Appendix B-1

SCWA petition to permanently change D1610

SONOMA COUNTY WATER AGENCY

File: CF/42-0-9 Water Agency Current Permits and Applications; CF/ 42-4.1-1District Applications 15736, 15737, 15779 (Permits 12949, 12950, 16596); CF/42-4.1-1 District Applications 12919A and 12920A

Hand Delivered

September 23, 2009

Vicky Whitney, Chief
State Water Resources Control Board
Division of Water Rights
PO Box 2000
Sacramento, CA 95812-2000

Re: Petition for Modification of Water-Right Permits

Dear Ms. Whitney:

The Sonoma County Water Agency (Agency) hereby submits the enclosed petition for an order modifying water-right Permits 12947A, 12949, 12950, and 16596 to change the minimum instream flow requirements specified for the Russian River and Dry Creek. Exhibit 1 accompanies the petition for modification and identifies for each water-right permit the specific requested changes to the permit terms.

I hope that you will find the enclosed information clear and satisfactory. If you should have any questions or comments, please feel free to Todd Schram at (707) 524-1173.

Sincerely,

Pamela Jeane for
Randy Poole
General Manager/Chief Engineer

Enclosures: 1) Petition for Modification, 2) Exhibit 1

cc Pam Jeane, Erica Phelps - Sonoma County Water Agency
Steve Shupe - Sonoma County Counsel
Alan Lilly - Bartkiewicz, Kronick & Shanahan

State of California
State Water Resources Control Board
DIVISION OF WATER RIGHTS
P.O. Box 2000, Sacramento, CA 95812-2000
Info: (916) 341-5300, FAX: (916) 341-5400, Web: http://www.waterrights.ca.gov

PETITION FOR MODIFICATION OF WATER-RIGHT PERMITS

(Cal. Code Regs., title 23, §791(e))

Application Nos. 12919A, 15736, 15737, & 19351 Permit Nos. 12947A, 12949, 12950, & 16596

Present Holder and User of Water-Right Permits

Sonoma County Water Agency	Randy D. Poole		(707) 526-5370
Company Name	*Contact Person*		*Telephone No.*
404 Aviation Boulevard	Santa Rosa	CA	95403-9010
Address	*City*	*State*	*Zip Code*

Authorized Agents

Randy D. Poole, General Manager/Chief Engineer
Sonoma County Water Agency
404 Aviation Boulevard
Santa Rosa, CA 95403-9010
Telephone: (707) 526-5370
Fax: (707) 544-6123
E-Mail: rdp@scwa.ca.gov

Alan B. Lilly
Bartkiewicz, Kronick & Shanahan, P.C.
1011 22nd Street
Sacramento, CA 95816-4907
Telephone: (916) 446-4254
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E-mail: abl@bkslawfirm.com

Petition for Modification of Water-Right Permits

The Sonoma County Water Agency (Agency) hereby petitions the State Water Resources Control Board (State Board) under the provisions of California Code of Regulations, title 23, section 791(e) for an order modifying the water-right permits listed above by making changes to the minimum instream flow requirements in these permits that are shown in the attached Exhibit 1.

The Agency requests that the State Board's order approving these changes find that implementing these changes will provide rearing habitat for salmonids and steelhead in the Russian River watershed that will be superior to that which occurs with the present minimum instream flow requirements, which were adopted by the State Board's Water Right Decision 1610 (D1610) in 1986.

The Agency requests that the State Board make these changes to the minimum instream flow requirements in the Agency's water-right permits to implement the reasonable and prudent alternative (RPA) specified by the

National Marine Fisheries Service (NMFS) in its *Biological Opinion for Water Supply, Flood Control Operations, and Channel Maintenance conducted by the U.S. Army Corps of Engineers, the Sonoma County Water Agency, and the Mendocino County Russian River Flood Control and Water Conservation Improvement District in the Russian River watershed,* which was issued on September 24, 2008. The Biological Opinion was issued after a formal consultation by NMFS on the actions carried out by the U.S. Army Corps of Engineers, the Agency, and the Mendocino County Russian River Flood Control and Water Conservation Improvement District under section 7(a)(2) of the federal Endangered Species Act of 1973.

