations of the EDR using a newer software program suitable for that length of canyon. Pasternack et al. (2010) reported a detailed historical aerial photo analysis of the EDR focusing on the history and status of Sinoro Bar in the vicinity of the confluence with Deer Creek. Finally, Pasternack (2009) did reconnaissance of the EDR to map the movement of injected gravel and cobble out of the Narrows II pool and quantify a sediment budget for that material.

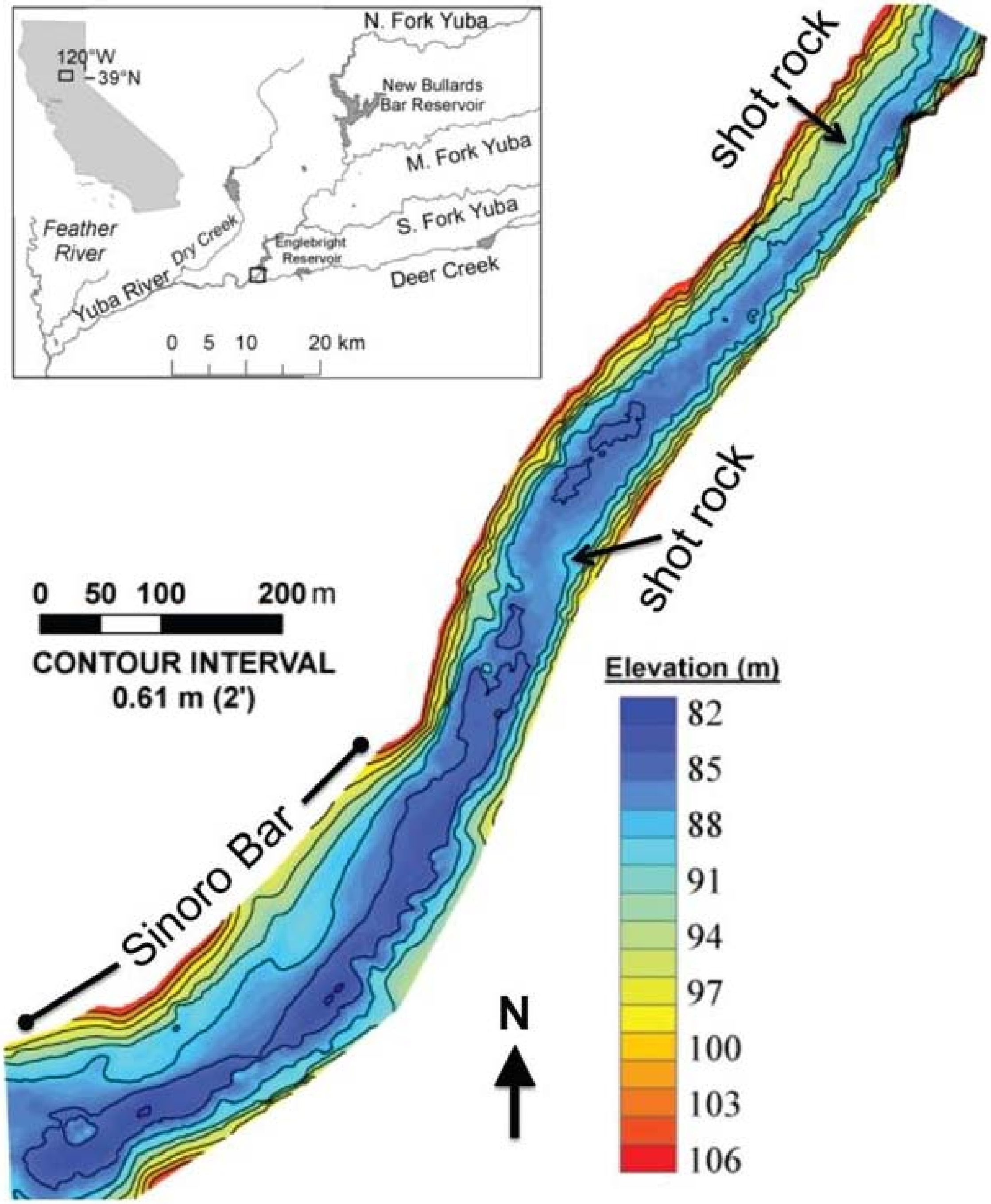


**Figure 3.1.** EDR topographic map showing locations of existing shot rock deposits. Inset map shows location of study site within the Yuba River basin and within California.

### 3.3. EDR Gravel/Cobble Deficit

The EDR is mostly devoid of any river-rounded gravel/cobble. This material is the basic building block of alluvial morphological units for the LYR. It is the necessary substrate for SRCS spawning. That leads to the following question:

*How much gravel/cobble is needed in the EDR to rehabilitate ecological functionality?*

To answer this question it needs to be recognized that different volumes of material would be required to achieve different combinations of geomorphic and ecologic functions. Let us define a placement volume (PV) as

$$PV = \alpha \bullet A \bullet D$$

where A is the plan-view wetted channel area ($m^2$), D is average depth (m) at spawning flow, and α is a non-dimensional depth scaling factor. A simple approach would be to fill in the entire wetted channel for a typical low autumnal spawning discharge to form one large, flat spawning riffle. Completely filling in the wetted channel in this way would involve assigning α=1, so PV=A•D. This amount would displace the water up, making it shallower and faster, due to a significant decrease in cross-sectional area. However, past studies have all concluded that large, flat spawning riffles do not work. Adult SRCS spawners need deep holding habitat for over-summer holding, local holding refugia proximal to red locations for rest during spawning activity, and locations with hydraulic complexity (presumably because it promotes better hyporheic flow).

Based on many years of experience with designing diverse spawning habitat rehabilitation projects, Pasternack (2008b) reported that for rehabilitating a small riffle of ~50-500’ length, a value of α=0.8 is appropriate. At this scale the focus is just on a single riffle crest and the presumption is that morphological unit diversity exists at a larger scale outside of this one riffle site. For a long reach for which a diversity of morphological units would need to be created, a value of α=0.5 is more appropriate. This value is lower, because riffle crests are the highest points by definition, so constructing a reach with other morphological unit types involves using less volume than that for a riffle crest. As a result, for an intermediate length scale between a site and a reach, an intermediate value of $0.5<\alpha<0.8$ would be appropriate. Although there is no formal scientific proof of these values, they provide a simple, low-cost method of estimating gravel/cobble needs. This provides a reasonable starting point for thorough analysis and design development.

To apply the above method for use in the EDR, the variables A and D were estimated using the SRH-2D model simulation for 855 cfs for three separate sub-reaches and the amount was totaled (Table 3.1). The volume-to-tonnage conversion of Merz et al. (2006) was applied (see section 2.2 above). The total amount of material to eliminate the deficit for the EDR is estimated to be 63,077 short tons (45,510 $yds^3$). To account for uncertainty, a higher estimate using $\alpha = 0.8$ was also generated, which yielded an estimate of 100,923 short tons (72,816 $yds^3$). These numbers bound the likely intermediate amount of storage that would be appropriate for the EDR.

Because the reach widens downstream, the largest component is associated with the area downstream of the gaging station rapid. However, that area has been heavily impacted by mechanized gold mining and would greatly benefit from an independent river rehabilitation effort to take advantage of the opportunity to fix Sinoro Bar, which is beyond the scope of the gravel/cobble augmentation plan required to account for the impacts of Englebright Dam. Also, material placed upstream in the narrower part of the canyon is expected to migrate downstream anyway, addressing the gravel deficit in the vicinity of Sinoro Bar over time. Recognizing that the section between the Narrows II and Narrows I facilities has other uncertainties with operations, the relevant area of gravel addition is therefore the area between the Narrows I facility and the top of the rapid downstream of the gaging station.

***The recommended long-term gravel storage volume for the section between the Narrows I powerhouse and the rapid downstream of the gaging station is 15,949 to 25,518 short tons.***

The exact value may be determined in future design development and evaluation. The idea would be to augment gravel into the appropriate area of the EDR until this amount of gravel storage is achieved. Then, as floods transport material out of the area, more additions would return the storage amount to the total level.

**Table 3.1.** Estimated gravel/cobble deficit for the EDR to have a diverse assemblage of morphological units (excludes any independent action related to rehabilitating Sinoro Bar). Assumes α = 0.5.

| subreach | A ($ft^2$) | D (ft) | volume ($ft^3$) | volume ($yds^3$) | short tons |
|---|---|---|---|---|---|
| Narrows II to I | 61107 | 4.313 | 131777 | 4881 | 6765 |
| Narrows I to top of rapid | 117373 | 5.294 | 310686 | 11507 | **15949** |
| bottom of rapid to end | 306193 | 5.136 | 786304 | 29122 | 40364 |
| total | | | 1228767 | 45510 | 63077 |

**Table 3.2.** Maximum estimated gravel/cobble fill associated with α = 0.8.

| subreach | A ($ft^2$) | D (ft) | volume ($ft^3$) | volume ($yds^3$) | short tons |
|---|---|---|---|---|---|
| Narrows II to I | 61107 | 4.313 | 210844 | 7809 | 10823 |
| Narrows I to top of rapid | 117373 | 5.294 | 497098 | 18411 | **25518** |
| bottom of rapid to end | 306193 | 5.136 | 1258086 | 46596 | 64582 |

### 3.4. EDR SRH 2D Model

Two-dimensional (depth-averaged) hydrodynamic models have existed for decades and are used to study a variety of hydrogeomorphic processes. Recently, their use in regulated river rehabilitation emphasizing spawning habitat rehabilitation by gravel placement has been evaluated (Pasternack et al., 2004, 2006; Wheaton et al., 2004a; Elkins et al., 2007). Two-dimensional models have also been applied to better understand the relative benefits of active river rehabilitation versus flow regime modification on regulated rivers.

The U.S. Bureau of Reclamation created and maintains a 2D model called Sedimentation and River Hydraulics 2D (SRH) that is freely available to the public. SRH is highly efficient in its computations and is also highly stable in performing wetting and drying, which is a common problem of other 2D models. The way it has been programmed, it is highly automated. Thus, it is now possible to make 2D models of dramatically larger river segments than before, while retaining the same high resolution desired for characterizing microhabitat.

Apart from characterizing the spatial pattern of hydraulics in the EDR, SRH 2D was to answer two specific questions:

1) *what the spatial pattern of hydraulic habitat for Chinook spawning at 855 and 4500 cfs?*
2) *what is the spatial pattern of gravel/cobble erosion potential for flows ranging from 855 to 96100 cfs?*

The former question addresses the need to determine the extent to which the inadequacy of spawning habitat is due solely to the lack of spawning substrate or whether it is a combination of more microhabitat factors. The latter question seeks to understand the stage-dependent hydrogeomorphic processes responsible for scour and deposition in the EDR, given its unique pattern of channel nonuniformity.

### 3.4.1. EDR 2D Model Setup

As part of this planning effort, the SRH 2D model of the EDR reported by Pasternack (2008a) was updated to the latest software version and used again. To maintain computational efficiency, three different computational meshes were used, each with an intermodal spacing of ~3' in the wetted area. For low-flow conditions, the original mesh from Pasternack (2008a) was used for flows <5000 cfs. This mesh covered the whole canyon width with ~3' internodal spacing in the channel and up to 6' internodal spacing along the edge. The wetted area for the low flow runs were all within the mesh elements with ~3' internodal spacing. A mid-flow mesh was made for flows 5000-30000 cfs. A high-flow mesh was made for flows 30000-96100 cfs. A higher flow mesh may always be used to run a lower flow, but it takes longer to run than using the appropriate lower flow mesh. Creating a new EDR mesh takes only ~1-2 hours compared with models running for 3-7 days, so making a mesh that is optimal for a given flow is worth the small time and effort.

Table 3.1 reports the stage-discharge relation estimated for the exit cross-section of the model reach as well as the constant Manning's n roughness parameter used and the constant eddy viscosity coefficient used for turbulence closure. For all simulations, 500 cfs was pushed into the river from the bank at the location of Narrows I and all remaining flow came from the upstream boundary in the Narrows II pool. Unfortunately, the stage-discharge relation for the end of the reach was not directly observed, but was estimated by linear slope interpolation based on the water surface elevation (WSE) values at the exit and at the Smartville gaging station observed at 855 cfs. The one test of the accuracy of this approach was obtained by surveying the photo-based evidence of the water line for the 88600 cfs flow occurring on 12/31/2005 (photo and land access for surveying graciously donated by local landowner Ralph Mullican). The two observed WSE's for that flood were 309.71' and 310.77', so the predicted value of 309.58' is reasonable, given the uncertainty in the field observations (especially the higher value, which was measured at a spot up on the side of a large boulder). Ideally, a water level recorder ought to be installed and maintained at the confluence with Deer Creek in support of future investigations.

The chosen constant Manning's n value is more certain as it was based on 2D model calibrations performed by Fulton (2008) for the same wide range of flows. Manning's n does not decrease with increasing stage in the EDR or Timbuctoo Bend, which is consistent with the concept that as flow increases, large roughness elements become active and maintain the overall roughness of the reach, even as grain-scale roughness and riffle-undulation form roughness become less important.

No velocity validation data exists for the EDR at this time, but WSE data is available over the full range of flows from Fulton (2008). Analysis of model performance with WSE indicated that it was within the normal range typical of 2D models. Extensive velocity validation has been performed for this model for the LYR between Hammon Grove Park and Hallwood Road, with the resulting metrics equaling or exceeding the performance of 2D models of other rivers (Barker et al., 2010). Velocity validation has also been done for Timbuctoo Bend (Moir and Pasternack, 2008; Pasternack, 2008) as well as for bedrock and boulder/cobble reaches of the upper South Yuba between Spaulding Dam and Washington, CA (Pasternack, unpublished data). All evidence indicates that the model is suitable and valid for the EDR.

**Table 3.3.** SRH 2D model inputs and parameters for the discharges simulated.

| Q (cfs) | exit WSE | Manning's n | eddy viscosity coefficient |
|---|---|---|---|
| 855 | 283.65 | 0.032 | 0.6 |
| 1590 | 284.86 | 0.032 | 0.6 |
| 4500 | 287.80 | 0.032 | 0.6 |
| 10000 | 291.16 | 0.032 | 0.6 |
| 15400 | 293.58 | 0.032 | 0.6 |
| 30000 | 298.38 | 0.032 | 0.6 |
| 50500 | 303.14 | 0.032 | 0.6 |
| 88600 | 309.58 | 0.032 | 0.6 |
| 96100 | 310.65 | 0.032 | 0.6 |

### 3.4.2. Microhabitat Prediction Method

Hydraulic habitat quality predictions for Chinook spawning were made by extrapolating 2D model depth and velocity results through independent habitat suitability curves. No bioverified habitat suitability curves (HSC) for depth, velocity, substrate, or cover for salmonid life stages are accepted by stakeholders on the LYR. Beak Consultants, Inc (1989) collected observations of depths and velocities for a typically small number of redds for that era and generated "utilization-based" curves. They compared their curves to those for the lower Mokelumne River available at that time and found a lot of similarities. CDFG (1991) published utilization-based curves for the lower Mokelumne River and in recent years these curves have been shown to perform very well at predicting Chinook spawning preference and avoidance for baseline and post-rehabilitation conditions (Pasternack, 2008b; Elkins et al., 2007). These Mokelumne curves were tested for use in Timbuctoo Bend on the LYR by Pasternack (2008a) and found to pass all bioverification tests. Other curves based on logistic regression proposed by the USFWS in recent years have not passed the same rigorous tests and remain controversial. Consequently, the bioverified curves used by Pasternack (2008a) were applied in this study.

A global habitat suitability index (GHSI) was calculated as the geometric mean of the depth and velocity indices (Pasternack et al., 2004). To account for uncertainty SRH-2D model predictions, GHSI values were lumped into broad classes, with GHSI = 0 as non-habitat, 0 < GHSI < 0.2 as very poor quality, 0.2 < GHSI < 0.4 as low quality, 0.4 < GHSI < 0.6 as medium quality, and 0.6 < GHSI < 1.0 as high quality hydraulic habitat (pasternack, 2008a). In bioverificaiton, it turned out that only the medium and high quality habitat classes proved to be preferred in terms of being utilized by spawners more than their percent availability, while the remaining classes were all avoided. Therefore, an even further simplification may be made by lumping GHSI into classes of 0-0.4 and 0.4-1.0. This reduces the possibility of error down to just misclassifications across this threshold.

### 3.4.3. Sediment Transport Regime Prediction Method

To evaluate gravel/cobble sediment scour risk across the widest possible range of flows, nondimensional Shields stress was calculated at each node in the model as described in Pasternack et al. [2006]. The reference grain size used to characterize the mixture of a gravel/cobble bed was 64 mm, which is close to the median size reported for Timbuctoo Bend (Pasternack, 2008a) and is in the range of common values used for assessing spawning habitat rehabilitation materials. Shields-stress values were categorized based on sediment transport regimes defined by Lisle et al. [2000] where values of $\tau^*<0.01$ correspond to no transport, $0.01< \tau^*<0.03$ correspond to intermittent entrainment, $0.03< \tau^*<0.06$ corresponds to "partial transport", and $\tau^*>0.06$ corresponds to full transport.

### 3.4.4. EDR 2D Model Results

Depth and velocity results are depicted in Figures 3.2-3.5 below. For flows <5000 cfs there are distinct areas of high and low velocity longitudinally down the river. As discharge increases, the longitudinal variation in velocity decreases and lateral variation increases. This is a common pattern previously reported for other constricted reaches (Brown and Pasternack, 2008). It is characteristic of the stage-dependent role of multiple scales of channel nonuniformity in controlling flow-habitat relations and fluvial geomorphology.

The GHSI pattern for Chinook spawning hydraulic habitat (Fig. 3.6) shows that regardless of gravel/cobble presence, the canyon presently has almost no suitable microhabitat (GHSI>0.4) capability to support SRCS spawning. At 855 cfs there is a small area of suitable hydraulics on the bedrock plateau just downstream of the Narrows II pool, a little upstream of the rapid by the gaging station, and a little habitat on the edge of the Sinoro Bar point bar. At 4500 cfs there is significantly less hydraulic habitat present.

The pattern of the sediment transport regime for the EDR (Fig. 3.7-3.8) is highly stage dependent. For flows below 15,400 cfs, the primary area of scour risk is in the narrowest part of the canyon between narrows I and II powerhouses, which is the area studied by Fulton (2007). The only other area of high scour potential is in the rapid below the gaging station. At 30,000 cfs, large area experience full bedload mobility, but there is a small area of lower Shield stress in the pool adjacent to the gaging station. Also, the widest part of the canyon around Sinoro Bar does not experience full mobility at this flow, so it is highly unlikely that a gravel/cobble mixture would move past that area. Note that the model does not include the perpendicular influx from Deer Creek, which would further reduce velocities and block transport. At 50,500 cfs there is full mobility through the upper 2/3 of the reach, but still no full mobility around Sinoro Bar. At 96,100 cfs, there is full mobility through the reach; again, not considering any influx from Deer Creek to block that.

In summary, detailed 2D hydraulic modeling of the EDR found that the river is too deep to provide Chinook spawning habitat right now, necessitating gravel augmentation to fill in the channel and provide opportunities for creating morphological unit complexity. Geomorphically, the river does not exhibit stage-dependent flow convergence, with routing of sediment through pools and deposition on high “riffles” at high discharges. Instead, as discharge increases, depth and velocity simply increase almost everywhere, so the area of scour increases down the river. The widest part of the canyon would be the ideal location for a diverse assemblage of morphological units, but it was degraded by mechanized mining in the 1960s. In terms of a gravel augmentation program, the indication is that the area in the upper half of the EDR where gravel might be augmented into the river is susceptible to full mobility at 10,000 cfs (except for the Narrows II pool, which is deep enough to require much higher discharge to scour the bottom of it). Meanwhile, augmented gravel would be unlikely to move out of the EDR until a flood of >95,000 cfs associated with minimal flow out of Deer Creek, such as during a snowmelt period or the later stages of a rain-on-snow event. The reason Deer Creek flow needs to be minimal (not maximal), is that at high flow the tributary enters the Yuba nearly perpendicular to it. This creates a barrier to sediment transport. Maximum export of sediment out of the EDR is thus expected to occur during the lowest Deer Creek outflow. The timing of flows out of the Yuba and Deer Creek catchments differs, based on their differing watershed hydrology.

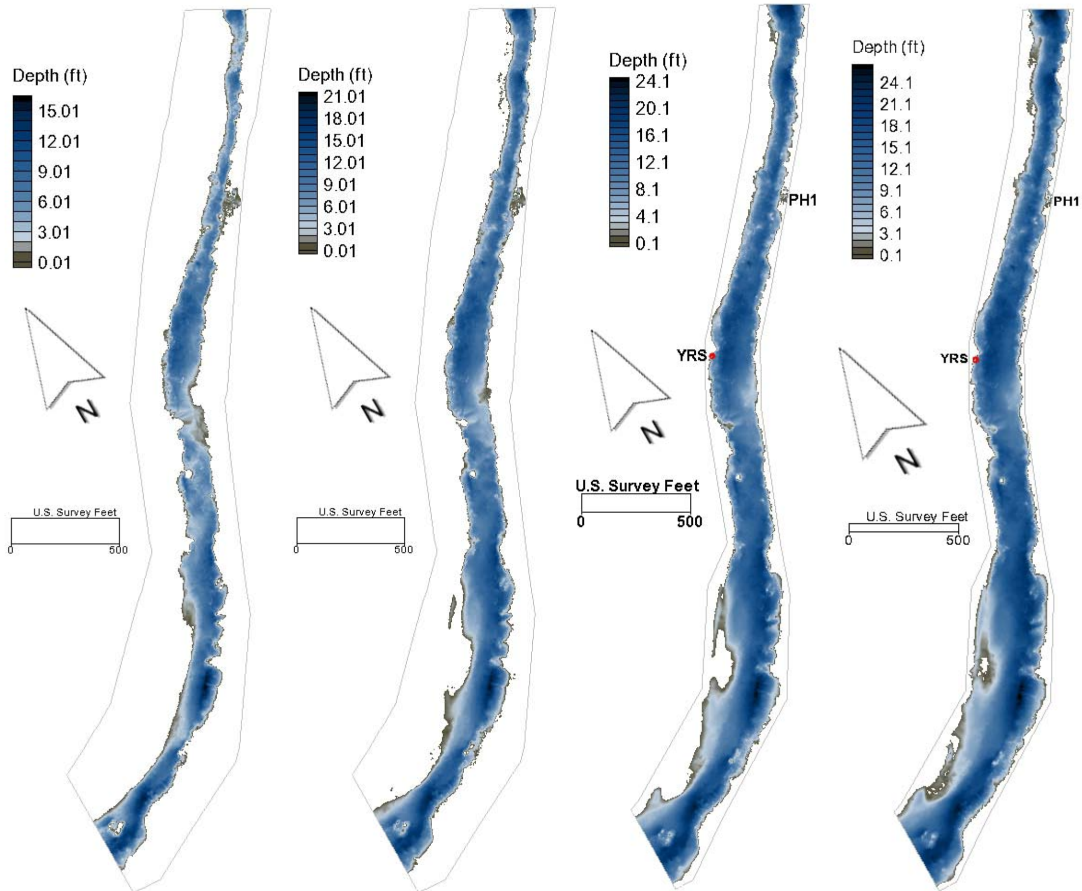


**Figure 3.2.** EDR water depth for increasing discharge from left to right (855, 4500, 10000, 15400 cfs). Color scale is different for each image.

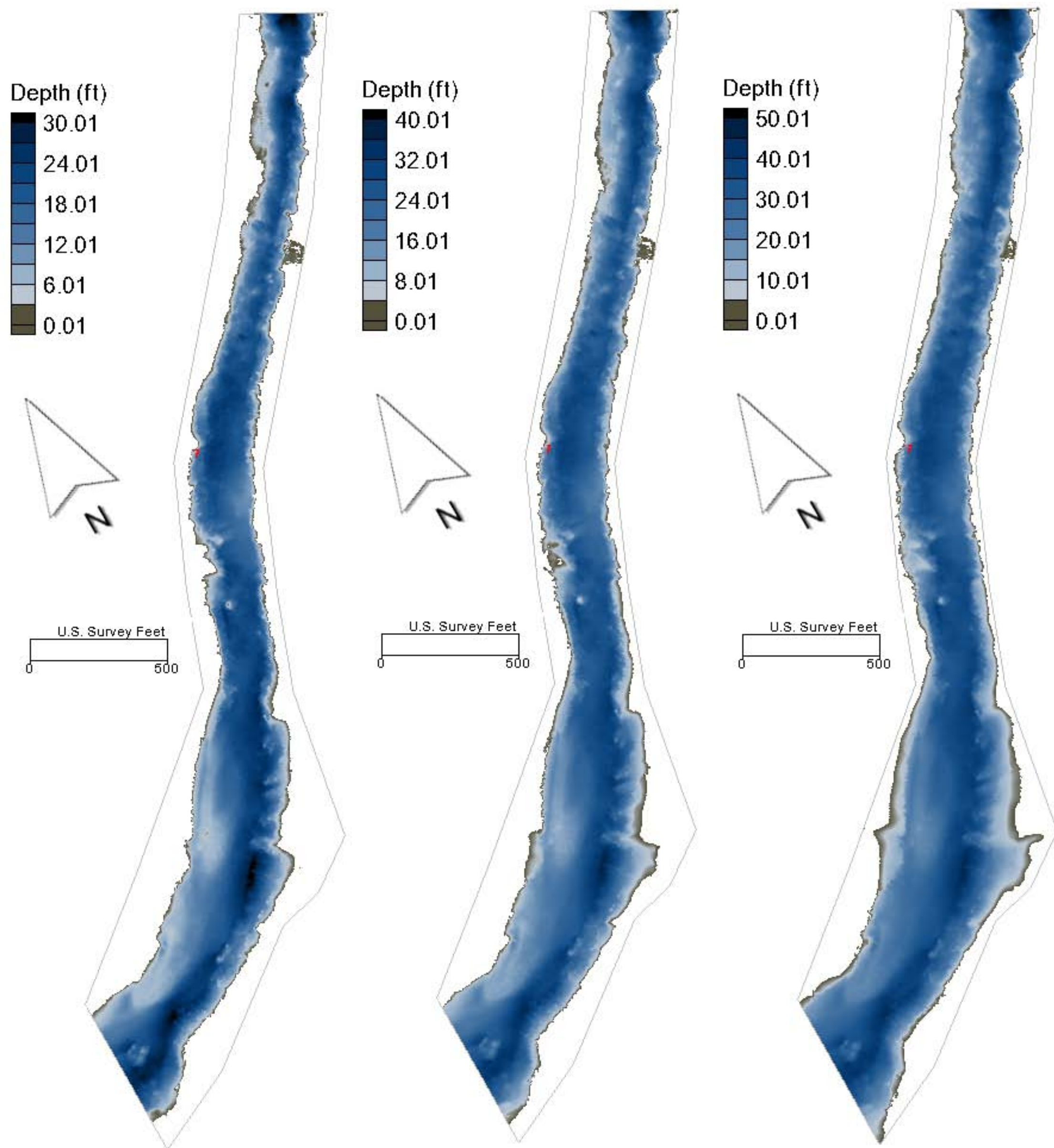


**Figure 3.3.** EDR water depth for increasing discharge from left to right (30000, 50500, 96100 cfs). Color scale is different for each image.

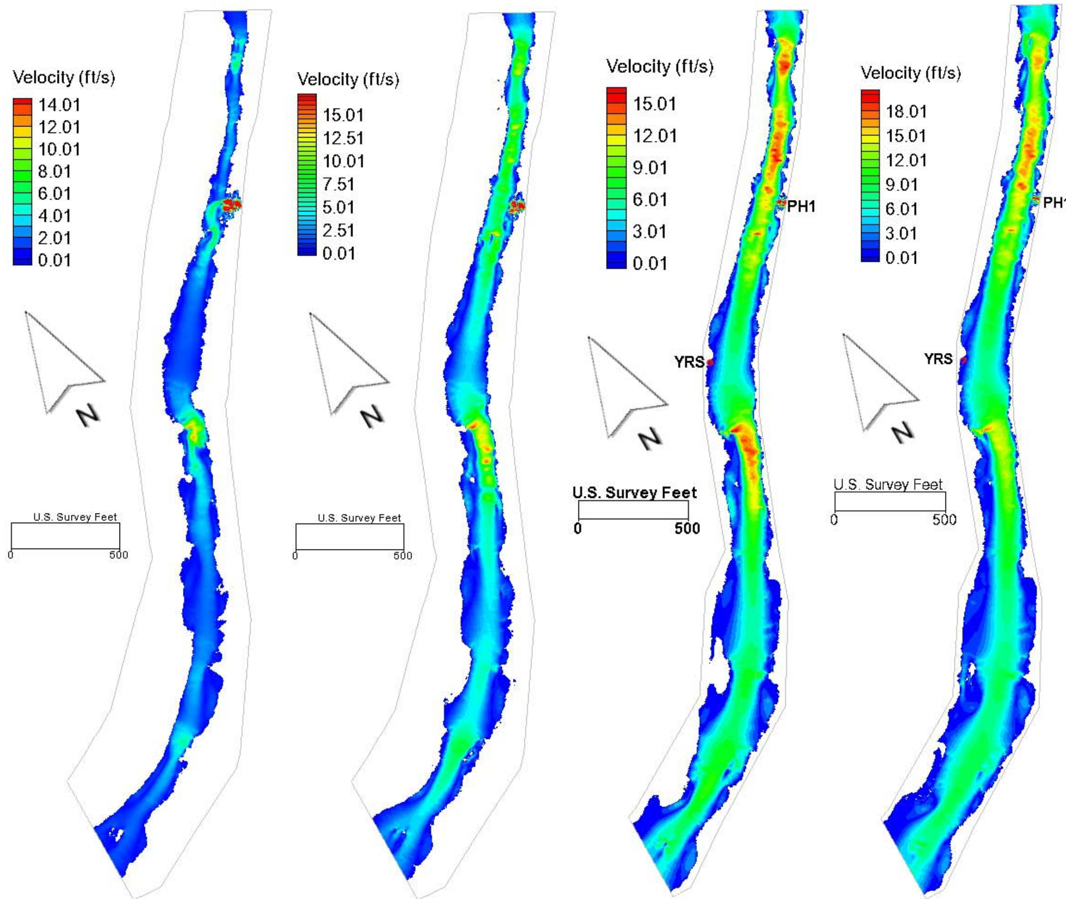


**Figure 3.4.** EDR water velocity for increasing discharge from left to right (855, 4500, 10000, 15400 cfs). Color scale is different for each image.

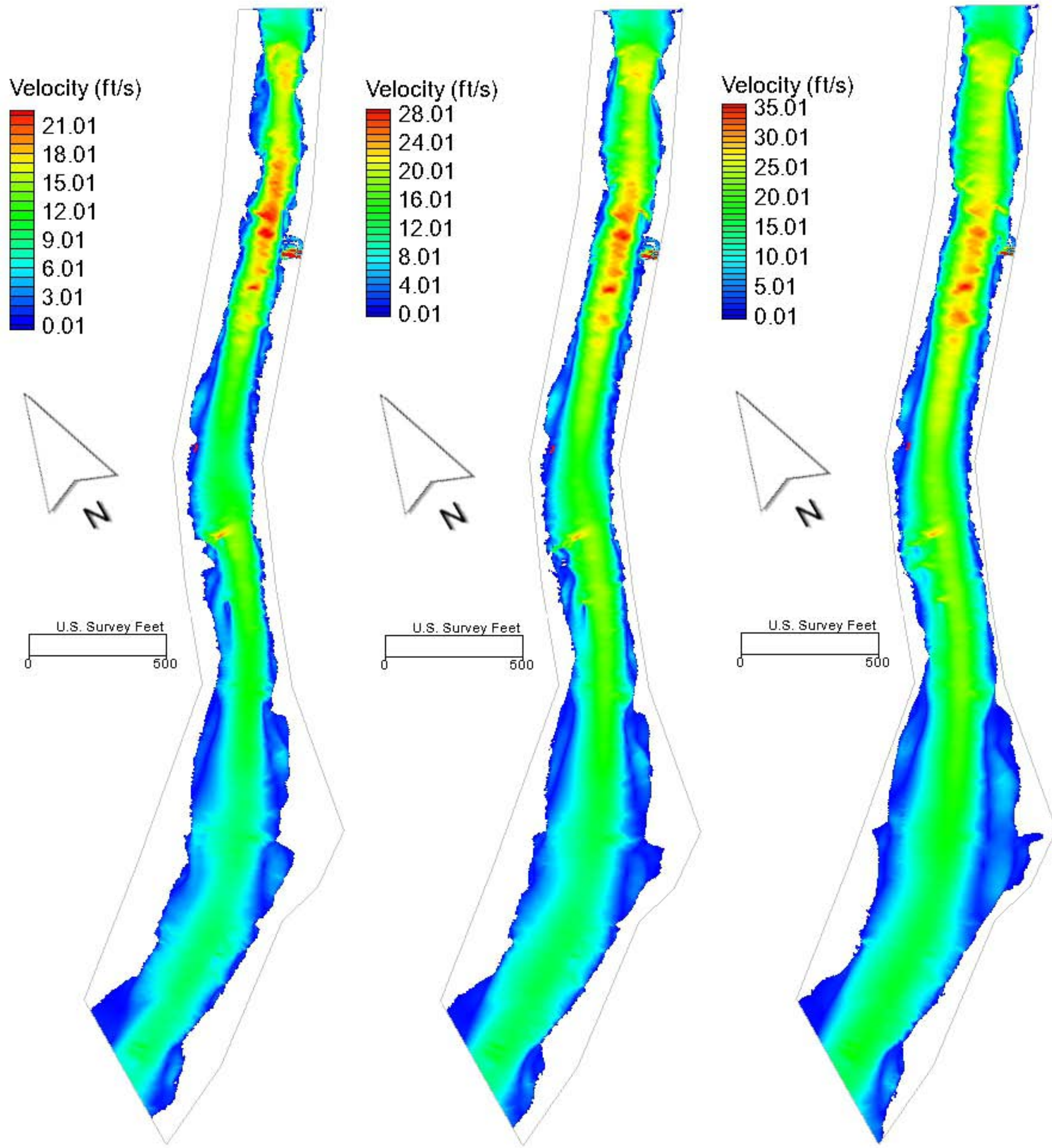


**Figure 3.5.** EDR water velocity for increasing discharge from left to right (30000, 50500, 96100 cfs). Color scale is different for each image.

