



COMPLIANCE REPORT
MUDDY HOLLOW CULVERT REMOVAL
FILE NUMBER 25358N

Submitted by the National Park Service
Point Reyes National Seashore
Point Reyes Station, California, 94956

Project Description:

Muddy Hollow Creek lies within the central California coast Evolutionarily Significant Unit (ESU) and provides critical habitat for steelhead trout (*Oncorhynchus mykiss*), a federally threatened species. National Park Service (NPS) surveys within Muddy Hollow Creek confirmed the presence of *O. mykiss* in 1997. It is likely that some component of the surveyed population is ocean-going. Prior to NPS acquisition of the land in the 1960's, an 80' culvert was installed to pass an access road over Muddy Hollow creek. Over time the culvert failed, creating fish impediments, elevating sediment load, and diminishing streambed stability. Removal of the culvert, or day-lighting, was performed to restore hydrologic connectivity and to reduce the long-term maintenance requirements associated with culvert operation.

The National Marine Fisheries Service (NMFS) designed a 2-step vortex boulder weir fish passage that was used to replace the culvert. As well as enhancing fish migration routes, the design allows for stream gradients to be maintained, stabilizes banks, and provides habitat for developing juvenile salmonids. The culvert was removed and recycled, and 1 to 4 ton boulders were installed to attain the desired intent of the project. Mitigating actions taken by NPS included the removal of all fish from the project site, diversion of water flow from direct impact, and the installation of fish fences upstream and downstream of project site to prevent fish access during the project. Revegetation and erosion control efforts included sprigging of willow stakes, alder and *Juncus* sp. transplants, installation of curlex bundles, and the redistribution of leaf litter and debris to break surface water flow patterns.

The purpose of this report is to summarize the hydrologic performance and effectiveness of the fish passage structure in its first year of operation. Since project completion, NPS has monitored the following parameters at the project site: flow conditions, stream levels, structural integrity, the fishery resource, revegetation, and sedimentation. NPS staff will continually monitor the project site in coming winters and will prepare a similar document in 2002 and 2003.

Permits were obtained from the appropriate regulatory authorities including the U.S. Army Corps of Engineers, Regional Water Quality Control Board, National Marine Fisheries Service, and the U.S. Fish & Wildlife Service.

2000-2001 Hydrologic Conditions

Rainfall was light in water year 2000 (approximately 60% of normal) and ranged from 15 to 24 inches at various rain gages located on the park. NPS staff monitored flow conditions at the Muddy Hollow project site at the completion of the project, and in close proximity to the storm events of winter 2000 – 2001 (Table 1). Stream flows were taken at the upstream weir pool tail-out with a Marsh-McBirney Flomate Model 2000 portable Flowmeter. Velocities were recorded at either every foot or half-foot depending on total stream width. Event flows were calculated in cubic centimeters per second (CFS).

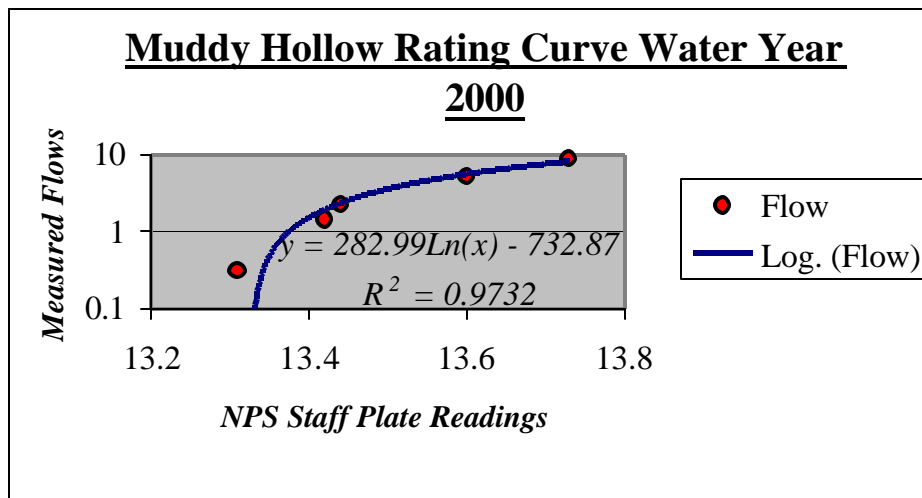
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Table 1 – Flow Table for Muddy Hollow Culvert (winter 2000-2001)

<i>Date</i>	<i>Flow (CFS)</i>
December 18, 2000	0.31
January 12, 2001	1.43
February 12, 2001	2.23
February 21, 2001	5.24
February 24, 2001	8.98
April 19, 2001	0.60

From these data, a rating curve for Muddy Hollow has been developed so NPS staff can interpolate flow conditions during the course of the water year (Chart 1). Rating curves will be developed on an annual basis and be submitted with subsequent reports. Water levels recorded by a Global WaterLogger WL-14 are entered into the logarithmic equation to determine correlated flow conditions at the project site. The Global WaterLogger WL-14 has recorded stream water levels since its installation in December 2000 and will operate indefinitely.

