FINAL REPORT

FOR

INSTREAM FISH BARRIER REMOVAL

JOHNSON CREEK, A TRIBUTARY OF THE SOUTH FORK BIG RIVER

ON

ORR SPRINGS ROAD

CR 223 AT M.P. 26.10

MCDoT Project No. D-0206

California Department of Fish & Game (CDF&G) Grant No. P0330421

COUNTY OF MENDOCINO

STATE OF CALIFORNIA

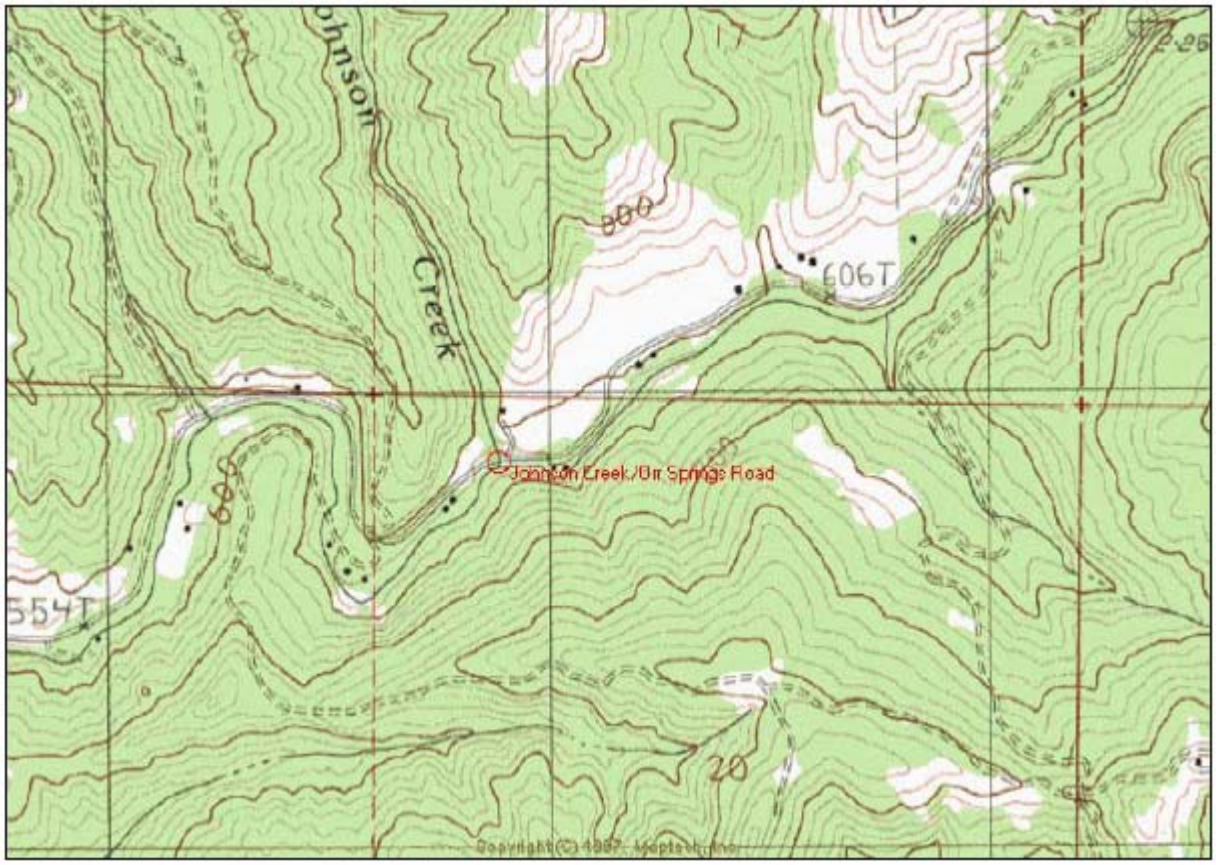
PREPARED BY

ALEX STRAESSLE
MENDOCINO COUNTY DEPARTMENT OF TRANSPORTATION (MCDoT)

February 27, 2006

Project Title: Johnson Creek Instream Fish Barrier Removal, Orr Springs Road, CR 223

Project Location:
The project is located on Johnson Creek, a tributary to the South Fork Big River within the Big River Hydrologic Area. Mile marker 26.10 on Orr Springs Road about 45 minutes west of Ukiah. NW ¼ Section 20, Township 16 N, Range 14 W, MDB&M. Latitude 39^0 14' 8" North, Longitude 123^0 26' 30" West. Bailey Ridge USGS 7.5 minute quadrangle.