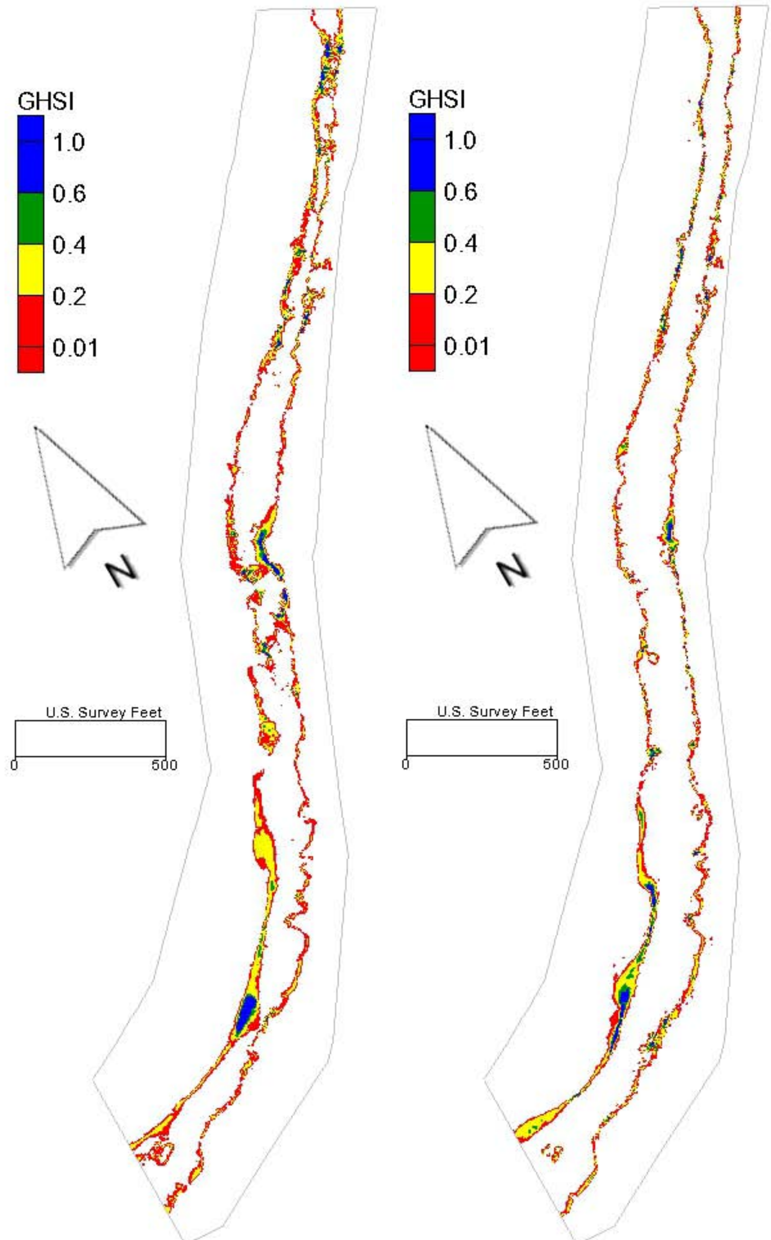


**Figure 3.6.** EDR Chinook spawning hydraulic habitat quality (GHSI) for 855 (left) and 4500 cfs (right). Color scale is identical for both images

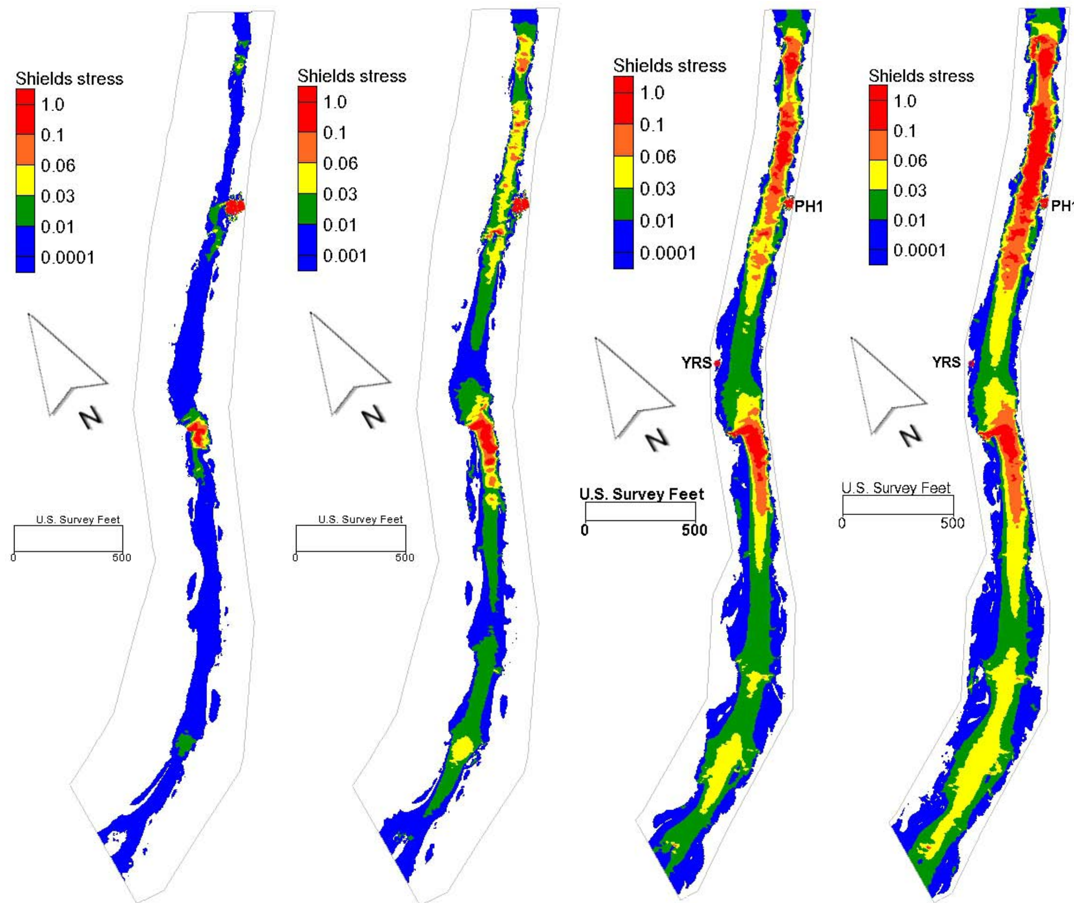


**Figure 3.7.** EDR Shields stress for increasing discharge from left to right (855, 4500, 10000, 15400 cfs). Color scale is identical for each image.

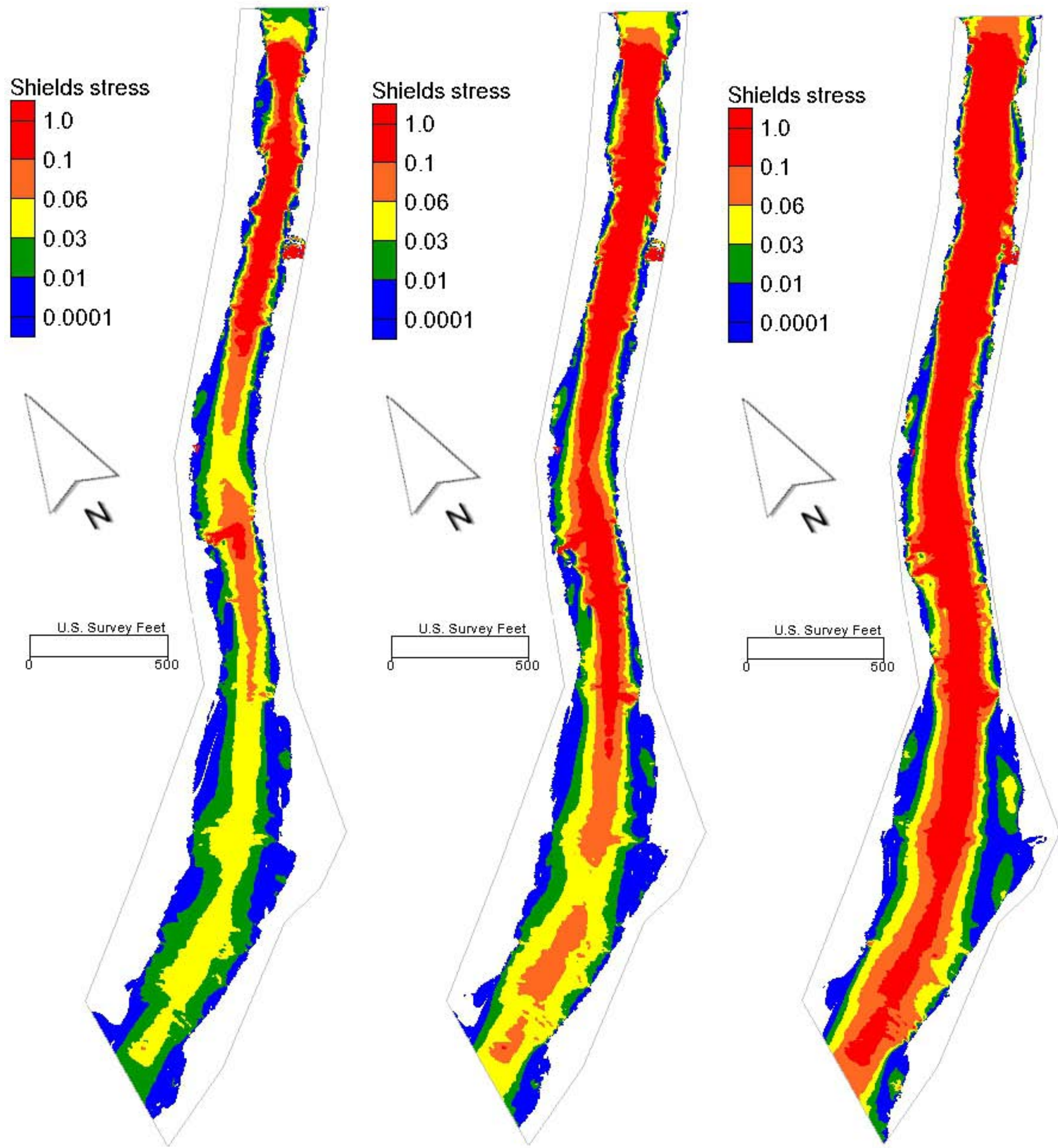


**Figure 3.8.** EDR Shields stress for increasing discharge from left to right (30000, 50500, 96100 cfs). Color scale is identical for each image.

## 4. RECOMMENDED METHOD FOR GRAVEL/COBBLE AUGMENTATION

Discussion of how to implement gravel/cobble augmentation below Englebright Dam has been on-going for years. Every idea that has been thought up by diverse stakeholders has been thoroughly discussed and vetted. The Lower Yuba River Technical Working Group and the Yuba Accord River Management Team have provided forums for discussion about this topic over the years. The 2007 pilot gravel injection with a truck-mounted conveyor belt demonstrated that gravel/cobble augmentation is not only technically feasible, but institutionally and politically possible. Observations of Chinook spawning in 2009 prove that salmon will use what is injected.

### 4.1. Elimination of Inadequate Methods

For the canyon below Englebright Dam, gravel is needed throughout the reach, but most especially in the longer and wider sections downstream of the Narrows I facility, as reflected in the estimates provided in Tables 3.1 and 3.2. This is a key constraint on augmentation methods. The truck-mounted conveyor belt method, roadside-dumping method, and (short of heroic measures) cableway delivery method are simply unable to get gravel into the river downstream of the Narrows I facility. A helicopter theoretically could dump gravel into the river, but the U.S. civil helicopter accident rate per 100,000 flight hours is 8.09 (IHSS, 2005), which is high. Operating in a narrow canyon with uncertain winds is even riskier than normal. Taking such a risk with human life is not necessary. That leaves road construction with front-loader placement and gravel/cobble sluicing.

Part of the reason why there is so much undesirable debris down at Sinoro Bar at the confluence of the Yuba and Deer Creek is that the pre-existing road down to the river at Englebright Dam washed away and deposited down there. Building a road requires a large amount of crushed aggregate, and in this case it has to be placed on a landslide-prone hillside where it will be attacked by large floods (Fig. 4.1). The 1997 flood was not a fluke. Floods of close to the same size or bigger occurred in 1955, 1963, 1964, and 1997 (Pasternack et al., 2010). That is four times in the last 55 years, or roughly once every ~14 years (foregoing detailed flood frequency analysis). If the road went all the way to the baseflow channel, then the lower part of the road would be submerged almost annually and seriously scoured every 3-5 years. The potential environmental harm from this is serious. Together with the long duration for permitting, the difficulty of getting big trucks down the steep road with switchbacks, and water quality impacts, the risk of aggregate entering the river makes road construction an unsatisfactory alternative.

**Figure 4.1.** Photo of the New Year's 2006 flood drowning the area where a road would have to be built to use trucks and front loaders as the delivery method for gravel/cobble augmentation. Aggressive velocities were evident all along the north bank.

### 4.2. Best Method for The EDR

By the process of elimination, the only remaining option is gravel/cobble sluicing. To my knowledge, no one has ever attempted to do gravel/cobble augmentation by as long of a sluice pipe as would be necessary for this plan. The long distance that water has to be pumped up and then slurry pumped down make the method much more expensive than for past projects using this method. Also, this method is relatively slow and potentially subjected to regular clogs. At an average rate of 150 tons per day, it would take 33 days to inject 5,000 tons. Front loaders typically place that much into a roadside river in ~4-6 days. On the other hand, the elevation drop for the EDR is so great that clogs may be relatively infrequent; a record speed of injection is possible. Once pipes are purchased in the first year, they can be stockpiled and used again in future years, reducing the overall cost of the system to a normal level. After thorough scrutiny, discussion, and on-site visit with the inventor of the method, no major impediment to the approach is evident at this time.

### 4.3. Detailed Concept for Sluicing Gravel Mix Down to EDR

Despite the fact that sluicing will have to be done over a long distance, the EDR has excellent attributes that promote the idea of attempting this method. The overall schematic for the application of sluicing to get gravel/cobble into the EDR is shown in Figure 4.2. Prior to the start of sluicing operations, 2000 short tons of gravel would be stockpiled in the three parking/turnaround areas at the overlook on the north side of the dam. This location is behind a locked gate and is inaccessible to the public. Englebright Reservoir is close by and easily accessible. Only ~2.3 cfs is needed for the sluicing operation, in comparison to the typical autumnal release of ~750 cfs- that's just 0.3%. A gravel road on the north side of the reservoir close to the dam (Fig. 4.3, right) goes right to the water's edge (Fig. 4.3, left), so that the water intake pump system (including fish screening custom built by Morrill Industries) can be safely positioned and easily operated. From there, water would be pumped in one or two 6-8" diameter pipes ~1070' up the side of the road (Fig. 4.3, right) to the crest. Where needed, the pipe would cross 1-2 roads in Rain-For-Rent Entrance/Exit Ramps, enabling vehicles to pass over the pipe with no interference to anyone's normal activities. The water pipe(s) would go over the crest of the hill and down the side of the paved road ~300' toward the Narrows II powerhouse until a point at which there is a noticeable slope break especially favorable to beginning gravel/cobble addition to the pipe. At that location a screened hopper on the north side of the road would receive sediment from a front loader bringing the material the short distance from the stockpile. The loader operator would gently bounce the bucket to trickle the sediment into the hopper as the primary control on the flow rate. A hopper operator would be standing there to ensure no blockages, clean out finger rocks as needed, and communicate conditions with other operations participants by radio. Under the hopper the gravel and water would join in a metal pipe that would then connect to the beginning of the 8" diameter, semi-flexible "Yelomine" pipe. This pipe would then go ~1270' down the ditch on the north side of the road to the switchback. From that point, the best option would be to go 264' straight down the grassy hillside (Fig. 4.4, left) to a terrace level where an old roadbed and foot trail is located. From there, the pipe would make a straight line 130' down to the water's edge near the upstream end of the gravel placement area for 2010 (Fig. 4.4, right). Overall, this approach would use roughly 2000' of Yelomine pipe to drop a vertical height of roughly 360', yielding an overall slope of 0.18 (18%).


**Figure 4.2.** Schematic of the gravel/cobble delivery system using a sluice method.

**Figure 4.3.** Landing area at the water's edge of Englebright reservoir (left) and gravel road leading up to the hillcrest (right).

**Figure 4.4.** Hillslope from road down to low terrace (left) and view from low terrace down to the Area A gravel placement location (right).

### 4.4. Gravel/Cobble Placement Location

The selection of the specific location within the EDR for focusing gravel/cobble placement was guided by constraints in powerhouse operations, potential benefits to the river, and feasible delivery methods. Powerhouse operations presently make gravel/cobble augmentation between Englebright Dam and the Narrows I powerhouse uncertain for the reasons described in section 2.3.3. To get the most benefit and longevity from adding gravel to the river, the further upstream it is introduced, the better. Thus, gravel/cobble augmentation could begin in the scour pool adjacent to the Narrows I facility. This pool is up to 8' deep at 855 cfs. To avoid having to fill in that scour hole and yield riffle habitat for immediate spawning use with the least amount of initial gravel injection during a pilot gravel sluicing operation, it would be advantageous to begin placement ~115' downstream of the end of the Narrows 1 powerhouse where the maximum depth is under 5' at 855 cfs. If the sluicing operation is successful, the Narrows 1 pool could be partially filled in a future year. Accessing this placement location with the gravel/cobble sluicing method is highly feasible according to the pipe pathway described in section 4.3. From this point, additional sluice pipe could be added to reach across the river or shift placement downstream in future years.

### 4.5. Gravel Cobble Mixture Design

Table 4.1 below provides the design of the gravel mixture to be used at the site. This mixture is consistent with the scientific literature on what is preferred for salmon spawning, embryo incubation, and fry emergence. Because the mix only specifies 2.5% of the material to be 4-5" in its B-axis dimension, that helps reduce the likelihood of having large finger rocks that can clog the sluice pipe.

**Table 4.1.** EDR gravel and cobble specifications (from USACE, 2007).

| Gravel Size (inches) | Percent Retained | Target % of Total Mix |
|---|---|---|
| 4 to 5 | 0 - 5 | 2.5 |
| 2 to 4 | 15 - 30 | 20 |
| 1 to 2 | 50 - 60 | 35 |
| ¾ to 1 | 60 - 75 | 15 |
| ½ to ¾ | 85 - 90 | 15 |
| ¼ to ½ | 95 - 100 | 10 |
| < ¼ | 100 | 2.5 |

## 5. 2010 EDR SPAWNING RIFFLE DESIGN DEVELOPMENT

The Watershed Hydrology and Geomorphology Lab at UC Davis has been designing spawning habitat rehabilitation projects since 1999 using the Spawning Habitat Integrated Rehabilitation Approach (SHIRA) (Fig. 5.1). Over the years, testing of numerous gravel-contouring schemes in 2D models and in actual construction has yielded a conceptual understanding of expected hydraulic attributes, geomorphic processes, and ecologic benefits. Numerous specific design examples are illustrated on the SHIRA website at http://shira.lawr.ucdavis.edu/casestudies.htm.

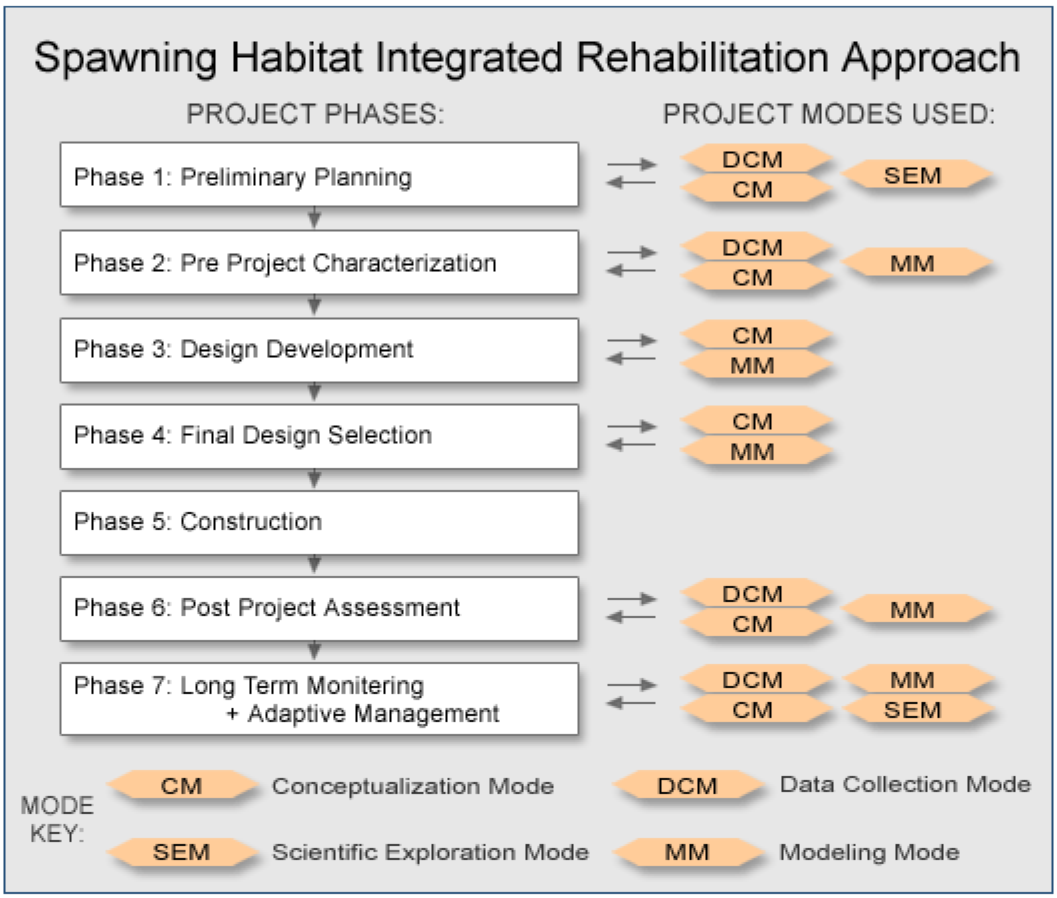


**Figure 5.1.** General schematic illustrating what is involved in the SHIRA framework.

### 5.1. Project Constraints

Based on past experience and site-specific constraints, it is possible to reduce the number of possible alternatives down considerably. An enumeration of key constraints helps put the options into focus. First, the amount of gravel to be added in the 2010 pilot trial of the gravel/cobble sluicing method has to be relatively small compared to the total deficit in the EDR given the uncertainty over how the method will work out. A lot of lessons may be learned from this trial in support of improvement to facilitate larger placements in future years. The consequence of placing a small amount of gravel is that there may not be enough material to form a resilient landform at the injection location in the face of a range of flow releases. Second, even at the typical low discharge of ~500-950 cfs in the EDR in September and October, baseline 2D modeling shows that the flow in the placement area is deep and fast (Figs. 3.1-3.4). This location is in a narrow part of the canyon that focuses flow over a range of discharges (Figs. 3.3-3.4). Several placement configurations (e.g. diagonal bar and chevron) would be at risk to scour away quickly under such focused scour. Third, the rate of gravel sluicing may be to low relative to the ambient velocity to control placement pattern at all. As sediment settles out of the water column, it will be pushed downstream in a way that is not easy to control.

One element excluded from consideration for this plan was the addition of large wood to the wetted channel in support of habitat heterogeneity, refugia, and cover. Presently there is large wood stored in the EDR (Fig. 5.2), which is ultimately derived from the small tributaries of the Middle and South Yuba Rivers. These two high-order tributaries have long stretches of unblocked channel network leading into Englebright Dam. The dam itself passes streamwood over its top during floods (wood floats, gravel/cobble does not), as evidenced by the available large wood stored in the EDR and the debris clogging Daguerre Point Dam and its fish ladders during and after floods. Historical photos 1909-2006 do not show wood jams or smaller wood accumulations in the wetted channel of the EDR. Given the width of the channel in the EDR and the power of the flow during floods, there is no reason to expect that large wood was ever stored in the channel there, in contrast to gravel/cobble, which was stored there and is now absent. Finally, because wood floats, any placement of large wood as part of the gravel/cobble augmentation plan would be highly likely to wash downstream. Use of engineered cables and fasteners to force wood to stay in place is problematic, because the underlying sediment is not expected to stay in place. Hard-wiring objects in place is also inconsistent with the approach of rehabilitating naturalized dynamic processes.

**Figure 5.2.** Example of large wood stored in the EDR.

### 5.2. Project Goals

*Regardless of these constraints, the primary project goal of injecting river-rounded gravel/cobble is not at risk in the choice of placement design.* If the sluice method gets the sediment into the wetted channel, then it is a success with regard to the primary goal of the project. *Creating a placement design is a bonus opportunity enabled by the ability of the sluicing method to have moderate control over where gravel is laid down on the river bed.* The extent to which the bonus can be achieved hinges on the amount of gravel added and ambient flow conditions. It is impossible to predict in advance how that will turn out. Nevertheless, it is sensible to be prepared for a successful outcome in which it is possible to control gravel placement on the bed. In that case the extra effort of controlling placement can yield physical habitat immediately available for Chinook salmon spawners to use (Elkins et al., 2007).

## 5.3. Design Objectives And Hypotheses

A design objective is a specific goal that is aimed for when a project plan is implemented. To achieve the objective, it has to be translated into a design hypothesis. According to Wheaton et al. (2004b), a design hypothesis is a mechanistic inference, formulated on the basis of scientific literature review and available site-specific data, and thus is assumed true as a general scientific principle. Once a design hypothesis is stated, then specific morphological features are designed to work with the flow regime to yield the mechanism in the design hypothesis. Finally, a test is formulated to determine after implementation whether the design hypothesis was appropriate for the project and the degree to which the design objective was achieved. Through this sequence, a process-oriented rehabilitation is achieved. From the mathematics of differential equations, it is evident that processes derive from the physics of motion, input conditions, and boundary conditions. Changes to either of input or boundary conditions impact processes, so it is possible and appropriate to design the shape of the river bed to yield specific fluvial mechanism associated with desired ecological functions.

The design objectives and associated information for the EDR gravel/cobble augmentation plan are enumerated in Table 5.1. This table provides a transparent accounting of the objectives, hypotheses, approaches, and tests for the gravel/cobble augmentation effort.

*The last column in the table lists specific measures for monitoring the success of gravel/cobble augmentation*.

**Table 5.1.** Design objectives and hypothesis for EDR gravel/cobble augmentation.

| Design objective | Design hypothesis | Approach | Test |
|---|---|---|---|
| 1. Restore gravel/cobble storage | 1A. Total sediment storage should be at least half of the volume of the wetted channel at a typical base flow under a heavily degraded state (Pasternack, 2008b). | Inject gravel into the river to fill up recommended volume of sediment storage space. | Use DEM differencing of bed topography over time to track changes in storage |
| 2. Provide higher quantity of preferred-quality Chinook spawning habitat | 2A. SRCS require deep, loose, river-rounded gravel/cobble for spawning (Kondolf, 2000). | Add river-rounded gravel/cobble. | Perform Wolman pebble counts of the delivered sediment stockpile and in the river after each gravel injection to insure that the mixture's distribution is in the required range. |
| | 2B. Spawning habitat should be provided that is as close to GHSI-defined high-quality habitat as possible (Wheaton et al., 2004b) | Place and contour gravel to yield depths and velocities consistent with salmon spawning microhabitat suitability curves. | Measure and/or simulate the spatial pattern of GHSI after project construction to determine quantity of preferred-quality (GHSI>0.4) habitat present. |
| 3. Provide adult and juvenile refugia in close proximity to spawning habitat. | 3A. Structural refugia in close proximity to spawning habitat should provide resting zones for adult spawners and protection from predation and holding areas for juveniles. | Create spawning habitat in close (<10 m) proximity to pools, overhanging cover, bedrock outcrops, boulder complexes, and/or streamwood. | Measure distance from medium and high GHSI quality habitats to structural refugia and check to see that most spawning habitat is within reasonable proximity. |
| 4. Provide morphological diversity to support ecological diversity, including behavoral choice by individuals. | 4A. Designs should promote habitat heterogeneity to provide a mix of habitat patches that serve multiple species and lifestages. | Avoid GHSI optimization of excessively large contiguous areas of habitat; design for functional mosaic of geomorphic forms and habitat. | Large (>2 channel widths) patches of homogenized flow conditions in hydrodynamic model and homogenized habitat quality in GHSI model results should not be present at spawning flows. |
| 5. Allow gravel/cobble to wash downstream | 5A.Suitable mechanisms of riffle-pool maintenance are not present or realistically achievable in the upper section of the EDR | no specific action required | Conduct annual recon of EDR to track where injected gravel/cobble goes. |
| | 5B. Flows that overtop Englebright Dam erode sediment off the placement area | no specific action required | Measure and/or simulate the spatial pattern of Shields stress and identify areas with values >0.06 |

### 5.4. Design Concept

Given the array of site and project constraints described earlier, there is a limited range of concepts possible for implementing spawning habitat rehabilitation. To facilitate a larger, longer term vision, a staged design concept was developed that can be aimed for over time. The design concept for the plan is illustrated in Figure 5.3. Area A is the focus of the effort for 2010. The design for Area A involves filling in the channel to a depth of ~2' for the primary spawning area at 855 cfs and then having a 3' deep thalweg going up to the crest. The thalweg is in the 2D model-predicted location of the pre-existing thalweg for 855 cfs. A deeper thalweg is required to cope with the total volume of flow focusing through the gravel-placement site. The thalweg ends at the riffle crest allowing water to diverge laterally across the crest. By design the thalweg does not go all the way through riffle, because that would increase the rate and likelihood of the flow cutting the gravel deposit into two lateral benches, which is not desirable (Pasternack et al., 2004). However, given the strength of the flow, it may be unavoidable, even without the thalweg going through the whole riffle by design. If fully built, Area A would use up an estimated 4673 short tons of gravel. The conversion of gravel amount from a design volume to a tonnage is based on the density measurements of Merz et al. (2006) reported earlier in section 2.2, noting that with the sluicing method there is no heavy machinery to compact the bed, in contrast to the effect of front loaders reported by Sawyer et al. (2009). A key reason to aim for 2' water depth at 855 cfs is that flows can drop to 700 cfs in a schedule A year and 500 cfs in a schedule B year. This depth provides a hydrologic buffer so that the riffle does not dewater. This is consistent with design objective #4. Another factor is that the design has to be constructible using the gravel sluicing method, and this simple design meets construction criteria based on past experience.

Figure 5.3 also illustrates design concepts for adding coarse sediment in future years to continue to meet the design objectives (Areas B and C). Because the channel deepens downstream, Area B uses more gravel than Area A, but is about half as long. Area B divides the flow and refocuses it into two 3'-deep thalwegs. Between them is a medial bar. This channel pattern is known to promote habitat diversity as well as resiliency against interannual flow differences during the spawning season. Area B requires an estimated 4870 short tons. Area C terminates the medial bar and joins the two thalwegs along the right bank, before beginning to shift it back toward the center. Area C requires an estimated 3192 short tons. Thus, the overall design concept would use 12735 short tons of gravel if it were possible to build it out over a period of a few years. This accounts for 56% of the estimated gravel/cobble storage deficit for the area from Narrows II to the rapid below the gaging station (Table 3.1). For the sake of comparison, a “blanket fill” design that would involve filling half of the pre-existing mean water depth at 855 cfs with coarse sediment between Narrows I and the rapid downstream of the gaging station would require an estimated 15850 short tons. Such a blanket installation is not feasible by gravel sluicing as it is currently practiced. Nevertheless, this value is helpful to appreciate that the creation of a heterogeneous spawning riffle in a relatively small area can achieve the same gravel/cobble storage goal, while also yielding the benefit of providing preferred SRCS spawning habitat.

If the gravel introduced in the first year washes downstream consistent with design objective #5, then that is fine, as the eroded material would still be serving the primary plan goal (design objective 1). Future injections would use the next amount of material purchased to rebuild as much of Area A, then Area B, and then Area C as possible. It is possible that frequent floods could preclude the complete design concept from ever being achieved, and that is an acceptable outcome consistent with the overall goals of the plan and the specific design objectives.

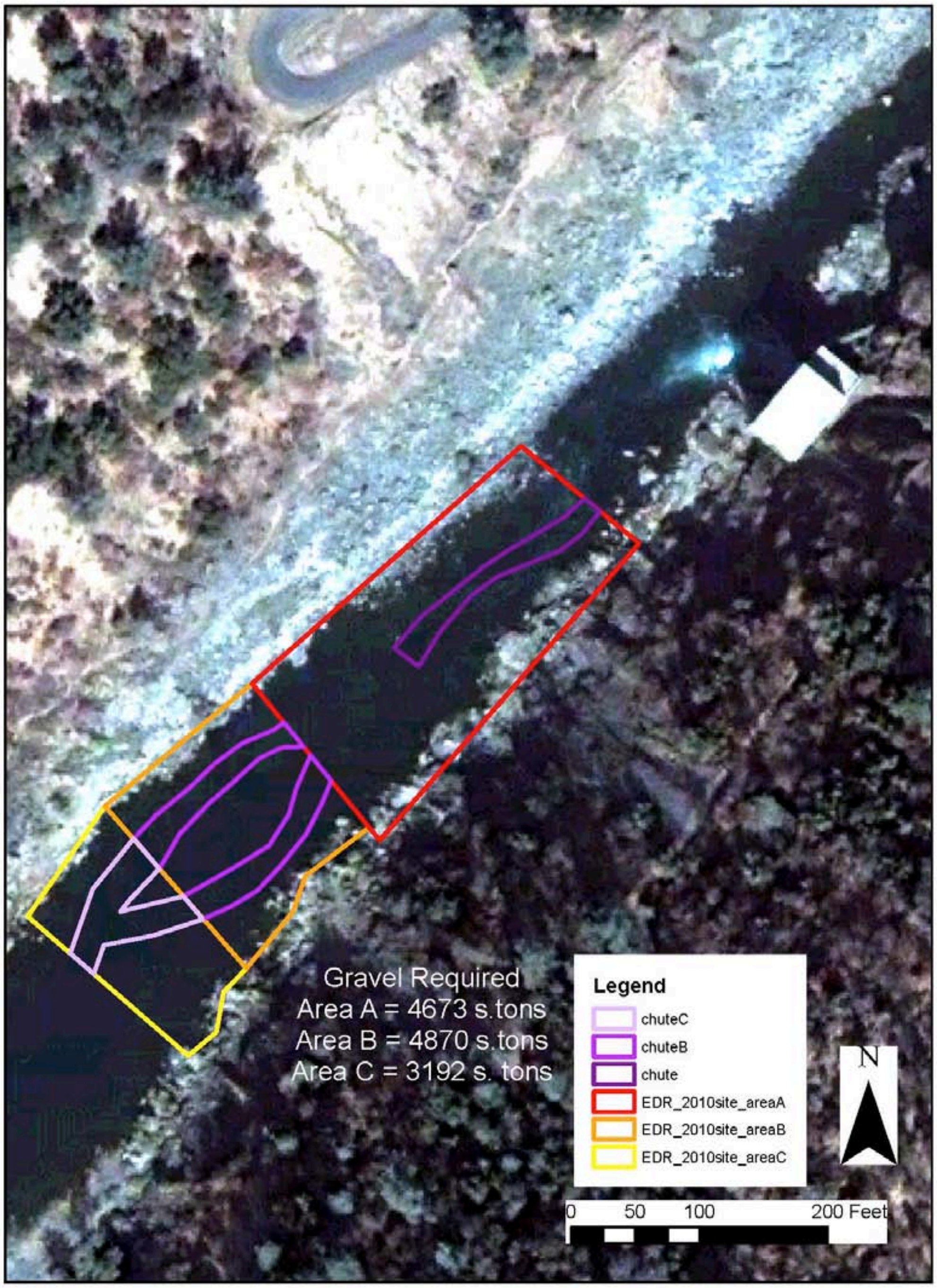


**Figure 5.3.** Design concept for using gravel augmentation in the EDR to possibly obtain a salmon-spawning riffle with diverse microhabitat features.

**5.5. 2D Model Testing of Design Hypotheses**

The likely ability of the design concept to achieve design objectives 2 and 5 is testable by performing spatially distributed, mechanistic numerical modeling of the design. Objective 2 and hypothesis 2B require that the design yield areas with GHSI>0.4 at a typical autumnal discharge of ~500-950 cfs. Objective 5 and hypothesis 5B require that the design yield areas with Shield stress values > 0.06 at flows overtopping Englebright Dam, which is Q>4500 cfs. The abilities of the design for Area A, Areas A+B, and Areas A+B+C to achieve these requirements were tested by incorporating their respective topographic features into SRH-2D models of the EDR and putting these models through the same paces as the models reported in section 3. The computational meshes used were the same as for the baseline simulations, with only the bed topography changed.

*The SRH-2D model simulation for 855 cfs revealed that the design concept for Area A successfully achieves substantial area of spawning habitat with GHSI>0.4 (Fig. 5.4).* Because excessive depth appears to be the limiting variable, lower discharges would have lower depths, higher GHSI values, and thus a larger total area of preferred Chinook spawning habitat.

*The SRH-2D model simulation for 855 cfs revealed that the design concept for Area A yields a stable bed with a Shields stress of 0.01-0.03 during this spawning discharge (Fig. 5.5).* Depending on how loosely the gravel/cobble settles onto the bed and whether any grain size fractionation occurs during settling, it is unclear whether this range of Shields stress values would be associated with partial transport. However, if that happened, the bed can be expected to adjust very quickly to yield a stable configuration prior to the autumn 2011 spawning season.

*The SRH-2D model simulation for 10,000 and 15,400 cfs revealed that the design concept for Area A successfully provides a condition of full bedload mobility over the majority of the project area at these discharges (Fig. 5.6).* That means that at these high discharges and any higher ones, the project site will scour significantly. Beginning with the 1991 water year, flows of >10,000 cfs have occurred in 12 out of 20 years, or once every 1.67 years. Therefore, there is a high likelihood that the placed grave/cobble will transport downstream in accordance with design objective #5. Results shown in Figures 3.6-3.7 indicate that the placed material is unlikely to leave the EDR. Considering that those analyses do not account for the impeding effects of flow out of Deer Creek, then the likelihood is even stronger that the material will stay in the EDR.