In its Biological Opinion, NMFS concluded that present activities in the Russian River watershed jeopardize the survival of the Central California Coast Steelhead (*Oncorhynchus mykiss*) and Central California Coast Coho Salmon (*Oncorhynchus kisutch*), and that implementation of the RPA is necessary to avoid this jeopardy. Specifically, NMFS concluded that, with current minimum instream flow requirements, the flow management for water supply during the late spring, summer, and fall that was proposed by the Corps to NMFS would continue to have an adverse effect on rearing habitat. The artificially elevated flows in the Russian River that are required by the current minimum instream flow requirements result in high water velocities that contribute to limiting the quality and quantity of the rearing habitat. Additionally, maintaining these flows disrupts lagoon formation in the Russian River estuary, and allowing this lagoon to develop would likely enhance juvenile steelhead and salmon habitat.

In its D1610, the State Board amended the Agency's water-right permits and also reserved jurisdiction to ". . . modify, delete or add minimum flow requirements or related criteria for the protection of fish and wildlife and the maintenance of recreation in the Russian River should (1) additional fishery studies be conducted in the Russian River, . . . " This reservation of jurisdiction is specified in the Agency's amended water-right permits. (See Amended Permit 12947A, p. 8, term 31; Amended Permit 12949, p. 5, term 19; Amended Permit 12950, p. 5, term 19; Amended Permit 16596, pp. 5-6, term 22.) The NMFS Biological Opinion is such a fisheries study, and, through this petition, the Agency asks the State Board to exercise this reserved jurisdiction.

Based on the findings in the NMFS Biological Opinion, the modifications to the minimum instream flow requirements that are requested in this petition are necessary to avoid the likelihood of jeopardy to the steelhead and coho salmon. Specifically, the RPA describes the need to reduce the minimum flows now required by D1610 to augment usable rearing habitat, to improve salmonid population growth rates and to improve the spatial structure of the populations. For these reasons, the requested changes to the present minimum instream flow requirements will provide a level of protection for fish that will be superior to that provided by the present requirements. Because the Russian River mainstem and Dry Creek still will be maintained as perennial live streams, water still will be available for diversions to the extent authorized by other water rights, and the requested changes therefore will not injure any legal user of water.

The Agency is the lead agency under the California Environmental Quality Act (CEQA), and the State Board will be a CEQA responsible agency, for this petition. As the Agency prepares its CEQA document for this petition, the Agency will provide the notices and submissions to the State Board that are required by CEQA.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge and belief.

Dated: 9/23/09, at Santa Rosa, California.

By: Pamela Jeane for

Randy D. Poole, General Manager/Chief Engineer, Sonoma County Water Agency

Exhibit 1

Requested Changes to the Sonoma County Water Agency Amended Permits 12947A, 12949, 12950, and 16596 (all amended permits issued on August 30, 2006)

Term 13 on pages 4-5 of Amended Permit 16596:

> "For the protection of fish and wildlife in Dry Creek and the Russian River and for the maintenance of recreation in the Russian River, permittee shall pass through or release from storage at Lake Sonoma sufficient water to maintain:
>
> A) The following minimum flows in Dry Creek between Warm Springs Dam and its confluence with the Russian River:
>
> 1) During normal water supply conditions:
>
> 75 cfs* from January 1 through April 30
> ~~80~~40 cfs from May 1 through October 31
> 105 cfs from November 1 through December 30
>
> 2) During dry or critical water supply conditions:
>
> 25 cfs from April 1 through October 31
> 75 cfs from November 1 through March 31
>
> * cubic feet per second
>
> B) The following minimum flows in the Russian River between its confluence with Dry Creek and the Pacific Ocean, unless the water level in Lake Sonoma is below elevation 292.0 feet with reference to the National Geodetic Vertical Datum of 1929, or unless prohibited by the United States Government:
>
> 1) During normal water supply conditions - ~~125~~ 70 cfs
> 2) During dry water supply conditions - ~~85~~ 70 cfs
> 3) During critical water supply conditions - 35 cfs
>
> . . ."

