ROCKY GULCH SALMONID ACCESS AND HABITAT RESTORATION PROJECT

PHASE I RESTORATION: FINAL REPORT

prepared for:

California Department of Fish and Game

and

US Fish and Wildlife Service

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1 INTRODUCTION

Small coastal watersheds were historically a stronghold of the *coho salmon (Oncorhynchus kisutch)* population along the north coast. Adult coho could gain quick access from the ocean into these small tributaries during the winter to spawn the next cohort, which then found abundant habitat in the streams and estuaries to rear and grow before entering the ocean. Many coastal streams were blessed with tidal marsh and estuarine habitats accessible to juvenile fish during spring and summer months for rearing. Tidal marshes and estuaries may have been critical to increasing juvenile growth rates and ocean survival for coho salmon, perhaps sustaining strong year classes when upstream conditions were less favorable. The period of estuarine residence of migrating juvenile coho salmon may be an important component of their life history (Miller and Sadro 2003). Estuaries provide the spatial salinity gradient necessary during the physiological adaptation from freshwater to salt water as well as high quality rearing habitat that offers a last opportunity for growth before ocean entrance (Healey 1982).

Population expansion and development during the past century and a half in these coastal watersheds has severely impacted salmon habitat, disrupted migratory access, and diminished salmon abundance. Human development has transformed not only the landscape, but has also changed the physical processes that sustained these habitats by altering sediment budgets, hydrodynamics, and salinity distributions. As a result of these disturbances and other factors such as ocean conditions, Coho salmon abundance has declined at least 70% since the 1960s, and is currently 6 to 15% of its abundance during the 1940s (CDFG 2004).

Few watersheds along the northcoast escaped impacts during the past century, but rarely does a watershed as small as Rocky Gulch (one square mile) embody so many historical impacts, contemporary issues, and restoration opportunities. As early as 1885, the removal of old growth redwood forests began in Rocky Gulch [Daily Humboldt Standard (23 April 1885) "Logging operations are about to be commenced on Rocky Gulch by Wm. Carson."]. The original railroad grade bisected the upper watershed from its seasonally flooded wetlands and the estuary. By the 1940's, timber mills had been built in the watershed, the entire tidal marshes had been diked and converted from wetland to pasture, and residential development had begun. The mill site upstream of Old Arcata Road contributed enormous sediment inputs into the creek. In 1957, California Department of Fish and Game's Fisheries Manager Ralph McCormick described lower Rocky Gulch "from the mouth up to Old Arcata Road a distance of about one mile [as] an intertidal estuary." The following historical information obtained from the CDFG Rocky Gulch files was provided to illustrate the history of impacts that has occurred to the stream and its fisheries as a result of logging operations. On December 12th 1956, Mr. John Williamson, a rancher on lower Rocky Gulch reported to Fish and Game Warden John O. Finigan that:

> *"There was a sudden rise in the creek and the abnormally heavy amount of clay silt was killing spawning salmon. These fish had been washed completely out of the creek by the sudden onrush of heavy silt. He [Mr. Williamson] further stated that*

> *the creek was so heavily silted that it didn't have the appearance of water at all, but appeared to be semi-solid, moving very sluggishly down the streambed*."

That catastrophic environmental calamity, caused by a huge land-slide in the Rocky Gulch watershed in 1956, may have caused the extirpation of Coho salmon, steelhead (*O. mykiss*), and coastal cutthroat trout (*O. clarkii clarkii*) populations from Rocky Gulch, and perhaps tidewater goby (*Eucylogobius newberryi*) if they were present in Rocky Gulch. Compounding the logging damage to Rocky Gulch's anadromous salmonid populations was the installation of a tidegate (first reported in 1964) at the mouth of Rocky Gulch, which significantly reduced the opportunity for migrating adult salmonids to enter the stream. After nearly fifty years since these two events occurred, CDFG's 2001-03 surveys still found no coho salmon, steelhead, or anadromous cutthroat trout in Rocky Gulch, nor has tidewater goby been observed. Resident cutthroat trout are abundant in Rocky Gulch.

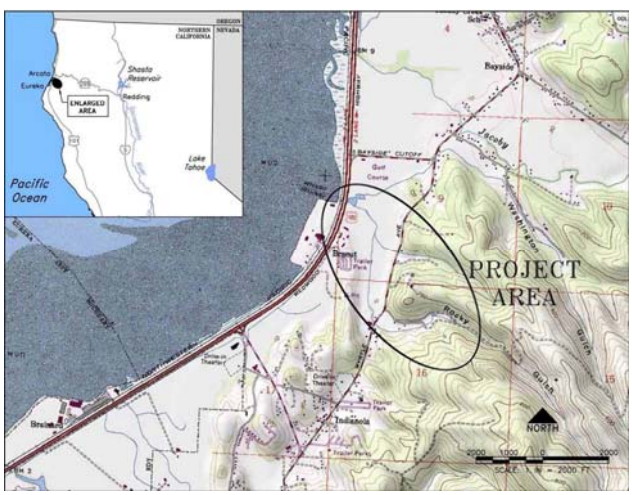

Figure 1. Location of Rocky Gulch, tributary to Humboldt Bay near Bayside CA.

Despite the history and persistence of numerous problems, including a moderately high sediment load, blocked migratory access, and limited estuarine rearing areas, Rocky Gulch has good potential to support populations of coho salmon and steelhead, and resident cutthroat trout are already present. The initial planning study for Rocky Gulch evaluated instream habitat from Old Arcata Road to the Old Rock Quarry approximately 2.0 miles upstream of the Humboldt Bay confluence (McBain & Trush 2002). Apart from short reaches with remnant impacts from the mill, this study found abundant, high quality habitat to support both coho salmon and steelhead. Pools with adequate depths to provide juvenile coho rearing habitat are plentiful. Spawning gravels, woody debris, root wads, undercut banks, and overhead cover are all abundant. The riparian understory and redwood canopy have also recovered from the most recent timber harvests.

The overarching goal for Rocky Gulch is to restore anadromous fish access and naturally reproducing anadromous salmonid populations (coho salmon and steelhead) from Humboldt Bay to approximately the Rock Quarry located 0.9 miles upstream of Old Arcata Road. This goal entails the following objectives :

- provide unimpeded fish passage through the tidegate;
- increase tidal marshes and slough channels in lower Rocky Gulch to provide juvenile salmonid rearing habitat and possibly tidewater goby habitat;
- widen the creek channel and re-create a floodplain, rehabilitate dikes to better contain winter floods and protect the grazed pasture from flooding;
- restore riparian and conifer vegetation on the newly created floodplain along Rocky Gulch;
- replace the upstream barrier culvert to restore fish access to upstream habitat (to be implemented in Phase II of restoration).

2 SITE DESCRIPTION

Rocky Gulch is a small watershed (1 mi^2) that drains into Arcata Bay approximately six miles north of Eureka, CA (Figure 1). The upper watershed is redwood forest, with headwaters along Greenwood Heights Ridge at approximately 1,000 ft elevation. The creek intersects Old Arcata Road approximately 4 miles south of Arcata and traverses bottomlands used as pasture, before passing under US Hwy 101 and flowing into Humboldt Bay.

The project area includes approximately 5,500 feet of stream, associated salt marshes, and riparian

corridor between Old Arcata Road and Hwy 101. The upper 2,000 feet of stream downstream of Old Arcata Road was narrowly channelized between poorly maintained dikes and the Old Arcata Road embankment. Much of this reach had become plugged by fine sediment deposition and overgrown by willow and alder thicket. In 2004 and 2005, the dike in this upper reach breached in several locations, allowing the entire stream discharge to flow onto the pasture. The lower 3,000 feet of stream runs through straightened sections across the middle of a pasture with sharp 90-degree bends. Dikes along the left bank (looking downstream) contained most tides (although extreme high tides in 2005 overtopped this dike) and flood-flows, including tributary input from three small perennial streams. At the downstream end, the stream flowed through an old wood tidegate with concrete wing-walls, and then joins Washington Gulch to form Brainard Slough above Highway 101. In 2005, the dike along the left bank (south side) of Washington Gulch was breached in several locations causing extensive flooding of the salt marsh and pasture in the project area.