One other consideration related to any riffle design is the fact that a riffle is a partial barrier to flow. Water backs up behind a riffle and accelerated over it. When a riffle is added artificially or degraded riffle-pool relief is rehabilitated, then an increased backwater effect will result (Wheaton et al., 2004a). The Area A 2D model simulations show that effect for that design. In the EDR, there is no negative environmental impact of this upstream backwater effect, because it serves to decrease velocity and increase depth in an area that is already mostly devoid of spawning habitat anyway. In terms of powerhouse operations, both powerhouses operate normally with a wide range of tailwater depths, so an increase in water surface elevation in the Narrow I pool and Narrows II pool should not impact their operations.

Overall, there do not appear to be any impediments for the use of the Area A design. The design uses a reasonable amount of gravel to pilot the gravel sluicing method in 2010. If the material survives in its placement location through winter and spring 2011, the design is predicted to yield preferred Chinook spawning habitat and is predicted to yield a stable riffle during spawning and embryo incubation in 2011 prior to winter storms in 2012. The designed riffle is predicted to be erodible during floods overtopping Englebright Dam roughly every other year, but when moved the material is expected to stay within the EDR. This means that the tonnage still counts toward achieving the geomorphic goal of eliminating the gravel/cobble deficit for the reach over the long term. Further gravel additions to re-build Area A in future years would yield short-term habitat benefits and add up toward the longer term geomorphic goal. The last column of Table 5.1 lists specific measures than can be used to test the efficacy of gravel augmentation toward meeting each specific design objective.

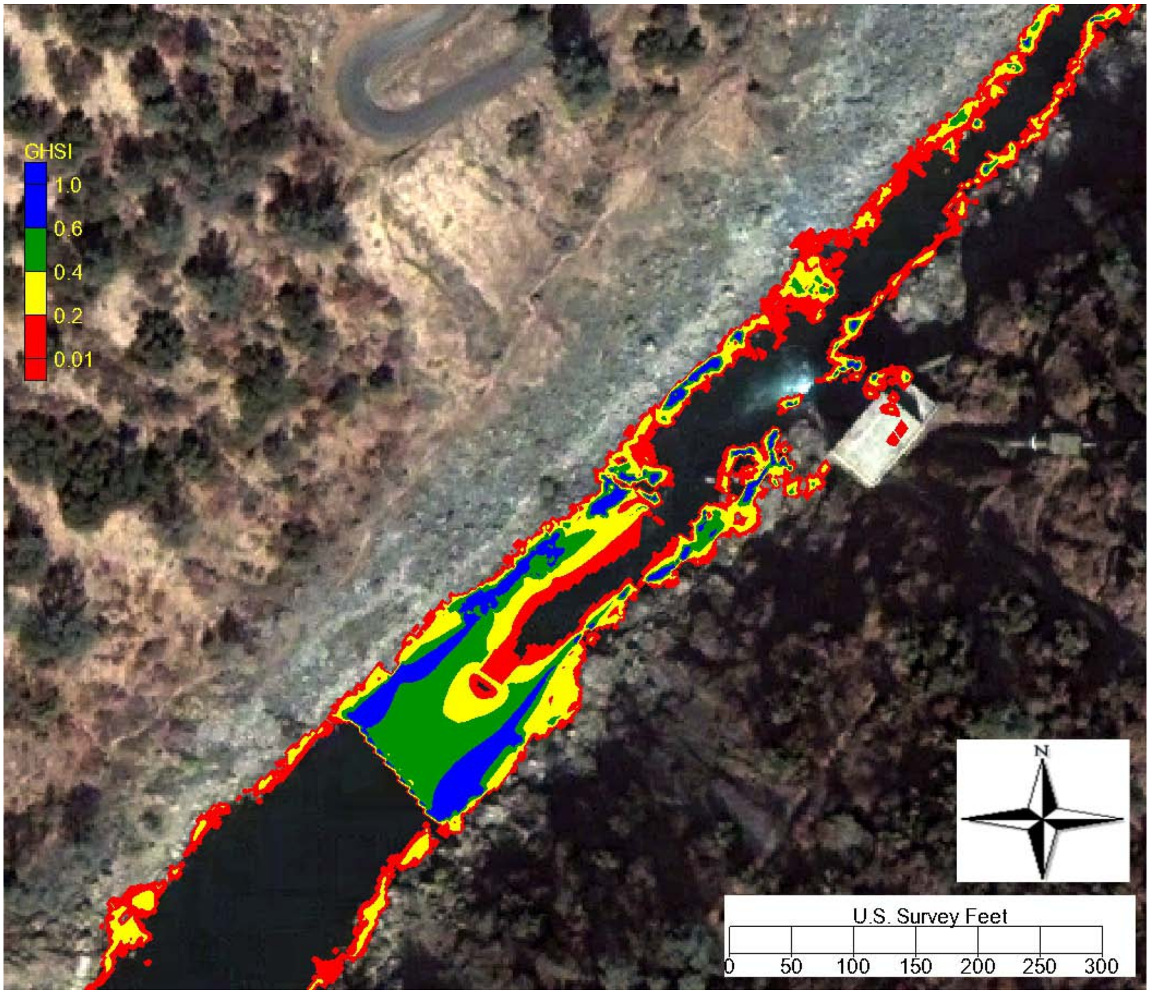


**Figure 5.4.** GHSI prediction for Area A at 855 cfs. Areas of green and blue are predicted to be preferred Chinook spawning habitat.

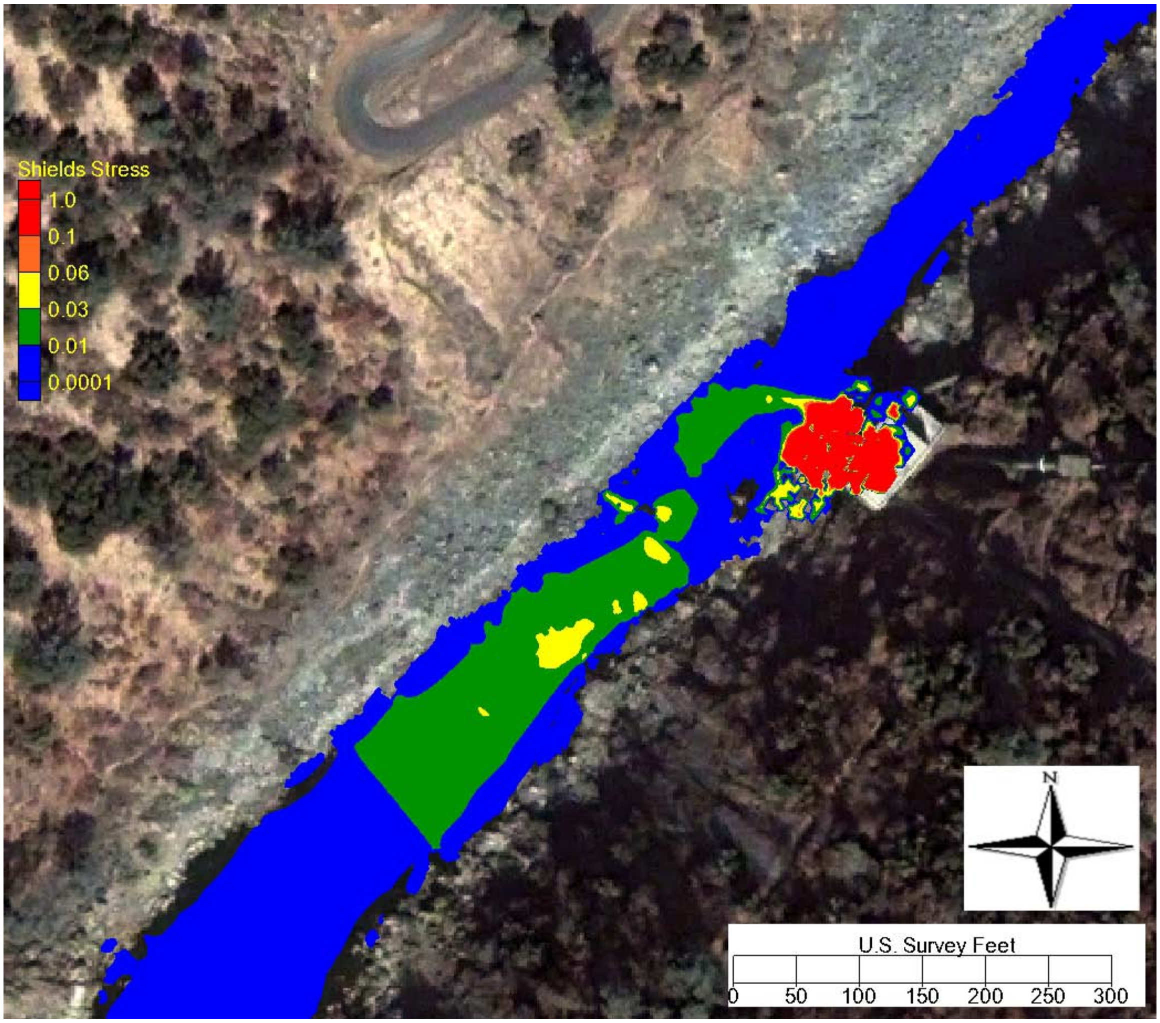


**Figure 5.5.** Shields stress prediction for Area A at 855 cfs.

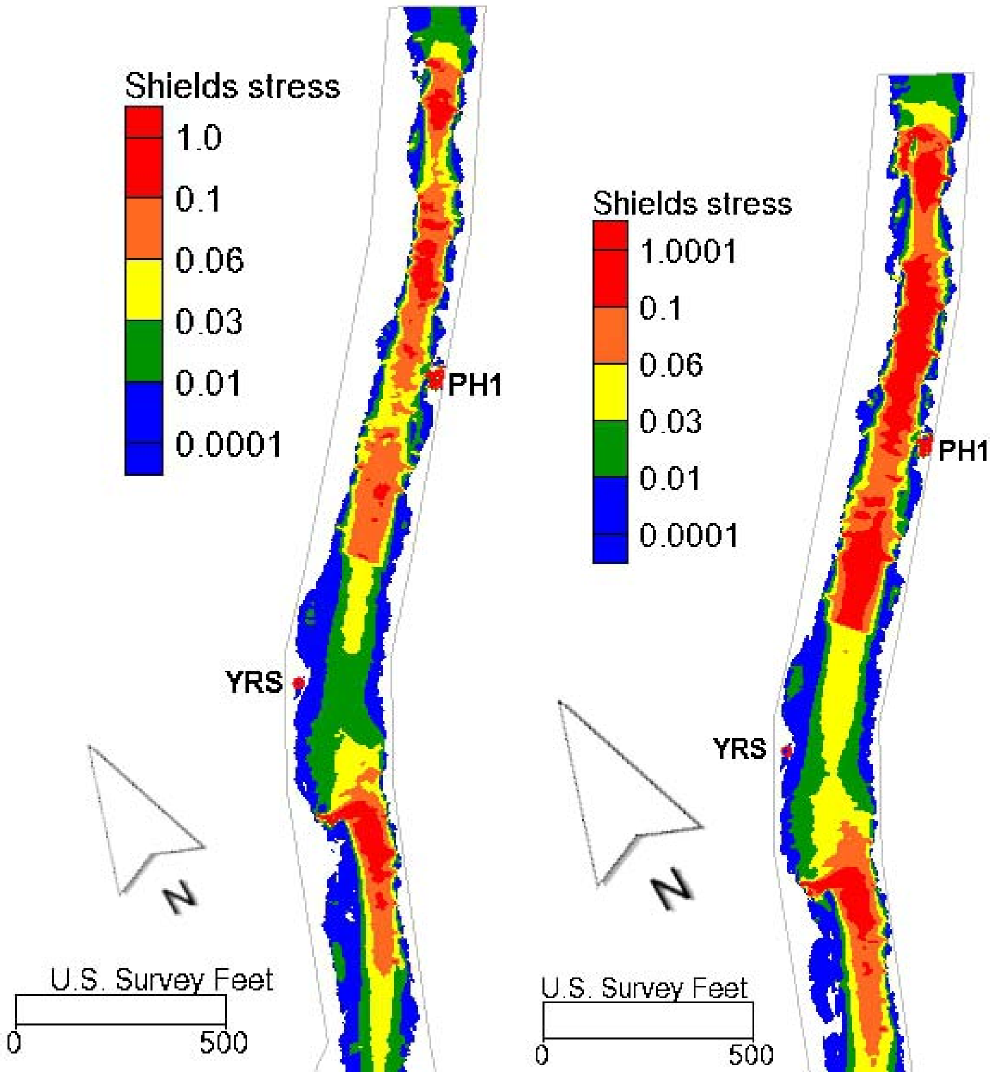


**Figure 5.6.** 2D model predictions of Shields stress for flows of 10,000 cfs (left) and 15,400 cfs (right), focusing on the location of gravel placement below the Narrows I powerhouse (PH1). In both scenarios, Shields stress > 0.06 over the majority of Area A.

## 6. LONG-TERM GRAVEL AUGMENTATION PLAN

The estimated gravel/cobble deficit for the EDR is 63,077 to 100,923 in the current condition. Considering just the area from the Narrows I powerhouse to the rapid downstream of the gaging station, the amount is 15,949 to 25,518 short tons. The lower value for each domain is consistent with the idea of having a diversity of complex morphological units in the reach, while the higher value for each domain is consistent with the idea of having a fully alluvial reach with a lot of riffle area and low morphological diversity. The former conception involving a balanced role of alluvial and bedrock influences is interpreted to be the best match for what was likely present prior to hydraulic mining. The latter conception of a fully alluvial river within the canyon would more resemble the state of the river during severe alluviation with hydraulic mining debris, and therefore is deemed less appropriate.

Strategically, different approaches are feasible for the sequencing of placing gravel and cobble. It is not feasible to erase the entire gravel/cobble deficit in one year. It is very important to use an incremental approach in this type of project, because it yields a more resilient and better-tested outcome (Elkins et al., 2007). The area of the river that is presently appropriate for gravel augmentation is the domain from the Narrows I pool to the top of the rapid downstream of the gaging station. The recommendation for the 2010 pilot project is to use the sluicing method to place 2000 to 5000 short tons of gravel/cobble to build up an Area A riffle. This project is a “pilot”, because the gravel/cobble sluicing method has never been attempted for salmon habitat rehabilitation over such a long distance and with such a high height drop.

During and after the 2010 pilot gravel/cobble placement, a monitoring program should be instituted to evaluate what happened. Baseline data exists for the pre-project characterization (see section 3). Observation, description, and photo-documentation of the gravel/cobble sluicing operation would help assess its logistical effectiveness to get gravel/cobble into the river. After construction, an as-built topographic survey should be performed to enable 2D hydrodynamic modeling for mapping of physical habitat and sediment transport potential for the site. The as-built survey is also required for DEM differencing to track volumetric change over time. Thereafter, the seven tests listed in

Table 5.1 should be carried out. These tests will ascertain the veracity of the design hypotheses and the suitability of the design objectives. Based on the outcome of a thorough evaluation, future projects may be designed differently to yield improved outcomes.

Assuming the gravel-sluicing method of doing gravel/cobble augmentation is judged successful after evaluation of the 2010 pilot project, then a long-term plan that continues to use this approach would be recommended. The concept would be to add gravel and cobble to Areas A, B, and C until the EDR deficit is erased. Building out the design concept for Areas A, B, and C would come close to achieving the total deficit for this section, and it would be easy to add an Area D to finish it off when and if that is needed. Thereafter, as floods relocate the sediment into the lowermost section of the EDR, further additions would be made to the placement area to keep up with the flux into the lowermost section plus any outflux leaving the EDR. Eventually, the gravel deficit for the whole reach would be erased. Once the overall deficit is erased, then further additions would only be appropriate after material is observed leaving the EDR, and then the amount would match the estimated loss.

For the section between the Narrows II and I powerhouses, it may or may not be feasible to ever erase the gravel/cobble deficit. Further evaluation of options in light of existing and possible future powerhouse operations is required.

Overall, the evidence shows that the EDR has the potential to accommodate thousands of Chinook spawners. Erasing the gravel/cobble deficit for the reach would be beneficial toward achieving that potential. Gravel sluicing is the recommended method for augmenting gravel into the EDR. Going further to build diverse morphological units in the reach would yield a sufficient amount of preferred holding, spawning, and embryo-incubation habitat for the population. Such actions would account for the most significant and evident geomorphic impacts of Englebright Dam on the lower Yuba River.

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# APPENDIX B
# SALMONID REDD SURVEY PROTOCOLS

# APPENDIX I
# SPECIFIC SAMPLING PROTOCOLS AND PROCEDURES FOR CONDUCTING ADULT CHINOOK SALMON AND STEELHEAD REDD SURVEYS

# Yuba River Chinook Salmon and Steelhead Redd Surveys

## Background

Anadromous salmonids in the lower Yuba River include Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead (*O. mykiss*). The California Department of Fish and Game (CDFG) conducted annual reconnaissance-level Chinook salmon redd surveys in the lower Yuba River from 2000 through 2005. These surveys were conducted during late-August through September to document the initial time of redd construction for early spawning Chinook salmon (presumably spring-run Chinook salmon). Initial Chinook salmon redd construction was observed in the Garcia Gravel Pit Reach (primarily above Parks Bar) by mid-September each year.

The lower Yuba Accord's River Management Team (RMT) conducted a 2008-2009 pilot redd survey to obtain information to be used in the development of a methodology to provide the data necessary to address the goals specified in the lower Yuba River Monitoring and Evaluation Program (M&E Program).

Redd counts have been used widely to estimate or provide indices of adult salmonid escapement or abundance, and examine the spatial and temporal distribution of spawning adult salmonids. Redd counts are the primary metric used for monitoring salmonids in Washington and Oregon (Boydstun and McDonald 2005, as cited in Gallagher *et al.* 2007). Since the 1950s, redd counts have been used in Idaho for relative abundance estimates and examining trends in abundance (Elms-Cockrum 1999, as cited in Kucera and Orme 2007). Chinook salmon redds varied spatially and temporally over a large wilderness basin in Idaho from 1995-2003 (Isaack and Thurow 2006).

Redd superimposition occurs when later arriving female salmonids dig redds on top of existing redds. Redd superimposition can occur when spawning gravel is limited and can cause substantial mortality to eggs deposited in a redd before redd superimposition occurred (Hayes 1987; McNeil 1964). Spawning gravel availability has been found to be an important factor limiting Chinook salmon populations in streams where dams capture sediments and reduce supply of gravel to downstream reaches (EA Engineering Science and Technology 1992).

Redd surveys conducted in the lower Yuba River will obtain data on Chinook salmon and steelhead redd attributes (i.e., redd size (area, $m^2$)), as well as abundance, and spatial and temporal spawning distribution. Redd surveys will be conducted throughout the spawning seasons of spring-run, fall-run, and late fall-run Chinook salmon and steelhead throughout the lower Yuba River ("extensive area" redd surveys).

In addition, data pertaining to redd location and size will be obtained to develop indices of redd superimposition using geographic information system (GIS) analyses for the Chinook salmon runs and steelhead in the lower Yuba River.

Goals of the redd surveys conducted in the lower Yuba River include: (1) evaluate and compare the spatial and temporal distribution of redds and redd superimposition over the spawning seasons for the Chinook salmon runs and steelhead spawning in the lower Yuba River; (2) compare the magnitude (and seasonal trends) of lower Yuba River flows and water temperatures with the spatial and temporal distribution of redds (and rates of redd superimposition) for the Chinook salmon runs and steelhead; (3) estimate the total annual abundance of adult fall-run Chinook salmon and steelhead in conjunction with angler surveys and Vaki Riverwatcher data; and (4) establish a long-term data set to be used to evaluate habitat utilization by the Chinook salmon runs and steelhead in the lower Yuba River under variable biotic and abiotic conditions.

## 1.0 Survey Location

The lower Yuba River extends about 38.6 km (24 mi) from Englebright Dam, the first impassible fish barrier on the river, downstream to the confluence with the Feather River near Marysville, California. Approximately 33.6 km (20.9 mi) of the 38.6 km (24 mi) of the total length of the lower Yuba River will be surveyed during the extensive area redd surveys. About 1.1 km (0.7 mi) of the lower Yuba River located immediately below the first set of riffles downstream of Deer Creek to the top of Narrows Pool will not be surveyed due to rugged and dangerous conditions in the steep canyon known as the Narrows. Additionally, an approximate 3.2 km (2 mi) section of the lower Yuba River from Simpson Lane Bridge to the confluence with the Feather River will not be regularly surveyed because redds have not been observed during past surveys. This section of the river will be surveyed once during peak Chinook salmon spawning to ascertain that this section is, in fact, not being utilized for spawning.

The area of the lower Yuba River to be surveyed for redds includes four major reaches (**Table 1**).

**Table 1. Lower Yuba River redd survey reaches.**

| **Reach** | **Location** | **Kilometers** | **(Miles)** |
|---|---|---|---|
| 1 | Englebright Dam to 1$^{st}$ set of riffles below Deer Creek | 1.4 | 0.9 |
| 2 | Narrows Pool to SR 20 Bridge | 6.4 | 4.0 |
| 3 | SR 20 Bridge to Daguerre Point Dam | 9.7 | 6.0 |
| 4 | Daguerre Point Dam to Simpson Lane Bridge | 16.1 | 10.0 |
| **Total** | | **32.2** | **20.9** |

## 2.0 Survey Period

With implementation of the Yuba Accord, the adult Chinook salmon and steelhead redd surveys will be considered a long-term monitoring effort. Extensive redd surveys are anticipated to be conducted annually for at least five years, from 2009/2010 through 2013/2014. The RMT will review the data and reports on an annual basis, and determine whether the overall duration of the redd surveys should be adjusted.

Reconnaissance-level redd surveys will begin on or about August 1 each year to document the initiation of spawning activity in the lower Yuba River. Prior redd surveys have documented the initiation of spawning activity from about mid-August to mid-September. Relatively few redds have generally been observed until spawning activity begins in earnest, typically from late-September to early-October. Hence, reconnaissance-level redd surveys will be conducted from approximately August 1 until the first redd is observed each year.

Extensive area redd surveys will begin the week after a redd is first observed during the reconnaissance-level redd survey and extend through about May 1 (or until newly constructed redds are no longer observed). This duration will encompass the spawning seasons of spring-run, fall-run, and late-fall run Chinook salmon, and steelhead.

## 3.0 Sampling Frequency

Reconnaissance-level redd surveys will be conducted weekly (in conjunction with the roving surveys associated with Acoustic Tracking - see *Appendix D: Specific Sampling Protocols and Procedures for Acoustic Tagging*). During the reconnaissance-level redd survey, <u>survey weeks with zero redds encountered are important and must be documented.</u>

Data obtained from the 2008-2009 pilot redd survey were evaluated to determine the sampling frequency for the extensive area redd surveys. Evaluation of these data utilized the temporal distribution of spawning activity and a simulation approach. A full description of the 2008-2009 pilot survey data evaluation is presented in **Attachment 1**.

The extensive area redd surveys will be conducted weekly beginning the week after a redd is first observed during the reconnaissance-level redd survey through the portion of the season encompassing the majority of Chinook salmon spawning activity. Prior redd and carcass surveys indicate that the majority of Chinook salmon spawning activity occurs through December, with reduced amounts of Chinook salmon spawning continuing through late-March, and steelhead spawning extending through April. From the 2008-2009 pilot redd survey data and a simulation approach, a weekly sampling frequency was found to result in the most precise and accurate (least biased) estimates of spawning activity (see Attachment 1). Therefore, weekly extensive area redd surveys will be conducted from the initiation of spawning activity through December each year.

For the last portion of the extensive area redd survey (i.e., January 1 through May 1), surveys will be conducted bi-weekly (see Attachment 1) to obtain required data in a most cost-effective manner.

Redd area measurements will be conducted to examine redd superimposition throughout the lower Yuba River for the Chinook salmon runs and steelhead. Evaluation of Chinook salmon redd areas ($m^2$) calculated for the 2008-2009 index area indicated that redd area significantly differed ($r^2 = 0.24$, $P < 0.01$) over the course of the majority of the spawning activity (mid-September through December). Therefore, a sampling design specifically addressing redd area estimation is necessary for the extensive area redd surveys.

A systematic sampling design will be used to collect redd area measurement data during the extensive area redd survey, where every 17$^{th}$ sampling unit (redd) will be included in the sample for redd area measurements (see **Attachment 2**). Systematic sampling is often used for ease of execution and convenience (Hansen *et al.* 2006). In addition, systematic samples are usually spread more evenly over the population, so population attributes can be estimated more precisely than simple random sampling (Hansen *et al.* 2006).

## 4.0 Sample Size

For estimates of total abundance, spatial and temporal distribution of Chinook salmon (by specific run) and steelhead redds, the sample size for the extensive redd surveys is the number of weekly or bi-weekly surveys conducted for the entire survey each year.

The sample size for redd area measurements will be the total number of redds measured at a frequency of every 17$^{th}$ redd observed.

## 5.0 Survey Protocols and Procedures

### 5.1 Preseason Planning – Lead Biologist Responsibilities and Coordination Activities

At least one month in advance of the reconnaissance-level redd survey (beginning approximately August 1), preseason planning activities for the extensive area redd surveys will be initiated by the lead biologist. Preseason preparations include: (1) developing the annual survey schedule; (2) obtaining all necessary equipment; and (3) training all survey personnel.

During July each year, a planning meeting will be held with the RMT to review the survey procedures and logistics. The purpose of this meeting is two-fold: (1) to verify that all necessary preparations and planning arrangements have been completed for that year's redd surveys; and (2) to provide an opportunity to make adjustments to the survey timing, logistics or approach if new information becomes available or if deemed necessary by the RMT.

### 5.2 Data Collection and Sampling Techniques

The observation of redds and species-specific redd identification is affected by the visibility of the substrate. Substrate visibility can be reduced by turbidity, surface disturbance, and other conditions including wind, fog, high flows, and angle of the sun. Visibility will be improved by surveyors wearing polarized sunglasses. Visibility will be measured each survey day using a secchi disk.

### 5.2.1 Species-specific redd identification

Initially, an established size criterion will be used to distinguish between Chinook salmon and steelhead redds. A redd that is less than 1.56 m long and less than 1.37 m wide will be considered a steelhead redd. Redds larger than this length and width will be considered a Chinook salmon redd. This criterion was used to classify 129 Chinook salmon redds with 96% accuracy and 28 steelhead redds with 53% accuracy in the lower Yuba River (USFWS 2008). Uncertainty regarding species-specific redd identification using this size criterion initially will be addressed by examining the timing of spawning, gravel size, and the location of the redd in the river channel during the annual redd surveys.

Uncertainty regarding species-specific redd identification will be reduced by comparing the physical dimensions and locations for all known redds (i.e., redds which were positively identified with one species or another building or guarding them). During the extensive area redd surveys, each redd observed with an adult building or guarding them will be measured, and the species identified and recorded. After several years of data collection, if a sufficient number of known redds are identified, then the size criterion will be re-calculated and applied to each year of the extensive area redd surveys.

Differentiating between steelhead redds and Sacramento sucker (*Catostomus occidentallis*) and Pacific lamprey (*Lampetra tridentata*) spawning nests is of concern because these three species clean the gravel during spawning. Suckers do not typically spawn until late-March and April, and are generally visible during their spawning season. Steelhead redds are generally easy to distinguish, because they create a noticeable pit and tail spill in the gravel during redd construction. DeHaven (2002; as cited by CDWR 2003) often found it difficult to distinguish Pacific lamprey spawning nests from steelhead redds. The Oregon Department of Fish and Wildlife (1999) distinguish lamprey spawning nests and steelhead redds using redd/nest dimension measurements. A steelhead redd is distinguished by a longer length than width and the tailings are evenly distributed downstream by the current (**Figure 1**). Lamprey spawning nests generally have a neat and round appearance, with a conical bowl (**Figure 2**). The unique characteristic of a lamprey spawning nest is the placement of the tailings upstream from the nest (**Figure 3**). Lamprey excavate their spawning nests by sucking onto the gravel and then depositing it outside the nest. **Figure 4** shows a lamprey spawning nest with tailings from the nest placed perpendicular to the flow. Based on the 2008/2009 pilot redd survey in the lower Yuba River, lamprey were observed spawning in late-March and early-April in the most downstream sampling reach of the lower Yuba River, where sand was the subdominant substrate.

**Figure 1. Steelhead redd (ODFW 1999).**

**Figure 2. Lamprey nest (ODFW 1999).**

**Figure 3. Lamprey nest, note placement of excavated rocks upstream and perpendicular to flow (ODFW 1999).**

**Figure 4. Lamprey nest showing placement excavated debris to the side of the nest (ODFW 1999).**

### 5.2.2 Extensive area redd surveys

The extensive area redd surveys will be conducted using four kayaks and two survey crews, each crew with two surveyors. Each surveyor will scan the river from the shore to the middle of the river, working downstream. Side channels in the survey area may require walking.

Prior to conducting a survey, the following data will be recorded: (1) survey date; (2) surveyors' initials; (3) survey section; (4) number of crews; (5) specific crew identification (Crew A or B); (6) weather; (7) streamflow (cfs); and (8) secchi disk depth (ft) (**Attachment 3**). Flow data will be obtained from the Yuba River Smartsville and Marysville gages through the California Department of Water Resources' (CDWR) online California Data Exchange Center (CDEC). The Smartsville gage will be used for flows above Daguerre Point Dam (DPD) and the Marysville gage for flows below DPD. Visibility will be measured using a secchi disk at the top of the survey section.

Each observed redd will be consecutively numbered from the very first redd observed during the extensive area redd survey through the entire redd sampling season to identify those redds to be measured for redd size (area $m^2$). For each new redd observed throughout the sampling season, the following data will be recorded (Attachment 3): (1) a GPS (Trimble GeoExplorer XT) location taken at the center of the redd's pit with a unique identifying number (i.e., Date + plus redd number; e.g. 082908-001); (2) total dimensional area (using a GPS) for areas appearing to contain multiple redds with no clear boundaries (i.e., mass aggregate spawning); (3) habitat type (i.e., pool, riffle, run, or glide); (4) substrate composition of ambient habitat based on substrate size immediately upstream of the pit (**Table 2**); (5) redd species identification; (6) number of fish observed on the redd; (7) location information (i.e., side channel or main channel); (8) comments regarding observable redd superimposition (i.e., redd overlap); and (9) any additional comments.

The path undertaken by each surveyor down the river will be recorded using Garmin GPSMAP 60Cx GPS units to document specific locations of the river surveyed.

Visual estimation of dominate/subdominant substrate sizes will be along the B axis of the substrate elements. Prior to conducting redd surveys, each surveyor will become familiar with visual substrate size estimation using a gravel template.

The GPS (Trimble GeoExploerXT) and a data dictionary will be used to ensure redds counted during the previous survey weeks are not double-counted. In addition, surveyors will mark each redd at the pit with a painted rock.

**Table 2. Wentworth (1922) substrate and size range.**

| Classification | Particle Size Range (mm) | Classification Number |
|---|---|---|
| Boulder | >256 | 6 |
| Coarse Cobble | 128-256 | 5 |
| Fine Cobble | 64-128 | 4 |
| Gravel | 2-64 | 3 |
| Sand | 0.0625-2 | 2 |
| Silt/Clay | <0.0625 | 1 |

#### 5.2.2.1 Redd Area Measurements

Each observed redd will be consecutively numbered from the very first redd identified in the extensive area redd surveys through the entire redd sampling season to identify those redds to be measured for redd size (area $m^2$). For every 17$^{th}$ redd encountered, the, physical dimensions will be measured. In addition to the data described in **Section 5.2.2,** surveyors will collect and record redd area data for each 17$^{th}$ redd using a fiberglass extendable rod demarcated at every 0.1 m according to the procedures identified in **Figures 5** and **6,** and **Table 3.**

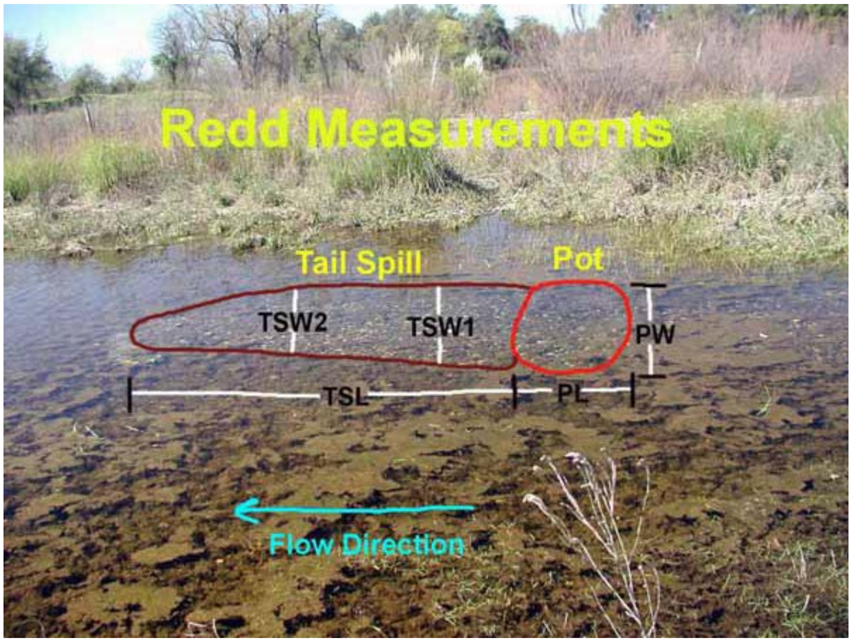


**Figure 5. Illustration of steelhead redd measurements (PL = pot length; PW = pot width; TSL = tail-spill length; TSW2 and TSW1 = tail-spill widths,), as presented in Hannon and Deason (2005).**

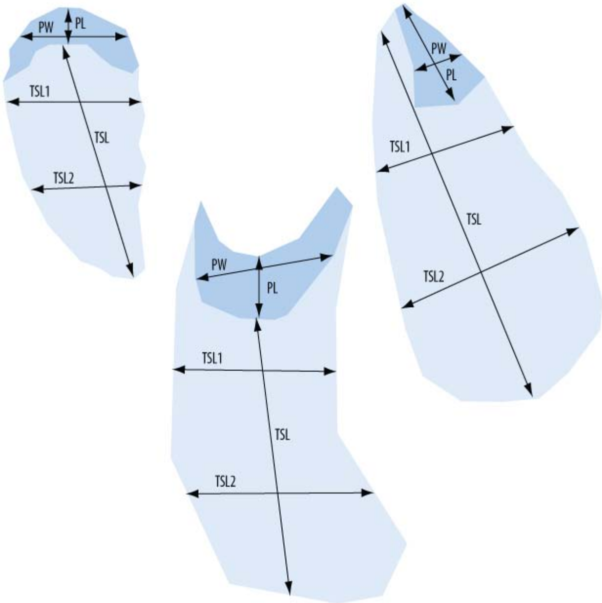


**Figure 6. Measurements for unusually shaped redds (PL = pot length, PW = pot width, TSL = tail-spill length, TSL1 and TSL2 = tail-spill widths). Illustration reproduced from Gallagher *et al*. 2007.**

**Table 3. Description of redd dimension measurements displayed on Figures 5 and 6.**

| | |
|---|---|
| Pot Length (PL) | Total length of the pot parallel to the stream flow, and should be measured in meters (to the nearest cm) from the top to bottom edge. When the pot is irregularly shaped, estimate the total length as accurately as possible. |
| Pot Width (PW) | Maximum width of the pot perpendicular to the stream flow or pot length in meters (to the nearest cm). When the pot is irregularly shaped, estimate the total length as accurately as possible. |
| Tail Spill Length (TSL) | Total length of the tail spill parallel to the stream flow (in meters to the nearest cm). Measurements will be taken from the top edge (i.e., downstream edge of the pot) to bottom edge of the tail spill. |
| Tail Spill Width 1 (TSW1) | Maximum width of the tail spill perpendicular to the stream flow or pot length (in meters to the nearest cm). Measurements will be taken from one edge to the other, about one-third of the distance downstream from the top edge of the tail spill |
| Tail Spill Width 2 (TSW2) | Maximum width of the tail spill perpendicular to the stream flow or pot length (in meters to the nearest cm). Measurements will be taken from one edge to the other, about two-thirds of the distance downstream from the top edge of the tail spill. |

## 5.3 Field Gear Decontamination

New Zealand mudsnails (*Potamopyrgus antipodarum*, NZMS) were first discovered in California (Owens River) in 1999. The NZMS has the ability to adapt to new ecosystems and alter food web dynamics. Controlling the spread of the NZMS is a top priority for the California Department of Fish and Game. CDFG needs to ensure that their employees are not spreading NZMS in the course of carrying out their duties. Therefore, a field gear decontamination protocol for NZMS has been developed and will be used for gear used in the lower Yuba River.