Chart 1 – Rating Curve Water Year 2000



The fish passage structure has performed well in response to the flow conditions of this past winter. Both boulder weirs are maintaining position and remain stable. Areas of scour, small amounts of gravel deposition, and revegetation have occurred on a continual and self-maintaining basis since the completion of the project. Long-term stability and success of the cross-vein structures is tied to the recruitment and maintenance of natural bedload within the system. The structure drops several feet in elevation and is subject to significant scour and flow velocity. The balance against scour is the recruitment and replacement by upstream bedload. In the first year following construction, stream flow induced scour and natural bedload material was recruited from upstream, stabilizing the structure.

Revegetation and Erosion Control Efforts

Increased water temperature can negatively impact fish success. Providing adequate shade and cover for salmonids at the project site is an important concern for NPS staff. Shade production and associated water temperature reductions at the site are long-term goals of the CSR. Revegetation efforts taken by NPS include: fifty willow plantings, ten alder transplants, transplant of *Juncus* sp., and the distribution of leaf litter and woody debris to break up surface flow patterns.

Concluding Remarks

It is the goal of the NPS that the Muddy Hollow restoration site regains as much of its natural character and functionality as possible. This includes the return of healthy salmonid populations, decreased sedimentation rates, revegetation, and increased water quality. Returning a piece of stream to productive use by anadromous fish is an immediate increase to the potential success of a salmonid population. The benefits to the fishery resource are the increased access to the upstream reaches of the creek and the increased habitat that the structure provides. NPS predicts that the restored habitat will recuperate to a fuller extent as more time elapses from the date of project completion. Thus far, the pool-riffle-pool habitat created by the project has provided high winter flow refugia and summer rearing habitat, and has the potential to provide spawning areas for adult fish. The fish passage structure also provides suitable habitat for other aquatic species, which are important to the overall integrity of the system. Flow conditions following this first year of operation indicate that the structure will maintain the hydrologic and geomorphic characters needed to sustain continued and effective use. Geomorphic surveys in upcoming years will help NPS staff better determine the levels of bedload recruitment that the upper reaches of the creek can provide to the structure, which is important for a self-maintaining weir structure.

The NMFS designed structure has allowed NPS staff to successfully restore a section of Muddy Hollow creek that would otherwise have remained impaired. As this was a relatively mild winter in regards to rain fall, the structural integrity of the structure will be monitored closely over the next few years. As well, NPS staff will continue to monitor the fisheries, revegetation, and hydrologic activity of the site on an annual basis. NPS staff hopes to use similar structures at alternative restoration sites throughout the park. Based on the performance of the two structures in place thus far (see Cheda Creek Compliance Report, File # 25315N), NPS staff support the use of the NMFS vortex-boulder weir fish passage structure as implemented at Point Reyes National Seashore.

Photographic Documentation

The following pages contain photographs from the fish passage structures first year of operation:

DETERIORATING CULVERT



Failed Culvert and Fish Impediment

CONSTRUCTION AND POST CONSTRUCTION PHOTOS

Date: November & December, 2000
Flow: 0.31 cubic feet / second (December 18)

Culvert Removal



Installation of Vortex Weir



Downstream Weir – just after project completion



FIRST STORM EVENT

January 8th – 11th, 2001 (rainfall = 2.5”)

Flow: 1.43 (01/1101) cubic feet / second

Downstream Weir



Upstream Weir



Flow over Apex Boulder



Upstream Weir

SECOND STORM EVENT

February 17th – 22nd, 2001 (Rainfall = 3.5")

Flow: a.) 5.24 (02/21/01) cubic feet / second

b.) 8.98 (02/24/01) cubic feet / second

Downstream Weir



Upstream Weir



Mid-Structure Riffle

LOW FLOW AND REVEGETATION EFFORTS

No Rain fall since 03/05/01

Flow: a.) estimated at 0.15 (06/20/01) cubic feet / second

b.) 0.60 (04/19/01) cubic feet / second