The entire project area is a pasture. Roger and Johanna Rodoni are the property owners, and use these bottomlands year-round to graze cattle. Humboldt County's Local Coastal Plan has designated the entire valley traversed by lower Rocky Gulch as a coastal wetland and transitional agricultural combining zone. Maintaining reclaimed tidelands for agricultural use requires repair of dikes, tidegates, drainage ditches, and stream channels. During the normal course of agricultural use, vehicles and equipment regularly traverse the pasture. Cattle graze the seasonal wetland pasture, riparian corridor, willow swamp, salt marsh, and uplands. Rocky Gulch is the primary source of water for these cattle, and there are several stream crossings and trails that they habitually use along the stream corridor. As a working ranch, there will be constant disturbances to these wetlands and need to maintain channels and dikes. This project intends to reduce the need for future maintenance.

2.1 Reach 1: Tidal Pool [Station 0+00 to 6+00]

In the following site description, stationing refers to distance (in feet) from the confluence with Humboldt Bay, The major project elements are summarized in Figure 2 and are shown in detail in the construction design drawings in Appendix A.

Reach 1 extends from the Arcata Bay side of the Highway 101 culvert up to the tidegate on Rocky Gulch. This area has been designated the 'tidal pool' due to the influence of Humboldt Bay tides and the Hwy 101 culvert. Water surface elevations are nearly equal on both sides of the Hwy 101 culvert, indicating that the culvert does not significantly affect tide stage. To the east of Highway 101, dikes enclose the tidal pool (Brainard Slough), which receives runoff from both Washington Gulch and Rocky Gulch. Two tidegate structures span the mouth of Rocky Gulch: one has been abandoned and filled with concrete. The other structure was upgraded by this project with a new tidegate to allow fish passage upstream of the tidegate. The newly installed tidegate is designed to maintain a muted tidal prism and brackish aquatic habitats while simultaneously allowing fish passage.

2.2 Reach 2: Tidal Slough [Station 6+00 to 16+50]

Reach 2 extends from the tidegate to station 16+50 and is still tidally influenced. The slough channel bottom is predominately fine silts and mud, approximately 10 feet wide by 4 feet deep. The south bank is confined by a dike that averages 2-3 feet higher than the pasture, and the north bank is a salt marsh that is confined farther to the north by another dike paralleling Washington Gulch. Both slough banks are vertical and undercut from tidal action. Regular tidal flushing in this reach has reduced sediment deposition and keeps the channel free of vegetation (Figure 3). The areas on both sides of the slough channel, with the exception of the dike, are salt marsh. Grazing within the salt marsh area is minimal. Discharge draining from the grazed wetland to the south enters Rocky Gulch at station 9+00 via a 2 ft diameter drainage culvert and flapgate installed under the dike. During the winter of 2004, a 10 ft section of the dike surrounding the drainage culvert eroded away.

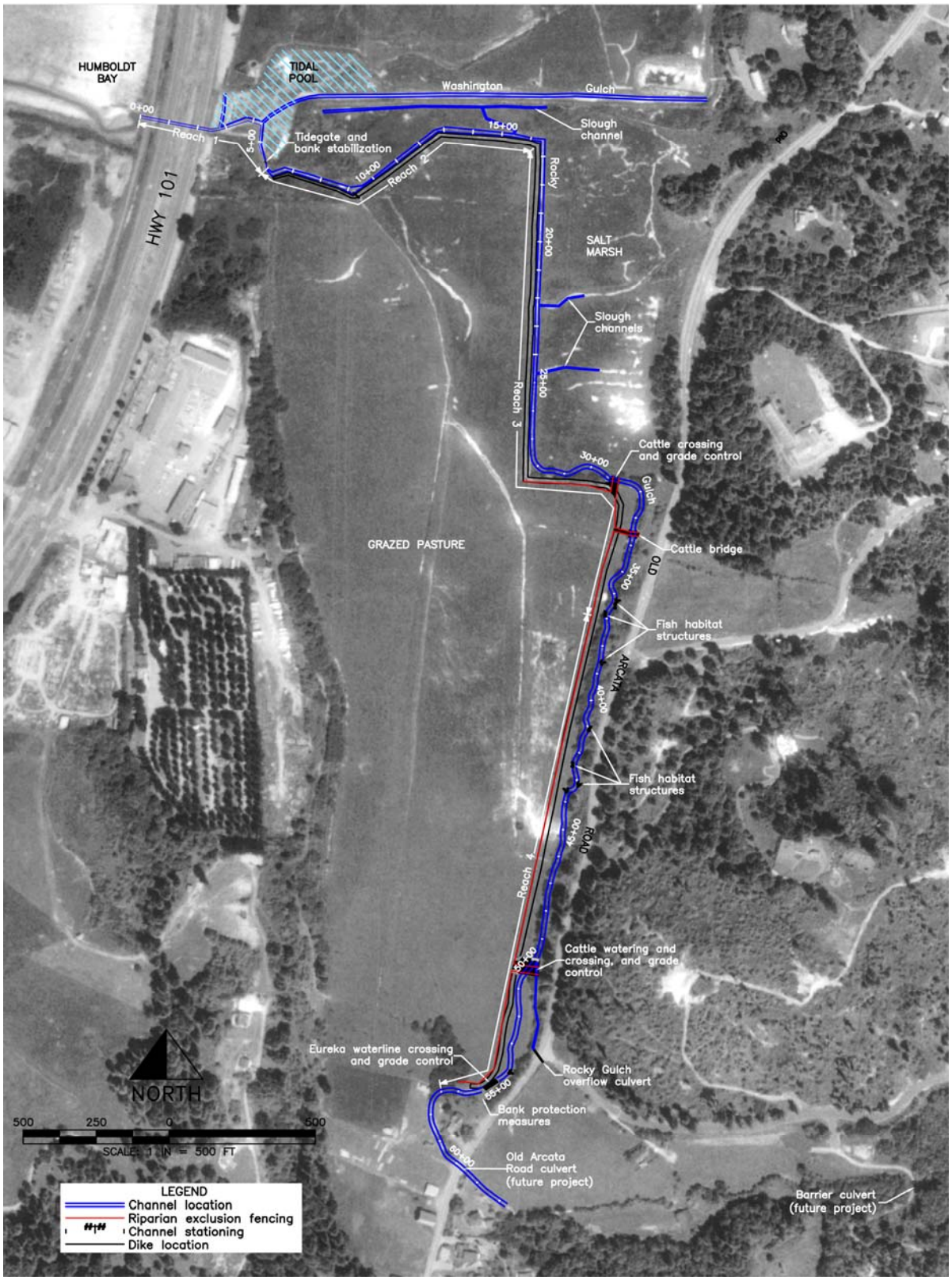

Figure 2. Location of major elements of the project.

Figure 3. Lower slough channel and dike at moderate high tide.

Tidal waters were temporarily allowed to ascend a tributary network, flooding the salt marsh and grazed wetlands. The landowners repaired the dike in Spring of 2004 and tilled under much of the grazed wetland to the south of the dikes that was inundated by saltwater intrusion. In 2005, high tides in excess of 8.5 ft MLW caused several breaches in the left bank dike between Washington Gulch and Rocky Gulch, flooding the salt marsh and pasture again.

2.3 Reach 3: Tidally Influenced Stream [Station 16+50 to 37+00]

In Reach 3, Rocky Gulch has been channelized to follow a north-south running property line. The stream was a ditch approximately 10 feet wide by 4 feet deep at its greatest width. From station 28+25 to 32+25, the channel has become so aggraded with sediment, that there is no discernable channel, and instead forms a willow swamp during winter/spring runoff. A dike 2-3 feet in height above the pasture borders the stream to the west and south (Figure 4). This reach is entirely straight channel sections with three 90-degree bends.