The following procedures for decontaminating field gear (i.e., waders, wading boots, boot insoles, nets, wading sticks, or anything else that comes into contact with the water) developed by CDFG (2008) will be followed prior to entering a new body of water or at the end of the day, whichever occurs first. Freezing field gear will be the first option if a freezer is available. Freezing has no adverse effect on field gear or on the environment, and is the most cost effective means of decontamination.

### 5.3.1 Freezing Procedure

1) Place field gear into a new large plastic bag and seal before placing into the vehicle. Any surface that comes in contact with field gear can become contaminated.

2) Upon returning to a CDFG office, place the plastic bag containing the field gear into a freezer (<0 °C) for a minimum of six hours.

### 5.3.2 Immersion Procedure

1) If field gear is not going to be decontaminated on site, place the field gear into a new large plastic bag and seal before placing into the vehicle.

2) Place all field gear that came in contact with water into a container of sufficient size to allow gear to be completely immersed in decontamination solution.

3) Pour decontamination solution (5% Sparquat) into container to allow complete immersion of all field gear. If necessary, weigh down the gear to ensure the gear is completely immersed. To make the decontamination solution, use a ratio of 7 oz of Sparquat to 1 gallon of water.

4) Soak field gear in decontamination solution for a minimum of 15 minutes.

5) Remove field gear from the decontamination solution and inspect gear to ensure that all debris that could contain NZMS has been removed. Use a stiff brush to remove any debris that remains on the field gear.

6) Rinse field gear with fresh water. Do not use water from the sampling site. Using water from the sampling site will contaminate your field gear. Rinse water should not be allowed to enter a storm drain or water body.

7) Decontamination solution must be disposed of into a sanitary fill for proper waste treatment. Decontamination solution cannot be dumped on the ground under any circumstances. Decontamination solution cannot be disposed into a septic system. Five-gallon disposal containers will be provided to personnel for use in disposing decontamination solution. Decontamination solution can be disposed of at the CDFG Regional office.

### 5.3.3 Spray Bottle Procedure

1) Create a decontamination solution that contains 10% Sparquat (900ml of water and 100ml of Sparquat).

2) Liberally spray field gear until gear is completely saturated. Ensure that hard to reach areas are sprayed thoroughly.

3) Allow decontamination solution to remain on field gear for a minimum of 15 minutes.

4) Rinse sampling gear with fresh water. Do not use water from the sampling site. Using water from the sampling site will contaminate the field gear.

5) Rinse water should not be allowed to enter a storm drain or water body.

The spray bottle procedure should not be used except under very extreme circumstances when freezing or immersion procedures cannot be completed. Contact time and concentration of decontamination solution from spray bottle procedures cannot be guaranteed, which does not ensure 100% mortality of NZMS.

### 5.4 Watercraft Decontamination

California's waterways currently face the challenge of invasion by quagga mussels *(Dreissena bugensis)* and zebra mussels *(Dreissena polymorpha)*. Zebra mussels, a species native to Eastern Europe, were first introduced in the United States through ballast water released into the Great Lakes in the late 1980s. Quagga mussels soon followed.

In January 2007, quagga mussels were discovered in Lake Mead and later in the Colorado River. They now infest water bodies in Riverside, San Diego and Orange counties. In January 2008, zebra mussels were discovered in the San Justo Reservoir in San Benito County.

Preventing the spread of quagga and zebra mussels is a top priority for CDFG. CDFG needs to ensure that their employees are not spreading quagga and zebra mussels in the course of carrying out their duties. Therefore, the following watercraft decontamination protocol for quagga and zebra mussels has been developed for immediate implementation by all CDFG employees (CDFG 2008).

1) Prior to leaving the launch facility; remove all plants and mud from the watercraft, trailer, and equipment. Dispose of all material in the trash.

2) Prior to leaving the launch facility; drain all water from the watercraft and dry all areas, including the motor, motor cooling system, live wells, bilges, and lower end unit.

3) Upon return to Regional facilities or local office, pressure wash the watercraft and trailer with 140 °F water, including all of the boat equipment (i.e., ropes, anchors, etc.) that came into contact with the water. (Pressure washers are available at the Region office for boat decontamination.)

4) Flush the engine with 140 °F water for at least 10 minutes and run 140 °F water through the live wells, bilges, and all other areas that could contain water.

5) For areas that cannot be washed, but have come into contact with the water, spray or wipe the areas with a solution of 4% muriatic acid.

6) Wash all field gear with 140 °F water or a decontamination solution that contains a 6% chlorine solution.

7) To ensure 100% mortality the water needs to be 140 °F at the point of contact or 155 °F at the nozzle.

Anyone with questions regarding the acquisition of chemicals, require proper training to implement these protocols, or need a field gear decontamination kit, call (916) 358-2895 (Mr. Jason Roberts; CDFG; Environmental Scientist) or (916) 358-2943 (Mr. Joseph Johnson; CDFG; Senior Environmental Scientist).

### 5.5 Quality Assurance/Quality Control Processes

A chain of custody and review process will occur for all data sheets. Surveyors in the field will review data sheets to verify all data has been collected, and they will record their initials on all data sheets and place them into a “data to be entered” binder. Subsequently, personnel that enter the data into a database will date and initial the data sheets and place them into an “entered data” binder. Following this, personnel will complete a final review the data entered into the database against the data sheets for quality assurance/quality control purposes and initial and date the bottom of the data sheet.

Although handheld GPS data recorders will be used in the field, a paper copy of the data will also be collected in the field and used to check the GPS data for errors.

## 6.0 Logistics

### 6.1 Personnel

Redd survey personnel will be responsible for conducting redd surveys according to this protocols and procedures. Copies of this protocols and procedures will be provided to all survey personnel prior to the onset of field data collection activities. All survey personnel will be expected to maintain complete survey field notes per this protocols and procedures.

#### 6.1.1 Qualifications

To successfully complete data collection associated with this study, the lead personnel conducting the work will have the following minimum qualifications: a related 4-year college degree (e.g., fisheries biology or biology) and a minimum of 2 years of professional experience in fisheries field surveys. Specifically, personnel will have experience with:

- ❑ Use of various fish and fish habitat sampling techniques
- ❑ Use of aerial photographs as a field mapping base
- ❑ Use of GPS equipment
- ❑ Design and analysis of biological field studies

The data collection methods will be conducted by two person (minimum) monitoring teams to facilitate safe and efficient data collection. At least one of the team members of the monitoring team will have the minimum qualifications as stated above and will be conducting the survey.

Redd survey personnel should be in such physical shape as to allow for extended and at times strenuous hiking while carrying equipment and personal gear that may weigh 20 pounds or more. Personnel must be able to swim. Survey personnel should expect to work extended daily hours as necessary to complete described surveys. Prior to the initiation of survey work, all survey personnel will have had to complete several training sessions on field collection techniques and safety. All necessary training will be provided during the preseason preparation and training period.

### 6.1.2 Training

This protocols and procedures will be available to all redd survey personnel to promote consistency among survey efforts and to address safety concerns. New hires will be scheduled to go on surveys with experienced redd survey personnel and receive training in the field. Safety, aspects of landowner relations, trespassing regulations, and redd count protocol training for all survey crew members will be scheduled and conducted prior to initiating the field season. Safety training for field crews will include first aid, wilderness medicine, swift water rescue training, boat safety, and wader safety training. Specialized training for using all-terrain vehicles, four-wheel drive vehicles, boats, or other equipment needed for conducting redd surveys will occur during the pre-field season period. Redd survey protocol training will include time for personnel to read and become familiar with the specifics of field procedures, redd identification, and data management.

## 6.2 Schedule

The timing of field surveys will be important in both the collection of relevant data and the interpretation of results. The following is a synopsis of the preparatory efforts, fieldwork, and analyses that will be completed over the course of an annual survey season.

**June through July 31**

- ❑ Conduct pre-season preparations and planning (e.g., hire field crews, logistics coordination, scheduling redd surveys, equipment maintenance and testing)
- ❑ RMT Planning Group Coordination
- ❑ Conduct Field Personnel Technical Training
- ❑ Conduct Field Personnel Safety Training

**August 1 through December 31**

- ❑ Conduct Reconnaissance-level Redd Surveys
- ❑ Conduct Extensive Area Redd Surveys

**January 1 through May 1**

- Conduct the Extensive Area Redd Survey Bi-weekly

**May 2 through June**

- Finalize Data QA/QC and Compilation
- Data Analysis and Interpretation of Results
- Prepare Draft Annual Monitoring Report
- RMT Planning Group Review of Draft Monitoring Report
- Prepare Final Annual Monitoring Report

## 6.3 Cost

Total cost for the annual Chinook salmon and steelhead trout extensive area redd surveys is estimated to be $67,606.34 (**Table 4**). The cost estimate reflects funding allocations for equipment, personnel time, travel, training, and administrative overhead for conducting the extensive area redd survey. Yearly cost may very depending on if equipment can be reused from year-to-year such as the Trimble GPS units.

**Table 4. Estimated budget for annual extensive area redd survey.**

| **Annual Lower Yuba River Redd Survey Budget** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| LABOR | # of Surveys | days/survey | total days | hrs/day | total hrs | labor rate/hr | # of personnel | | |
| Tech | 22 | 3.5 | 77 | 8 | 616 | $14.28 | 3 | | $26,389.44 |
| Biologist | 22 | 3.5 | 77 | 8 | 616 | $39.24 | 1 | | $24,171.84 |
| | | | | | | | | Subtotal | $50,561.28 |
| TRANSPORTATION | # of Surveys | days/wk | total days | miles/day | total miles | rate | # DFG vehicles | | |
| Vehicles | 22 | 4 | 88 | 50 | 4400 | $0.59 | 2 | | $5,192.00 |
| EQUIPMENT | item | price | number | | | | | | |
| | FV 700R/GMRS Motorola Radios | $49.99 | 2 | | | | | | $99.98 |
| | 5mm Reg. Stocking Foot Waders | $59.99 | 4 | | | | | | $239.96 |
| | 5mm Tall/Stout Stocking Foot Waders | $64.99 | 4 | | | | | | $259.96 |
| | Guidewear Felt Sole Wading Boots | $69.99 | 4 | | | | | | $279.96 |
| | Comfort Mesh Vest Type III PFD | $39.95 | 4 | | | | | | $159.80 |
| | Helly Hansen Roan Anorak Rain Jacket | $64.95 | 4 | | | | | | $259.80 |
| | Large Roll Top Dry Bags | $24.99 | 4 | | | | | | $99.96 |
| | Bending Branches Slice Angler Kayak Paddle | $129.99 | 4 | | | | | | $519.96 |
| | Aluminum Kayak Carriers | $79.99 | 2 | | | | | | $159.98 |
| | First Aid Kit | $54.10 | 1 | | | | | | $54.10 |
| | Stearns Cold Water Neoprene Gloves | $17.10 | 4 | | | | | | $68.40 |
| | Rite in the Rain Copier Paper | $26.20 | 2 | | | | | | $52.40 |
| | Redi-Rite Clipboard | $25.40 | 2 | | | | | | $50.80 |
| | Trimble GeoXT Handheld GPS Unit | $4,495.00 | 2 | | | | | | $8,990.00 |
| | Waterproof plastic case for GPS | $34.00 | 2 | | | | | | $68.00 |
| | Fiberglass extendable measuring rod | $70.00 | 2 | | | | | | $140.00 |
| | Spray paint | $7.00 | 10 | | | | | | $70.00 |
| | Secchi disk | $40.00 | 2 | | | | | | $80.00 |
| | Weighted Rope with gradations for secchi disk | $40.00 | 2 | | | | | | $80.00 |
| | Polarized Sunglasses | $30.00 | 4 | | | | | | $120.00 |
| | | | | | | | | Subtotal Equipment | $11,853.06 |
| | | | | | | Grand Total: | | | $67,606.34 |

### 6.4 Equipment

| Redd Surveys | |
|---|---|
| • 4 Kayaks & paddles | • Waterproof plastic case for GPS unit |
| • 2 Trimble Geoexplorer GPS units, with data dictionary loaded | • Data Box |
| • Chest Waders or Wading Boots | • Data sheets |
| • Wetsuit(s)/mask(s) | • Pencils |
| • Boots | • Duct tap |
| • Gloves | • Motorola handheld radios |
| • Survey Protocols and Procedures | • Data Sheets |
| • Waterproof Camera | • Secchi Disk |
| • Brimmed Hat | • Field Notebook |
| • Dry Cloth (to dry off equipment, etc.) | • Polarized Sunglasses |
| • Cellular or Satellite Phone | • Decontamination Solution |
| • Contact and Emergency Phone Numbers | • Swift Water Safety Gear |
| • Food and Water | • First Aid Kit |
| • UC Davis Key | • Lifejackets/Other Personal Floatation Devices (inflatable) |
| • Sunscreen | • Fiberglass extendable measuring rod (0.1 m) |
| | • Cans of Bright Colored Spray Paint |

## 7.0 Data Management

### 7.1 Data Entry and Data Processing

A relational database will be developed using Microsoft Access to manage all of the data collected during the redd surveys. A metadata document will be developed for the database that contains at least: 1) a data dictionary and description of all of the codes; 2) a list of all of the fields in each table; 3) units of measure for each field; 4) description of how the tables are related; 5) description of the purpose of each table; and 6) step-by-step explanation of the process to enter data and use any developed queries.

Data on the data sheets will be entered into the relational database and quality assurance and quality control steps will be taken for data entry as described in Section 5.5. Additional quality assurance and quality control (QA/QC) procedures will include a series of queries designed to test if all redds were observed at least once, to look for duplicate records, and to sort individual redd observations by date to ensure that a date of first observation exists in the database. A record of data entry errors will be kept and used to identify and alleviate common problems.

Data stored in the relational database that is needed for GIS analyses will be exported from the database to GIS software.

## 7.2 Data Storage and Archival Procedures

All original data sheets will be photocopied, well organized, clearly labeled, and archived. Photo copied datasheets will be used for data entry.

Reports will be prepared annually and archived. Electronic versions of the data sets, as well as hardcopies of reports, will be submitted to the RMT Planning Group.

- ❑ Raw Data Electronic Storage Format (Software): Microsoft Access
- ❑ Processed Data Electronic Storage Format (Software): Microsoft Excel, Access, ArcMap

Electronic files and print copies of the field data sheets will be located at:

Yuba County Water Agency
1220 F Street
Marysville, CA 95901-4226

California Department of Fish and Game
2545 Zanella Way, Suite F
Chico, CA 95928

Data Retrieval Contact: M&E Lead Biologist – Colin Purdy
Telephone Number: (530) 895 - 5522
Email Address: CPurdy@dfg.ca.gov

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## ATTACHMENT 1

### Assessment of the Influence of Redd Survey Sampling Frequency on the Estimation of Redd Abundance and Timing of Redd Construction

Redd surveys are an important component of the Lower Yuba River Accord M&E Program. They will provide the data for one method to evaluate the abundance of Chinook salmon and steelhead spawning in the lower Yuba River (M&E Sections 3.1.2.2, 3.1.2.3, 3.1.2.5, 3.1.3.4, 3.1.3.5) and the timing of spawning (M&E Sections 3.1.2.8, 3.1.3.3, 3.3.2.6, 3.3.3.1), as well as to determine the presence and timing of distinct Chinook salmon runs spawning in the river (M&E Sections 3.1.2.1, 3.1.2.7).

The evaluation of the data obtained during the 2008-2009 Pilot Yuba River Chinook Salmon and Steelhead Redd Survey (hereinafter referred as the Pilot Survey) by aerial and ground-based surveys indicated that the ground-based redd surveys were the most cost effective survey to be implemented as long-term extensive-area redd surveys. However, the most adequate sampling frequency for the long-term extensive-area survey still remains to be identified. The survey sampling frequency (*i.e.*, how many times during the year the three lower Yuba River reaches will be monitored for newly built Chinook salmon and steelhead redds) will affect the accuracy and precision of any estimate of overall abundance, the spatial and temporal distribution of spawning, and the likelihood of separating Chinook salmon runs. Surveys with high sampling frequency (*e.g.*, surveys performed every week within the year) will increase the accuracy and precision of the derived abundance and timing estimates, and enhance the likelihood of separating Chinook salmon runs, as opposed to low sampling frequency surveys (*e.g.*, surveys performed every month within the year). On the other hand, high sampling frequency surveys require larger field crews than low sampling frequency surveys, resulting in higher cost.

The objective of this study is to evaluate the potential effects that redd surveys performed every week, two weeks, three weeks and four weeks (*i.e.*, monthly surveys) within a sampling season extending from August 1 through May 1 have in the estimates of Chinook salmon spawning abundance (*i.e.*, total number of redds built within the sampling season) and timing of spawning (*i.e.*, dates at which particular percentages of the cumulative distribution of all newly-built redds are achieved), as well as the likelihood of evaluating the correct number of spawning groups or runs present.

A simulation approach was chosen to achieve the objective of this study because no direct comparison of the data obtained by the high sampling frequency surveys (*i.e.*, Index-Area redd surveys) and low sampling frequency surveys (*i.e.*, monthly extensive-area survey) performed during the 2008-2009 Pilot Survey was possible. Although the Index-Area surveys provided rich data to allow for reasonable Chinook salmon spawning abundance and timing estimates, they were performed in a very restricted area. On the other hand, the monthly surveys extended over the three Yuba River study reaches, but provided a limited amount of data.

# 1. Method

## 1.1 General Approach

The simulation approach chosen to address the objective of this study consists of several steps. First, the rich data collected in the Index-Area redd surveys of the 2008-2009 Pilot Redd Survey were used to fit a statistical model that provided the population and sampling parameters of the assumed "true" redd distribution for the August 1 - May 1 sampling season (Section 1.2). Second, 100 schedules of sampling dates per sampling frequency category (*i.e.*, weekly, bi-weekly, tri-weekly and monthly) were randomly selected within the sampling season (Section 1.3). Third, the number of counted redds per sampling date for each of the 100 randomly selected schedules was simulated from the fitted statistical model (Section 1.4). Next, the model population parameters were estimated again from each set of the 100 sets of weekly, bi-weekly, tri-weekly and monthly simulated redd counts (Section 1.5), and the new model population parameter estimates were used to evaluate redd abundance and spawning timing for the four sets of 100 simulated redd data.

## 1.2 Statistical Model and Assumptions

The statistical model predicts the number of Chinook salmon redds counted at any given sampled date *j* ($\hat{C}_j$) of the Index-Area redd survey. The sampling date *j* is an integer number running from 1 (August 1) to 274 (May 1). There were a total of $N$ = 34 sampling dates *j* actually sampled during the Index-Area redd survey, and they were spaced every other 2 or 3 days from September 15 through December 1, every week until December 15, and every two weeks afterwards.

The predicted number of redds counted at any given sampled date is defined by the following equation:

$$\hat{C}_j = \hat{q} \times \left\{ \sum_{j=i}^{i-12} \hat{\pi}_{j-i} \times \left[ \sum_{R=1}^{3} \left( \hat{Y}_{R,j+1} - \hat{Y}_{R,j} \right) - \hat{C}_{j-1} \right] \right\} \quad \textbf{(1)}$$

where $\hat{q}$ is a constant with value between 0 and 1 that indicates the counting efficiency. The subscript *i* is an integer number running from 1 (August 1) to 274 (May 1), and the subscript *R* indicates the run or spawning group to which the redd count belongs. Initial inspection of the temporal distribution of the redd counts during the 2008-2009 Index-Area redd survey suggested the presence of at least 3 runs or spawning groups, one centered around October 15 (probably mostly associated with spring-run Chinook salmon mixed with some fall-run Chinook salmon), a second group centered around mid November (probably mostly fall-run Chinook salmon), and a third group dispersed from late December through March (initially identified as late fall-run Chinook salmon). The values $\hat{Y}_{R,j}$ and $\hat{Y}_{R,j+1}$ are the cumulative number of redds belonging to run or spawning group $R$ built through days $j$ and $j$+1 as described by the following logistic equation:

$$\hat{Y}_{R,j} = \frac{\hat{K} \times \hat{\theta}_R}{\left(1 + \exp\left(\hat{\alpha}_R + \hat{\beta}_R \times j\right)\right)} \qquad \textbf{(2)}$$

where $\hat{K}$ is the asymptotic total number of redds (a measure of redd abundance), $\hat{\alpha}_R$ and $\hat{\beta}_R$ are the logistic intercept and slope associated to the logistic curve of the run or spawning group $R$. Finally, $\hat{\theta}_R$ is the proportion of the asymptotic total number of redds that corresponds to the run or spawning group $R$, subject to the constraint $\sum_{R=1}^{3} \hat{\theta}_R = 1$.

The model assumes that a certain fraction of redds built in days prior to sampling day $j$ will still remain distinguishable for counting as a fresh redd during sampling day $j$. In equation **(1)** this fraction, hereinafter called "distinguishability", is indicated by $\hat{\pi}_i$ and was modeled as:

$$\hat{\pi}_i = \frac{\left(1 + \exp\left(-\hat{\alpha}_\pi\right)\right)}{\left(1 + \exp\left(-\hat{\alpha}_\pi + i\right)\right)} \qquad \textbf{(3)}$$

for $i = \{0, 1, 2 \ldots 12\}$.

The model described in equations **(1)** through **(3)** has a total of 11 parameters to be estimated for a sample size $N$ = 34. Of these 11 parameters, 9 are population parameters (*i.e.*, $\hat{K}$, $\hat{\alpha}_R$ and $\hat{\beta}_R$ for $R$ =1, 2 and 3, and $\hat{\theta}_R$ for $R$ =1 and 2) and 2 are sampling parameters (*i.e.*, $\hat{q}$ and $\hat{\alpha}_\pi$ ).

The 11 parameters of the model were estimated by minimizing the residual sum of squares *RSS* for the $N$ = 34 days sampled during the 2008-2009 Index-Area redd survey:

$$\sum_{d=1}^{34} \left(\hat{C}_d - C_d\right)^2,$$

where $\hat{C}_d$ are the redd counts predicted by the model and $C_d$ are the redds counted in any of the 34 sampled days ($d$). The minimization of *RSS* was achieved using Excel® function add-in Solver.

In fitting the statistical model, described above, the following assumptions were made:

- Chinook salmon redds were identified without error.

- Individual newly built redds were counted only once during the whole extent of the survey season (August 1 –May 1).

- The timing of redd construction is described by a logistic distribution of time.

- There were three spawning groups or runs present during the survey season, each with distinct timings described as logistic functions.

- For a given sampling day a certain fraction of the redds built in days prior to the sampling day still remain distinguishable to be counted as newly built during the particular sampling day.

- The "distinguishability" of newly built redds follows an exponential decay from 1 during the day of construction to 0, 12 days after redd construction.

## *1.3 Selection of Sampling Dates*

A set of 100 schedules of sampling dates was randomly chosen per sampling frequency category (*i.e.*, weekly, bi-weekly, tri-weekly and monthly). A total of 100 initial sampling dates was chosen by randomly selecting an integer number between 1 (corresponding to August 1) and 46 (corresponding to September 15) to guarantee that the initial portion of the spawning distribution will be sampled.

Once the 100 initial sampling dates were selected, the remaining dates of the sampling schedules corresponding to the weekly, bi-weekly, tri-weekly and monthly sampling frequency categories were determined by selecting every 7$^{th}$, 14$^{th}$, 21$^{st}$ and 28$^{th}$ day from the initial sampling date.

The resulting 100 schedules consisted of 33 to 44 sampling dates for the weekly sampling frequency category, 17 to 20 sampling dates for the bi-weekly sampling frequency category, 11 to 14 sampling dates for the tri-weekly sampling frequency category, and only 9 to 10 sampling dates for the monthly sampling frequency category.

## *1.4 Redd Counts Simulation*

Once the four 100 sampling schedules have been determined, the number of redd counts for each selected date $j$ in the schedules was randomly selected assuming Binomial distributions with number of trials $N$ equal to the rounded value $\hat{C}_j / \hat{q}$ predicted by the fitted model (Section 1.2) and probability $p$ equal to $\hat{q}$.

## *1.5 Fitting of Simulated Data*

Once four 100 simulated data sets of redd counts have been generated, the statistical model (Section 1.2) was fitted to each simulated data set to estimate new population parameters (*i.e.*, $\hat{K}$, $\hat{\alpha}_R$ and $\hat{\beta}_R$ for $R$ =1, 2 and 3, and $\hat{\theta}_R$ for $R$ =1 and 2) and leaving the sampling parameters (*i.e.*, $\hat{q}$ and $\hat{\alpha}_\pi$) fixed at the values estimated with the Index-Area redd survey data. The new sets of population parameter estimates were saved to evaluate the effects of the survey sampling frequency on the abundance and timing estimates and on the likelihood of evaluating the correct number of spawning groups or runs present.

### *1.6 Summarizing of Results*

The 400 sets of 9 newly estimated population parameters were used to calculate cumulative distributions of newly built Chinook salmon redds relative to all Chinook salmon redds (those belonging to all the runs or spawning groups) built from August 1 through May 1. These cumulative distributions are used to evaluate timing of redd construction and compare with the "true" cumulative distribution (*i.e.*, the cumulative distribution that resulted from the fit of the statistical model to the Index-Area redd survey data and was used to originate the 400 sets of simulated redd data).

Effects on redd abundance estimates will be obtained by comparing the 400 new estimates of *K* with the original value $\hat{K}$.

The timing and abundance estimates from each of the 100 sets of 9 newly estimated population parameters were summarized per sampling frequency category in terms of the averages and 95% confidence intervals of the 100 estimated abundances, and the 100 estimated times (dates) associated with the 1%, 10%, 25%, 50%, 75%, 90% and 99% of each estimated cumulative distribution of newly built redds. Additionally, the bias (*i.e.*, *B* = (Average – True Value)/True Value) in the estimates of timing and abundance per sampling frequency category also was calculated.

## 2. Results

### 2.1. Model Fit

**Figure 1** displays the model fitted to the 2008-2009 Index-Area redd survey data by comparing the redd counts predicted by the fitted model and the redds actually counted in the 34 sampled days of the 2008-2009 Index-Area redd survey. The fitted model explained 83% of the data variability (*i.e.*, $R^2$ = 0.83). *MSE*, the mean square error of the fit was 3.2 (*i.e.*, $MSE = \sqrt{RSS/(N-p)} = \sqrt{241.2/(34-11)}$ ).

The fitted model predicted the daily distribution of newly built redds for 3 runs or spawning groups (**Figure 2**). The predicted peak for run 1 (probably mostly associated with spring-run Chinook salmon mixed with some fall-run Chinook salmon) was October 10, and that for run 2 (probably mostly fall-run Chinook salmon) was November 10. The predicted peak for the third run (assumed to be associated to the spawning of late fall-run Chinook salmon) was January 15.

The three curves depicted in Figure 2 arise from the following fitted logistic equations:

$$\hat{Y}_{1,j} = \frac{599 \times 0.63}{\left(1+\exp\left(12.066-0.168\times j\right)\right)} \text{ for run 1} \qquad \textbf{(4)}$$

$$\hat{Y}_{2,j} = \frac{599 \times 0.13}{\left(1 + \exp\left(22.491 - 0.220 \times j\right)\right)} \text{ for run 2} \quad \textbf{(5)}$$

$$\hat{Y}_{3,j} = \frac{599 \times 0.24}{\left(1 + \exp\left(13.090 - 0.076 \times j\right)\right)} \text{ for run 3} \quad \textbf{(6)}$$

where $\hat{K} = 599$ is the asymptotic total number of redds (i.e., measure of total redd abundance).

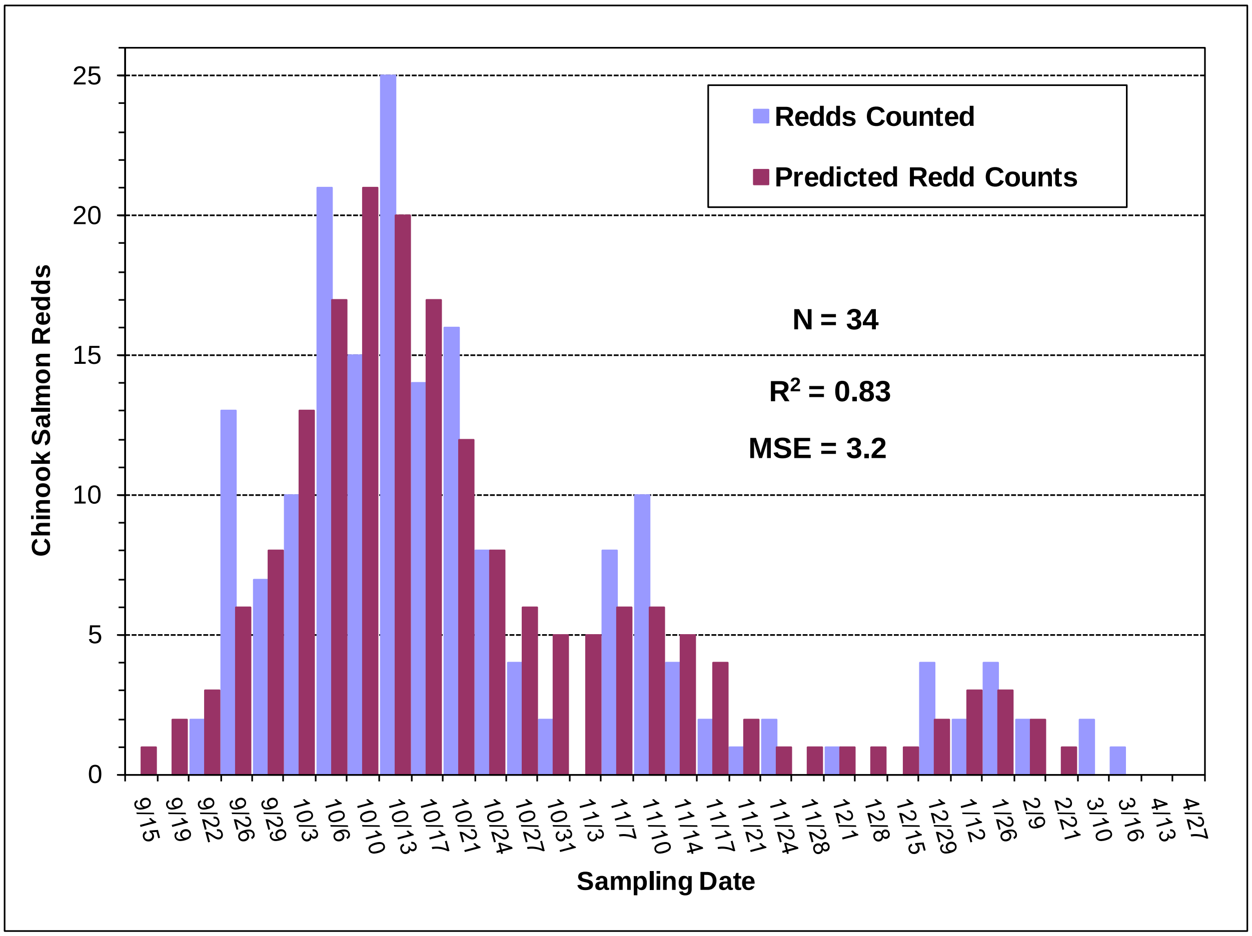


**Figure 1. Comparison of the number of Chinook salmon redds counted during the Index-Area survey performed as part of the 2008-2009 Yuba River Pilot Redd Survey and the number of redds and number of redd counts predicted by the fitted statistical model for the 34 sampling days of the survey. $R^2$ indicates the coefficient of determination, and MSE is the mean square error of the fit.**

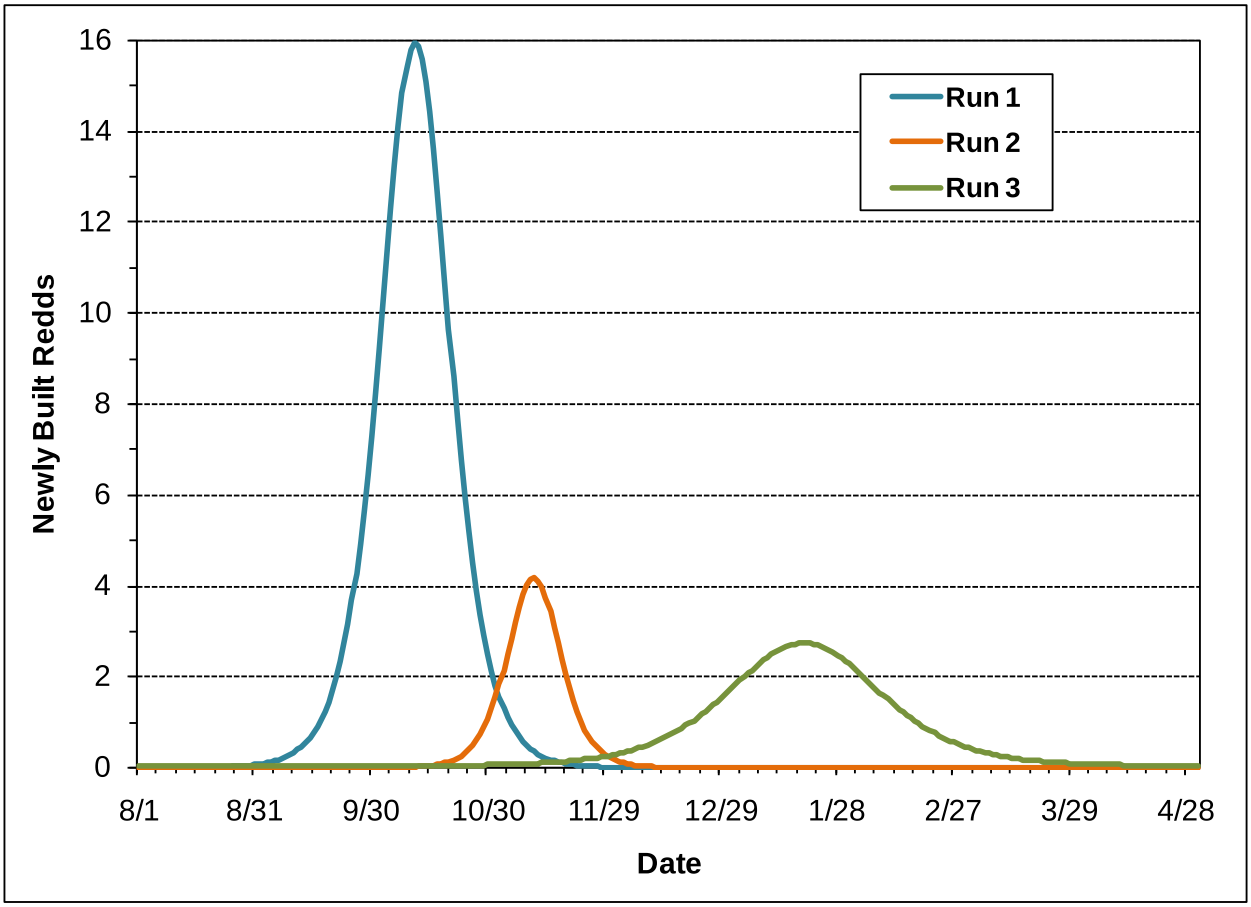


**Figure 2. Predicted temporal distribution of newly built Chinook salmon redds during the season extending from August 1 through May 1, obtained from redds observed during the 2008-2009 Index-Area Pilot Redd Survey. The colored lines display the temporal distributions for the three runs assumed in the model.**

The sum of the three logistic relationships expressed by equations **(4)**, **(5)** and **(6)** divided by $\hat{K} = 599$ generates the relative cumulative distribution of newly built Chinook salmon redds over the entire survey season (August 1 through May 1). This relative cumulative distribution, depicted by the bold black line in **Figure 3**, was used to compute the true timing of redd construction that was contrasted with the timings originated from the fit of the model to the simulated data.

Figure 3 indicates that 25% of all Chinook salmon redds were constructed by October 8, 50% by October 18 and 75% by November 20. Moreover, Figure 3 indicates that by November 20 most of the redds built by runs 1 and 2 had been built.

In addition to values for the 9 population parameters that define equations **(4)**, **(5)** and **(6)**, the fitted model provided values for two sampling parameters (*i.e.*, the counting efficiency $\hat{q}$ and the parameter $\hat{\alpha}_{\pi}$ that defines the shape of the "redd-distinguishability" function). The estimated counting efficiency was $\hat{q} = 0.566$.