Background:

From 1998 to 2000, The Five Counties Salmon Restoration effort funded, through a grant from the California Department of Fish and Game, employed Ross Taylor, a fisheries biologist, to evaluate and rank Mendocino County road stream crossings for fish passage ability *(FINAL REPORT: COASTAL MENDOCINO COUNTY CULVERT INVENTORY AND FISH PASSAGE EVALUATION*, 2001). Taylor used inventory methods and protocols consistent with CDFG standards and protocols.

The tasks for that project were to conduct an inventory of stream crossings on Mendocino County roads, evaluate juvenile and adult fish passage, and develop a project-scheduling document that prioritizes corrective treatments to provide unimpeded fish passage. The

inventory was limited to the anadromous reaches of streams known historically and/or currently to support runs of coho salmon, chinook salmon, and steelhead.

The inventory process identified a priority site (#5 of 54 sites visited in Mendocino County) along Orr Springs Road in the Big River watershed.

Johnson Creek flows directly into Big River just below Orr Springs Road. The surrounding area is covered by coniferous and hardwood forests in a steep terrain ranging from 600 to 1,200 feet in elevation. The drainage area above the culvert at Johnson Creek and Orr Springs Road is 1.9 square miles, with 8,900 feet of useable habitat.

The existing culvert is a 10.8-foot diameter and 50-foot length CMP. The active channel width is 10.4 feet. This project ranks # 5 in priority on Taylor's Final Rank List.

Land Use and Ownership:

The road property and right-of-way are owned by the county and will continue as such. Surrounding property is private rural and a state preserve, and there are no proposals for change.

Expected benefits to Anadromous Salmonids from Project Implementation:

For the range of migration flows, FishXing software determined that the culvert is a total barrier for adult coho salmon and steelhead, and all age classes of juveniles due primarily to excessive velocities over steep slope, lack of depth at lower migration flows, and leap required to enter the culvert.

The Johnson Creek fish barrier removal is intended reduce or eliminate the high jump distance at the tail of the culvert, increase water depth at low flows and reduce velocity during higher flows.

It is estimated that this project will allow salmon and steelhead renewed or enhanced access to approximately 8,900 feet of historic spawning and/or rearing habitat.

Project Description:

The original work plan was to replace the existing circular culvert with a bottomless, multi-plate arch culvert of adequate size that will allow anadromous fish passage at all life stages that is designed to be 1.5 x the active channel width of 10.4 feet according to the National Marine Fisheries Service (NMFS) Guidelines. The construction of this 16' wide x 9' high x 50' long structure will help with the recovery of depleted salmonid populations and demonstrate MCDoT actions that can be accomplished in conjunction with the Five-County salmonid restoration effort.

Backwater analysis during the design stage indicated that complete culvert replacement was not warranted. The existing circular culvert was modified by removing the bottom and installing a

series of 7 concrete weirs to establish an open-bottom, pool-and-chute configuration that will allow anadromous fish passage at all life stages.

Project Design Basis Discussion:

The drainage area above the Johnson Creek crossing is 1.9 sq. miles. The watershed is comprised of Douglas Fir and Redwood forest and is classified as soil unit 188B by the U. S. Soil Conservation Service (SCS) – now Natural Resource Conservation Service (NRCS) Soils Survey. For purposes of analysis, the watershed was placed in hydrologic group "B" 60% good and 40%. The SCS TR55 hydrology model was used to determine the design flows and also compare results to the Rational Hydrology Method as well as the USGS 77-21 empirical equations. Based on the analysis and averages of the three methods, the following design flows were established:

Johnson Creek: 1% probability, i.e. 100 year storm event = 1,050 cfs
Johnson Creek: 4% probability, i.e. 25 year storm event = 670 cfs
Johnson Creek: 10% probability, i.e. 10 year storm event = 440 cfs

The drainage area for the South Fork Big River above the confluence with Johnson Creek is 20 sq. miles. The watershed is comprised of Douglas Fir and Redwood forest. For the purposes of analysis the USGS 77-21 empirical equations were used to established the following design flows:

South Fork of Big River: 1% probability, i.e. 100 year storm event = 5,560 cfs
South Fork of Big River: 2% probability, i.e. 50 year storm event = 4,833 cfs
South Fork of Big River: 4% probability, i.e. 25 year storm event = 3,865 cfs
South Fork of Big River: 10% probability, i.e. 10 year storm event = 3,010 cfs
South Fork of Big River: 20% probability, i.e. 5 year storm event = 2,266 cfs
South Fork of Big River: 50% probability, i.e. 2 year storm event =1,448 cfs