During the winter 2002-03, most flow overflowed the channel at the 90-degree bend near station 32+50 and passed across a salt marsh, abandoning the reach between station 28+25 and 32+25 at low flow (Figure 5).

Figure 4. View looking south, showing the dike and heavily aggraded channel near the upstream boundary of tidal influence in 2004.

During winter 2003-04, conditions worsened when the dike breached at station 46+00, extending the section of abandoned channel from station 28+25 up to station 46+00. Most flow drained across the seasonal wetland pasture and through the dike and drainage culvert at station 9+00. The landowners repaired the dike in spring of 2004 and tilled under much of the grazed wetland to the west of the dikes.

Figure 5. Heavily aggraded section of channel between two 90-degree bends, overgrown with willow and grass in the channel.

There was a cattle crossing at station 35+00 where the stream passed through a 1-½ foot steel culvert. This culvert was undersized and had caused severe sediment aggradation upstream for nearly 1,200 ft. During the winter of 2004-05 this culvert began to back up water and cause the stream to flow out of the channel and across the

pasture. On the east side of the channel, salt marsh vegetation dominates up to station 27+00. Riparian vegetation begins to line the channel at station 28+50 and continues upstream to station 61+00, primarily along the east (right) bank. An un-named perennial tributary joins Rocky Gulch near station 35+00.

2.4 Reach 4: Freshwater-Riparian Reach [Station 37+00 to 57+00]

In Reach 4, streamflow is not influenced by tides, average discharges are estimated during summer low flow to be 0.5 to 1.0 cfs, and winter base flow averages 3.5 cfs, while the 100-year flood is estimated between 350 to 450 cfs (McBain & Trush 2002). In the 1950s, this reach was relocated to its present location and channelized to parallel Old Arcata Road along the eastern side of the wetland pasture. The channel was contained by dikes in a narrow corridor, and served as a drainage ditch. This reach had a dike along its west bank up to station 56+00 that confined the stream to less than 20 feet from Old Arcata Road in many locations. The channel ranged from 3 to 10 feet wide and 1 to 3 feet deep, and the dike averaged 2-3 feet high (Figure 6). Significant aggradation of the channel had occurred from station 35+00 to 47+00. There were sections of dike in this transitional (tidal to freshwater) zone that were breached and allowed runoff to leave the channel and flow across the wetland pasture. During the winter of 2004, a breach in the dike at station 46+00 captured all stream flow and discharged the flow onto the grazed wetland pasture, causing much of the pasture to be saturated with standing water. The landowners repaired this breached dike in summer 2004. In the winter 2004-05, the dike again breached in several locations between station 42+00 and 46+00. These breaches allowed all the streamflow to exit the Rocky Gulch channel, flow across the pasture, then collect in drainage ditches that routed water back into the diked system through the culverted flapgate at station 9+00, 300 ft upstream of the tidegate.

Figure 6. Upper section of channel heavily confined between Old Arcata Road and the dike.

The lower section of this reach flowed through a willow swamp from station 28+50 to 41+70.Above station 41+70 was dense riparian woodland with stands of redwood.At station 54+50, a PG&E high pressure gas main transmission line crosses under the Rocky Gulch channel and had become exposed due to local channel downcutting, requiring on-site repairs to protect the pipeline from damage or leaks. From station 56+00 to 61+00 (upstream of the project area), Rocky Gulch flows around a private residence and is not bound by dikes. There is very little riparian vegetation in this area. The upper boundary of this reach is at station 61+50 where Old Arcata Road crosses the stream. This Humboldt County culvert is considered to be undersized and causes occasional flooding upstream, but is not a barrier to anadromous salmonid migration. High flows in Rocky Gulch often back-up above Old Arcata Road, and water is routed into a bypass channel paralleling the road and is then conveyed through a culvert beneath the road to again discharge into Rocky Gulch at station 53+00.

2.5 Vegetation Survey

Vegetation is defined as “all the plant species in a region, and the way they are arranged” and usually appears as a mosaic of numerous, definable plant stand types (Saywer and Keeler-Wolf 1995). The dominant plant species in the canopy defines the stand type. A vegetation classification system utilizing stand types was used to inventory

vegetation within the project area. Unvegetated polygons were assigned a cover attribute based on visible substrate and level of human disturbance.

We mapped wetland vegetation using habitat classes developed by Shapiro (1980) in December 2003. The wetland habitat classification lumps marsh-related cover types into salt, brackish, and freshwater emergent classes. The wetland habitat class map illustrates the site vegetation at a coarser scale (Figure 7).

We mapped cover types during a vegetation inventory in December 2003 (Figure 8). A field based inventory ensured a highly detailed and accurate vegetation map. A riparian botanist conducted the field inventory by walking the entire site and mapping all plant stands onto a laminated aerial photo. Mapped plant stands were no smaller than 100 ft^2 and included all salt, brackish, and freshwater wetlands, and adjacent upland plant stands within the project boundary.

The cover type map was used to describe vegetation, particularly wetland vegetation, in greater detail than the wetland habitat classification map. The habitat based map is useful for NEPA/CEQA permitting purposes, while a cover type map based on species dominance is useful for assessing vegetation quality at the site.

We mapped twenty two cover types within the Rocky Gulch project area in December 2003. Mapped cover types developed by Saywer and Keeler-Wolf (1995) were related to the wetland habitat classes developed by Shapiro (1980) and are briefly described within the respective wetland habitat class.

2.5.1 Salt Marsh Habitats

Salt marshes are plant-dominated intertidal habitats. Salinity can vary greatly within these habitats (Zedler 2001). Plant species occurring in this habitat are salt tolerant and able to withstand frequent and prolonged tidal inundation. Less than 10% of the original salt marsh coverage around Humboldt Bay remains, making the remaining salt marshes rare and important species reserves. The salt marsh habitat class begins below mean lower low water (MLLW) and continues to the extreme high water tidal elevation (EHW). We mapped five cover types within the salt marsh habitat class, representing 53.1% of the project area.

Within the salt marsh habitat class, three special status plant species could potentially occur: Humboldt Owls Clover (*Castilleja ambigua* ssp. *Humboldtiensis*), Point Reyes Bird Beak (*Cordylanthus maritimus*), and Lyngbye's sedge (*Carex lyngbyei*). A floristic survey using the Nelson method of intuitive control assessed the presence of these species at a seasonally appropriate time.

2.5.2 Brackish Marh Habitats

Brackish marshes are plant-dominated intertidal habitats with suppressed salinities. Salinity can vary greatly within these habitats (0.5-30ppt), but salinity is depressed because of freshwater influence (Zedler 2001). The brackish marshhabitat class begins at mean higher high water (MHHW) and may continue past the extreme high water tidal elevation (EHW) to where salinity is no longer present. We mapped two cover types within the brackish marsh habitat class, representing 1.3% of the project area.

2.5.3 Freshwater Marsh Habitats

Freshwater marshes are plant-dominated non-tidal freshwater habitats. There is no salinity associated with freshwater marshes. Freshwater marshes occur along the margins of seasonal and perennial freshwater bodies to a depth of 6 feet. All freshwater emergent cover types are dominated by obligate wetland indicator species. We mapped one cover type within this habitat class, representing 0.5% of the project area.

2.5.4 Grazed Wetland Habitats

Grazed wetlands are plant-dominated non-tidal freshwater habitats. These wetlands are agriculturally valuable. There is no salinity associated with grazed wetlands. Grazed wetlands dominate the project area. All grazed wetland cover types are dominated by obligate wetland indicator species. We mapped three cover types within this habitat class, representing 28.1% of the project area.