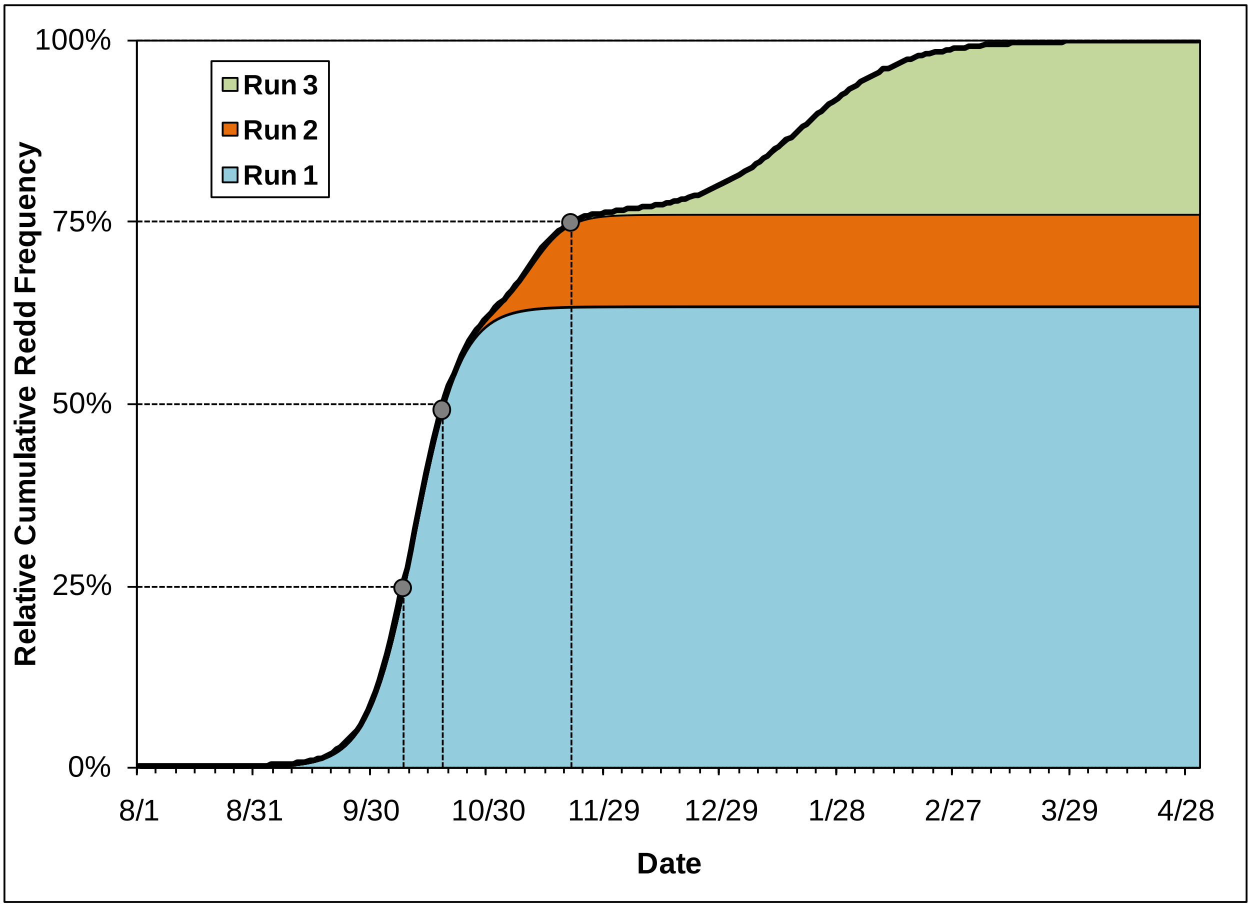


**Figure 3. Predicted cumulative distribution of newly built Chinook salmon redds relative to all Chinook salmon redds built from August 1 through May 1, based on redds observed during the 2008-2009 Index-Area Pilot Redd Survey. The colored areas display the relative cumulative proportions of redds belonging to any of the three runs assumed in the model in any given date.**

Finally, the predicted function describing "redd-distinguishability" depicted in **Figure 4** was:

$$\hat{\pi}_i = \frac{\left(1+\exp\left(-1\right)\right)}{\left(1+\exp\left(-1+i\right)\right)} \qquad \textbf{(7)}$$

The predicted function depicts a rather sharp decrease in "redd-distinguishability" with only 16% of newly-built redds distinguishable by the third day after redd construction, and with nearly 0% distinguishable 9 days after construction.

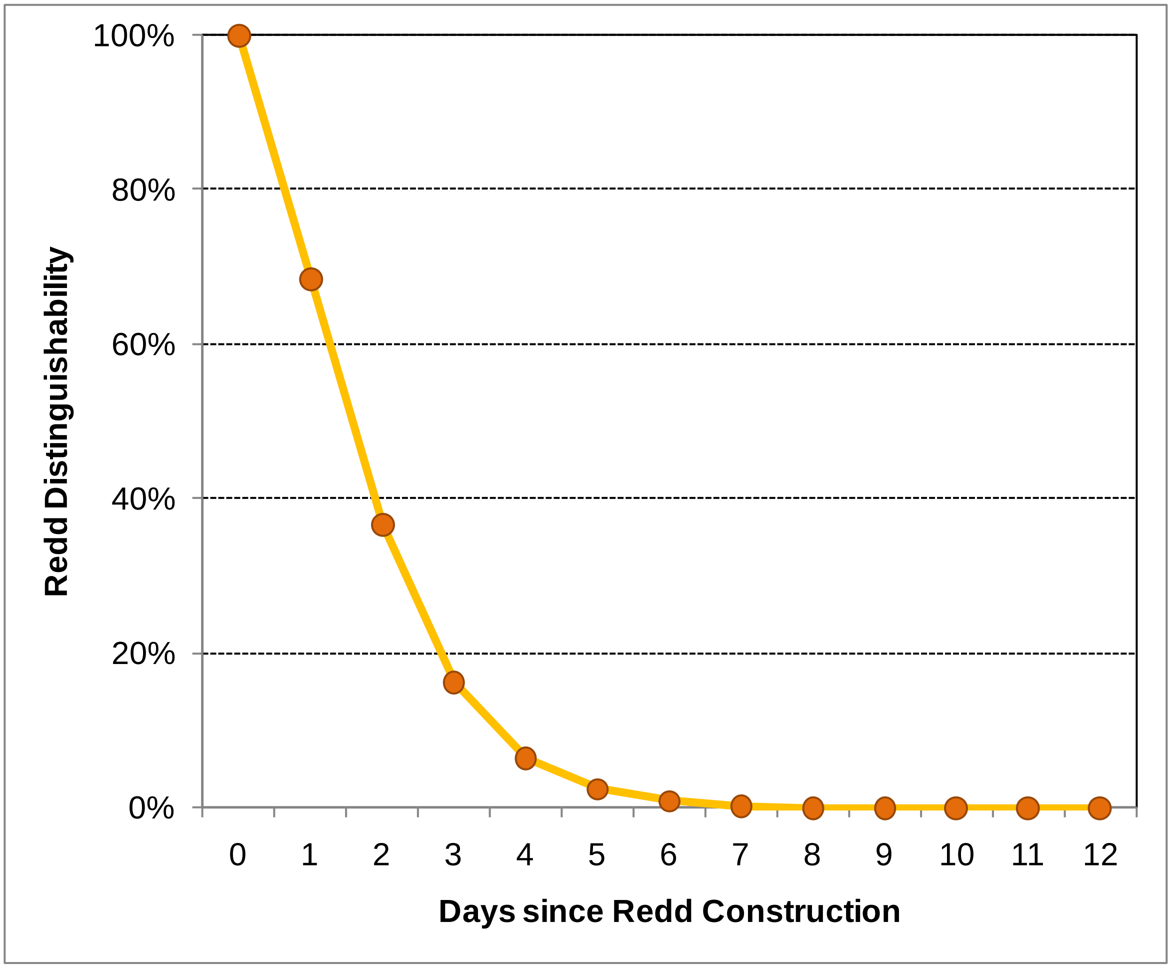


**Figure 4. Predicted distinguishability of newly-built redds as function of days after redd construction.**

## 2.2. *Effect of Sampling Frequency on Redd Abundance*

**Table 1** compares the redd abundance estimates (*i.e.*, $\hat{K}$) resulting from fitting the statistical model of Section 1.2 to the four sets of 100 simulated redd survey data with $\hat{K} = 599$, the value obtained from fitting the model to the 2008-2009 Index-Area redd survey data that is considered the "true" abundance.

The averages of the 100 redd abundance estimates from weekly and bi-weekly redd survey sampling frequencies were somewhat smaller than the true value $\hat{K} = 599$. On average, both sampling strategies produced negatively biased abundance estimates, with the abundance estimates for the bi-weekly redd survey sampling frequencies being slightly more biased. The averages of the 100 redd abundance estimates from tri-weekly and monthly redd survey sampling frequencies were larger than the true value $\hat{K} = 599$. On average, the abundance estimates were positively biased with the relative bias increasing from 4% to almost 15% with the decrease of the survey sampling frequency from tri-weekly to monthly. Additionally, the width of the 95% confidence intervals of the 100 abundance estimates increased as the redd survey sampling decreases from weekly to monthly.

**Table 1. Comparison of total Chinook salmon redd abundances for the true redd distribution and those estimated from simulated redd observations of 100 simulated annual redd surveys with weekly, bi-weekly, tri-weekly and monthly sampling frequencies.**

| True Redd Abundance (Redds) | Redd Survey Sampling Frequency | Redd Abundance Estimated from 100 simulations | | |
|---|---|---|---|---|
| | | Average Redd Abundance (Redds) | 95% Confidence Interval (Redds) | Relative Bias (%) |
| 599 | Weekly | 596 | (517 - 679) | -0.42% |
| | Bi-Weekly | 591 | (494 - 682) | -1.24% |
| | Tri-Weekly | 624 | (488 - 781) | 4.19% |
| | Monthly | 686 | (498 - 1021) | 14.58% |

## 2.3. *Effect of Sampling Frequency on Redd Timing*

**Figure 5** through **Figure 8** display the average (red line) and 95% confidence intervals (orange areas) of the 100 relative cumulative distributions generated from the simulated redd survey data collected under the four sampling frequency strategies, together with the true relative cumulative distribution (blue line). These figures help evaluate redd timing under each sampling frequency strategy. For example, the date at which 75% of the true cumulative distribution of redds has been built is found by reading the x-coordinate associated to the intersection of the blue line with the 75% dotted line.

Similarly, for any of the 4 sampling frequency strategies, the average date associated with the 75% of the simulated cumulative distributions is the x-coordinate (date) that corresponds with the intersection of the red line (the average of the 100 relative cumulative distributions generated from the simulated redd survey data) and the 75% dotted line. Moreover, the 95% confidence interval of the date associated with the 75% of the simulated cumulative distributions is determined by the x-coordinates of the points at the intersection of the 75% dotted line and the upper and lower boundary of the orange area.

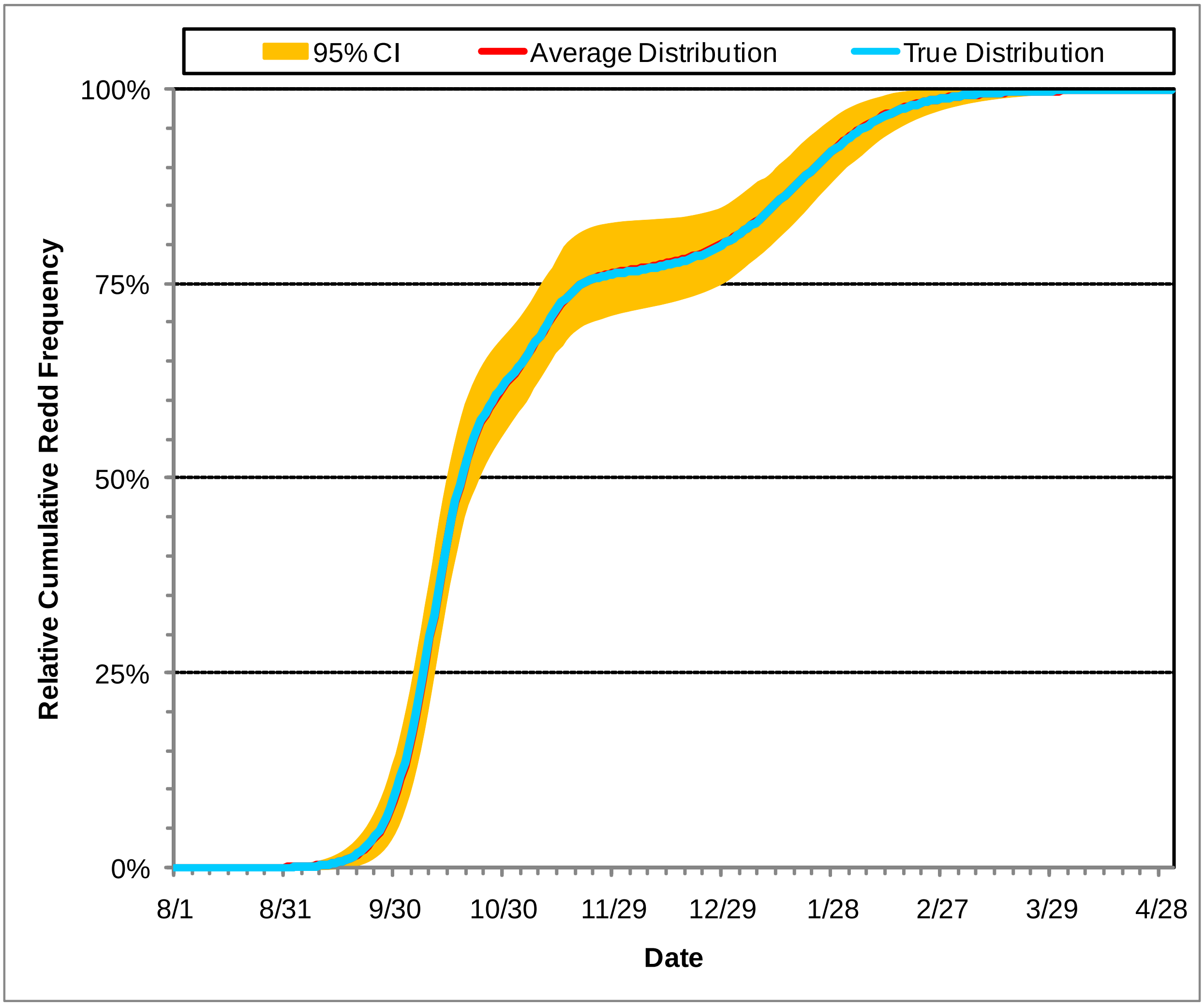


**Figure 5. True cumulative distribution of newly built Chinook salmon redds relative to all Chinook salmon redds built from August 1 through May 1 (blue line) compared to distributions estimated from simulated redd observations of 100 simulated annual redd surveys with weekly sampling frequencies. The red line indicates the average distribution over the 100 simulations and the orange area demarks the 95% confidence intervals.**

The comparison of Figures 5 through 8 shows that within any given sampling frequency strategy, the width of the 95% confidence intervals of estimated timing for particular percentages of the cumulative distributions generally increases as the percentage increases. Moreover, for the four sampling frequency strategies, the width of the 95% confidence intervals of estimated timing are larger for 65% through 90% of the respective cumulative distributions. These wider 95% confidence intervals may be associated with the difficulties in estimating the right combination of population parameters to define run 2. Additionally, the width of the 95% confidence intervals of estimated timings increases as the survey sampling frequency decreases from weekly to monthly.

In Figures 5 through 8, the distances separating the blue line of the "true" cumulative distribution and the red line of the average distribution gives a measure of the average bias in the redd timings calculated with the simulated cumulative distributions, when read on the x-axis.

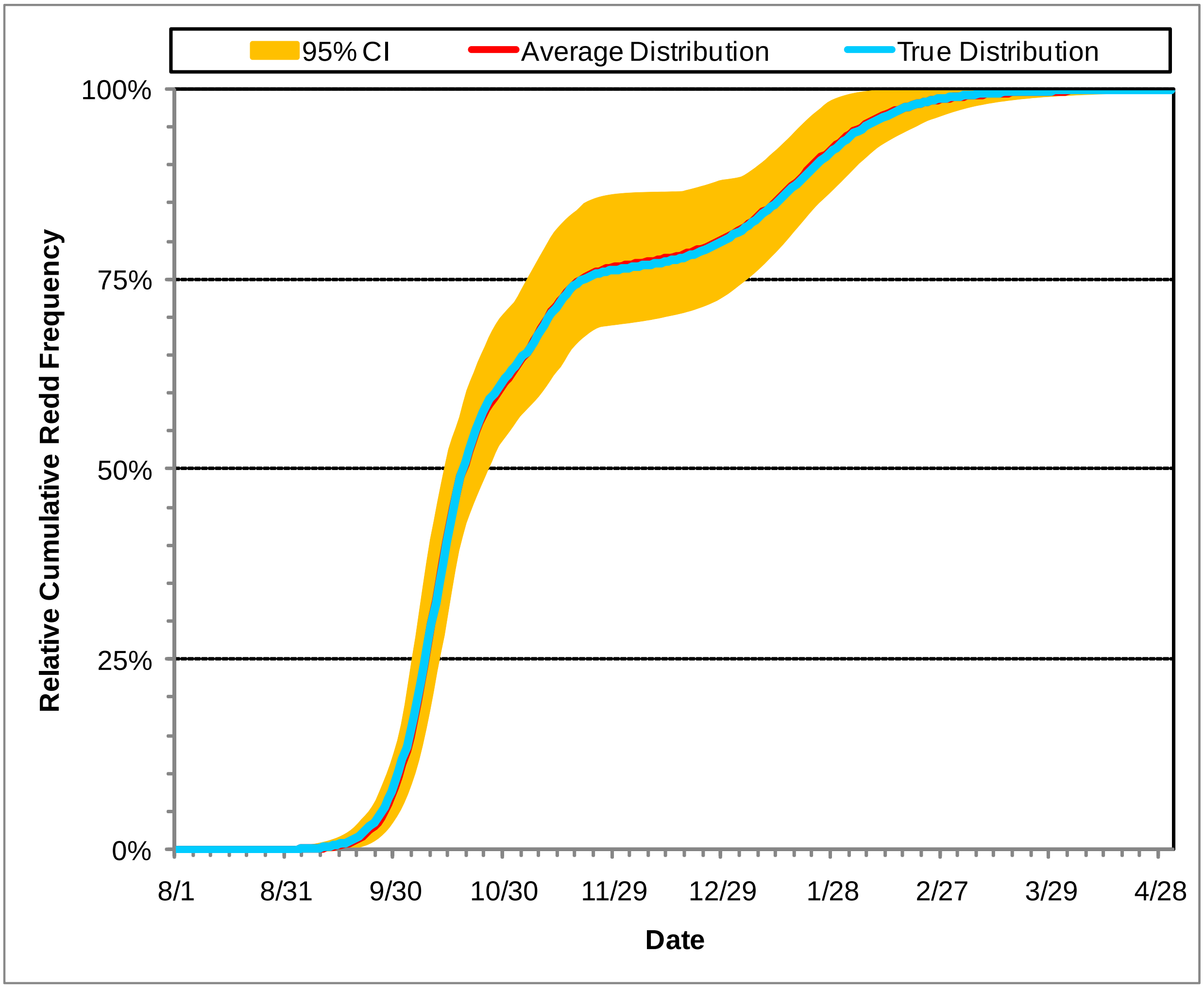


**Figure 6. True cumulative distribution of newly built Chinook salmon redds relative to all Chinook salmon redds built from August 1 through May 1 (blue line) compared to distributions estimated from simulated redd observations of 100 simulated annual redd surveys with <u>bi-weekly</u> sampling frequencies. The red line indicates the average distribution over the 100 simulations and the orange area demarks the 95% confidence intervals.**

The distances separating the blue and red lines (i.e., the timing bias) were almost undetectable for the simulated distributions of the weekly and bi-weekly sampling frequency categories (Figures 5 and 6, respectively). They became detectable for the tri-weekly sampling frequency category (Figure 7) and very noticeable for the monthly sampling frequency category (Figure 8), particularly for the redd timing associated with 60% to 75% of the simulated cumulative distributions.

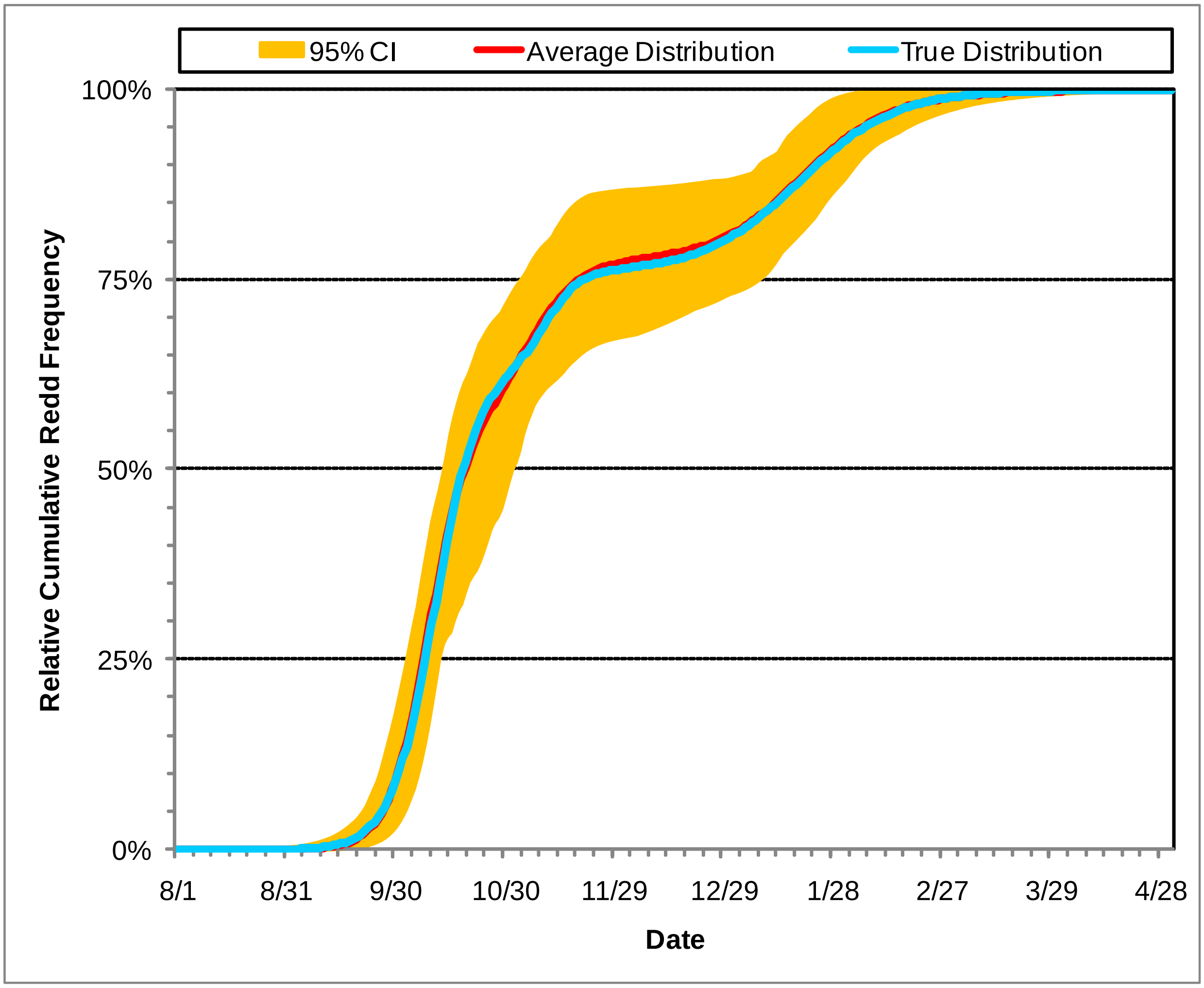


**Figure 7. True cumulative distribution of newly built Chinook salmon redds relative to all Chinook salmon redds built from August 1 through May 1 (blue line) compared to distributions estimated from simulated redd observations of 100 simulated annual redd surveys with <u>tri-weekly</u> sampling frequencies. The red line indicates the average distribution over the 100 simulations and the orange area demarks the 95% confidence intervals.**

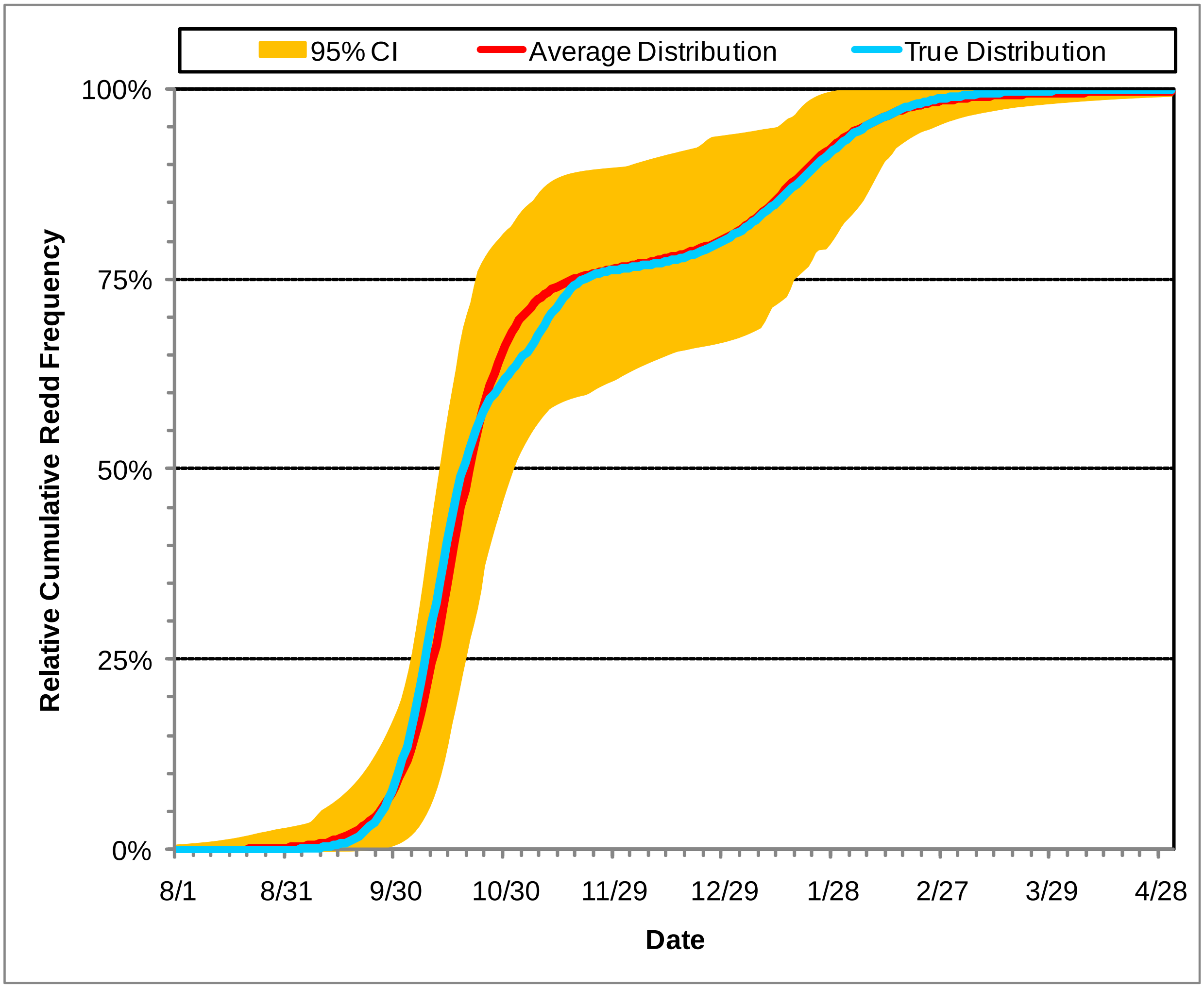


**Figure 8. True cumulative distribution of newly built Chinook salmon redds relative to all Chinook salmon redds built from August 1 through May 1 (blue line) compared to distributions estimated from simulated redd observations of 100 simulated annual redd surveys with monthly sampling frequencies. The red line indicates the average distribution over the 100 simulations and the orange area demarks the 95% confidence intervals.**

Finally, **Table 2** summarizes the comparison of the timings of Chinook salmon redd construction associated with the 1%, 10%, 25%, 50%, 75%, 90% and 99% of the estimated cumulative distributions under the four sampling frequency strategies. Relative bias exceeding 1% is highlighted in Table 2.

**Table 2. Comparison of the timing of Chinook salmon redd construction (expressed as the date at which a particular proportion of the cumulative redd distribution is observed) for the true redd distribution and those estimated from simulated redd observations of 100 simulated annual redd surveys with weekly, bi-weekly, tri-weekly and monthly sampling frequencies.**

| Redd Cumulative Proportion | True Date | Weekly Redd Survey Sampling Frequency | | | Bi-weekly Redd Survey Sampling Frequency | | |
|---|---|---|---|---|---|---|---|
| | | Average Date | 95% Confidence Interval | Relative Bias (%) | Average Date | 95% Confidence Interval | Relative Bias (%) |
| 1% | 9 / 16 | 9 / 16 | 9 / 11 - 9 / 22 | 0.8% | 9 / 17 | 9 / 11 - 9 / 22 | 2.3% |
| 10% | 9 / 30 | 9 / 30 | 9 / 27 - 10 / 4 | 0.8% | 9 / 30 | 9 / 28 - 10 / 4 | 1.3% |
| 25% | 10 / 8 | 10 / 7 | 10 / 5 - 10 / 10 | -0.4% | 10 / 7 | 10 / 4 - 10 / 11 | -0.3% |
| 50% | 10 / 18 | 10 / 18 | 10 / 14 - 10 / 22 | 0.2% | 10 / 18 | 10 / 13 - 10 / 24 | 0.2% |
| 75% | 11 / 20 | 11 / 26 | 11 / 9 - 12 / 27 | 5.5% | 11 / 28 | 11 / 5 - 1 / 2 | 7.5% |
| 90% | 1 / 23 | 1 / 22 | 1 / 13 - 1 / 31 | -0.3% | 1 / 21 | 1 / 8 - 2 / 2 | -0.8% |
| 99% | 3 / 1 | 2 / 27 | 2 / 11 - 3 / 13 | -0.7% | 2 / 26 | 1 / 30 - 3 / 20 | -1.0% |

| Redd Cumulative Proportion | True Date | Tri-weekly Redd Survey Sampling Frequency | | | Monthly Redd Survey Sampling Frequency | | |
|---|---|---|---|---|---|---|---|
| | | Average Date | 95% Confidence Interval | Relative Bias (%) | Average Date | 95% Confidence Interval | Relative Bias (%) |
| 1% | 9 / 16 | 9 / 17 | 9 / 8 - 9 / 24 | 2.8% | 9 / 14 | 8 / 24 - 9 / 29 | -4.1% |
| 10% | 9 / 30 | 9 / 30 | 9 / 25 - 10 / 6 | 0.6% | 10 / 1 | 9 / 20 - 10 / 11 | 2.6% |
| 25% | 10 / 8 | 10 / 7 | 10 / 2 - 10 / 11 | -1.1% | 10 / 10 | 10 / 4 - 10 / 18 | 3.0% |
| 50% | 10 / 18 | 10 / 18 | 10 / 13 - 10 / 31 | 1.2% | 10 / 20 | 10 / 12 - 10 / 31 | 2.8% |
| 75% | 11 / 20 | 11 / 26 | 11 / 2 - 1 / 7 | 5.8% | 11 / 26 | 10 / 22 - 1 / 17 | 5.6% |
| 90% | 1 / 23 | 1 / 22 | 1 / 7 - 2 / 3 | -0.5% | 1 / 19 | 11 / 29 - 2 / 9 | -2.2% |
| 99% | 3 / 1 | 2 / 25 | 1 / 28 - 3 / 19 | -1.5% | 2 / 26 | 1 / 23 - 4 / 15 | -1.0% |

## 2.4. *Effect of Sampling Frequency on Run Identification*

Although, even under the weekly sampling frequency strategy it was normally harder to estimate the right combination of population parameters to define run 2, the three runs were estimated for the 100 redd survey data simulated under the weekly and bi-weekly sampling frequency strategies. The parameters defining run 2 could not be estimated 5 out of the 100 redd survey data sets simulated under the tri-weekly sampling frequency strategy. In other words, under the tri-weekly sampling strategy, the parameters that define the daily redd distributions of the three runs were estimated 95% of the time.

Only the population parameters defining two out of the three runs were estimated with the 100 redd survey data simulated under the monthly sampling frequency strategy. This is not surprising, because defining the three runs assumed by the statistical model requires the estimation of 9 population parameters, and the sample size of the survey $N$ (the number of sampling days during the survey season) must be greater than 10. As mentioned in Section 1.3, the 100 schedules obtained for the monthly sampling frequency category consisted of only 9 to 10 sampling dates. Consequently, the population parameters for only two runs (run 1 and run 3) were estimated with the 100 redd survey simulated data, based on the monthly sampling strategy.

## 3. Conclusions

This evaluation results in the following conclusions:

- The sampling frequency of the redd surveys affects the estimated total number of redds built within the sampling season (i.e., a measure of spawning abundance)

- The sampling frequency of the redd surveys affects the estimates of timing of spawning (i.e., dates at which particular percentages of the cumulative distribution of all newly-built redds are achieved)

- The sampling frequency of the redd surveys affects the likelihood of evaluating the correct number of spawning groups or runs present during the survey season

- Redd surveys performed with a weekly sampling frequency provides the most precise and accurate (least biased) estimates of total redd abundance and timing of redd construction, as well as the likelihood of detecting modalities in the temporal distribution of redd counts that could lead to the identification of distinct spawning groups or runs present during the sampling season

- Redd surveys performed with a bi-weekly sampling frequency provides the second most precise and accurate estimates of total redd abundance and timing of redd construction, but also provides relatively wide confidence intervals compared to the weekly sampling frequency. The bi-weekly sampling frequency also allows for the detection of modalities in the temporal distribution of redd counts that could lead to the identification of distinct spawning groups or runs present during the sampling season

- Redd surveys performed with a tri-weekly sampling frequency provides estimates of total redd abundance and timing of redd construction that are less precise and accurate than those produced by redd surveys with a weekly or bi-weekly sampling frequency, and may result in difficulties in detecting modalities in the temporal distribution of redd counts that could be used in the identification of distinct spawning groups or runs present during the sampling season

- Redd surveys performed with a monthly sampling frequency provides the least precise and accurate (most biased) estimates of total redd abundance and timing of redd construction, much wider confidence intervals, and a reduced likelihood of detecting modalities in the temporal distribution of redd counts that could lead to the identification of distinct spawning groups or runs present during the sampling season

## 4. Recommendations

The following recommendations are based on the results and conclusions of this evaluation and the need to identify an adequate sampling frequency for the long-term extensive-area redd survey to be performed in the lower Yuba River.

- The long-term extensive-area redd survey should be performed with a weekly sampling frequency, at least from the start of the sampling season through December 31 (which represents the majority of spawning activity), to provide enough sampling events during the season of most intense Chinook salmon spawning activity to facilitate the gathering of unbiased estimates of total redd abundance and timing of redd construction, and to enhance the probability of differentiating spring-run and fall-run spawning activity

- The start date of the long-term extensive-area redd surveys should occur some time between August 1 and early September to guarantee that the start of the spawning activity is adequately sampled

- A bi-weekly sampling frequency, if used at all (as a cost-efficiency measure) during the long-term extensive-area redd survey, should be employed during the last portion of the survey season (*i.e.*, January 1 through May 1) when Chinook salmon spawning activity has declined and most of the spawning still occurring is probably associated with late fall-run Chinook salmon

- Tri-weekly and monthly sampling frequency strategies are not recommended for Yuba River long-term extensive-area redd surveys

# ATTACHMENT 2

## Establishing Sample Size for Redd Area Measurements in Order to Address Redd Superimposition

Redd area measurements are needed to examine redd superimposition throughout the lower Yuba River for Chinook salmon and steelhead. Evaluation of Chinook salmon redd areas ($m^2$) calculated for the 2008-2009 index area indicated that redd area significantly differed ($r^2 = 0.24$, $P < 0.01$) during the majority of the spawning activity (mid-September through December). Therefore, a sampling design specifically addressing redd area estimation is necessary for the extensive area redd surveys.

A systematic sampling design will be used to collect redd area measurement data during the extensive area redd survey, where every $17^{th}$ sampling unit (redd) will be included in the sample for redd area measurements. Systematic sampling is often used for ease of execution and convenience (Hansen *et al.* 2006). In addition, systematic samples are usually spread more evenly over the population, so population attributes can be estimated more precisely than simple random sampling (Hansen *et al.* 2006).