Term 20 on pages 5-6 of Amended Permit 12947A:

> "For the protection of fish and wildlife, and for the maintenance of recreation in the Russian River, permittee shall pass through or release from storage at Lake Mendocino sufficient water to maintain:
>
> A. A continuous streamflow in the EFRR from Coyote Dam to its confluence with the Russian River of 25 cfs at all times.

B. The following minimum flows in the Russian River between the EFRR and Dry Creek:

1. During normal water supply conditions and when the combined water in storage, including dead storage, in Lake Pillsbury and Lake Mendocino on May 31 of any year exceeds 150,000 acre-feet or 90 percent of the estimated water supply storage capacity of the reservoirs, whichever is less:

From June 1 through August 31	~~185~~ 125 cfs
From September 1 through ~~March~~ October 31	~~150~~ 125 cfs
From November 1 through March 31	150 cfs
From April 1 through May 31	185 cfs

2. During normal water supply conditions and when the combined water in storage, including dead storage, in Lake Pillsbury and Lake Mendocino on May 31 of any year is between 150,000 acre-feet or 90 percent of the estimated water supply storage capacity of the reservoirs, whichever is less, and 130,000 acre-feet or 80 percent of the estimated water supply storage capacity of the reservoirs, whichever is less:

From June 1 through ~~March~~ October 31	125~~150~~ cfs
From November 1 through March 31	150 cfs
From April 1 through May 31	185 cfs
If from October 1 through December 31, storage in Lake Mendocino is less than 30,000 acre-feet	75 cfs

3. During normal water supply conditions and when the combined water in storage, including dead storage, in Lake Pillsbury and Lake Mendocino on May 31 of any year is less than 130,000 acre-feet or 80 percent of the estimated water supply storage capacity of the reservoirs, whichever is less:

From June 1 through December 31	75 cfs
From January 1 through March 31	150 cfs
From April 1 through May 31	185 cfs

4. During dry water supply conditions 75 cfs

5. During critical water supply Conditions 25 cfs

C. The following minimum flows in the Russian River

between its confluence with Dry Creek and the Pacific Ocean to the extent that such flows cannot be met by releases from storage at Lake Sonoma under Permit 16596 issued on Application 19351:

1. During normal water supply conditions	~~125~~ 70 cfs
2. During dry water supply conditions	~~85~~ 70 cfs
3. During critical water supply conditions	35 cfs

. . . "

Term 17 on pages 4-5 of Amended Permit 12949:

"For the protection of fish and wildlife, and the maintenance of recreation in the Russian River, permittee shall allow sufficient water to bypass the points of diversion to maintain the following minimum flows to the Pacific Ocean:

(1) During normal water supply conditions	~~125~~ 70 cfs*
(2) During dry water supply conditions	~~85~~ 70 cfs
(3) During critical water supply conditions	35 cfs

*cubic feet per second

. . . "

Term 17 on pages 4-5 of Amended Permit 12950:

"For the protection of fish and wildlife, and the maintenance of recreation in the Russian River, permittee shall allow sufficient water to bypass the points of diversion to maintain the following minimum flows to the Pacific Ocean:

(1) During normal water supply conditions	~~125~~ 70 cfs*
(2) During dry water supply conditions	~~85~~ 70 cfs
(3) During critical water supply conditions	35 cfs

*cubic feet per second

. . . "

Appendix B-2

Public Notice of State Water Board Order WR 2009-0027

State Water Resources Control Board

Division of Water Rights
1001 I Street, 14th Floor ♦ Sacramento, California 95814 ♦ 916.341.5426
Mailing Address: P.O. Box 2000 ♦ Sacramento, California 95812-2000
FAX: 916.341.5400 ♦ www.waterrights.ca.gov