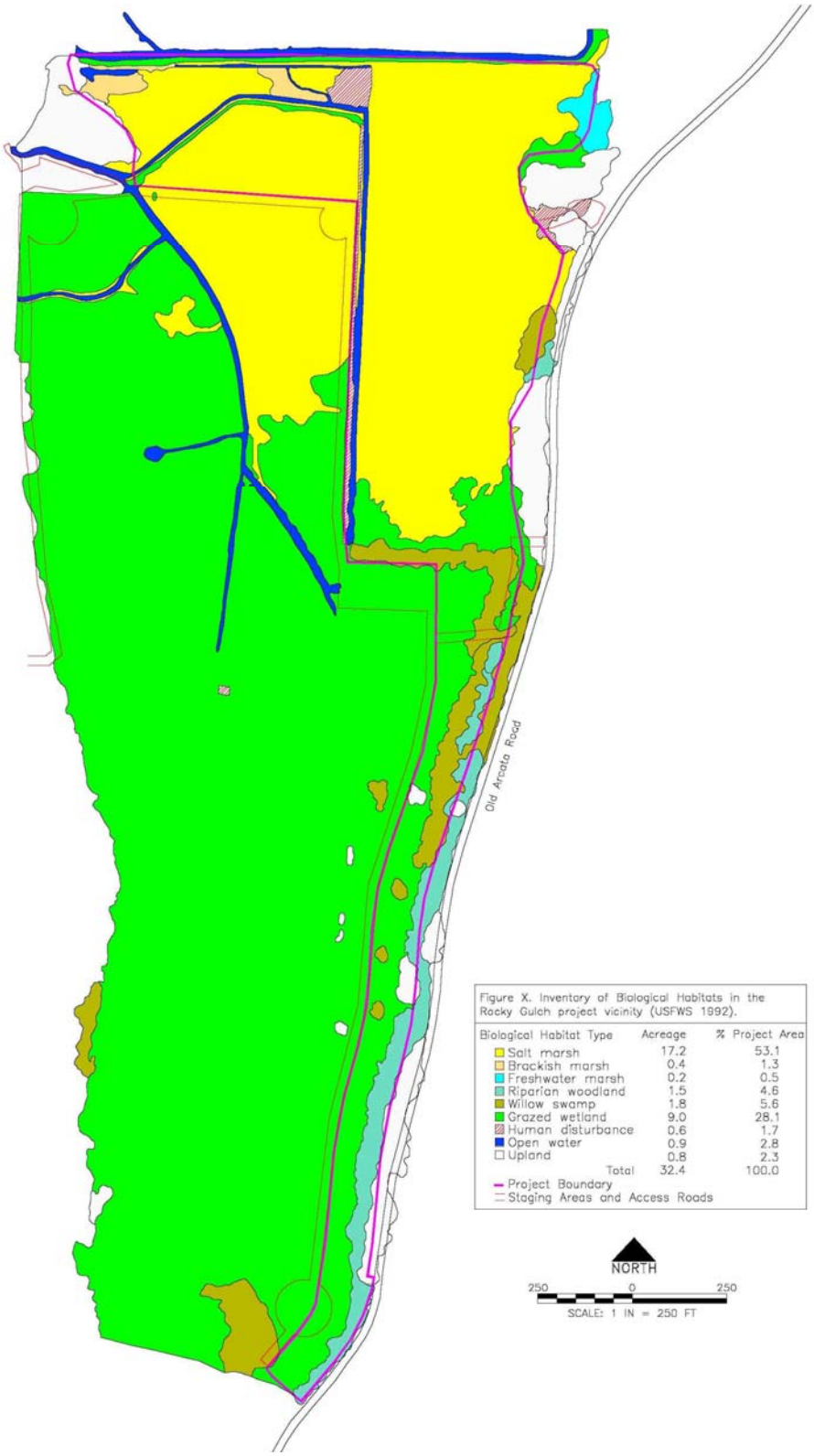

Figure 7. Inventory of biological habitats occurring within the Rocky Gulch project vicinity, mapped in December 2003.

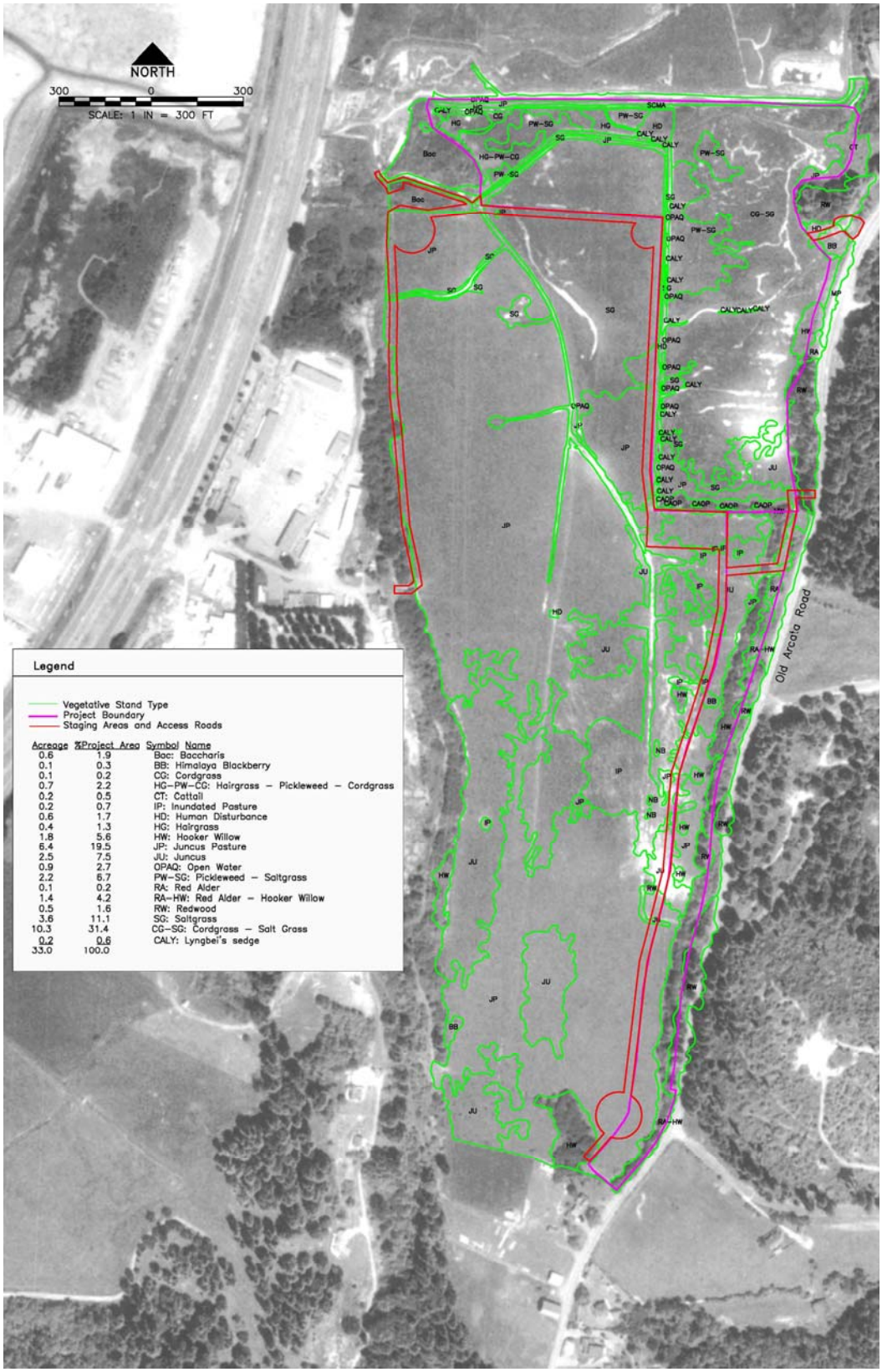

Figure 8. Inventory of cover types occurring within the Rocky Gulch project vicinity, mapped in December 2003.