During the 2008-2009 pilot extensive area redd survey, a total of 1257 Chinook salmon redds were observed in the lower Yuba River. However, it is recognized that this is a minimum number of redds due to the relatively infrequent sampling (i.e., monthly) and duration of fresh redd visibility. Therefore, for sample size considerations, it is assumed that up to 2000 Chinook salmon redds could be potentially observed during each annual redd survey season. Given the variance of redd area measured at 169 Chinook salmon redds in the index area during the 2008-2009 pilot survey season, as estimated 111 redds would need to be measured in order to estimate redd size within 10% of the calculated average redd area. Therefore, assuming a similar variance structure in the future and further assuming a potential total of 2000 Chinook salmon redds constructed annually, an estimated 5.6% of the total number of redds would need to be measured to obtain an estimate of the average redd area with a precision of 10%, resulting $k^{th}$ sampling unit of 17.8. Consequently, rounding downwards in order to avoid establishing a sample size resulting in an anticipated less precise estimate, the $k^{th}$ sampling unit will be 17. In other words, 1 out of every 17 redds observed in the lower Yuba River during the extensive area redd survey will be measured to estimate redd area.

# ATTACHMENT 3: Extensive Area Redd Survey Data Sheet – Document all newly constructed redds

| Survey Date: | Surveyor Initials: | Survey Section: | Number of Crews: | Crew (A or B): |
|---|---|---|---|---|
| Weather (Clear, Cloudy, Rain, Wind): | | Secchi Reading (ft): | Average flow (cfs): | |

| | Redd GPS I.D. (Date + plus redd number) example 082908-001 | GPS waypoints collected (Yes/No) | Species Constructing Redd | # of Fish observed on Redd | Substrate (dominant/sub-dominant) | Area measurments | Comments (location, side channel, potential imposition etc.): |
|---|---|---|---|---|---|---|---|
| 1 | | Y N | | | / | PL____, PW____, TL____, TW1____, TW2____ | |
| 2 | | Y N | | | / | PL____, PW____, TL____, TW1____, TW2____ | |
| 3 | | Y N | | | / | PL____, PW____, TL____, TW1____, TW2____ | |
| 4 | | Y N | | | / | PL____, PW____, TL____, TW1____, TW2____ | |
| 5 | | Y N | | | / | PL____, PW____, TL____, TW1____, TW2____ | |
| 6 | | Y N | | | / | PL____, PW____, TL____, TW1____, TW2____ | |
| 7 | | Y N | | | / | PL____, PW____, TL____, TW1____, TW2____ | |
| 8 | | Y N | | | / | PL____, PW____, TL____, TW1____, TW2____ | |
| 9 | | Y N | | | / | PL____, PW____, TL____, TW1____, TW2____ | |
| 10 | | Y N | | | / | PL____, PW____, TL____, TW1____, TW2____ | |
| 11 | | Y N | | | / | PL____, PW____, TL____, TW1____, TW2____ | |
| 12 | | Y N | | | / | PL____, PW____, TL____, TW1____, TW2____ | |
| 13 | | Y N | | | / | PL____, PW____, TL____, TW1____, TW2____ | |
| 14 | | Y N | | | / | PL____, PW____, TL____, TW1____, TW2____ | |
| 15 | | Y N | | | / | PL____, PW____, TL____, TW1____, TW2____ | |
| 16 | | Y N | | | / | PL____, PW____, TL____, TW1____, TW2____ | |
| 17 | | Y N | | | / | PL____, PW____, TL____, TW1____, TW2____ | |
| 18 | | Y N | | | / | PL____, PW____, TL____, TW1____, TW2____ | |
| 19 | | Y N | | | / | PL____, PW____, TL____, TW1____, TW2____ | |
| 20 | | Y N | | | / | PL____, PW____, TL____, TW1____, TW2____ | |
| 21 | | Y N | | | / | PL____, PW____, TL____, TW1____, TW2____ | |

Comments:

**Note:** If multiple crews are out per day, **Crew A will use I.D. redd number 001- 499** and **Crew B will use 500- 999**. Collect area measurements on every 17th Chinook salmon redd encountered and on every Steelhead redd. For every redd encountered, in the data dictionary of the GPS record: species constructing the redd, number of fish observed, potential for superimposition, and habitat type (i.e. pool, riffle, run, or glide) for every redd. Redds greater than 1.56m long and or 1.37m wide are CHN, smaller are considered Steelhead.

Page__of___

# APPENDIX C
# CLEAN WATER ACT:
# 404(B)(1)
# CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD 401 CERTIFICATION

# Section 404(b) (1) Evaluation

## Lower Yuba River Pilot Gravel Augmentation Project
## Yuba and Nevada Counties, California

## I. Project Description

The U.S. Army Corps of Engineers (Corps) is proposing to implement a gravel injection project with the placement of approximately 2,000 tons, with the option to place an additional 3,000 tons (in increments of 1,000 tons) of a heterogeneous mix of gravel and cobble (0.25 – 5.0 inches in diameter) injected directly into the Lower Yuba River channel. The proposed gravel injection site is located approximately 25 feet downstream of the Yuba County Water Agency (YCWA) Narrows II hydroelectric power facility. The proposed action would occur in November of 2010.

a. Location

The Project area is located on the Lower Yuba River starting at Englebright (Yuba River mile 23.9) downstream to Daguerre Point Dam (Yuba River mile 11.4), Yuba and Nevada Counties, California. The proposed gravel injection site is less than one acre and confined to the river channel located in the steep Narrows canyon off Highway 20, about 23 miles east of Marysville, California.

b. General Description

Specialized equipment called a "Habitat Builder" will be used to inject 150 to 300 tons of gravel per day directly into the water within the Lower Yuba River channel. The Habitat Builder is comprised of the following equipment: 2 water pumps, hopper, 8-inch flexible gravel sluice pipe, 8-inch PVC line, and floats.

Gravel transport dump trucks shall deliver gravel to the staging area from a local aggregate producer within the local watershed via paved public and private roads. Dump trucks with trailers shall unhitch the trailer at a pre-designated transfer area while the dump truck delivers and stockpiles materials adjacent to the hopper. The empty dump truck would return to the trailer, re-hitch, deliver, and dump the trailer load. The empty dump truck and trailer shall then be driven back to the aggregate producer and the process shall repeat until 2,000 to 5,000 tons of material are delivered and injected into the river. A front-end loader shall be used to feed the gravel into the hopper. Gravel from the hopper shall feed into an 8-inch flexible gravel sluice pipe. An operator will stand by the pumps to shut them off in the case of a clogged pipe, in order to prevent pipes from bursting. Two water pumps shall pump water from the reservoir and feed into the sluice pipe. The pipe shall run inside an existing dry drainage ditch for approximately 0.25 mile where it shall then turn and be directed towards the gravel placement site. The sluice pipe shall be converted to a PVC line at the water's surface where it will be supported by floats. The sluice pipe shall be moved as needed to inject the gravel directly into the water within the river channel

c. Background

Englebright Dam has effectively cut off the supply of gravel delivered to the Lower Yuba River from upstream sources and has greatly altered geomorphic processes and aquatic habitat conditions in the channel downstream of the dam. Without additional gravel delivery to the channel, the existing gravel supply in the bed and usable gravel stored in bars will decrease as it is gradually transported downstream, leading to a reduction of quality spawning gravel for the federally-listed Central Valley steelhead and spring-run Chinook salmon.

A pilot study was conducted in 2007 (Lower Yuba River Pilot Study) to determine the effectiveness of the gravel injection. Outflow released from Narrows II aided in transporting the gravel downstream to various sections of the Lower Yuba River that have been designated as critical habitat for the Central Valley spring-run Chinook salmon and the Central Valley steelhead. The University of California, Davis (UCD) tracked the fate of the gravel with the addition of approximately 360 uniquely identified tracer cobbles added to the gravel mix before injection of the gravel into the river channel. The results of the pilot gravel injection were then used to develop a long-term gravel augmentation program. This program shall serve to improve the overall function of the habitat by providing spawning gravel to key areas on the Lower Yuba River

d. Authority and Purpose

The proposed action would satisfy the Terms and Conditions of the incidental take statement included in the November 21, 2007, Biological Opinion prepared by National Marine Fisheries Service (NMFS) pursuant to Section 7 of the Endangered Species Act (ESA) of 1973, as amended. Specifically, the BO states: “the Corps, in cooperation with the UCD and the Anadromous Fish Restoration Program, shall implement the proposed pilot gravel injection project below Englebright Dam within 1 year of the issuance of this BO.” Knowledge gained from the pilot gravel injection study has allowed the Corps to develop and implement a long-term gravel augmentation program. The long-term program shall serve to improve the function of the habitat by providing spawning gravel to key areas on the Lower Yuba River.

e. Project Alternatives

The proposed project is to inject gravel into the Lower Yuba River just below Englebright Dam. Due to the nature of this project, it is not possible to avoid placing fill in the river. Therefore, the only possible project alternative is to inject the gravel at a different location further downstream. Injecting gravel at a different location downstream would be difficult due to inadequate site access. All possible locations would have a similar effect as the current proposed project location. The preferred alternative is within a hydraulically efficient stretch of the Lower Yuba River which would serve to distribute the gravel downstream to desired spawning areas.

f. General Description and Quantity of Dredged or Fill Material

(1) General Characteristics of Material:

Gravel and cobble specifications would include 2,000 tons with the option to place an additional 3,000 tons (in 1,000 ton increments) of uncrushed "natural river rock" from local aggregate producers within the local watershed that meet the gradations as follows:

| Gravel Size (inches) | Percent Retained | Target % of Total Mix |
|---|---|---|
| 4 to 5 | 0 - 5 | 2.5 |
| 2 to 4 | 15 - 30 | 20 |
| 1 to 2 | 50 - 60 | 35 |
| ¾ to 1 | 60 - 75 | 15 |
| ½ to ¾ | 85 - 90 | 15 |
| ¼ to ½ | 95 - 100 | 10 |
| < ¼ | 100 | 2.5 |

To ensure that the specifications meet cleanliness values as required under the Clean Water Act, all gravel would be thoroughly washed and rinsed before arriving at the injection site. Mixing of earth material with stockpiled or delivered gravel would not be allowed.

(2) Source of Material. Gravel and cobble would be sourced from local aggregate producers within the local watershed. Following is a list of potential sources for materials that meet the described specifications:

Silica Resources
6130 State Highway 20
Browns Valley, CA
(530) 742-2890

Silica Resources, Inc.
4553 Hammonton Rd
Marysville, CA
(530) 741-0290

f. <u>Description of the Proposed Discharge Site(s)</u>

(1) Location:

The YCWA Narrows II powerhouse is located off Highway 20 about 23 miles east of Marysville, Yuba County, CA. Take Peoria Road off Highway 20 (2 miles downstream of Parks Bar Bridge). Peoria Road merges into Scott Forbes Road to Narrows II powerhouse. Total distance from Highway 20 to Narrows II powerhouse: 8 miles.

(2) Size:

The proposed gravel injection site is less than one acre.

(3) Type of Site:

Confined bedrock-dominated river channel.

(4) Type(s) of Habitat:

The Lower Yuba River channel at the project injection site is mostly devoid of vegetation. Small isolated clumps of shining willow, mulefat, and other riparian species are widely scattered along the otherwise barren rocky banks for approximately 2 miles downstream. The substrate is comprised primarily of bedrock with shock rock (sharp angled rock blasted off the canyon walls).

(5) Timing and Duration of Discharge:

The gravel injection would begin in the first two weeks of November, 2010 with the option to extend into the first week of December, 2010.

g. Description of Disposal Method (hydraulic, drag line, etc.)

All gravel would be washed before arriving at the injection site and all equipment including pipe lines would be removed by the contractor to be re-used in future ventures when the project is complete. Therefore, no disposal material would result from the proposed project.

**II. Factual Determinations (Section 230.11)**

a. Physical Substrate Determinations (consider items in Section 230.11(a# and 230.20 Substrate)

(1) Substrate Elevation and Slope:

The project injection site is 305 feet above sea level with a channel slope of 14 to 15 feet per mile.

(2) Sediment Type:

Soils of the site are river deposits, which include silts, sands, gravel, and bedrock.

(3) Dredged/ Fill Material Movement:

The project injection site is within a hydraulically efficient stretch of Lower Yuba River. The gravel would be flushed from the area under high flows downstream of the injection site to create salmonid spawning habitat.

(4) Physical Effects on Benthos (burial, changes in sediment type, etc.):

Higher invertebrate density and biomass are expected after the proposed gravel injection as compared to the existing site conditions. These benefits may only be temporary because of the transient nature of injected gravels within the hydraulically efficient stream channel.

(6) Other Effects:

The project would increase the amount of suspended sediment and thus turbidity within the project area. However, the increase would be temporary and localized.

(7) Actions Taken to Minimize Impacts:

To ensure that the specifications meet cleanliness values as required under the Clean Water Act, all gravel would be washed before arriving at the injection site. Mixing of earth material with stockpiled or delivered gravel would not be allowed.

b. <u>Water Circulation, Fluctuation, and Salinity Determinations</u>

(1) Water (refer to sections 230.11(b), 230.22 Water, and 230.25 Salinity Gradients; test specified in Subpart G may be required). Consider effects on:

The gravel for the proposed project would come from a local source to avoid changing the chemical composition or environmental characteristic of the water. All gravel would be cleaned prior to arriving at the injection site. No alteration of the environmental characteristic or value of the water is expected. Any turbidity would be due to temporary disturbance of the existing substrate, not from the injected gravel. The proposed project is in water that does not contain salt and salt water does not occur near that proposed project site. Therefore, salinity would not be affected.

(2) Current Patterns and Circulation (consider items in sections 230.11 (b), and 230.23), Current Flow and Water Circulation. Consider effects on:

(a) Current Patterns and Flow

The project injection site is within a hydraulically efficient stretch of Lower Yuba River. The gravel might cause a temporary blockage that would force the water to flow around it, but would likely be flushed from the area under high flows into the Narrows Pool – a deep in-channel pool downstream of the proposed injection site. Some gravel injected in the same location during the pilot study in 2007 moved downstream at high flows. It is expected that the majority of the injected gravel would move downstream.

(b) Velocity

The injected gravel may cause temporary changes in water velocity. The water velocity is relatively fast at the proposed injection site and changes occur depending on rainfall and water released from Englebright Dam. It is expected that high flows would distribute the gravel downstream and water velocity would not be permanently affected.

(c) Stratification

The stratification of the water column could be temporarily changed due to the gravel injection. However, the project injection site is within a hydraulically efficient stretch of the Lower Yuba River and stratification changes naturally with changes in water velocity.

(d) Hydrologic Regime

The hydrologic regime is controlled by the Englebright Dam and natural storm events. The amount of gravel proposed to be injected into the Lower Yuba River is not sufficient enough to change or affect the hydrologic regime.

(3) Normal Water level Fluctuations (tides, river stage, etc.) (consider items in sections 230.11 (b) and 230.24):

The normal water level fluctuations are controlled by the Englebright Dam and natural storm events. The amount of gravel proposed to be injected into the Lower Yuba River is not sufficient enough to change or affect the normal water level fluctuations.

(4) Salinity Gradients (consider items in sections 230.11 (b) and 230.25:

The proposed project is in water that does not contain salinity gradients. Therefore, the salinity gradients would not be affected.

(5) Actions That Will Be Taken to Minimize Impacts (refer to Subpart H):

Gravel would arrive pre-washed from a local commercial source and would be injected directly into the river. No mechanized equipment will be entering the channel. The gravel injection site is minimized to less than one acre.

c. <u>Suspended Particulate/ Turbidity Determinations</u>

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Site (consider items in sections 230.11 (c) and 230.21):

Increases in turbidity would be localized where gravel is injected into the Lower Yuba River channel. Increases in turbidity would be short-term and considered less than significant.

(2) Effects (degree and duration) on Chemical and Physical Properties of the Water Column (consider environmental values in section 230.21, as appropriate):

(a) Light Penetration

Increases in turbidity would be short-term and considered less than significant. Therefore light penetration would not be significantly impacted.

(b) Dissolved Oxygen

Gravel would arrive pre-washed from a local commercial source. It is not expected to react with the dissolved oxygen in the water or cause oxygen depletion.

(c) Toxic Metals and Organics

Gravel would arrive pre-washed from a commercial aggregate source to remove sediments that may contain mercury. Any mercury levels remaining in residual gravel sediments would be considered low and its release would not be expected to pose any environmental or health risk.

(d) Pathogens

Gravel would arrive pre-washed from a local commercial source. It is expected that any pathogens adhering to fine particulate matter would be removed during the washing process and would therefore not adversely affect the Lower Yuba River.

(e) Aesthetics

Gravel would arrive pre-washed from a local commercial source. Any turbidity would be the result of disturbing the existing substrate, would be localized, and temporary. No significant change is anticipated.

(f) Others as Appropriate

There would be no other significant adverse effects to the chemical and physical properties of the water column.

(3) Effects on Biota (consider environmental values in sections 230.21, as appropriate):

(a) Primary Production, Photosynthesis

Gravel injection activities would result in localized and temporary increases in turbidity. Increases in turbidity would be minimal and would not inhibit photosynthesis in the channel.

(b) Suspension/ Filter Feeders

The project may temporarily affect suspension and filter feeders on a localized scale. However, the effect would be temporary and less than significant for the area.

(c) Sight Feeders

The project would temporarily affect sight feeders on a localized scale. However, the effect would be temporary and less than significant for the area.

(4) Actions Taken to Minimize Impacts (Subpart H):

Gravel would arrive pre-washed from a commercial source and would be injected directly into the river. No mechanized equipment will be entering the channel. The gravel injection site is minimized to less than one acre. Effects to the aquatic biota would be temporary and not significant in the area downstream of the gravel injection site. Therefore, no additional measures to minimize effects are necessary.

d. Contaminant Determinations (consider requirements in section 230.11 (d))

The proposed project would not add contaminants to any nearby body of water. Best management practices to reduce the potential of accidental spills during gravel injection would follow all regulatory requirements in conjunction with the National Pollution Discharge Elimination System permitting process.

e. Aquatic Ecosystem and Organism Determinations (use evaluation and testing Procedures in Subpart G, as appropriate)

(1) Effects on Plankton:

Effects to plankton would be temporary and not significant, no additional measures to minimize effects are needed for placement of gravel in the site.

(2) Effects on Benthos:

Effects to the benthos would be temporary and not significant, no additional measures to minimize effects are needed for placement of gravel in the site.

(3) Effects on Nekton:

Effects to nekton would be temporary and not significant, no additional measures to minimize effects are needed for placement of gravel in the site.

(4) Effects on aquatic Food Web (refer to section 230.31):

There would be no adverse effects to the aquatic food web, or the plankton, benthic and nekton communities with the proposed project.

(5) Effects on Special Aquatic Sites (discuss only those found in project area or disposal site):

(a) Sanctuaries and Refuges (refer to section 230.40).

There are no sanctuaries or refuges within the project area.

(b) Wetlands (refer to section 230.41)

There are no wetlands within the project area.

(c) Mud Flats

There are no mud flats within the project area.

(d) Vegetated Shallows

There are no vegetated shallows within the project area.

(e) Coral Reefs

There are no coral reefs within the project area.

(f) Riffle and Pool Complexes

A potential short-term localized effect to the geomorphologic process would be expected in response to the gravel injection. The geomorphic stability of the river would reach dynamic equilibrium with the redistribution of injected gravel into hydraulically shielded areas that allow coarse sediment deposition to occur. Because the proposed injection site is within a hydraulically efficient stretch of Lower Yuba River, it is expected that the gravel would be flushed from the injection area under high flows downstream to create spawning habitat. The pilot study conducted in 2007 found that of the 327 cubic yards injected in the fall of 2007, 75 cubic yards of gravel had moved downstream by June of 2009. The anticipated changes in geomorphic conditions of the site resulting from gravel injection are expected to benefit anadromous fish.

(6) Threatened and Endangered Species:

The proposed project may affect, but is not likely adversely affect, the following Federally listed and candidate species: Central Valley fall/late fall-run chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead. The proposed action would also not adversely affect designated critical habitat of the spring-run Chinook salmon and steelhead.

The proposed project short-term effects may include localized and temporary disturbance, displacement, or impairment of feeding, migration, or other essential behaviors by adult and juvenile salmon and steelhead from noise, suspended sediment, turbidity, and sediment deposition generated during gravel injection activities. Gravel injected into the river would cause short-term increases in turbidity and temporarily disturb salmonids within the stream channel. Short-term increases in turbidity and suspended sediment may disrupt feeding activities of salmonids or result in temporary displacement from preferred habitats. Gravel injected into the river bed can also bury stream substrates that provide habitat for aquatic invertebrates, an important food source for salmonids. Consequently, growth rates of salmonids could be reduced if suspended sediment and turbidity levels substantially exceeded ambient levels for prolonged periods.

Long-term effects of the proposed gravel injection on the critical habitat of salmonids include alteration of river hydraulics and substrate conditions within the river channel. The total aquatic volume of the Narrows II pool may be initially decreased by deposition of injected gravel. However, it is expected that a substantial portion of the introduced substrate would eventually be transported downstream to hydraulically shielded areas during periods of greater discharge.

Whether the modified channel offers more favorable habitat for spawning and rearing, and whether more favorable fish habitat translates to increased biological production remains uncertain. The Yuba Accord River Management Team observed 79 Chinook salmon redds in the Englebright Dam Reach between 2009 and 2010. The proposed gravel injection site within the Narrows reach may have primarily served as a pathway for fish traveling to and from spawning habitat farther upstream in the drainage network. With upstream migration blocked by Englebright, this mainstream channel becomes the upstream-most available location to create alluvial habitat. Fish have already been observed spawning just downstream of Englebright Dam, but the current substrate is not suitable.

The key challenge is to balance the need for reduced gravel mobility with the biological requirement of preferred substrate, depth, and flow velocity for spawning and redd survival. Achieving this balance is particularly difficult because of the wide range of flow magnitudes that must be accounted for. Implementation of the pilot gravel injection project has helped to improve the understanding of how gravel resources (spawning habitat) respond to changes in flow. It is the hope that this gravel injection project would successfully distribute gravel to appropriate areas to create good spawning habitat.

(7) Other Wildlife:

The proposed project action would have no significant adverse effect on wildlife because of the limited scope and duration of the action. Any displaced wildlife would be expected to return to the area after the action is completed.

(8) Actions to Minimize Impacts:

There would be no significant adverse effects to wildlife due to proposed project action. Therefore, there would be no minimization measures needed.

f. Proposed Disposal Site Determinations

(1) Mixing Zone Determination:

No mixing zone would be required and no disposal material would result from the proposed project.

(2) Determination of Compliance with Applicable Water Quality Standards:

No water quality or effluent standards would be violated during proposed project action. All gravel would be washed before arriving at the injection site and all equipment including pipe lines would be removed by the contractor to be re-used in future ventures when the project is complete.

(3) Potential Effects on Human Use Characteristics:

(a) Municipal and Private Water Supply

The proposed project would not have any significant adverse effects to municipal and private water supply.

(b) Recreational and Commercial Fisheries

The proposed project would not have any significant adverse effects on recreational and commercial fisheries.

(c) Water Related Recreation

The proposed project would not have any significant adverse effects to water related recreation.

(d) Aesthetics

The proposed project would not have any significant adverse effects to the aesthetics of the Lower Yuba River.

(e) Parks, National and Historical monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves.

The proposed project would not have any significant adverse effects to parks, national and historical monuments, national seashores, wilderness areas, research sites, or similar preserves.

g. Determination of Cumulative Effects on the Aquatic Ecosystem

The proposed project would not have any significant cumulative effects on the aquatic ecosystem. The proposed project would benefit, rather than adversely impact, the fluvial geomorphologic characteristics of the Lower Yuba River by replenishing gravel to the starved lower reaches of the Lower Yuba River below Englebright Dam.

h. Determination of Secondary Effects on the Aquatic Ecosystem

Local physical habitat changes, such as improved availability and quality of spawning gravel, are to be expected. Behavioral and biological benefits for salmonids can also be expected downstream of the proposed gravel injection site, including reduced redd superimposition, improved spawner distribution, and improved invertebrate production.

**III. Findings of Compliance or Non-Compliance with the Restrictions on Discharge**

a. Adaptation of the Section 404(b)(1) Guidelines to this Evaluation

No significant adaptations of the guidelines were made relative to this evaluation.

b. Evaluation of Availability of Practicable Alternatives to the Proposed Discharge Site Which Would Have Less Impact on the Aquatic Ecosystem

The proposed project is to inject gravel into the Lower Yuba River just below Englebright Dam. Due to the nature of this project, it is not possible to avoid placing fill in the river. Therefore, the only possible project alternative is to inject the gravel at a different location further downstream. Injecting gravel at a different location downstream would be difficult due to inadequate access. All possible locations would have a similar effect as the current proposed project location. The preferred alternative is within a hydraulically efficient stretch of the Lower Yuba River which would serve to distribute the gravel downstream to desired spawning areas.

c. Compliance with Applicable State Water Quality Standards, and;
d. Compliance with Applicable Toxic Effluent Standard or Prohibition Under Section 307 of the Clean Water Act

State water quality standards would not be violated. The proposed project would not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act. A 401 certification would be obtained prior to project implementation. No disposal material would result from the proposed project. All gravel would be washed before arriving at the injection site and all equipment including pipe lines would be removed by the contractor to be re-used in future ventures when the project is complete.

e. Compliance with Endangered Species Act (ESA) of 1973

The Corps has initiated consultation with NOAA National Marine Fisheries Service under Section 7 of the Endangered Species Act for potential effects to listed species. The proposed project would not harm any endangered species or their critical habitat.

f. Compliance with Specified Protection Measures for Marine Sanctuaries Designated by the Marine Protection, Research, and Sanctuaries Act of 1972

Not applicable.

g. Evaluation of Extent of Degradation of the Waters of the United States

The proposed project would not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic life and other wildlife would not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values would not occur.

h. Appropriate and Practicable Steps Taken to Minimize Potential Adverse Impacts of the Discharge on the Aquatic Ecosystem

To minimize potential adverse impacts of the discharge on aquatic systems all specifications would meet cleanliness values as required under the Clean Water Act, and all gravel would be washed before arriving at the injection site. Mixing of earth material with stockpiled or delivered gravel would not be allowed.

i. On the Basis of the Guidelines. the Proposed Disposal Site(s) for the Discharge of Dredged or Fill Material (specify which) is (select one)

Not applicable.

# CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
# CENTRAL VALLEY REGION

## SECTION 401 WATER QUALITY CERTIFICATION
APPLICATION FORM

A minimum of $500.00 processing fee is required; however, additional fees in accordance with Title 23 CCR § 2200 (a)(2) may also be required. Please use the fee calculator at http://www.waterboards.ca.gov/cwa401/docs/dredgefillfeecalculator.xls to determine the total fee. Please include a check payable to the **State Water Resources Control Board.** Attach additional sheets as necessary. Submit the complete form to the appropriate Regional Board office.

| 1. APPLICANT INFORMATION | 2. AGENT INFORMATION* |
|---|---|
| Applicant: US Army Corps of Engineers | Agent* |
| Contact Name: Mitch Stewart | Contact Name: |
| Address: 1325 J Street | Address: |
| Sacramento, CA 95814 | |
| Phone No: 916-557-6734 | Phone No: |
| Fax No: 916-557-7856 | Fax No: |

*Complete only if applicable

### 3. PROJECT DESCRIPTION

a) Project Title: Englebright Dam Reach Gravel Injection Project, Yuba and Nevada Counties, CA.

b) Project Location: The project area is located on the Lower Yuba River starting at Englebright Dam (Yuba River mile 23.9) downstream to Daguerre Point Dam (Yuba River mile 11.4). The proposed gravel injection site is less than 1 acre and confined to the river channel approximately 100 feet downstream of the Pacific Gas and Electric Company's Narrows I hydroelectric power facility located in the steep Narrows canyon off Highway 20, about 23 miles east of Marysville, California (Plate 1).

County: Yuba and Nevada Counties Section: 14 Township: 16N Range: 6E

Latitude: 039° 14' 20.72"N Longitude: 121° 16' 10.44"W

c) Project Description: The U.S. Army Corps of Engineers (Corps) is proposing to implement a gravel augmentation project with the placement of approximately 2,000 tons with the option of an additional 3,000 tons (5,000 tons total) of a heterogeneous mix of gravel and cobble (0.25 – 5.0 inches in diameter) injected directly into the lower Yuba River channel. No ground-breaking activities are associated with this project. No mechanized equipment would be entering the channel or operating within the 100-year floodplain.

The proposed action would satisfy the Terms and Conditions of the incidental take statement included in the November 21, 2007, Biological Opinion (BO) prepared by National Marine Fisheries Service pursuant to Section 7 of the Endangered Species Act of 1973, as amended. This long-term program would serve to improve the overall function of the habitat by providing spawning gravel to key areas on the Lower Yuba River.

d) Proposed Schedule: *(start-up, duration, and completion dates)*: The gravel placement would commence on November 1, 2010. Estimated 14 days to complete the work for 2,000 tons with the option to extend an additional 7 days for each additional 1,000 tons injected (up to 21 additional days).

e) Total Project size: *(clearing, grading, other construction activities)*
Project area: 66,000 linear feet. Gravel injection site: < 1 acre.

## 4. IMPACTED WATER BODIES

a) Name*(s)* of Receiving Water Body*(ies)*: Lower Yuba River.

b) Anticipated potential stream flow during project activity: Approximately 850 cfs (fall flows).

c) Describe potential impacts to water quality: The placement of gravel within the channel would temporarily increase the amount of suspended sediment and thus turbidity in the immediate vicinity of the injection site and for an unknown distance downstream. All gravel would be pre-washed to reduce the amount of turbidity. Turbidity associated with the proposed project activities would not exceed the CRWQCB objectives for turbidity in the Sacramento River Basin. Turbidity would not increase more than 20 percent above naturally occurring background levels.

d) Indicate in ACRES and LINEAR FEET *(where appropriate)* the proposed **waters of the United States** to be impacted by any discharge other than dredging, and identify the impacts*(s)* as permanent and/or temporary for each water body type listed below:

| Water Body Type | Permanent Impacts | | Temporary Impacts | |
|---|---|---|---|---|
| | (acres) | (linear feet) | (acres) | (linear feet) |
| Jurisdictional Wetland | N/A | N/A | | |
| Riparian | N/A | N/A | | |
| Streambed unvegetated | N/A | N/A | <1 | 66,000 |
| Lake/Reservoir | N/A | N/A | | |

e) Indicate the volume of the dredged material (cubic yards) to be discharged to waters of the United States: No dredging would occur as part of the proposed project. Approximately 2,000 cubic yards with the option for an additional 3,000 tons (5,000 tons total) of a heterogeneous mix of gravel and cobble (0.25 to 5.0 inches in diameter) would be injected directly into the Lower Yuba River channel at the proposed injection site (less than 1 acre) over a maximum period of 35 days.

f) Indicate type(s) of material proposed to be discharged to waters of the United States: Uncrushed "natural river rock" from local aggregate producers within the local watershed that meet the gradations as follows:

| Gravel Size (inches) | Percent Retained | Target Percent of Total Mix |
|---|---|---|
| 4 to 5 | 0 - 5 | 2.5 |
| 2 to 4 | 15 - 30 | 20 |
| 1 to 2 | 50 - 60 | 35 |
| ¾ to 1 | 60 - 75 | 15 |
| ½ to ¾ | 85 - 90 | 15 |
| ¼ to ½ | 95 - 100 | 10 |
| < ¼ | 100 | 2.5 |

## 5. COMPENSATORY MITIGATION

a) Indicate in ACRES and LINEAR FEET *(where appropriate)* the total quantity of **waters of the United States** proposed to be Created, Restored and/or Enhanced for purposes of providing Compensatory Mitigation: The proposed project would be self-mitigating as it is beneficial to the river system.

| Water Body Type | Created | | Restored | | Enhanced | |
|---|---|---|---|---|---|---|
| | (acres) | (linear ft) | (acres) | (linear ft) | (acres) | (linear ft) |
| Jurisdictional Wetland | N/A | N/A | N/A | N/A | N/A | N/A |
| Riparian | N/A | N/A | N/A | N/A | N/A | N/A |
| Streambed | N/A | N/A | N/A | N/A | < 1 acre | 66,000 |
| Lake/Reservoir | N/A | N/A | N/A | N/A | N/A | N/A |

b) If contributing to a Mitigation or Conservation Bank, indicate the agency, dollar amount, acreage, and water body type *(if applicable)*:
Conservation Agency ______________________ N/A______________________
$__________ for_______ acres of _______________________________ *(water body type)*
How many acres of this mitigation area qualify as waters of the United States?___________

c) Other Mitigation *(omit if not applicable)*: N/A

How many acres of this mitigation area qualify as waters of the United States?___________

d) Location of Compensatory Mitigation Site*(s)* *(attach map of suitable quality and detail)*: N/A

City of Area _________________________ County_____________________________

Longitude/Latitude ____________________ Township/Range ____________________

## 6. OTHER ACTIONS/BEST MANAGEMENT PRACTICES (BMPs)

Briefly describe other actions/BMPs to be implemented to Avoid and/or Minimize impacts to waters of the United States, including preservations of habitats, erosion control measures, project scheduling, flow diversions, etc.: The findings of the Section 404(b)(1) analysis determined compliance with the requirements of the guidelines specified under CFR 40, Part 230, Section 404(b)(1) of the Clean Water Act, with the inclusion of appropriate and practicable discharge conditions to minimize pollution or adverse effects to the affected aquatic ecosystem. Given the limited duration and timing of the activity, as well as minimal area of effects, the appropriate and practicable conditions include the requirement that the gravel arrive screened and pre-washed to the injection site from the commercial aggregate source. Standard pollution prevention measures including erosion and sediment control measures, proper control of non-storm water discharges, and hazardous spill prevention and response measures would be implemented, as necessary, by the contractor during the gravel placement.

## 7. OTHER PERMITS/AGREEMENTS/ETC

a) U.S. Army Corps of Engineers Permit
Indicate the type of ACOE permit *(check one)*
Nationwide Permit No(s)______ Individual Permit No*(s)*:______ Regional Permit No*(s)*:______

Have you notified ACOE of project? ____Corps Project______

Have you reviewed the General Conditions for your ACOE permit? _Corps Project__

Have you attached a copy of the application/notification to ACOE? _See Appendix B in EA for 404(b)(1) Evaluation.

b) California Department of Fish and Game Lake or Streambed Alteration Agreement: Not Applicable. Federal Project on Federal lands.

Date of Application:_____________

Have you attached a copy of the application?

Has the Agreement been issued? _____ if so, list Agreement number:______

## 8. CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA)

a) Indicate the type of CEQA Document required for project and Lead Agency:

Categorical Exemption ____ Negative Declaration ____ Environmental Impact Report _____

Has the document been certified/approved, or has a Notice of Exemption been filed? ________

If yes date of approval/filing __________ If no, expected approval/filing date: __________

Lead Agency ____Federal project by the Corps; thus, NEPA document (Environmental Assessment) is being provided.

Submit final or draft copy if available*

b) Threatened or Endangered Species impacted by this project *(list potential)*: The proposed project may affect, but not likely adversely affect, the following Federally listed and candidate species: Central Valley fall/late fall-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead. The proposed action is also not likely to adversely affect designated critical habitat of spring-run Chinook salmon and steelhead.

## 9. PAST/FUTURE PROPOSALS BY THE APPLICANT

Briefly list/describe any projects carried out in the last 5 years or planned for implementation in the next 5 years that are in any way related to the proposed activity or may impact the same receiving body of water. A pilot study (the Lower Yuba River Pilot Gravel Injection Project) was carried out for this project in November 2007 (ref. WDID#5A58CR00047). A long-term gravel augmentation program would likely be established.

## 10. CERTIFICATION

"I certify under penalty of law that this document, including all attachments and supplemental information, were prepared under my direction and supervision in accordance with a system designed to assure that qualified personnel property gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment."