Linda S. Adams
Secretary for Environmental Protection

Arnold Schwarzenegger
Governor

NOTICE OF STATE WATER RESOURCES CONTROL BOARD, DIVISION OF WATER RIGHTS ORDER APPROVING A TEMPORARY URGENCY CHANGE PETITION BY SONOMA COUNTY WATER AGENCY REGARDING PERMITS 12947A, 12949, 12950, AND 16596 (APPLICATIONS 12919A, 15736, 15737, 19351)

On April 6, 2009 the State Water Resources Control Board (State Water Board), Division of Water Rights (Division) issued Order WR 2009-0027-DWR approving Sonoma County Water Agency's (SCWA) petition for a Temporary Urgency Change to the subject permits. SCWA submitted the petition pursuant to California Water Code section 1435. The Order approves the reduction in minimum instream flow requirements for the Russian River as follows:

(1) From April 6 through June 30, 2009, instream flow requirements for the upper Russian River (from its confluence with the East Fork of the Russian River to its confluence with Dry Creek) will be reduced from 185 cubic feet per second (cfs) to 75 cfs, and the requirements for the lower Russian River (downstream of its confluence with Dry Creek) will be reduced from 125 cfs to 85 cfs; and

(2) From July 1 through October 2, 2009, instream flow requirements for the upper Russian River will be reduced from 185 cfs to 75 cfs, and the requirements for the lower Russian River will be reduced from 125 cfs to 85 cfs, if during the period from April 1 through June 30 total inflow to Lake Mendocino is greater than 25,000 acre feet; or

(3) From July 1 through October 2, 2009, instream flow requirements will be further reduced to 25 cfs for upper Russian River and 35 cfs for the lower Russian River, if during the period from April 1 through June 30 total inflow to Lake Mendocino is less than or equal to 25,000 acre feet.

The request is made to prevent depletion of storage in Lake Mendocino, which would severely impact threatened or endangered Russian River fish species, create serious water supply impacts in Mendocino County and in Sonoma County's Alexander Valley, and harm Lake Mendocino and Russian River recreation.

SCWA, as lead agency, as defined in the California Environmental Quality Act (CEQA), is proposing to prepare a Notice of Exemption for this project. The State Water Board, as responsible agency, has reviewed the information submitted by the SCWA and has determined that the petition qualifies for an exemption under CEQA.

A Class 7 exemption "consists of actions taken by regulatory agencies as authorized by state law or local ordinance to assure the maintenance, restoration, or enhancement of a natural resource where the regulatory process involves procedures for protection of the environment." (Title 14, California Code of Regulations, section 15307) The proposed action will assure the maintenance of a natural resource, i.e., the instream resources of the Russian River. A Class 8 exemption "consists of actions taken by regulatory agencies, as authorized by state or local ordinance, to assure the maintenance, restoration, enhancement, or protection of the

environment where the regulatory process involves procedures for protection of the environment." (Title 14, California Code of Regulations, section 15308.) The proposed action will assure the maintenance of the environment, i.e., the instream environment of the Russian River.

On February 27, 2009, Governor Schwarzenegger declared a drought related state of emergency. Additionally, on March 23, 2009 the Mendocino County Board of Supervisors declared a local emergency and imminent threat of disaster due to drought conditions. Storage in Lake Mendocino is extremely low. Information provided by SCWA demonstrates that continued releases of water under normal year operating rules would prematurely drain remaining storage. If storage in Lake Mendocino is depleted, water will not be available to support threatened and endangered species, agriculture, and domestic/municipal water service. Approval of the petition for Temporary Urgency Change is therefore necessary to prevent and mitigate damage to the environment, fishery resources, property, public health, and essential public services. Accordingly the project is statutorily exempt from CEQA because it is necessary to prevent or mitigate an emergency. (Pub. Resources Code, §§ 21080, subd. (b)(4), 21172.)