2.5.5 Willow Swamp Habitats

Willow swamps are woody-plant-dominated non-tidal freshwater habitats. There is no salinity associated with willow swamps. Willow swamps occur where seasonal and perennial freshwater bodies pond. Willow swamps are dominated by wet facultative wetland indicator species. We mapped one cover type within this habitat class, representing 5.6% of the project area.

2.5.6 Riparian Woodland Habitats

Riparian woodlands are woody plant dominated terrestrial freshwater habitats. Riparian woodlands occur along the margins of streams, and freshwater bodies (both perennial and seasonal). Riparian woodlands are most often dominated by wet facultative wetland indicator species. We mapped two cover types within this habitat class, representing 4.6% of the project area.

2.5.7 Upland Habitats

Upland cover types are plant-dominated non-wetland habitats. These cover types are not inundated for any length of time and have groundwater supplied by local precipitation alone. Upland cover types may have some wetland indicator species but the majority of plants with these cover types are facultative wetland or upland plants. We mapped five cover types within this habitat class, representing 2.3% of the project area.

2.5.8 Other Habitats

These habitats include all unvegetated cover types. The cover type classification is independent of hydrology with the exception of the open water cover type. We mapped two cover types within this habitat class, representing 4.5% of the project area.

2.5.9 Special Status Species

The project area is in close proximity to documented populations of Humboldt Bay Owls clover (*Castilleja ambigua ssp. Humboldtiensis*) and Point Reyes Bird Beak. (*Cordylanthus maritimus ssp. palustris*) at the Bracut Marsh Restoration Project and the Jacoby Creek National Wildlife refuge Salt Marsh. These plant species could therefore occur within the project site, though it is improbable due to the restriction of incoming seed sources by tidegate structures. Lyngbye's sedge is known to occur at the site (Mad River Biologists 2001).

In June 2004 a qualified botanist visited the site and performed a complete floristic survey of the site using the Nelson method of intuitive control for the special status plant species (CDFG 2000, CNPS 2001b). An intuitive control searches areas on the site where these special status plants are likely to occur. Other than Lyngby's sedge, no other special status species were observed

3 PROJECT IMPLEMENTATION

The major phases of this project are briefly described in the following sections:

3.1 Initial Planning

In 2001, McBain & Trush was awarded a grant for the "**Rocky Gulch Stream Assessment Project" (CDFG Contract No. P0010372).** The objectives of this project were to assess migratory access, habitat conditions, and restoration needs of Rocky Gulch, prioritize restoration actions, and develop site-specific recommendations for habitat restoration. In addition, we coordinated with the landowners, resource agencies, and the local community to hear different restoration perspectives and ultimately achieve a shared vision for restoration in Rocky Gulch.

3.2 Conceptual Restoration Design

A proposal for the "**Rocky Gulch Salmonid Access and Habitat Restoration Project" (CDFG Contract No. P0010372)** was submitted to the CA Department of Fish and Game California Coastal Salmon Recovery Program (CCSRP) in May of 2002. The proposal contained a conceptual restoration design developed during the Stream Assessment Project. This original conceptual design was negotiated and agreed to by the landowner (Roger and Johanna Rodoni) and CDFG prior to submittal of the 2002 proposal. After the grant was awarded and a contract was in place, the project environmental planner (Aldaron Laird) conducted a "regulatory constraints analysis" as an initial step toward developing a regulatory compliance strategy. This constraints analysis formally identified sensitive species and

habitats within the proposed project footprint, identified a lead agency pursuant to CEQA, and identified regulatory permits that would be required. The constraints analysis also discovered ACOE and NOAA Fisheries documents that had classified a portion of the grazed wetland within the project boundary as tidal marsh, which then required several project tasks to be modified. The resulting updated conceptual restoration design was formalized in a meeting with CDFG representatives, the landowners, and the project team in February 2004. This final restoration design contained eight elements that formed the basis of the Salmonid Access and Habitat Restoration project. These elements were:

1) Installation of a new tidegate at the bottom end of Rocky Gulch designed to provide reliable salmonid fish passage to the upstream watershed, and allow a muted tide cycle that was calibrated to maintain the existing tidal marsh habitat upstream of the tidegate;
2) Excavation of aggraded sediments from approximately 1,100 ft of slough channel that reduced channel capacity and impeded adult salmonid fish passage to the upstream watershed
3) Reconstruction of nearly 2,800 ft of channel to eliminate unnatural 90 degree bends and re-meander straightened sections to increase channel capacity and improve fish habitat;
4) Use of dredged material to rehabilitate approximately 4,900 feet of dikes to contain winter floods and tidal waters, and protect the grazed pastures to the south and west of the dikes;
5) Relocation of the 2,500 ft section of dike that parallels Old Arcata Road to 50 ft back from the existing stream channel by excavating the existing dike and moving the fill material away from the channel, creating a floodplain and increasing the riparian corridor and floodway capacity;
6) Installation of 3,200 ft of riparian fencing, two armored cattle crossings and watering access sites and one bridge, to reduce impacts from cattle grazing on stream, wetland, and riparian habitats;
7) Revegetation of native riparian and wetland plant species, installation of willow baffles and other materials to reduce erosion from excavated areas;
8) Development of a maintenance procedure and protocols for future maintenance (if needed) in the channel.

3.3 Engineering Design and Regulatory Compliance

The engineering design phase and the regulatory compliance phase were conducted concurrently during the period from February 2004 to August 2005. With completion of a conceptual design, we proceeded to develop a formal ‘project description’ that formed the basis of an impact analysis, and then developed elements to mitigate significant project impacts. The project description, impact analysis, and proposed mitigation were summarized in the “Biological Assessment: Lower Rocky Gulch Salmonid Access and Habitat Restoration Project: Bayside, Humboldt County, California” (Rocky Gulch BA), dated February 2005. This document was submitted to the Army Corp of Engineers for the ACOE Permit and for ESA consultations, and was used by Humboldt County Planning Department (acting as CEQA Lead Agency) as the basis for developing a Mitigated Negative Declaration pursuant to provisions of CEQA.

In early 2004, a decision was made to pursue informal ESA consultations with NOAA Fisheries and the USFWS. This decision eventually resulted in a one-year delay in project implementation because the federal agencies’ workload delayed them from addressing our project permit requests. Without action on the permits, we were unable to implement the project in summer 2004, and the project was postponed. At that point a second decision was made, to pursue separate administrative permits to implement the tidegate replacement task independent of the other project elements. The rationale behind this decision was that: (1) tidegate replacement represented a maintenance action regulated but allowed under Army Corp Section 404 and the California Coastal Act, and (2) installing the tidegate before winter 2004-05 would allow adult salmon to access the Rocky Gulch watershed and potentially accelerate reestablishment of the population. This strategy proved successful and the new tidegate was installed in December 2004.

Between December 2004 and August 2005, the project team worked to complete all regulatory agency permit requirements. Permits required for implementation of this project included:

- US Army Corp of Engineers Individual Permit; US Army Corp of Engineers Nationwide Permit 27 Stream and Wetland Restoration;
- NOAA Fisheries Section 7 Consultation and Biological Opinion;
- US Fish and Wildlife Service Section 7 Consultation and Concurrence;
- California Department of Fish and Game Streambed Alteration Agreement;
- North Coast Regional Water Quality Control Board Water Quality Certification;
- California Office of Historic Preservation Section 106 Compliance;
- Humboldt County Coastal Development Permit CDP 04-92 and Conditional Use Permit CUP 04-32;
- Humboldt Bay Harbor, Recreation, and Conservation District Encroachment Permit;
- City of Eureka Engineering Department Encroachment Permit;
- Pacific Gas & Electric Encroachment Permit;

The engineering design was developed by Jeff Anderson (the consulting project engineer) and McBain & Trush. The primary elements of the engineering design were (1) development of hydraulic models to evaluate existing conditions and predict flood stages through the restored project reach and within the freshwater/tidal interface, (2) development of grading plans with proposed longitudinal channel profile, cross sections, and grading contours which were used to estimate cut and fill volumes and construction sequencing, and (3) development of plans to protect utility infrastructure, including the City of Eureka Mad River water pipelines and PG&E gas transmission pipeline. The utility infrastructure was an unanticipated design constraint that required close correspondence with engineers representing both the City of Eureka and PG&E.