Print Name: William J. Leady Title: Colonel, Engineer Commanding

Signature: [signature] Date: 8 OCT 2010

# California Regional Water Quality Control Board
## Central Valley Region
Katherine Hart, Chair

Linda S. Adams
*Secretary for Environmental Protection*

11020 Sun Center Drive #200, Rancho Cordova, California 95670-6114
Phone (916) 464-3291 • FAX (916) 464-4645
http://www.waterboards.ca.gov/centralvalley

Arnold Schwarzenegger
*Governor*

10 November 2010

Mitch Stewart
U.S. Army Corps of Engineers
1325 J Street
Sacramento, CA 95814

***CLEAN WATER ACT §401 TECHNICALLY CONDITIONED WATER QUALITY CERTIFICATION FOR DISCHARGE OF DREDGED AND/OR FILL MATERIALS FOR THE ENGLEBRIGHT DAM REACH GRAVEL INJECTION PROJECT (WDID#5A58CR00081), YUBA COUNTY***

This Order responds to your 13 October 2010 application submittal for the Water Quality Certification of a gravel augmentation project impacting approximately 0.90 acre of waters of the United States.

**WATER QUALITY CERTIFICATION STANDARD CONDITIONS:**

1. This certification action is subject to modification or revocation upon administrative or judicial review, including review and amendment pursuant to §13330 of the California Water Code and §3867 of Title 23 of the California Code of Regulations (23 CCR).

2. This certification action is not intended and shall not be construed to apply to any discharge from any activity involving a hydroelectric facility requiring a Federal Energy Regulatory Commission (FERC) license or an amendment to a FERC license unless the pertinent certification application was filed pursuant to 23 CCR subsection 3855(b) and the application specifically identified that a FERC license or amendment to a FERC license for a hydroelectric facility was being sought.

3. The validity of any non-denial certification action shall be conditioned upon total payment of the full fee required under 23 CCR §3833, unless otherwise stated in writing by the certifying agency.

4. Certification is valid for the duration of the described project. This certification is no longer valid if the project (as currently described) is modified, or coverage under Section 404 of the Clean Water Act has expired.

5. All reports, notices, or other documents required by this Water Quality Certification or requested by the Central Valley Regional Water Quality Control Board (Central Valley Water Board) shall be signed by a person described below or by a duly authorized representative of that person.

a. For a corporation: by a responsible corporate officer such as (1) a president, secretary, treasurer, or vice president of the corporation in charge of a principal business function; (2) any other person who performs similar policy or decision-making functions for the corporation; or (3) the manager of one or more manufacturing, production, or operating facilities if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

b. For a partnership or sole proprietorship: by a general partner or the proprietor.

c. For a municipality, State, federal, or other public agency: by either a principal executive officer or ranking elected official.

6. Any person signing a document under Standard Condition number 5 shall make the following certification, whether written or implied:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

**ADDITIONAL TECHNICALLY CONDITIONED CERTIFICATION CONDITIONS:**

In addition to the above standard conditions, U.S. Army Corps of Engineers shall satisfy the following:

1. U.S. Army Corps of Engineers shall notify the Central Valley Water Board in writing 7 days in advance of the start of any in-water activities.

2. Except for activities permitted by the U.S. Army Corps under §404 of the Clean Water Act, soil, silt, or other organic materials shall not be placed where such materials could pass into surface water or surface water drainage courses.

3. All areas disturbed by project activities shall be protected from washout or erosion.

4. U.S. Army Corps of Engineers shall maintain a copy of this Certification and supporting documentation (Project Information Sheet) at the Project site during construction for review by site personnel and agencies. All personnel (employees, contractors, and subcontractors) performing work on the proposed project shall be adequately informed and trained regarding the conditions of this Certification.

5. An effective combination of erosion and sediment control Best Management Practices (BMPs) must be implemented and adequately working during all phases of construction.

6. All temporarily affected areas will be restored to pre-construction contours and conditions upon completion of construction activities.

7. U.S. Army Corps of Engineers shall perform surface water sampling: 1) When performing any in-water work; 2) In the event that project activities result in any materials reaching surface waters or; 3) When any activities result in the creation of a visible plume in surface waters. The following monitoring shall be conducted immediately upstream out of the influence of the project and 300 feet downstream of the active work area. Sampling results shall be submitted to this office within two weeks of initiation of sampling and every two weeks thereafter. The sampling frequency may be modified for certain projects with written permission from the Central Valley Water Board.

| Parameter | Unit | Type of Sample | Frequency of Sample |
|---|---|---|---|
| Turbidity | NTU | Grab | Every 4 hours during in water work |
| Settleable Material | ml/l | Grab | Same as above. |
| Visible construction related pollutants | Observations | Visible Inspections | Continuous throughout the construction period |

8. Activities shall not cause turbidity increases in surface water to exceed:
   - (a) where natural turbidity is less than 1 Nephelometric Turbidity Units (NTUs), controllable factors shall not cause downstream turbidity to exceed 2 NTU;
   - (b) where natural turbidity is between 1 and 5 NTUs, increases shall not exceed 1 NTU;
   - (c) where natural turbidity is between 5 and 50 NTUs, increases shall not exceed 20 percent;
   - (d) where natural turbidity is between 50 and 100 NTUs, increases shall not exceed 10 NTUs;
   - (e) where natural turbidity is greater than 100 NTUs, increases shall not exceed 10 percent.

   Except that these limits will be eased during in-water working periods to allow a turbidity increase of 15 NTU over background turbidity as measured in surface waters 300 feet downstream from the working area. In determining compliance with the above limits, appropriate averaging periods may be applied provided that beneficial uses will be fully protected. Averaging periods may only be assessed by prior permission of the Central Valley Water Board.

9. Activities shall not cause settleable matter to exceed 0.1 ml/l in surface waters as measured in surface waters 300 feet downstream from the project.

10. The discharge of petroleum products or other excavated materials to surface water is prohibited. Activities shall not cause visible oil, grease, or foam in the work area or downstream. U.S. Army Corps of Engineers shall notify the Central Valley Water Board immediately of any spill of petroleum products or other organic or earthen materials.

11. U.S. Army Corps of Engineers shall notify the Central Valley Water Board immediately if the above criteria for turbidity, settleable matter, oil/grease, or foam are exceeded.

12. U.S. Army Corps of Engineers shall comply with all California Department of Fish and Game 1600 requirements for the project.

13. U.S. Army Corps of Engineers must obtain coverage under the NPDES General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities issued by the State Water Resources Control Board for any project disturbing an area of 1 acre or greater.

14. The Conditions in this water quality certification are based on the information in the attached "Project Information." If the information in the attached Project Information is modified or the project changes, this water quality certification is no longer valid until amended by the Central Valley Water Board.

15. In the event of any violation or threatened violation of the conditions of this Order, the violation or threatened violation shall be subject to any remedies, penalties, process, or sanctions as provided for under State law and section 401 (d) of the federal Clean Water Act. The applicability of any State law authorizing remedies, penalties, process, or sanctions for the violation or threatened violation constitutes a limitation necessary to ensure compliance with this Order.

    a. If U.S. Army Corps of Engineers or a duly authorized representative of the project fails or refuses to furnish technical or monitoring reports, as required under this Order, or falsifies any information provided in the monitoring reports, the applicant is subject to civil, for each day of violation, or criminal liability.

    b. In response to a suspected violation of any condition of this Order, the Central Valley Water Board may require U.S. Army Corps of Engineers to furnish, under penalty of perjury, any technical or monitoring reports the Central Valley Water Board deems appropriate, provided that the burden, including cost of the reports, shall be in reasonable relationship to the need for the reports and the benefits to be obtained from the reports.

    c. U.S. Army Corps of Engineers shall allow the staff(s) of the Central Valley Water Board, or an authorized representative(s), upon the presentation of credentials and other documents, as may be required by law, to enter the project premises for inspection, including taking photographs and securing copies of project-related records, for the purpose of assuring compliance with this certification and determining the ecological success of the project.

16. U.S. Army Corps of Engineers shall provide a Notice of Completion (NOC) no later than 30 days after the project completion. The NOC shall demonstrate that that the project has been carried out in accordance with the project's description (and any amendments approved). The NOC shall include a map of the project location(s), including final boundaries of any in situ restoration area(s), if appropriate, and representative pre and post construction photographs. Each photograph shall include a descriptive title, date taken, photographic site, and photographic orientation.

17. This project must implement all conservation measures described in the National Marine Fisheries Service's section 7 consultation response (2010/05132).

## REGIONAL WATER QUALITY CONTROL BOARD CONTACT PERSON:

Daniel Worth, Environmental Scientist
11020 Sun Center Drive #200
Rancho Cordova, California 95670-6114
dworth@waterboards.ca.gov
(916) 464-4709

## WATER QUALITY CERTIFICATION:

I hereby issue an order certifying that any discharge from the U.S. Army Corps of Engineers, Englebright Dam Reach Gravel Injection Project (WDID# 5XXXCR00XXX) will comply with the applicable provisions of §301 ("Effluent Limitations"), §302 ("Water Quality Related Effluent Limitations"), §303 ("Water Quality Standards and Implementation Plans"), §306 ("National Standards of Performance"), and §307 ("Toxic and Pretreatment Effluent Standards") of the Clean Water Act. This discharge is also regulated under State Water Resources Control Board Water Quality Order No. 2003-0017 DWQ "Statewide General Waste Discharge Requirements For Dredged Or Fill Discharges That Have Received State Water Quality Certification (General WDRs)".

Except insofar as may be modified by any preceding conditions, all certification actions are contingent on (a) the discharge being limited and all proposed mitigation being completed in strict compliance with U.S. Army Corps of Engineers' project description and the attached Project Information Sheet, and (b) compliance with all applicable requirements of the *Water Quality Control Plan for the Sacramento River and San Joaquin River*, Fourth Edition, revised September 2009.

for Pamela C. Creedon
Executive Officer

Enclosure: Project Information

cc: See enclosure, page 8

## PROJECT INFORMATION

**Application Date:** 13 October 2010

**Applicant:** Mitch Stewart
U.S. Army Corps of Engineers
1325 J Street
Sacramento, CA 95814

**Project Name:** Englebright Dam Reach Gravel Injection Project

**Application Number:** WDID#5A58CR00081

**Type of Project:** Gravel Augmentation

**Project Location:** Section 14, Township 16 North, Range 6 East, MDB&M. Latitude: 39°14'20.72" and Longitude: 121°16'10.44"

**County:** Yuba County

**Receiving Water(s) (hydrologic unit):** Yuba River, Sacramento Hydrologic Basin, Unit #515.30, Lower Yuba River HA

**Water Body Type:** Streambed

**Designated Beneficial Uses:** The *Water Quality Control Plan for the Sacramento River and San Joaquin River*, Fourth Edition, revised September 2009 (Basin Plan) has designated beneficial uses for surface and ground waters within the region. Beneficial uses that could be impacted by the project include, but are not limited to: Municipal and Domestic Water Supply (MUN); Agricultural Supply (AGR); Industrial Supply (IND), Hydropower Generation (POW); Groundwater Recharge, Water Contact Recreation (REC-1); Non-Contact Water Recreation (REC-2); Warm Freshwater Habitat (WARM); Cold Freshwater Habitat (COLD); and Wildlife Habitat (WILD). A comprehensive and specific list of the Beneficial Uses applicable for the project area can be found at: http://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/

**303(d) List of Water Quality Limited Segments:** The project does not impact an already impaired water body. The most recent list of approved water quality limited segments can be found at: http://www.waterboards.ca.gov/water_issues/programs/tmdl/docs/303dlists2006/epa/r5_06_303d_reqtmdls.pdf

**Project Description (purpose/goal):** The Englebright Dam Reach Gravel Injection Project consists of the placement of gravel and cobble into the Lower Yuba River channel to provide suitable substrate for Chinook salmon reproduction. The U.S. Army Corps of Engineers proposes to place 2,000 to 5,000 short tons (7,407 to 18,518 cubic yards) of washed gravel into the Yuba River 300 feet below Englebright Dam during November and December 2010. Gravel will be placed in an area of river approximately 400 feet in length, which is currently void of suitable substrate for salmonid spawning. The gravel will be obtained from a local aggregate producer within the local watershed. To reduce water quality impacts, all gravel will be washed thoroughly before arriving at the project site. The gravel will be placed into the river through a sluice pipe. Water pumped from Englebright Reservoir will be added to the uphill end of the pipeline to facilitate the flow of gravel through the pipe. No heavy equipment will enter the river during this project. If all 5,000 tons of gravel cannot be placed in the Yuba River during 2010, the U.S. Army Corps of Engineers intends to place the remaining amount in 2011.

**Preliminary Water Quality Concerns:** Construction activities may impact surface waters with increased turbidity and settleable matter.

**Proposed Mitigation to Address Concerns:** U.S. Army Corps of Engineers will implement Best Management Practices (BMPs) to control sedimentation and erosion. All temporary affected areas will be restored to pre-construction contours and conditions upon completion of construction activities. U.S. Army Corps of Engineers will conduct turbidity and settleable matter testing during in-water work, stopping work if the Basin Plan criteria are exceeded or are observed.

**Fill/Excavation Area:** Approximately 18,518 cubic yards of clean gravel and cobble will be placed into approximately 0.90 acres of waters of the United States.

**Dredge Volume:** None

**U.S. Army Corps File Number:** None

**U.S. Army Corps of Engineers Permit Number:** None

**Department of Fish and Game Streambed Alteration Agreement:** U.S. Army Corps of Engineers is not required to apply for a Fish and Game permit.

**Possible Listed Species:** Central Valley steelhead, Chinook salmon

**Status of CEQA Compliance:** The Central Valley Water Board filed a Notice of Exemption for this project on 10 November 2010 under Section 15333, which exempts small habitat restoration projects less than five acres in size.

**Compensatory Mitigation:** None

**Application Fee Provided:** U.S. Army Corps of Engineers has refused to pay fees as required by 23 CCR §3833b(3)(A) and by 23 CCR §2200(e). The State Water Resources Control Board's 4 April 2010 Fee Policies and Procedures memo, that was titled Billing Guidelines For Federal Facilities, suggests that federal dischargers have a legal basis to refuse payment of fees specifically associated with dredge and fill operations.

## DISTRIBUTION LIST

United States Army Corp of Engineers
Sacramento District Office
Regulatory Section, Room 1480
1325 J Street
Sacramento, CA 95814-2922

United States Fish & Wildlife Service
Sacramento Fish & Wildlife Office
2800 Cottage Way
Sacramento, CA 95825

Jeff Drongesen
Department of Fish and Game
1701 Nimbus Road, Suite A
Rancho Cordova, CA 95670

Bill Jennings
CA Sportfishing Protection Alliance
3536 Rainier Avenue
Stockton, CA 95204

(Electronic copy only) Bill Orme
State Water Resources Control Board
401 Certification and Wetlands Unit Chief

(Electronic copy only) Dave Smith
Wetlands Section Chief (W-3)
United States Environmental Protection Agency

# APPENDIX D
# SPECIAL-STATUS SPECIES

**United States Department of the Interior**

FISH AND WILDLIFE SERVICE

Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825

September 13, 2010

Document Number: 100913031241

Mariah M. Garr
U.S. Army Corps of Engineers
1325 J Street
Sacramento, CA 95814

Subject: Species List for Lower Yuba River Gravel Augmentation

Dear: Ms. Garr

We are sending this official species list in response to your September 13, 2010 request for information about endangered and threatened species. The list covers the California counties and/or U.S. Geological Survey 7½ minute quad or quads you requested.

Our database was developed primarily to assist Federal agencies that are consulting with us. Therefore, our lists include all of the sensitive species that have been found in a certain area *and also ones that may be affected by projects in the area*. For example, a fish may be on the list for a quad if it lives somewhere downstream from that quad. Birds are included even if they only migrate through an area. In other words, we include all of the species we want people to consider when they do something that affects the environment.

Please read Important Information About Your Species List (below). It explains how we made the list and describes your responsibilities under the Endangered Species Act.

Our database is constantly updated as species are proposed, listed and delisted. If you address proposed and candidate species in your planning, this should not be a problem. However, we recommend that you get an updated list every 90 days. That would be December 12, 2010.

Please contact us if your project may affect endangered or threatened species or if you have any questions about the attached list or your responsibilities under the Endangered Species Act. A list of Endangered Species Program contacts can be found at [www.fws.gov/sacramento/es/branches.htm](http://www.fws.gov/sacramento/es/branches.htm).

Endangered Species Division

TAKE PRIDE IN AMERICA

# U.S. Fish & Wildlife Service

# Sacramento Fish & Wildlife Office

### Federal Endangered and Threatened Species that Occur in or may be Affected by Projects in the Counties and/or U.S.G.S. 7 1/2 Minute Quads you requested

Document Number: 100913031241

Database Last Updated: April 29, 2010

---

## Quad Lists

### Listed Species

#### Invertebrates

*Branchinecta conservatio*
Conservancy fairy shrimp (E)

*Branchinecta lynchi*
Critical habitat, vernal pool fairy shrimp (X)
vernal pool fairy shrimp (T)

*Desmocerus californicus dimorphus*
valley elderberry longhorn beetle (T)

*Lepidurus packardi*
Critical habitat, vernal pool tadpole shrimp (X)
vernal pool tadpole shrimp (E)

#### Fish

*Hypomesus transpacificus*
delta smelt (T)

*Oncorhynchus mykiss*
Central Valley steelhead (T) (NMFS)
Critical habitat, Central Valley steelhead (X) (NMFS)

*Oncorhynchus tshawytscha*
Central Valley spring-run chinook salmon (T) (NMFS)
Critical Habitat, Central Valley spring-run chinook (X) (NMFS)
winter-run chinook salmon, Sacramento River (E) (NMFS)

#### Amphibians

*Rana draytonii*
California red-legged frog (T)

#### Reptiles

*Thamnophis gigas*
giant garter snake (T)

### Candidate Species

#### Birds

*Coccyzus americanus occidentalis*
Western yellow-billed cuckoo (C)

### Quads Containing Listed, Proposed or Candidate Species:

SMARTVILLE (543A)

BROWNS VALLEY (543B)

---

## County Lists

# Yuba County

## Listed Species

### Invertebrates

*Branchinecta lynchi*
Critical habitat, vernal pool fairy shrimp (X)
vernal pool fairy shrimp (T)

*Desmocerus californicus dimorphus*
valley elderberry longhorn beetle (T)

*Lepidurus packardi*
Critical habitat, vernal pool tadpole shrimp (X)
vernal pool tadpole shrimp (E)

### Fish

*Acipenser medirostris*
green sturgeon (T) (NMFS)

*Oncorhynchus mykiss*
Central Valley steelhead (T) (NMFS)
Critical habitat, Central Valley steelhead (X) (NMFS)

*Oncorhynchus tshawytscha*
Central Valley spring-run chinook salmon (T) (NMFS)
Critical Habitat, Central Valley spring-run chinook (X) (NMFS)
winter-run chinook salmon, Sacramento River (E) (NMFS)

### Amphibians

*Ambystoma californiense*
California tiger salamander, central population (T)

*Rana draytonii*
California red-legged frog (T)
Critical habitat, California red-legged frog (X)

### Reptiles

*Thamnophis gigas*
giant garter snake (T)

### Plants

*Senecio layneae*
Layne's butterweed (=ragwort) (T)

## Proposed Species

### Amphibians

*Rana draytonii*
Critical habitat, California red-legged frog (PX)

## Candidate Species

### Birds

*Coccyzus americanus occidentalis*
Western yellow-billed cuckoo (C)

## Key:

(E) *Endangered* - Listed as being in danger of extinction.
(T) *Threatened* - Listed as likely to become endangered within the foreseeable future.
(P) *Proposed* - Officially proposed in the Federal Register for listing as endangered or threatened.
(NMFS) Species under the Jurisdiction of the National Oceanic & Atmospheric Administration Fisheries Service. Consult with them directly about these species.
*Critical Habitat* - Area essential to the conservation of a species.
(PX) *Proposed Critical Habitat* - The species is already listed. Critical habitat is being proposed for it.
(C) *Candidate* - Candidate to become a proposed species.
(V) Vacated by a court order. Not currently in effect. Being reviewed by the Service.
(X) *Critical Habitat* designated for this species

# Important Information About Your Species List

## How We Make Species Lists

We store information about endangered and threatened species lists by U.S. Geological Survey 7½ minute quads. The United States is divided into these quads, which are about the size of San Francisco.

The animals on your species list are ones that occur within, **or may be affected by** projects within, the quads covered by the list.

- Fish and other aquatic species appear on your list if they are in the same watershed as your quad or if water use in your quad might affect them.
- Amphibians will be on the list for a quad or county if pesticides applied in that area may be carried to their habitat by air currents.
- Birds are shown regardless of whether they are resident or migratory. Relevant birds on the county list should be considered regardless of whether they appear on a quad list.

## Plants

Any plants on your list are ones that have actually been observed in the area covered by the list. Plants may exist in an area without ever having been detected there. You can find out what's in the surrounding quads through the California Native Plant Society's online Inventory of Rare and Endangered Plants.

## Surveying

Some of the species on your list may not be affected by your project. A trained biologist and/or botanist, familiar with the habitat requirements of the species on your list, should determine whether they or habitats suitable for them may be affected by your project. We recommend that your surveys include any proposed and candidate species on your list. See our Protocol and Recovery Permits pages.

For plant surveys, we recommend using the Guidelines for Conducting and Reporting Botanical Inventories. The results of your surveys should be published in any environmental documents prepared for your project.

## Your Responsibilities Under the Endangered Species Act

All animals identified as listed above are fully protected under the Endangered Species Act of 1973, as amended. Section 9 of the Act and its implementing regulations prohibit the take of a federally listed wildlife species. Take is defined by the Act as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect" any such animal.

> Take may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or shelter (50 CFR §17.3).

## Take incidental to an otherwise lawful activity may be authorized by one of two procedures:

- If a Federal agency is involved with the permitting, funding, or carrying out of a project that may result in take, then that agency must engage in a formal consultation with the Service.

  During formal consultation, the Federal agency, the applicant and the Service work together to avoid or minimize the impact on listed species and their habitat. Such consultation would result in a biological opinion by the Service addressing the anticipated effect of the project on listed and proposed species. The opinion may authorize a limited level of incidental take.

- If no Federal agency is involved with the project, and federally listed species may be taken as part of the project, then you, the applicant, should apply for an incidental take permit. The Service may issue such a permit if you submit a satisfactory conservation plan for the species that would be affected by your project.

  Should your survey determine that federally listed or proposed species occur in the area and are likely to be affected by the project, we recommend that you work with this office and the California Department of Fish and Game to develop a plan that minimizes the project's direct and indirect impacts to listed species and compensates for project-related loss of habitat. You should include the plan in any environmental documents you file.

## Critical Habitat

When a species is listed as endangered or threatened, areas of habitat considered essential to its conservation may be designated as critical habitat. These areas may require special management considerations or protection. They provide needed space for growth and normal behavior; food, water, air, light, other nutritional or physiological requirements; cover or shelter; and sites for breeding, reproduction, rearing of offspring, germination or seed dispersal.

Although critical habitat may be designated on private or State lands, activities on these lands are not restricted unless there is Federal involvement in the activities or direct harm to listed wildlife.

If any species has proposed or designated critical habitat within a quad, there will be a separate line for this on the species list. Boundary descriptions of the critical habitat may be found in the Federal Register. The information is also reprinted in the Code of Federal Regulations (50 CFR 17.95). See our Map Room page.

## Candidate Species

We recommend that you address impacts to candidate species. We put plants and animals on our candidate list when we have enough scientific information to eventually propose them for listing as threatened or endangered. By considering these species early in your planning process you may be able to avoid the problems that could develop if one of these candidates was listed before the end of your project.

## Species of Concern

The Sacramento Fish & Wildlife Office no longer maintains a list of species of concern. However, various other agencies and organizations maintain lists of at-risk species. These lists provide essential information for land management planning and conservation efforts. More info

## Wetlands

If your project will impact wetlands, riparian habitat, or other jurisdictional waters as defined by section 404 of the Clean Water Act and/or section 10 of the Rivers and Harbors Act, you will need to obtain a permit from the U.S. Army Corps of Engineers. Impacts to wetland habitats require site specific mitigation and monitoring. For questions regarding wetlands, please contact Mark Littlefield of this office at (916) 414-6580.

## Updates

Our database is constantly updated as species are proposed, listed and delisted. If you address proposed and candidate species in your planning, this should not be a problem. However, we recommend that you get an updated list every 90 days. That would be December 12, 2010.

| Species | Common Name | Federal List | State List | CDFG | CNPS |
|---|---|---|---|---|---|
| Invertebrates | | | | | |
| *Branchinecta conservatio* | conservancy fairy shrimp | Endangered | None | | |
| *Branchinecta lynchi* | vernal pool fairy shrimp | Threatened | None | | |
| *Branchinecta lynchi* | Critical Habitat: vernal pool fairy shrimp | - | - | | |
| *Desmocerus californicus dimorphus* | valley elderberry longhorn beetle | Threatened | None | | |
| *Lepidurus packardi* | vernal pool tadpole shrimp | Endangered | None | | |
| *Lepidurus packardi* | Critical Habitat: vernal pool tadpole shrimp | - | - | | |
| *Linderiella occidentalis* | California linderiella | None | None | | |
| Fish | | | | | |
| *Acipenser medirostris* | green sturgeon | Threatened | None | | |
| *Hypomensus transpacificus* | delta smelt | Threatened | Threat ened | | |
| *Oncorhynchus mykiss* | Central Valley steelhead | Threatened | None | | |
| *Oncorhynchus mykiss* | Critical Habitat: Central Valley steelhead | - | - | | |
| *Oncorhynchus tshawytscha* | chinook salmon - Central Valley spring-run ESU | Threatened | Threat ened | | |
| *Oncorhynchus tshawytscha* | Critical Habitat: chinook salmon - Central Valley spring-run ESU | - | - | | |
| *Oncorhynchus tshawytscha* | winter-run chinook salmon, Sacramento River | Endangered | Endangered | | |
| Amphibians | | | | | |
| *Rana draytonii* | California red-legged frog | Threatened | None | | |
| Reptiles | | | | | |
| *Emys marmorata* | western pond turtle | None | None | SC | |
| *Thamnophis gigas* | giant garter snake | Threatened | Threat ened | | |
| Birds | | | | | |
| *Agelaius tricolor* | tricolored blackbird | None | None | SC | |
| *Asio otus* | long-eared owl | None | None | SC | |
| *Athene cunicularia* | burrowing owl | None | None | SC | |
| *Buteo swainsoni* | Swainson's hawk | None | Threat ened | | |
| *Coccyzus americanus occidentalis* | Western yellow-billed cuckoo | Candidate | Endangered | | |
| *Laterallus jamaicensis coturniculus* | California black rail | None | Threat ened | | |
| Mammals | | | | | |
| *Lasiurus blossevillii* | western red bat | None | None | SC | |
| *Lasiurus cinereus* | hoary bat | None | None | | |
| *Myotis yumanensis* | Yuma myotis | None | None | | |
| Plants | | | | | |
| *Clarkia biloba ssp. brandegeeae* | Brandegee's clarkia | None | None | | 1B.2 |
| *Downingia pusilla* | dwarf downingia | None | None | | 2.2 |
| *Legenere limosa* | legenere | None | None | | 1B.1 |

| Species | Common Name | Federal List | State List | CDFG | CNPS |
|---|---|---|---|---|---|
| Habitat | | | | | |
| *Northern Hardpan Vernal Pool* | Northern Hardpan Vernal Pool | None | None | | |

Notes:
*CDFG = California Department of Fish and Game*
*SC = CDFG Species of Concern designation*
*CNPS = California Native Plant Society*
*1B.1 = Plants rare, threatened, or endangered in California and elsewhere; seriously threatened in California*
*1B.2 = Plants rare, threatened, or endangered in California and elsewhere; fairly threatened in California*
*2.2 = Plants rare, threatened, or endangered in California, but more common elsewhere; fairly threatened in California*

# APPENDIX E
# AIR QUALITY STANDARDS

**Table I. Emissions for the 2010 Proposed Lower Yuba River Gravel Augmentation**

| Emission Estimates for -> Project Phases (English Units) | Lower Yuba River Gravel Augmentation ROG (lbs/day) | CO (lbs/day) | NOx (lbs/day) | Total PM10 (lbs/day) | Exhaust PM10 (lbs/day) | Fugitive Dust PM10 (lbs/day) | Total PM2.5 (lbs/day) | Exhaust PM2.5 (lbs/day) | Fugitive Dust PM2.5 (lbs/day) | CO2 (lbs/day) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Maximum (pounds/day)** | 10.1 | 40.3 | 51.1 | 18.1 | 3.1 | 15.0 | 6.0 | 2.9 | 3.1 | 4,977.9 |
| **Total (tons/construction project)** | 0.2 | 0.5 | 0.7 | 0.3 | 0.0 | 0.2 | 0.1 | 0.0 | 0.0 | 68.6 |

**Table II. The National Ambient Air Quality Standards as of Dec 2008**

| **Pollutant** | **Standard** | **Averaging Time** |
|---|---|---|
| $PM_{10}$ | 150 ug/m3 | 24 hour average |
| $PM_{2.5}$ | 15.0 ug/m3 | Annual Arithmetic Mean |
| | 35 ug/m3 | 24 hour average |

*Reference: FRAQMD 2010

**Table III. The California Ambient Air Quality Standards as of Dec 2008**

| **Pollutant** | **Standard** | **Averaging Time** |
|---|---|---|
| $PM_{10}$ | 20 ug/m3 | Annual Average |
| | 50 ug/m3 | 24-hour Average |
| $PM_{2.5}$ | 12 ug/m3 | Annual Average |

*Reference: FRAQMD 2010

**Table IV. Feather River Air Quality Management District Thresholds of Significance**

| **Project Phase** | **Nitrogen Oxides** | **Reactive Organic Gases** | $PM_{10}$ | $PM_{2.5}$ | **Greenhouse Gasses** |
|---|---|---|---|---|---|
| Operational | 25 lbs/day | 25 lbs/day | 80 lbs/day | Not Yet Established | Not Yet Established |
| Construction | 25 lbs/day, not to exceed 4.5 tons/year | 25 lbs/day, not to exceed 4.5 tons/year | 80 lbs/day | Not Yet Established | Not Yet Established |

*Reference: FRAQMD 2010

# APPENDIX F
# U.S. FISH AND WILDLIFE COORDINATION ACT REPORT

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1846

In Reply Refer To:
81420-2010-CPA-0320

NOV 9 2010

Alicia Kirchner
Chief, Planning Division
Corps of Engineers, Sacramento District
1325 J Street
Sacramento, California 95814

Dear Ms. Kirchner:

This letter constitutes the U.S. Fish and Wildlife Service's (Service) Fish and Wildlife Coordination Act Report regarding the U.S. Army Corps of Engineers (Corps) proposed Lower Yuba River Gravel Injection Project (project), Yuba and Nevada Counties, California. The information considered by the Service was obtained from a preliminary Draft Environmental Assessment for the project and conversation with Beth Campbell of the Service, attendee of the Yuba River Fisheries Technical Working Group (YRTWG). The Service has been actively participating in the YRTWG, where the proposed project has been discussed.

The purpose of the project is to place suitable-sized spawning gravel within the upper Narrows reach of the lower Yuba River, which is now almost devoid of river-rounded gravel and cobble necessary for salmon spawning. This would initiate a long-term gravel augmentation program for the restoration of geomorphic processes and aquatic habitat in the river channel downstream of Englebright Dam. The program would serve to improve the overall function of the existing habitat by providing spawning gravel to key areas on the lower Yuba River that have been designated as critical habitat for the Central Valley spring-run Chinook salmon and the Central Valley steelhead.

The project involves the placement of 2,000 to 5,000 short tons of a heterogeneous mix of gravel and cobble in the Yuba River downstream of Englebright Dam via gravel sluicing. This entails drawing water up from a source and into a flexible pipe, where gravel and cobble is added from the top to produce a water/sediment slurry that is then piped down to a site for directed placement. The migration of the injected gravel would be tracked for an improved understanding of the geomorphic processes and to improve the implementation of the long-term gravel augmentation program. The project would be implemented in the fall of 2010 during the low flow season and would be completed in about 33 workdays.

We have reviewed the project information and determined that the proposed gravel injection project would have temporary minimal effects on fish and wildlife species and their habitat. The impacts include temporary local increases in turbidity, temporary displacement of fish, and the covering of aquatic invertebrate habitat, which serves as a food source for the fish. Negative impacts could also occur due to the timing of the project. Rotary screw trap data from the lower Yuba River suggests that emergence of spring-run Chinook salmon fry begins around mid-November (Campos and Massa 2010). Therefore, eggs, redds, or emergent fry may be present just downstream (e.g. presumably within a few hundred yards) of the work site. The main adverse effects on these life stages would be increased turbidity and noise/shock waves. However, the increased turbidity should be localized and within acceptable limits and the noise should be muffled by the sluicing method of injection (Campbell 2010).

Additionally, the injected gravel could mobilize under high flow conditions and be deposited on top of existing redds. This would be expected to be a problem only in the Englebright Dam Reach because, with the exception of at very high flows, much of the gravel would be deposited in deep pools as it travels downstream. Currently, we are experiencing a mild La Nina event and a dry fall is expected, so little mobilization of the gravel is anticipated. Also, few redds are expected to be present in the Englebright Dam Reach because there is little suitable spawning habitat available there. The project does not require the construction of any new staging areas or haul routes so we do not anticipate any effect resulting from these activities on fish, wildlife, or their habitat.

Because of the minimal impacts of the project and the subsequent creation of beneficial habitat for the Central Valley spring-run Chinook salmon and the Central Valley steelhead, the Service recommends that the proposed Lower Yuba River Gravel Injection project be implemented as described, provided the Corp has completed consultation with the National Marine Fisheries Services under the Endangered Species Act of 1973, as amended, and certification from the California Regional Water Quality Control Board under Section 401 of the Clean Water Act.

If you have any questions regarding this report, please contact Staff Biologist Tyler Willsey at (916) 414-6577.

Sincerely,

for M. Kathleen Wood
Assistant Field Supervisor

cc:
Elizabeth Campbell, Stockton FWO, Stockton, CA
Mariah Garr, Corps, Sacramento, CA
NOAA Fisheries, Sacramento, CA
Regional Manager, CDFG, Region 2, Rancho Cordova, CA

## LITERATURE CITED

Campos, Casey and Massa, Duane. 2010. "Lower Yuba River Accord Monitoring and Evaluation Plan: Annual Rotary Screw Trapping Report." Pacific States Marine Fisheries Commission. Portland, Oregon.

## PERSONAL COMMUNICATION

Campbell, Beth. "Re: Lower Yuba River." Email to Tyler Willsey. October 1, 2010.

# APPENDIX G
# NATIONAL MARINE FISHERIES SERVICES
# ENDANGERED SPECIES ACT

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, SACRAMENTO
CORPS OF ENGINEERS
1325 J STREET
SACRAMENTO, CALIFORNIA 95814-2922

REPLY TO
ATTENTION OF

Environmental Resources Branch

OCT 01 2010

Mr. Rodney R. McInnis
Regional Administrator
National Marine Fisheries Service
650 Capitol Mall, Suite 8-300
Sacramento, California 95814-4706

Dear Mr. McInnis:

This letter serves as the Corps' biological assessment for the Lower Yuba River Gravel Augmentation Project, Yuba and Nevada Counties, California. We are enclosing a copy of the draft Environmental Assessment (EA), which describes potential effects of the project on Federally listed endangered, threatened, and candidate species in the project area. This letter requests your agency's concurrence that the U.S. Army Corps of Engineers' (Corps) proposed gravel augmentation project fulfills a non-discretionary reasonable and prudent measure specified in the incidental take statement included in your November 21, 2007 Biological Opinion (BO) (151422-SWR-2006-SA00071:MET). We also request your concurrence that the proposed project is not likely to adversely affect Federally listed species or their designated critical habitat.

The BO analyzed the effects of the Corps operation of Englebright and Daguerre Point Dams on the Yuba River in Yuba and Nevada Counties, California (proposed project) on threatened Central Valley spring-run Chinook salmon *(Oncorhynchus tshawytscha),* threatened Central Valley steelhead (*O. mykiss),* the respective designated critical habitats for these salmonid species, and the threatened southern Distinct Population Segment of North American green sturgeon *(Acipenser medirostris).* Pursuant to Section 7(b)(4) of the Endangered Species Act, reasonable and prudent measures were found necessary and appropriate to minimize take of these species and their critical habitat. Specifically, the BO states: "The Corps shall develop and implement a long-term gravel augmentation program to restore quality spawning habitat below Englebright Dam. The Corps shall utilize the information obtained from the pilot gravel injection project to develop and commence implementation of a long-term gravel augmentation program within three years of the issuance of this biological opinion".