The State Water Board will welcome comments regarding the petition for Temporary Urgency Change at a Public Workshop to be held in Sacramento on Wednesday May 6, 2009. A separate notice with details of this workshop will be sent out in the near future. This petition notice, SCWA's petition, and Order WR 2009-0027-DWR can be viewed at http://www.waterrights.ca.gov/application/tempurgnotices.htm.

Any interested person may file an objection to the Temporary Urgency Change. Comments and objections filed in response to this notice shall be submitted to the persons listed below and must be received by 5:00 p.m. on Friday, April 24, 2009.

Send comments and/or objections to both:

Jeanine Townsend
Clerk to the Board
State Water Resources Control Board
1001 I Street
Sacramento, CA 95814

Randy Poole
General Manager/Chief Engineer
Sonoma County Water Agency
P. O. Box 11628
Santa Rosa, CA 95406

Email: commentletters@waterboards.ca.gov

Telephone comments or inquiries can be directed to the Division of Water Rights dedicated telephone line for the SCWA petition at (916) 341-5759, or sent via email to scwatucp@waterboards.ca.gov.

STEVEN HERERRA, MANAGER
Water Rights Permitting Section

DATED:

APR 1 0 2009

Appendix B-3

Revised Order WR 2009-034_EXEC

STATE OF CALIFORNIA
CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
STATE WATER RESOURCES CONTROL BOARD

DIVISION OF WATER RIGHTS

ORDER WR 2009-0034-EXEC

In the Matter of Permits 12947A, 12949, 12950, and 16596
(Applications 12919A, 15736, 15737, 19351)

Sonoma County Water Agency

SOURCES: Dry Creek and Russian River

COUNTIES: Sonoma and Mendocino Counties

ORDER AMENDING ORDER WR 2009-0027-DWR AND CONDITIONALLY APPROVING TEMPORARY URGENCY CHANGE IN PERMITS 12947A, 12949, 12950, AND 16596

BY BOARD MEMBER ARTHUR G. BAGGETT, JR.:

1.0 INTRODUCTION

On April 6, 2009, Sonoma County Water Agency (SCWA or Permittee) filed a petition with the State Water Resources Control Board (State Water Board or Board) requesting approval of a Temporary Urgency Change to the subject permits pursuant to California Water Code section 1435. This order amends Order WR 2009-0027-DWR, which was issued by the Division of Water Rights (Division), and conditionally approves SCWA's petition.

The petition requests that from April 6, 2009 through October 2, 2009, instream flow requirements for the Upper Russian River (from its confluence with the East Fork of the Russian River to its confluence with Dry Creek) be reduced from 185 cubic feet per second (cfs) to 75 cfs, and the requirements for the lower Russian River (downstream of its confluence with Dry Creek) be reduced from 125 cfs to 85 cfs. The petition also requests that instream flow requirements be further reduced from July 1 through October 2, 2009, to 25 cfs for the upper Russian River and 35 cfs for the lower Russian River if during the period from April 1 through June 30 total inflow to Lake Mendocino is less than or equal to 25,000 acre-feet. The petition, in effect, requests that minimum flows for the Russian River be established based on dry-year

criteria for the period from April 6 to October 2, 2009 and, in the event that cumulative inflow to Lake Mendocino is less than or equal to 25,000 acre feet from April 1 through June 30, critical year criteria for the period from July 1 to October 2, 2009. No changes to the instream flow requirements for Dry Creek are requested. The request is made to prevent depletion of storage in Lake Mendocino, which would severely impact threatened or endangered Russian River fish species, create serious water supply impacts in Mendocino County and in Sonoma County upstream of the Dry Creek confluence, and harm Lake Mendocino and Russian River recreation.

2.0 DELEGATION

Pursuant to Resolution No. 2007-0057, the State Water Board has delegated authority to the Division Chief to act on petitions for temporary urgency change, provided no objections are outstanding. As explained below, the Division issued Order WR 2009-0027-DWR on April 6, 2009, conditionally approving the change petition. The State Water Board then provided notice of the change petition, received written comments and objections, and held a public workshop on the change petition. This Order revising Order WR 2009-0027-DWR is issued pursuant to Resolution No. 2007-0057, which delegates the authority to an individual Board Member to act on a petition for temporary urgency change.