The engineering design phase resulted in 18 construction design sheets (Appendix A), each detailing specific components of the project. These construction drawings were used by the contractor to build the project during summer 2005.

3.4 Project Construction

3.4.1 Tidegate Installation

At the downstream end of Rocky Gulch, the stream flows through a tidegate and joins Washington Gulch to form Brainard Slough, before passing through a culvert under Hwy 101. The old tidegate (Figure 9) was a barrier to anadromous salmonid migration. Because former tidelands behind the tidegate are currently used as cattle pasture, these lands had to be protected from saltwater intrusion.

However, some areas of the pasture had been receiving periodic tidal inundation due to damage to the tidegate, and these tidal marshes had to be maintained by the upgraded tidegate.The new tidegate (Figure 9) thus required a “muted tide cycle” in which a controlled volume of seawater is allowed past the tidegate during each tide cycle.

Because the new tidegate installation proposed to modify an existing structure, and was designed to maintain the existing hydrology, the project was determined to be exempt from ACOE jurisdiction. We obtained administrative permits from the Humboldt Bay Harbor District and the California Coastal Commission for the tidegate construction task. The Army Corp was notified in writing of the scope of the project. Our analysis determined the project had “no effect” on federally listed chinook or coho salmon, steelhead, or tidewater goby, or to critical habitat designated for coho salmon or on any coastal resources.

Figure 9. Top: The old tidegate at ebb tide showing the gate partially open but a barrier to adult migration. Middle: The new side-hinged tidegate at ebb tide showing the door wide open to fish passage. Bottom: The new tidegate at low tide showing the auxiliary door which is always open.

The subcontractor Nehalem Marine, owned and operated by Leo Kuntz, constructed and installed the new tidegate during the week of 11/29/04 to 12/3/04. The new tidegate is a custom-fabricated, side-hinged aluminum gate mounted on the wing-walls of the existing structure (Figure 2 and 10). The new tidegate has a muted opening with an adjustable "guillotine-style" auxiliary door with maximum aperture of 1 ft wide by 2 ft tall. The auxiliary door is a top-hinged gate mounted on a track that can be adjusted up and down by rotating a stainless nut and threaded rod. The 1 ft wide auxiliary opening can be reduced to 0.5 ft wide by mounting a choke plate over the opening on the back side of the gate. The auxiliary door can be closed completely by screwing down the stainless nut and threaded rod. Installation of the new tidegate required repairs to the existing concrete wing-walls and construction of a concrete "ceiling" spanning the wing-walls between the new tidegate headwall and the existing headwall. After installation of the new tidegate, the concrete headwall of the adjacent non-functioning tidegate was repaired to plug a hole.

The project was implemented in 4 days during low tides. Vehicular and equipment access to the work site was provided by an existing dirt road maintained by the property owner. Approximately 30 yd^3 of 3" x 6" crushed rock were imported to improve the road access. The rock base was left in place after the project was completed.

The new tidegate headwall included a 4 ft aluminum sleeve that was bolted onto the inside of the concrete wing-walls. The sleeves enclosed the ends of the eroded wing-walls (Figure 10) and created small void spaces that were dry-packed with concrete to reinforce the walls. A "high-early" type of concrete was used that hardened rapidly and allowed full loading by approximately 12 hours. Metal rebar was installed to reinforce the concrete. Approximately 4 cubic ft of concrete were required for the aluminum sleeve installation. Before being inundated with tidewater, the concrete wing-walls and aluminum sleeve were scrubbed down, and the wash-water and debris were collected on the floor of the tidegate in temporary tarpaulin ponds where it was removed for disposal in the upland area. This activity prevented discharge of concrete or other debris into the adjacent waters.

Figure 10. Top view looking inside new tidegate during construction, showing aluminum sheeting reinforcement of the concrete wingwalls.

After the tidegate was installed onto the wing-walls and secured adequately, an aluminum ceiling was installed over the wing-walls to create an enclosed box culvert. The project originally proposed using concrete for the ceiling, but during implementation the existing concrete was judged to be not structurally sound enough to support the weight of concrete, so the aluminum ceiling was installed. This reduced the amount of concrete used in the project by approximately 12-15 cubic ft. All bolting was done with stainless steel expansion bolts. After adequate time to allow the concrete to fully harden, spaces between concrete and the new aluminum tidegate headwall were grouted and sealed with urethane injection on dry areas and concrete on the parts that were sealed in the water.

Once the new tidegate installation was complete, the fill material plugging the hole in the adjacent tidegate's headwall was removed to allow the hole to be permanently plugged. The area surrounding the hole was cleared, and forms were installed to plug the hole with approximately a cubic yard of concrete. This task also used a rapid drying concrete and was done on the upstream side of the tidegate to prevent tidewater from inundating the concrete patch until after the concrete had set-up. Once the concrete was set, the forms were removed.

After completion of the tidegate installation, the area surrounding the construction site was seeded with grass to reduce erosion of exposed soil. The tidegate auxiliary door was initially kept closed until the tidegate was observed during a one-month period of tide cycles, including high tides that exceeded 9 ft MLW. The hydraulic model developed for the project was used to determine the size of the auxiliary door opening, which has been set at 1.0 ft^2.

Daily tidal inundation of the tidegate now allows a muted tide prism to flow through the auxiliary door to fill the slough channels upstream of the tidegate. There are numerous benefits to daily seawater intrusion upstream of the tidegate. Regular tidal flux will help maintains slough channel capacity by flushing fine sediments delivered from the upper watershed into the bay, suppresses vegetation from growing in the tidally influenced channel, and provides valuable brackish aquatic habitat used by migratory marine, anadromous, and resident fish species. At the peak tide, the auxiliary door allows tidewater to rapidly fill behind the tidegate and achieve equilibrium in water surface elevations on the inside and outside of the tidegate. As the tide ebbs, the tidegate is pushed fully open to nearly 90 degrees. This wide opening will allow anadromous salmonids to pass through the tidegate and migrate upstream to their spawning grounds.

3.4.2 Channel and Dike Reconstruction

We recognize that restoration practice—as well as restoration science—is continually evolving, with considerable uncertainties and unknowns. We rediscovered this concept during the lead-up to construction. In June 2005, the CEQA Mitigated Negative Declaration was approved by the Humboldt County Planning Commission. In August 2005, the final permits were obtained from the Coastal Commission (issued August 15th) and the ACOE (issued August 18th) for the main project construction elements. Up until the middle of August 2005 it was unclear whether or not these permits would even be issued. The construction schedule was delayed several weeks from our expected start date, causing the construction window to be pushed up against the October 15th required construction end-date and the threat of early fall rains. Once permits were obtained, on-the-ground construction activities were initiated,

and lasted a total of eight weeks into middle of October.

The construction was lead by Matt Smith of Environmental Restoration Services, and employed an excavator, D5 bulldozer, and backhoe. The construction phase included dredging the existing channel and/or excavating new sections of channel for approximately 3,900 ft of stream, widening and deepening the channel in all but approximately 500 ft of the stream within the project area. Channel dimensions varied from 12-13 ft wide (bankfull width within the upper freshwater reach) (Figure 11) to 20 ft wide (lower slough channel top width) (Figure 12), and 2-3 ft average depth. Channel excavation removed approximately 3,200 yd^3 of fill. The existing dike along the upper 2,400 ft of stream was removed to produced an additional 1,300 cu yds of fill. Approximately 2,800 ft of channel that was previously a straight ditch was re-meandered to increase channel length, provide better aquatic habitat, and improve planform morphology.