The Corps proposes to implement the gravel augmentation project in November 2010 with the placement of 2,000 to 5,000 short tons of a heterogeneous mix of gravel and cobble (0.25 to 5.0 inches in diameter) directly into the Lower Yuba River channel below Englebright Dam. The gravel sluicing method involves drawing water up from a source and into a flexible pipe where gravel and cobble is added from the top to produce a water, gravel slurry. The gravel slurry mix is then piped down to a pre-selected site for directed placement by one to two operators. The gravel augmentation project would serve to meet the required Terms and Conditions, as listed under the BO, and initiate the long-term gravel augmentation program for restoring geomorphic processes and aquatic habitat in the Lower Yuba River channel below Englebright Dam.

The enclosed draft EA examined various alternatives to deliver and place the gravel, described the environmental resources in the project area, determined the potential effect of the preferred alternative on those resources, and proposed mitigation measures to reduce any effects to less than significant. The findings of this draft EA determined that implementation of the gravel augmentation project would have no significant adverse effects on the threatened Central Valley spring-run Chinook salmon, threatened Central Valley steelhead, the respective designated critical habitats for these salmonids species, and the threatened southern Distinct Population Segment of North American green sturgeon.

We request your concurrence with our finding of not likely to adversely affect these Federally listed species or their critical habitat. We also request your concurrence that the proposed project may satisfy the reasonable and prudent measure specified in the incidental take statement included in your November 21, 2007 BO. If you have any questions, contact Mr. Mitch Stewart, Environmental Resources Branch, at (916) 557-6734 or Ms. Mariah Garr, Environmental Resources Branch, at (916) 557-7702. Thank you for your cooperation and effort on this important project.

Sincerely,

Alicia E. Kirchner

Alicia E. Kirchner
Chief, Planning Division

Enclosure

Copy furnished w/encl:
Mr. Gary Sprague, Fish Biologist, National Marine Fisheries Service, 650 Capitol Mall, Suite 8-300, Sacramento, California 95814-4706

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

NOV - 3 2010

In response refer to:
2010/05132

Alicia E. Kirchner
U.S. Army Corps of Engineers
1325 J Street
Room 1480
Sacramento, California 95814-2922

Dear Ms. Kirchner:

This letter is in response to your October 1, 2010, letter requesting section 7 consultation pursuant to the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.), with NOAA's National Marine Fisheries Service (NMFS), in support of the Department of the Army's Lower Yuba River Gravel Augmentation project. This project partially fulfills the reasonable and prudent measure (RPA) specifying gravel augmentation in the November 21, 2007, Biological Opinion for the operations of Englebright and Daguerre Point Dams on the Yuba River.

The U.S. Army Corps of Engineers (Corps) has proposed a project that consists of placing 2,000 to 5,000 short tons of pre-washed spawning gravel into the Yuba River, immediately below the Narrows I powerhouse. The gravel will be placed into the Yuba River through a pipeline. Water pumped from Englebright Reservoir will be added to the gravel at the uphill end of the pipeline, to facilitate the flow of gravel through the pipe.

The Corps has determined that the proposed Lower Yuba River Gravel Augmentation project is not likely to adversely affect Federally listed species or their designated habitats. The Corps has determined the Lower Yuba River Gravel Augmentation project may affect, but is not likely to adversely affect Federally listed threatened Central Valley (CV) steelhead (*Onchorynchus mykiss*), threatened CV spring-run Chinook salmon (*O. tshawytscha),* and the threatened Southern distinct population segment (DPS) of North American green sturgeon (*Acipenser medirostris*), or their respective designated critical/essential habitats. In addition, the Corps has identified the proposed project is within Essential Fish Habitat (EFH) of Pacific salmon and has requested initiation of consultation pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (MSA). This letter also serves as consultation under the authority of and in accordance with the provisions of the Fish and Wildlife Coordination Act of 1934, as amended.

Action Area

The proposed project is in the Yuba River located feet downstream of Englebright Dam, below the Narrows I powerhouse, at approximately Latitude 39 degrees 14 minutes10.38" seconds north and Longitude 121 degrees 16 minutes' 20.55 seconds. The action area encompasses waterways where CV steelhead and spring-run Chinook may be present, and includes waters that have been designated as critical habitat for CV steelhead, and spring-run Chinook salmon. Federally listed CV steelhead and spring-run Chinook have the potential to occur in the action area throughout the year.

Proposed Project Description

The Corps proposal is to place 2,000 to 5,000 short tons of washed gravel into the Yuba River 300 feet below Englebright Dam, during four to six weeks in November and December 2010. If less than 2,000 tons are placed in the river in 2010, the project will place the remaining amount in 2011. This gravel augmentation project was identified as a reasonable and prudent measure in the 2007 Biological Opinion for the operation of Englebright and Daguerre Dams. The gravel is intended to provide spawning habitat for Chinook salmon, in areas where spawning gravel is not currently present. The gravel will be placed into the river through a pipeline. The gravel will be from the Yuba River watershed. This is being done to address concerns about salmon homing. The gravel will also be washed to remove fines, to maximize the benefits of the project for fish, and minimize potential risks to fish. No heavy equipment will enter the river. If all 5,000 tons of gravel cannot be placed in the Yuba River this year, the Corps intends to place the remaining amount in 2011.

The following conservation measures have been incorporated into the project plan to minimize potential for any adverse impacts to listed salmonids or their critical habitat:

1. In water work will be limited to areas currently devoid of spawning gravels. This will minimize the potential impacts to spawning fish or their eggs.
2. The gravel will be prewashed to remove fines. This will reduce the risk of increased turbidity and silting in of downstream redds.
3. Heavy equipment will not enter the river. This will greatly reduce the risk of an oil spill which would impact fish in the river.
4. Except for the water pump, motorized equipment for this project will be more than 100 feet from shorelines. This will provide protection to fish bearing waters by minimizing increases in turbidity and the risk of spills of hazardous material into the water.

Endangered Species Act (ESA) Section 7 Consultation

NMFS has received the information necessary to initiate consultation on Federally listed anadromous fish species and their designated critical habitat within the action area. Based on our review of the material provided and the best scientific and commercial information currently available, NMFS concurs with the Corps' determination that the proposed Lower Yuba River Gravel Augmentation project will not likely adversely affect Federally listed threatened Central

Valley (CV) steelhead (*Onchorynchus mykiss*), threatened CV spring-run Chinook salmon (*O. tshawytscha),* and the threatened Southern distinct population segment (DPS) of North American green sturgeon (*Acipenser medirostris*), or their respective designated critical/essential habitats.

The potential for adverse effects is discountable and not expected to reach the level where take will occur for the following reasons:

1. The in water work is in an area not currently used by fish for spawning, because of the lack of gravel. When gravel is being added, rearing fish are highly unlikely to be present in the small area in which gravel is being placed. Effects on rearing fish are expected to be insignificant or discountable.
2. Due to the location and the timing of the project, fish are expected to be in extremely low abundance.
3. The work will be completed prior to the beginning of steelhead spawning. This will minimize any potential effects to adult steelhead, and avoid impacts to steelhead eggs.
4. The out of water work is not expected to affect fish, or fish bearing waters.
5. The pipeline method of adding gravel to the river will minimize the potential of impacts to water quality.

Activities associated with construction of the Lower Yuba River Gravel Augmentation project have the potential to impact Federally listed fishes through noise and turbidity. The project, as proposed, provides good protective measures for listed fish through minimizing the risk of pollution, and locating the work in an area not currently used by Federally listed species. Implementation of the protection and conservation measures will minimize the potential of impacts to Federally listed fish to insignificant levels.

This concludes the ESA consultation for the proposed action. This concurrence does not provide incidental take authorization pursuant to section 7(b)(4) and section 7(o)(2) of the ESA. It is illegal to "take" a species listed under the Federal ESA. The term "take" is defined by the ESA (section 3(19)) to mean *"to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct."* Reinitiation of consultation is required where discretionary Federal agency involvement, or control over the action has been retained (or is authorized by law) and if: (1) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered; (2) the action is subsequently modified in a manner that causes adverse effects to listed species or critical habitat; or (3) a new species is listed or critical habitat designated that may be affected by this action.

Essential Fish Habitat (EFH) Consultation

With regards to EFH consultation, the proposed project area has been designated for all races of CV Chinook salmon (*Oncorhynchus tshawytscha*), including the fall/late fall-run in Amendment 14 of the Pacific Salmon Fishery Management Plan pursuant to the MSA. Federal action agencies are mandated by the MSA (section 305[b][2]) to consult with NMFS on all actions that may adversely affect EFH, and NMFS must provide EFH conservation recommendations to those agencies (section 305[b][4][A]). Because the proposed action has been designed to avoid adverse impacts to the aquatic and riparian habitat within Yuba River and has incorporated the previously described conservation measures to ensure that EFH features will not be diminished, EFH Conservation Recommendations are not required at this time; however, if there is substantial revision to the action, the lead Federal agency will need to reinitiate EFH consultation.

Fish and Wildlife Coordination Act (FWCA) Consultation

The purpose of the FWCA is to ensure that wildlife conservation receives equal consideration, and is coordinated with other aspects of water resources development [16 U.S.C. 661]. The FWCA establishes a consultation requirement for Federal departments and agencies that undertake any action that proposed to modify any stream or other body of water for any purpose, including navigation and drainage [16 U.S.C. 662(a)]. The FWCA allows the opportunity to offer recommendations for the conservation of species and habitat beyond those currently managed under ESA and MSA. Because of the conservation measures listed above, NMFS has no additional FWCA comments to provide.

If you have any questions concerning this project, or require additional information, please contact Gary Sprague at (916) 930-3615, or via email at: Gary.Sprague@noaa.gov.

Sincerely,

Maria Rea

for Rodney R. McInnis
Regional Administrator

cc: Copy to File ARN: 151422SWR2006SA00071
NMFS-PRD, Long Beach, CA

# APPENDIX H
# RESPONSE TO COMMENTS

(1)

October 14, 2010

Mr. Mitch Stewart
Environmental Resources Branch
U.S. Army Corps of Engineers, Sacramento District
1325 J Street, Sacramento, California 95814

Re: Lower Yuba River Gravel Augmentation Project Draft Environmental Assessment September 2010

Dear Mr. Stewart:

As you are aware, the Yuba County Water Agency (Agency) owns and operates the Narrows 2 Powerhouse located immediately downstream of the US Army Corps of Engineers (USACE) Englebright Dam and Reservoir. The Agency operates Narrows 2 facilities in accordance with the Agency's Federal Energy Regulatory Commission (FERC) license, and in accordance with the Lower Yuba River Accord agreements which are binding legal agreements between the Agency, California Department of Fish & Game, and other entities. Finally, the Agency is always cognizant of the various threatened and endangered species that inhabit the Lower Yuba River, and always endeavors to avoid impacts to sensitive species. 1.1

The Agency supports efforts to restore and enhance the aquatic environment in the Lower Yuba River, and applauds the USACE efforts to undertake potentially highly beneficial projects for Lower Yuba aquatic species. The Agency also understands the USACE interest in moving forward expeditiously with the enhancement action described in the Draft Environmental Assessment (EA). The Agency has reviewed with great interest the Corps gravel injection plan, and associated EA, and at this time we have three specific comments on the injection plan and EA: 1.2

1.3

1. The Agency must have access to the Narrows 2 powerhouse facilities as needed to operate the facilities in normal and emergency conditions. The Narrows 2 facilities operate around the clock; and, depending on specific river flow requirements, are often the primary release point for cold-water flows for the Lower Yuba River. In addition to regular inspections and adjustments, in the event of a facility or system emergency Agency operations staff could need to access the facilities at any time. Careful coordination between the USACE, USACE contractors, and Agency staff must be maintained to ensure uninterrupted operational access to the Narrows 2 facilities.

2. The Agency understands that the gravel injection plan will call for at least 2,000 and as much as 5,000 short tons of gravel to be placed in the river. We understand that as many as 250 truck trips will be required to transport the necessary gravel stocks, as well as dozens of additional light truck, equipment transport, fuel transport, and other trips to the injection site. The injection site is located adjacent to the Narrows 2 access road, the Narrows 2 access road is single-lane in many locations, and most of the gravel project traffic will share the Narrows 2 access road. The Agency is concerned that traffic, any traffic blockage or breakdowns, load or unloading, or other activities have the potential to interrupt Agency access to the Narrows 2 faculties. The Agency requests a meeting with the Corps to develop

a plan that provides for Agency access to Narrows 2 facilities and provides for gravel injection. This was successfully accomplished in the past and we expect we can come up with mutually agreeable terms for this gravel injection project. Here is a list of items for discussion purposes: 1.3

a. If more than one haul truck is utilized, the USACE's transport contractor should develop a system of communications and/or pull outs as needed to ensure continued two-way traffic on the narrow portions of the road.
b. USACE should be responsible for ensuring traffic safety measures (e.g. speed limits, load limits) for USACE's transport contractor.
c. USACE should be responsible for maintaining, or returning, the road to pre-gravel project conditions in terms of surface and shoulder integrity. This would include taking a video of the road before and after the gravel injection work.
d. The USACE transportation and injection plans should include provisions for appropriate materials handling (e.g. equipment fueling in the vicinity of the Narrows 2 facilities and Englebright and Lower Yuba water bodies).
e. The USACE or USACE's transport contractor should provide a schedule of work/haul days to Agency operators, and coordinate transport logistics with Agency staff to ensure access to the Agency's Narrows 2 facilities.

3. Under the description of Effects of the Proposed Action, the Draft EA states *"As there is no suitable habitat for any of the wildlife or plant species in or near the gravel placement site, the proposed action would have no adverse effects on any of these species"* (Draft EA, Section 3.7.2, pg 40). However, data collected by the Lower Yuba River Management Team (RMT), a multi-agency working group that includes National Marine Fisheries Service (NMFS), US Fish & Wildlife Service (USFWS), and California Department of Fish & Game (CDFG) indicates that Chinook salmon are currently utilizing, and spawning in, the river reach below Englebright Dam in the vicinity of where the gravel injection project will occur. The Draft EA also states *"The proposed gravel placement may include minimal short-term effects such as localized and temporary disturbance, displacement, or impairment of feeding, migration, or other behaviors by adult and juvenile salmon and steelhead from noise, suspended sediment, turbidity, and sediment deposition generated during gravel placement activities."* The Agency will defer to NMFS, USFWS, and CDFG with regards to the magnitude and concern regarding short-term project impacts, but did want to establish that the project area is currently utilized by sensitive species. 1.4

The Agency understands from explanations of the project by the USACE and its consultants, and review of the USACE's Gravel/Cobble Augmentation Implementation Plan (GAIP) for the Englebright Dam Reach of the Lower Yuba River (September 2010) that the gravel injection project will be conducted in such a way as it might provide near term (essentially immediate) benefits. The GAIP at page 61 states *"the extra effort of controlling placement can yield physical habitat immediately available for Chinook salmon spawners to use"*. The Agency will again defer to NMFS, USFWS, and CDFG with regards to the potential benefits and impacts of having the various species access the project area during the estimated 30 days of gravel placement duration.

The Agency coordinates the flows into the Lower Yuba River with PG&E. Flow releases can be made from YCWA's Narrows 2 Powerhouse, PG&E's Narrows 1 Powerhouse or a combination of both Narrows 1 (up to 700 cfs release capability) and Narrows 2. Operations of these facilities include adjustments of flows up or down in response to hydrologic conditions, water supply requirements, and environmental requirements (e.g. Lower Yuba River flow requirements). During the course of the gravel injection project (understood to be early November through early to mid-December of 2010, barring unforeseen circumstances) the anticipated flow releases below Englebright Dam would range from a low of about 700 cfs to a high of up to 1150 cfs. However, in the advent of a rainfall event, flow releases could be considerably higher. Using the Smartville gauge rating table, it appears that the stage-discharge relationship for these types of flows is about 2.2 inches per 100 cfs in this vicinity.

In addition to compliance with FERC license terms, water rights license terms and the provisions of the Yuba Accord, the Agency works closely with the jurisdictional agencies and the RMT to ensure that the Agency's operations are as benign as possible with regards to potential impacts to aquatic species. In particular, the Agency takes great care to manage
flow changes and relative stage levels (trends upward or downward) to avoid potential 1.4
impacts. It seems clear that the potential attraction of Chinook salmon to a location immediately downstream of the Narrows 2 powerhouse (before natural attenuation of flow changes has much effect) is of concern to the Agency. It is not clear that the USACE's Draft EA has evaluated the potential short term impacts of the gravel injection project with regards to the Agency's normal operations in compliance with its authorizations, to ensure that the USACE project will not cause impacts to aquatic resources that do not currently exist as a result of Agency operations.

To alleviate the potential for USACE project impacts, the Agency would strongly recommend that all placement of gravel be at such depth that there is no possibility that Agency flow changes or other routine actions could cause potential harm to aquatic resources such as dewatering of salmon redds. In the event that the USACE undertakes gravel placement at a depth less that 24 inches below the water surface at a flow of 800 cfs (with approximately 600 cfs of the 800 cfs being released through Narrows 1) as measured at the Smartville gauge, then the Agency will feel compelled to request that a more thorough analysis of the potential effects of the project be undertaken. We are very willing to discuss this with you since this is an important issue.

As stated previously, the Agency strongly supports efforts to restore and enhance the aquatic environment in the Lower Yuba River; based on research that the Agency has reviewed we believe
that routine gravel injection into the Englebright Dam reach will benefit aquatic species, particularly 1.5
salmonids. Separately, the Agency will work with the USACE and its consultants to continue to investigate other locations for and methods of gravel placement, that may have less potential for impacts to Agency operations of the Narrows 1 and 2 Powerhouses.

Thank you for the opportunity to comment on the Draft EA.

Regards,

Curt Aikens
General Manager

CC: Peter Wade, YCWA
Steve Onken, YCWA
Doug Grothe, USACE
Kevin Goishi, PG&E
Gene Geary, PG&E
Gary Sprague, NMFS
Tracy McReynolds, CDFG

**Response to Comments on Draft EA**

**Lower Yuba River Gravel Augmentation Project**
**Yuba and Nevada Counties, California**

1.0 Yuba County Water Agency (YCWA)

1.1 The comment presents introductory material. No response is necessary.

1.2 The comment expresses support by the YCWA for the project as proposed in the draft EA. No additional response is necessary.

1.3 The comment addresses concerns regarding YCWA access to Narrows 2 Powerhouse facilities, as needed, to operate the facilities in normal and emergency conditions and the need for coordination between YCWA and the Corps. Additionally, YCWA has a concern regarding the impact of the gravel augmentation project traffic (haul trucks, etc.) on the Narrows 2 access road. The Corps will ensure that the YCWA has unrestricted access to the Narrows 2 Powerhouse facilities. Additionally, the Corps will coordinate and communicate with YCWA regarding any access issues prior to the implementation of the gravel augmentation project. A pre-work meeting will be scheduled to involve YCWA in order to satisfy their concerns. In terms of damage to the Narrows 2 access road, the contractor is not liable for damage caused from normal wear and tear to infrastructure. However, damage caused from the contractor's negligence is covered under the contract clauses and the contractor is responsible for those repairs. The Corps will work with the YCWA to document the existing roadway condition, and, if damages are caused by the contractor outside of normal wear and tear, they will be repaired.

1.4 The comment addresses concerns regarding effects to Chinook salmon in the river reach below Englebright Dam. The EA states: "... there is no suitable habitat for any of the wildlife or plant species in or near the gravel placement site..." This is in reference to non-ESA listed taxa. Under consultation with the U.S. Fish and Wildlife (USFWS), the Fish and Wildlife Coordination Act Report (dated November 9, 2010) states that the "proposed gravel injection project would have temporary minimal effects on fish and wildlife species and their habitat." USFWS deferred any potential effects to listed species (e.g. Chinook salmon) to the National Marine Fisheries Service (NMFS) under the Endangered Species Act of 1973 and the California Department of Fish and Game (CDFG) under the California Endangered Species Act. In their Section 7 report dated November 3, 2010, NMFS stated the proposed project will not likely adversely affect Federally listed threatened Central Valley steelhead, threatened Central Valley spring-run Chinook salmon, and the threatened Southern distinct population segment of North American green sturgeon, or their respective designated critical/essential habitats.

The comment also addresses concerns with the Gravel/Cobble Augmentation Implementation Plan (GAIP) immediately yielding habitat to spawning Chinook salmon, but defers to NMFS judgment regarding any potential benefits and impacts during the project construction period. The Corps understands this concern, and under consultation with NMFS, determined that implementation of a gravel placement project immediately below Englebright Dam would have no significant adverse effects on the listed Central Valley spring-run Chinook salmon and Central Valley steelhead, nor would it likely destroy or adversely modify the designated critical habitat for these species.

Additionally, the comment expresses concern that a rainfall event during the gravel injection project could increase the flow releases made by YCWA, as necessary in response to the meteorological and hydrologic conditions, and that changes in flow as adjusted by YCWA might impact aquatic species that might utilize the new habitat that would be available immediately downstream of the Narrows 2 powerhouse. The Corps understands and concurs with YCWA's concern regarding changes in flow during and after the gravel injection project. The GAIP offers a very thorough analysis of the potential effects of the gravel augmentation project and analyzes the impact of flow on the proposed project. According to the GAIP (pg 64 - 66, Pasternack 2010):

> Area A is the focus of the effort for 2010 (See Plate 5 of the EA for Area A). The design for Area A involves filling in the channel to a depth of ~2' for the primary spawning area at 855 cfs and then having a 3' deep thalweg going up to the crest...A key reason to aim for 2' water depth at 855 cfs is that flows can drop to 700 cfs in a schedule A year and 500 cfs in a schedule B year. This depth provides a hydrologic buffer so that the riffle does not dewater.

The Corps believes this will alleviate the potential impacts due to changes in flow during the construction gravel augmentation project. Additionally, if a rainfall event causes releases and flows to go above a level that is considered safe during the gravel injection process, the contractors will remove from the river channel and remain out of the river until flows recede to a safe level.

1.5. The comment provides a closing statement that the YCWA is willing to support the Lower Yuba River Gravel Augmentation Project and continue to work with the Corps for refinements that may be necessary towards a long-term program. No additional response is necessary.

(2)

SYRCL

SOUTH YUBA RIVER CITIZENS LEAGUE

Mr. Mitch Stewart
U.S. Army Corps of Engineers
1325 J Street
Sacramento, CA 95814

October 14, 2010

Upon review of the EA and FONSI for the Lower Yuba River Gravel Augmentation Project, I wish to file the following comments on behalf of the South Yuba River Citizens League. SYRCL supports the implantation of this type of project in November 2010. The following comments are intended to strengthen the project by clarifying the purpose of the project and maximizing intended benefits. 2.1

**The EA states contradictions regarding the purpose of the project**

The following statement (section 1.2) undermines the purpose of the project:
"The information gathered from the monitoring of the placed gravel will allow the Corps to determine if it will be necessary to place additional quantities of gravel, if any, within the Lower Yuba River channel below Englebright Dam."

By implying that additional gravel augmentation may not be necessary, this statement misrepresents the both the Corps obligations to restore spawning habitat, and the available science indicating what is required to do that. As cited lower in the EA, the Biological Opinion of the National Marine Fisheries Service (2007) requires implementation of a long-term gravel augmentation program to restore quality spawning habitat. The Gravel/cobble Augmentation Implementation Plan for the Englebright Dam Reach of the Lower Yuba River (aka GAIP, Pasternack 2010) provides a clear scientific framework for evaluating the amounts of gravel, and locations to be used to provide spawning habitat. This plan suggests that the gravel deficit in the Englebright Dam Reach is 63,077 to 100,923 tons, and that within the short section proposed for augmentation in 2010, the deficit is 15,949 to 25,518 tons. It is inconceivable that monitoring following the augmentation of a mere 2000-5000 tons would relieve the Corps of additional action to retore spawning habitat. Accordingly, the statement should be revised to indicated that information gathered from monitoring gravel augmentation in 2010 would be used to confirm or revise details of the GAIP. 2.2

**The stated amount of 2000 tons is inadequate to provide substantial benefit to spawning salmon and steelhead.** As shown in Plate 5 of the EA – excerpted from the GAIP (Pasternack 2010) -- 4635 tons 2.3

is required to provide designed habitat benefits for the first (section A) of several potential areas for injection. Injection of even that required amount would not maximize functional habitat because lack of augmented gravel in sections B and C would lead to gravel instability and migration. Within the design parameters of this gravel augmentation, 5000 tons would be minimal to provide functional spawning habitat. The GAIP demonstrates that a target volume of 12000-15000 tons would be more appropriate for initial achievement of project goals. Additionally, subsequent augmentations will be necessary due to downstream migration of placed gravels. 2.3

**The project does not "satisfy the terms and conditions" of the ITS from the NMFS BiOp (2007).**

The EA states in Section 1.4 (Purpose) and again in the 401 certification application, that "The proposed action would satisfy the Terms and Conditions of the incidental take statement included in the November 21, 2007 Biological Opinion (BO) prepared by National Marine Fisheries Service (NMFS) pursuant to Section 7 of the Endangered Species Act (ESA)". 2.4

This statement is false since that BiOp issued five terms and conditions for the incidental take statement and only one of those involved gravel augmentation. Moreover, that first required action, as cited in the EA, requires the Corps to "implement a long-term gravel augmentation program to restore quality spawning habitat below Englebright Dam" by November 21, 2010. As worded, the EA and proposed action fall short of this single term by providing an insufficient amount of gravel to "restore" high quality spawning habitat and failing to clearly implement a long-term plan gravel augmentation program.

**Other problem statements or errors**

Section 1.3: "The proposed gravel placement site is located within the first 300-feet downstream of Englebright, downstream of the Narrows II Powerhouse."

> Actually, the proposed site is much further from Narrows II, and this may be a typo with the intention having been PG&E's Narrows 1 Powerhouse. 2.5

Section 1.4:
"Englebright Dam plays a crucial role in protecting the downstream region from being overwhelmed by sedimentary mining waste debris still being eroded off hillsides and stored in long sections of the channel network upstream."

> This is an overstatement with no reference to evidence.

Thank you for the opportunity to comment on this EA. Good luck with implementation of gravel augmentation, an important project for restoring spawning habitat below Englebright Dam. I would like to offer my support in the constructive finalization, and adaptive management of the Gravel/cobble Augmentation Implementation Plan for the Englebright Dam Reach of the Lower Yuba River. 2.6

Respectfully,

Gary Reedy

**Response to Comments on Draft EA**

**Lower Yuba River Gravel Augmentation Project**
**Yuba and Nevada Counties, California**

1.0 South Yuba River Citizens League (SYRCL)

2.1 The comment presents introductory material and support by the SYRCL for the project as proposed in the draft EA. No additional response is necessary.

2.2 The comment addresses concerns regarding contradictory language on the purpose of the project. Language in Section 1.2 of the EA (Proposed Action) was clarified to remove any potential contradictory language regarding the purpose of the project.

2.3 The comment expresses concern that 2,000 short tons of gravel are inadequate to provide substantial benefits to spawning salmon and steelhead. The EA offered the analysis of an augmentation amount of 2,000 to 5,000 short tons of gravel in order to best understand the impacts of injecting the gravel in potential phases during the construction period of 2 to 6 weeks. The Corps will be injecting the whole of 5,000 short tons, and finds that this action is the initiation of the long-term gravel augmentation program, as required by the November 2007 NMFS BO, and that, according to the GAIP, subsequent gravel injections will be conducted, as necessary, to fulfill that requirement.

2.4 The comment states that the project does not "satisfy the terms and conditions" of the Incidental Take Statement of the November 2007 NMFS BO. As stated in the BO, the Corps, "shall develop and implement a long-term gravel augmentation program to restore quality spawning habitat below Englebright Dam." The 2,000 to 5,000 short tons of gravel proposed to be injected into the Lower Yuba River within the EDR during the fall of 2010 is the is the initiation of the long-term gravel augmentation program, as required by the November 2007 NMFS BO, thusly fulfilling the Terms and Conditions of the Incidental Take Statement. Subsequent gravel injections will be conducted, as necessary, to fulfill that requirement.

2.5 The comment refers to other problem statements and typo errors within the Draft EA. Each "problem statement" has been revisited within the EA, and the language revised to avoid potential typos and add clarification to the document. Additionally, it is documented (James 2005, Wright and Schoellhamer 2004, Pasternack 2010, etc) that Englebright Dam does indeed play a crucial role in protecting the downstream region from sedimentary mining waste and debris.

2.6 The comment provides a closing statement that the SYRCL is willing to support the Lower Yuba River Gravel Augmentation Project and continue to work with the Corps for refinements that may be necessary towards a long-term program. No additional response is necessary.

(3)

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Sacramento Area Office
650 Capitol Mall, Suite 8-300
Sacramento, California 95814-4706

In response refer to:
2010/05132

OCT 20 2010

Alicia E. Kirchner
U.S. Army Corps of Engineers
1325 J Street
Room 1480
Sacramento, California 95814-2922

Dear Ms. Kirchner:

This letter provides the National Marine Fisheries Service (NMFS) comments on the Department of the Army's Lower Yuba River Gravel Augmentation project. We are writing to provide comments on the draft environmental assessment for this project. NMFS is providing our response to your request for section 7 consultation in a separate letter. 3.1

General Comments on the Environmental Assessment

While the environmental assessment (EA) for this project provides good information, there are some areas where additional information would be helpful. It would be useful if the EA provided additional information about the monitoring program, how that information will be used and the likely resulting actions. 3.2 At times the EA has contrary information. Such as identifying that the project will address the reasonable and prudent measures in the 2007 Biological Opinion. The Gravel/Cobble Augmentation Implementation Plan (GAIP) for the Englebright Dam Reach of the Lower Yuba River, CA (Pasternack, September 30, 2010) cited in the EA, identifies that the gravel/cobble deficit for the Englebright Dam Reach is between 63,000 and 101,000 tons. The scope of this project is for 2,000 to 5,000 short tons. Given this information, it does not appear that this gravel augmentation project fully addresses the gravel augmentation measure in the 2007 biological opinion. While the EA states that the gravel is not expected to leave the Englebright Dam Reach, it does not explain where the gravel that one would naturally expect to be in this reach of river has gone. It is NMFS opinion that this project partially fulfills one of the RPAs in the take statement in the 2007 Biological Opinion. This project does not fulfill all of those RPAs (as stated on page 2 of the EA), and likely does not fully fulfill the gravel augmentation RPA. Determination of the fulfillment of this RPA will require long term monitoring of gravel movement. 3.3

The upstream extent of CV Chinook EFH is not Englebright Dam on the Yuba River. The Federal Register states that in the Yuba River, EFH is all areas occupied or historically accessible to Chinook salmon. 3.4

Specific Comments on the Environmental Assessment

*Page 2, Section 1.4 Pupose and Need for Action, second paragraph, second sentence.*
The proposed action would partially satisfy a term and condition of the incidental take statement, not all of "the" terms and conditions. 3.5

*Page 6, Section 2.3 Gravel Sluicing, second paragraph.*
It would be useful to know under what criteria the decision will be made to place additional gravel. 3.6

*Page 6, Section 2.3.1 Gravel Placement Process, first paragraph, last sentence.*
Identifying that the pump inlet will be "screened to prevent aquatic fauna from being taken up into the pumping system" is good. You need to include the criteria that are being used for the screen. The criteria should at least meet NMFS criteria for a pump, see:

http://swr.nmfs.noaa.gov/hcd/HCD_webContent/aboutus/policies.htm 3.7
including:
http://swr.nmfs.noaa.gov/hcd/pumpcrit.pdf.

It would be helpful if you identified the species and life stages for which you are designing the screen. It is likely that you do not intend to screen for macroscopic plankton or smaller organisms. .

*Page 7, Section 2.3.1 Gravel Placement Process, last paragraph.*
It identified that the "Yelomine" pipe will be placed in the ditch on the north side of the road. Will this impair the ability of the ditch to convey water, thereby potentially causing water damage to the road, and sediment to enter the river? 3.8

*Page 9, Section 2.3.5, Work Schedule.*
It is identified that "Any work conducted past 2010 will also conform to the same time frames, or as approved by the resource agencies." The timeframe identified is two to six weeks in early November, on normal workdays, from 8 a.m. to 5 p.m. It is likely that in subsequent years NMFS will require this type of work in this area to be completed by the beginning of spring-run Chinook spawning. Spring-run Chinook salmon begin spawning in the Yuba River on September 1st. The work this year was identified to occur in an area without any spawning gravel present, and at a time when spring-run Chinook, are not likely to be affected, 3.9

*Page 9, Section 2.3.6 Monitoring Program.*
It is unclear how redd surveys will be compared with "hypothetical quantitative predictions based on the ecologic, geomorphic, and hydrodynamic conditions at the placement site." Any 3.10

monitoring program needs to identify what parameters will be monitored, and should identify the purpose of the information being collected, how the information will be evaluated, and the range of the potential resulting actions. 3.10

*Page 37, Central Valley Steelhead.*
Steelhead populations are not identified by evolutional significant units, they are identified by distinct population segments (DPS). 3.11

*Page 39, Essential Fish Habitat, second paragraph, last sentence.*
On the Yuba River the upstream extent of essential fish habitat definition is not limited by Englebright Dam. In the Federal Register / Vol. 73, No. 200/ Wednesday, October 15, 2008 / Rules and Regualtions at pages 60988 and 60994 EFH for Pacific salmon is identified as including "... all those water bodies occupied or historically accessible ..." except where barriers identified in Table 1 represent the upstream extent of salmon access. In Table 1, the Lower and Upper Yuba are identified for Chinook salmon, and no upstream impassible man-made barrier is identified (n/a - not applicable). Since no dam is identified in the Lower or Upper Yuba as the upper extent of Chinook passage, the EFH for Chinook salmon in the Yuba is defined as the areas that are occupied or were historically accessible to Chinook salmon. 3.12

If you have any questions concerning this project, or require additional information, please contact Gary Sprague at (916) 930-3615, or via email at: Gary.Sprague@noaa.gov.

Sincerely,

Jeffrey McLain

for Maria Rea
Supervisor, Central Valley Office

cc: Copy to File ARN: 151422SWR2006SA00071
NMFS-PRD, Long Beach, CA

**Response to Comments on Draft EA**

**Lower Yuba River Gravel Augmentation Project**
**Yuba and Nevada Counties, California**

3.0 National Marine Fisheries Service

3.1 The comment presents introductory material. No additional response is necessary.

3.2 The comment addresses some areas where additional information would be helpful to a reader of the EA (e.g., additional information about the monitoring program.) The Corps is currently developing a gravel monitoring program, which is expected to be in place by the time the project is complete. This program will include a baseline condition assessment for implementation following gravel placement. Changes to the baseline condition through the 2011 winter and spring runoff periods will be monitored and data will be compiled for refinement of a long-term program, as necessary.

3.3 The comment addresses concerns regarding the long-term gravel augmentation plan. This action is the initiation of the long-term gravel augmentation plan, as required by the November 21, 2007 BO. Please see the attached Gravel/Cobble Augmentation Implementation Plan (GAIP: Appendix X of the final EA) for the long-term gravel augmentation plan.

3.4 The comment addresses an error in the draft EA regarding the essential fish habitat (EFH) on the Yuba River. The error was noted and has been changed in the final EA.

3.5 The comment addresses how the EA partially satisfies a term and condition of the NMFS BO. This was noted and the language was changed in the EA, Section 1.4 Purpose and Need for Action.

3.6 The comment states that it would be useful to know what criteria will be used to decide when to place additional gravel. The Corps will utilize the post-injection monitoring data on the movement of the gravel. When enough gravel has migrated out of the project area, additional gravel will be injected, as directed by the GAIP.

3.7 The comment addresses concerns regarding the screen criteria for the pump intake. This has been noted and addressed within the EA.

3.8 The comment addresses concerns regarding the pipe being placed within the ditch on the north side of the road and possible impairment to the ditch and water quality. The ditch is of sufficient size to accommodate the Yelomine pipe and any potential rainwater runoff.

3.9 The comment addresses concerns regarding future work schedules (beyond the 2010 injection). This was noted and clarified within the EA.

3.10 The comment addresses concerns regarding the redd survey monitoring program and parameters. This was noted and clarified within the EA.

3.11 The comment addresses an error in the EA regarding identification of steelhead populations as distinct population segments. This was noted and corrected in the EA.

3.12 The comment addresses concerns regarding the EFH definition on the Yuba River. This was noted and corrected within the EA.

# APPENDIX I
# MAILING LIST

**Lower Yuba River Gravel Augmentation Project**
**Yuba and Nevada Counties, California**

## Federal Agencies

National Marine Fisheries Service
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**Local Agencies**

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Browns Valley Irrigation District
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Cal-Sierra Development, Inc.
Tony Massey
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Marysville, CA 95901

Cordua Irrigation District
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Hallwood Irrigation Company
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