The high water line for South Fork of Big River observed by our engineer in the field put the natural depth of flow between 10 to 12 feet, thus the backwater level was established at 10 feet conservatively. This is also consistent with calculations, which place the depth of flow in South Fork of Big River at 10 to 13 feet for 5yr & 10yr storm events respectively. The Haestad Methods, Inc "Flow Master" software that is based on the popular Manning's Equation for modeling hydraulic facilities was used. Analysis demonstrated that the South Fork of Big River backwaters or floods the subject Johnson Creek culvert during even the more common 5yr & 10yr storm events (20% & 10% probability). The analysis further demonstrated that the South Fork of Big River backwaters or floods the subject Johnson Creek culvert and Orr Springs Road which follows the bank of the South Fork of Big River during large 50yr & 100yr storm events (2% & 1% probability). This condition was the justification used to modify the existing culvert structure rather than full replacement. Because of the Johnson Creek road crossing's close proximity to the South Fork of Big River we believe that a new natural bottom structure would backwater or flood as well.

Based on a stabilized channel configuration, which simulates the natural channel 200' above the

existing 10.8' diameter culvert, the stream channel should achieve 2%± gradient with an average 100 yr storm event average velocity of 9.4 fps (feet per second). Due to the velocity distribution within the channel the velocity at the stream bed is estimated to be 5 fps up to 13 fps on the surface during 100 yr event if there are no effects from the South Fork of Big River. The culvert after construction of modifications will produce a 5 foot wide channel through the structure with a 10% gradient at low flows, which will likely cause flow to achieve critical depth and critical velocities which average 10.6 fps. With velocity distributions we estimate to produce velocities of 6 or 7 fps at the channel bed if there are no effects from the South Fork of Big River. When the South Fork of Big River is at storm stage, the gradient through the Johnson Creek culvert structure will be less than 10% - even 0% due to back flooding from the South Fork of Big River. Thus, during big storms when excessive velocities in the Johnson Creek culvert would create a velocity fish barrier the effects of the South Fork of Big River will cancel those effects. The series of weirs along with the lowering of the existing culvert inlet cutoff wall by one foot will allow movement of normal upstream bed load along the channel through the culvert without allowing uncontrolled upstream down cut until reasonable equilibrium is achieved during lower flows.

In addition to removal of a fish barrier the project is intended to affect the geomorphology of the stream (movement of stream rock and sediment, "bedload", to form the topography of the stream channel bottom) by restoring it to a more natural condition. The presence of the existing culvert structure has, over time, created the unnatural condition of an outlet plunge pool and an accumulation of bedload upstream (gradation). The proposed modification of the existing structure will, over time, allow more natural geomorphology to distribute bedload and form a stable channel bed upstream, downstream, and inside the modified structure. However, leaving part of the existing cutoff wall at culvert entrance will prevent excessive upstream channel down cutting and release of sediment.

Project Start Date: September 14, 2005

Project Completion Date: November 1, 2005

List of References:

1) 7.5 min. USGS, Bailey Ridge Quadrangle

2) U. S. Geological survey, Water Resources Investigation 77021

3) "Urban Hydrology for Small Watersheds" SCS – TR55-1986

4) Geotechnical Report by RGH #1888.06.00.1, 12/27/02

5) Coastal Mendocino County Culvert Inventory and Fish Passage Evaluation

Project Budget Breakdown:

TASK	COST
Personal Services (252 hours) (Engineering, Permits, R/W)	$11,116
Personal Services (1,094 hours) (Construction Labor)	$40,912
Personal Services (Equipment)	$4,630
Operating Expenses (Geotechnical Report)	$4,400
Operating Expenses (Fish Capture/Relocation)	$1,773
Operating Expenses (Misc. Fees)	$109
Operating Expenses (Materials, Equipment)	$9,357
TOTAL	$72,298