The combined 3,700 yd^3 of cut material was used to rebuild approximately 2,300 ft of dike 50 ft away from the stream channel in the upper reach, and increase the dike elevation along the entire 2,300 ft of lower reach (Figures 13-14). The target elevation for the top of dike was 9.0 ft (NAVD 88). We were able to achieve a slightly higher dike elevation with the volume of dredged material available. Along the lower 1,100 ft section of dredged reach where Lyngby's sedge was growing in the channel, the sedge was removed in large "wafer" sections and immediately placed back into the excavated channel to re-establish along the channel margins instead of mid-channel (Figure 13).

The grading plans had no design contours for the new floodplain because the dikes were simply moved to a new location, theoretically eliminating the need for floodplain grading. However, during construction, several areas of the floodplain were nevertheless re-graded to eliminate areas that were too-high or too-low, but the floodplain was left as the pre-construction topography. After the first season's rains in late October, swales were dug in several shallow depressions that ponded water to reconnect them to the channel and reduce ponded water on the floodplain.

Figure 11. Newly reconstructed upstream channel reach with habitat structure and small gravel deposit from late-October rainstorm.

Figure 12. Newly reconstructed lower slough channel that replaced the straightened, aggraded section and eliminated 90-degree bends.

There were four "instream structures" installed during construction. Two structures were Ercon® concrete mattresses installed over the top of the PG&E gas transmission line to protect the pipe from exposure from future channel erosion (Figure 15). These mattresses were laid in place on top of the final grade and pumped full of slurry concrete to form a 6-8" thick protective shield.

Figure 13. Lower section of reconstructed dike adjacent to the salt marsh. Wetland plant material was salvaged and replaced back into the channel during the dredging operation.

Figure 14. Upper dike section that was set back to create new floodplain.

The top elevation of the Ercon® mats were also set as grade control for longitudinal profile elevations. The mattresses were backfilled with 1-3" washed river rock to provide a hardened path for cattle to water and cross the stream. The third structure was installed to protect the City of Eureka Mad River Water Pipelines. At the pipeline crossing, the channel was over-excavated and backfilled with a 6" layer of 1-3" river rock to protect the top of pipes. Bank rock-slope-protection (RSP) and rock grade control were installed along the bank and in the channel downstream of the pipeline crossing to prevent unwanted bank and channel erosion (Figure 16).

The fourth structure was a cattle bridge installed to replace the undersized culvert (Figure 17). The bridge was pre-engineered with dimensions of 12x20 ft, and was placed on top of two concrete blocks (1.5x5x13 ft) set upright in the channel banks as bridge abutments. The base of the concrete abutments were protected with ½ to 1 ton boulders, and the bridge was bolted down to the concrete abutments. The abutments were not engineered to bear any specific weight because it is only intended to be used as a cattle crossing. The bridge surface and approaches were backfilled with 1.5" crushed quarry rock.

Figure 15. Lower gas pipe crossing with Ercon mattress installed and partially backfilled with gravel. The log installed at the downstream edge of the mattress is for grade control.

Ten fish habitat structures were installed in the stream bed and banks by Matt Smith. Habitat structures used redwood stumps salvaged locally, "culled" logs acquired from Simpson/Green Diamond Timber, and large 1-2 ton quarry boulders (Figure 18). Structures were installed and anchored in place following standard methods described in the CDFG Stream Restoration Manual (CDFG 1998). Pool and riffle sequences were excavated around the habitat structures to provide aquatic habitat and promote stream scour at these structures.

Figure 16. Bank RSP and grade control were installed to protect the Eureka waterline crossing.

The remnant section of abandoned channel within the willow swamp (between station 28+25 and 32+25) was left as-is and reconnected to the new channel section. This channel is small but is inundated at high tides and streamflows and functions as a slough channel that may provide tidewater goby and/or salmonid habitat. The remnant section of abandoned channel between station 50+00 and 57+00 was partially backfilled to become a shallow depression along Old Arcata Road that drains surface runoff back to the newly constructed channel. The gas pipeline that was exposed in this reach was backfilled with sand and then covered with dirt.

The temporary diversion ditch at the upstream boundary of the project was only partially backfilled and the diversion entrance was sandbagged to prevent streamflow from entering the channel. If extremely high flows occur this winter, sandbags may be removed to allow a portion of the floodwaters down the diversion ditch to protect the project reach from damage while the new channel and floodplain are still recovering. Next summer, the diversion ditch will be permanently plugged with large rock to prevent channel capture at this location.

Following the channel and dike construction activities, approximately 3,100 ft of riparian cattle fence and six cattle gates were installed (Figure 20). The fencing allows the entire riparian corridor to be closed to cattle grazing, and creats three separate "riparian pastures" within the new floodplain pasture. CDFG will develop a riparian grazing agreement with the landowners, which will allow seasonal cattle grazing within the riparian floodplain. Cattle will be permanently excluded during the first two or more growing seasons to allow planted riparian vegetation to become established.

The newly created floodplain will be planted with 95% of the total area in trees and 5% in shrubs, composed of the following species:

<u>Coniferous Trees: 260 tree-pot sized containers</u>
15 Coast Redwood, *Sequoia sempervirens*
22 Grand Fir, *Abies grandis*
180 Sitka Spruce, *Picea sitchensis*
43 Western Red Cedar, *Thuja plicata*
<u>Deciduous Trees: 227 tree-pot sized containers</u>
66 Black Cottonwood, *Populus balsamifera*
116 Red Alder, *Alnus rubra*
45 Cascara, *Rhamnus purshiana*
Salix species, poles taken on site
<u>Shrubs: 164 one gallon sized containers</u>
14 Douglas Spirea, *Spirea douglasii*
25 Red Elderberry, *Sambucus racemosa*
80 Pacific Wax Myrtle, *Myrica californica*
10 Western Azalea, *Rhododendron occidentale*
14 Twinberry, *Lonicera involucrata*
7 Oso Berry, Oemleria cerasiformis
14 Oregon Crab Apple, *Malus Fusca*

200 plugs Coastal hairgrass, *Deschampsia cespitosa*.

After the earthwork phase was completed on October 19th, student-volunteers from the HSU Natural Resources Club, organized by CDFG representatives, installed erosion control measures along the entire 5,000 ft long project reach, including grass seed and mulch, willow sprigging, straw waddles, and additional cattle fencing. These measures will help reduce short-term erosion during the coming winter. Planted riparian vegetation, once established, will provide long-term protection.

Throughout the planning and construction phases, there were no appeals to the project regulatory and permit documents, no landowner complaints or unresolved issues, no code violations or infractions related to the project permits, no major unresolved problems or uncompleted tasks, and no accidents, injuries, or harm to person or property.

Figure 17. A bridge was installed to replace the culvert and provide cattle access to the north side of the pasture.

3.4.3 Summary of Benefits

Some of the primary benefits of the completed project are:

- fish passage at the tidegate at all times during the tide cycle, either through the main tidegate during ebb tide or through the 1x2 ft auxiliary door within the main door that is permanently open (currently open 1x1 ft);
- improved adult passage by eliminating the potential for dikes to breach and flood the pasture during winter, and creating a defined channel with adequate widths and depths for upstream migration;
- significant protection of the pasture by: (1) reducing or eliminating flooding onto the pasture, (2) reducing or eliminating salt water intrusion onto the pasture, (3) providing watering access for cattle at erosion-resistant hardened streambeds, (4) improving access to the pasture along Old Arcata Road via the new bridge crossing;
- a defined floodway within reconstructed dikes that will contain floods of approximately Q_5 to Q_{10} year recurrence and a muted tidal prism;
- greatly improved rearing habitat in the freshwater/tidal "ecotone" for high quality summer and winter rearing, and down into the brackish estuarine slough channels;
- maintenance of pre-existing salt marsh sustained by the muted tidal prism from the tidegate;
- long-term protection of utility infrastructure;
- increased riparian vegetation along Old Arcata Road, existing mature conifer cover that was preserved, and improved plant species diversity;
- better drainage of tributaries along Old Arcata Road (Halvorsen Gulch, Stevens Gulch, others) to flow directly into Rocky Gulch, improving overall drainage of rainfall runoff.

In addition to the benefits described above, there are several important ancillary benefits to this project. First, by working successfully with the private landowners to implement this project, we have clearly demonstrated the mutual benefits to both the landowners and the fishery resources. This success may encourage future cooperation with other landowners for restoration projects around Humboldt Bay. Additionally, despite a one-year delay to the original implementation schedule, we were able to design, permit, and implement this project in a little over two years from completion of the CDFG Agreement (Agreement completed June 1, 2003; project completed October 19, 2005). This timeline demonstrates the feasibility of implementing other large-scale projects around Humboldt Bay. Finally, in August 2005, following the first winter with a new "fish-friendly" tidegate in place, young-of-year coho salmon were positively identified in Rocky Gulch for the first time in nearly 50 years! Assuming adults continue to stray into Rocky Gulch, achieving our goal of re-establishing an entirely new, naturally reproducing coho salmon population is already underway.

4 MONITORING

The most important task remaining for the Rocky Gulch Phase I restoration project is to develop, fund, and implement a monitoring program. Monitoring should assess compliance with mitigation requirements and the performance of the project relative to the project goals and objectives. Compliance monitoring is required by several permitting agencies for at least five years, including the Coastal Commission, Fish and

Game, and the Army Corp of Engineers. Annual and final reports that describe the as-built conditions, fish habitat availability and fish presence, water quality and sedimentation, vegetation recovery in disturbed areas (primarily Lyngby's sedge), and survival success of planted riparian vegetation will be provided. CDFG is responsible for this compliance monitoring component.

Performance monitoring should evaluate project objectives such as (1) re-establishment of viable anadromous salmonid populations in Rocky Gulch, (2) adult salmonid passage through the tidegate and across the lower restored reaches, (3) amount and condition of salmonid spawning and rearing habitat in restored and unrestored reaches, (4) juvenile salmonid use of habitat in the reach above Old Arcata Road, and downstream within the Phase I project area, and (5) presence of tidewater goby within the lower slough channels.

Figure 18. Aerial photograph of the upper reach after project completion.

5 FUTURE CHANNEL AND RIPARIAN MAINTENANCE

An objective of the Rocky Gulch project was to design a stable channel that better conveys the estimated bankfull discharge and improves sediment transport continuity from headwaters to the ocean. Different channel dimensions were developed for three distinct reaches of the Rocky Gulch project reach. In general, the channel designs resulted in a wider and deeper channel cross section capable of conveying the bankfull discharge. The increased channel cross section should also provide a more geomorphically stable channel in balance with the sediment load. The channel dimensions constructed in Phase I, combined with reconstructed dikes that contain larger floods, should improve sediment transport throughout the project reach, and should reduce the need and frequency of in-channel maintenance.

Periodic maintenance of the Rocky Gulch channel and floodplain, however, will likely be necessary. Long-term maintenance may include: (1) selective thinning of riparian vegetation to allow equipment access to the creek channel, and (2) removal of sediment that has accumulated in the channel. Maintenance could be required after larger floods, and if needed, will proceed as follows:

Reach-1. Periodically during the summer period of low streamflow, and during moderately low high-tides not exceeding 5-6 ft MHW, the Rocky Gulch tidegate may be propped open for several days or weeks to allow a larger tidal prism to flush out fine sediments accumulated in the channel. This operation will help maintain the lower reach at approximate design channel dimensions, and will help keep the channel free of vegetation. Under no circumstance should the high tide elevation exceed the bankfull channel elevations in the reaches upstream of station 34+00.

Reach 2. Due to the sharp slope transition, Reach 2 will likely be the most susceptible to sediment deposition and will therefore have a higer potential for maintenance needs. Future maintenance will be limited to restoring the channel dimensions to the as-built 2005 constructed dimensions. In-channel woody debris or other structural habitat features will not be disturbed. Permanent survey monuments (e.g., rebar cross section pins) will be installed to allow surveying of the channel during maintenance operations.

Reach 3. The upstream-most reach has adequate slope to maintain sediment transport and discourage sediment accumulation in the channel. However, given past experience and uncertainty about sediment delivery rates from the upstream watershed, some maintenance in this reach may be necessary. Maintenance will be limited to restoring channel dimensions to the as-built 2005 constructed dimensions.

Channel and floodplain maintenance will incorporate routine measures and "best management practices" (BMP's) intended to avoid unnecessary and/or temporary adverse affects to fish and wildlife including federally listed salmonid species. These measures include:

- A qualified fishery biologist will be present during all maintenance activities to assure that no avoidable harm occurs to listed fish species;
- Prior to in-channel excavation, exclusionary fencing (blocking nets, hardware cloth, or other suitable materials) will be installed upstream and downstream of the maintenance sites to prevent fish from moving into the maintenance areas, and reasonable efforts will be made to trap and remove all fish and aquatic organisms from within the maintenance area and relocate them to sites outside the maintenance area;
- Prior to excavation, erosion control silt fences will be installed at the downstream end of the maintenance reach to reduce turbidity during maintenance operations;
- Excavation of fine sediment material will proceed with backhoe or small excavator equipment, and excavated "spoils" will be discarded on-site onto adjacent upland areas. Under no circumstance will spoiled sediment material be permanently placed onto the pasture (wetland) areas;
- During excavation, channel elevations will be surveyed intermittently (relative to survey monuments) to ensure that design channel widths and depths are achieved.
- Following the maintenance operations, all temporary fencing or block-net structures will be removed from the channel, the volume of sediment removed will be estimated, and known or assumed fish mortalities will be recorded. This information will be available from the landowner on request.

6 CONCLUSION

Coho salmon recovery is integrally tied to restoration of migratory access and aquatic habitat in small coastal watersheds of Northern California. Projects of the scope of the *Rocky Gulch Salmonid Access and Habitat Restoration Project* are essential for species recovery.

In December 2002 we laid out a plan to restore fish access and habitat conditions in Rocky Gulch, with the hope and intention that "if you build it, they will come". The 2002 plan recommended

seven primary actions be implemented in several phases of restoration, which were:

Task A: Replace the tidegate;

Task B: Enhance estuarine conditions in lower Rocky Gulch;

Task C: Realign the channel to reduce confinement and increase flow capacity;

Task D: Set-back dikes confining the creek along Old Arcata Road;

Task E: Rehabilitate the channel at old Williamson ranch (downstream of Old Arcata Road);

Task F: Enlarge the Old Arcata Road culvert;

Task G: Replace the barrier culvert to allow fish passage upstream.

Tasks A through D have now been completed in the first phase of implementation. Funding has also been provided by the Five-Counties Restoration Program to prepare engineering designs for the 500 ft reach (Task E) around the old Williamson Ranch (now owned by Ginni Hasrick), and the Humboldt County Public Works Department has re-submitted a proposal to the CDFG California Coastal Salmon Recovery Program (CCSRP) for funding to upgrade the Old Arcata Road culvert (Task F) with a larger capacity culvert that can convey up to the Q100 flood event. If funding is awarded in 2006, the targeted schedule for replacing this culvert would be 2007. Finally, grant funding from the State Coastal Conservancy has been provided for design and implementation to replace the upstream barrier culvert (Task G) with a bridge. This task will be completed in 2006. With completion of these remaining tasks, the entire length of Rocky Gulch historically available to anadromous salmonids will have been restored, and a viable fish population may once again inhabit Rocky Gulch.

Figure 19. Aerial photo of the middle section of Rocky Gulch with new meandering channel, reconstructed dikes, and new floodplain.

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