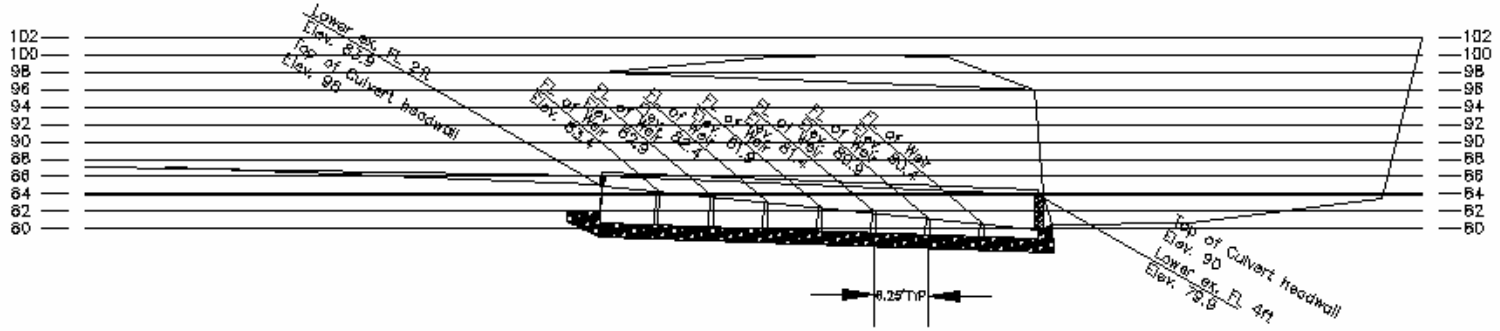
Johnson Creek Culvert Fish Passage Improvement

Before

After

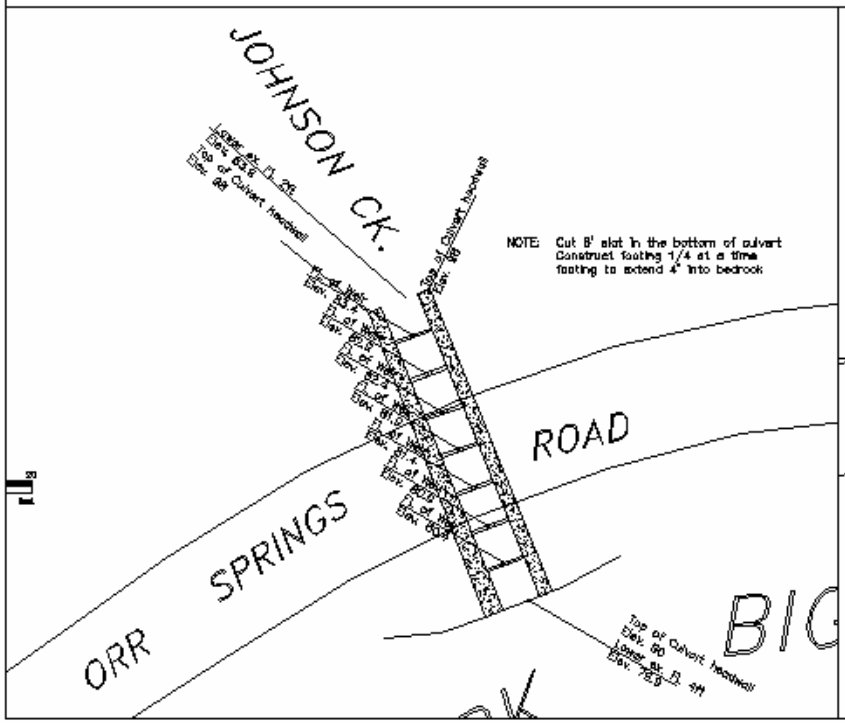
During Construction

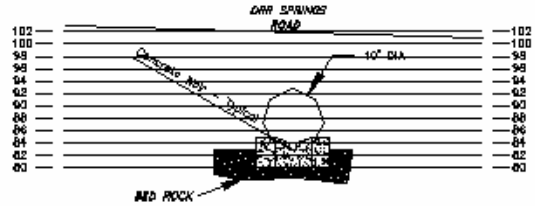
After the New Years Storms of 2005 / 2006



PROFILE JOHNSON CREEK (A)

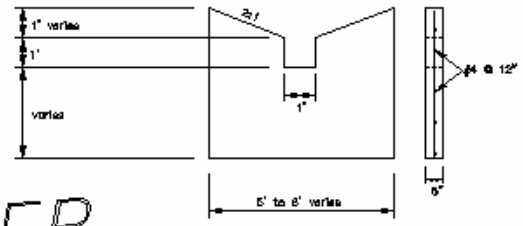
NO SCALE





TYP. CROSS SECTION JOHNSON CREEK (B)

NO SCALE



TYP. CONCRETE WEIR

NO SCALE