3.0 BACKGROUND

SCWA's petition involves the following permits:

- Permit 12947A is for direct diversion of 92 cubic feet per second (cfs) from the East Fork Russian River and storage of 122,500 acre-feet per annum (afa) in Lake Mendocino from January 1 through December 31 of each year.

- Permit 12949 is for direct diversion of 20 cfs year-round from the Russian River at the Wohler and Mirabel Park Intakes near Forestville.

- Permit 12950 is for direct diversion of 60 cfs from the Russian River at the Wohler and Mirabel Park Intakes from April 1 through September 30 of each year.

- Permit 16596 is for year-round direct diversion of 180 cfs from the Russian River and storage of 245,000 afa in Lake Sonoma from October 1 of each year to May 1 of the succeeding year.

SCWA submitted with the petition a document prepared by its staff titled, "Hydrologic Analysis of Lake Mendocino Storage Under Dry 2009 Conditions" (Hydrologic Analysis) dated April 2009. The Hydrologic Analysis indicates that projections for Lake Mendocino water levels in 2009 are far more severe than they were in water year 2007, the last time the State Water Board approved a temporary urgency change reducing the Russian River instream flow requirements. As of April 1, 2009, storage level in Lake Mendocino was approximately 53,000 acre-feet (af). This is roughly 20,000 af less than Lake Mendocino storage was in 2007 at this time. During water years 2002, 2004, and 2007, hydrologic conditions in the Eel River and Russian River watersheds caused Lake Mendocino storage levels to decline to dangerously low levels by the end of the dry season. Recreation at Lake Mendocino was severely impaired, and serious risks existed for water supply and state and federally listed Russian River salmonid fishery resources, particularly adult Chinook salmon. The storage levels in Lake Mendocino dropped to a low of 24,400 af in December 2002. Water year 2004 and 2007 presented similar risks that were mitigated by SCWA filing for, and the State Water Board approving, a temporary urgency change petition that reduced the minimum instream flow requirements on the Russian River, thereby allowing more water to remain in Lake Mendocino for a longer period of time.

In June 2004, the Federal Energy Regulatory Commission directed Pacific Gas and Electric Company (PG&E) to reduce the amount of water diverted through the Potter Valley Project (PVP) tunnel into the Russian River, further reducing inflow to Lake Mendocino. Since October 2008, approximately 27,000 af less water has flowed through the PVP tunnel and into Lake Mendocino than during the same period during water year 2007, the last time the State Water Board approved a Temporary Urgency Change to reduce the Russian River instream flow requirements.

Without the requested reductions in the instream flow requirements, SCWA Hydrologic Analysis predicted that Lake Mendocino storage would drop to 10,000 acre-feet by mid August 2009 and go dry by the end of September. Lake Mendocino has never dropped below 12,000 af since it was first filled in 1959, and it is uncertain whether water could continue to be released from Lake Mendocino into the East Fork Russian River if lake storage were to drop to 10,000 af. If water cannot be released from Lake Mendocino during October and November 2009, there most likely will be severe impacts on the fishery and recreation resources that depend on the upper Russian River, and on water users that rely on the upper Russian River for their water

supplies. On March 23, 2009, the Mendocino County Board of Supervisors declared a local emergency and imminent threat of disaster due to drought conditions.

Following is the language contained in SCWA's permits regarding minimum instream flow requirements:

Term 18 of SCWA's Permit 12947A states:

For the protection of fish and wildlife, and for the maintenance of recreation in the Russian River, Permittee shall pass through or release from storage at Lake Mendocino sufficient water to maintain:

(A) A continuous streamflow in the East Fork Russian River from Coyote Dam to its confluence with the Russian River of 25 cfs at all times.

(B) The following minimum flows in the Russian River between the East Fork Russian River and Dry Creek:

(1) During normal water supply conditions when the combined water in storage, including dead storage, in Lake Pillsbury and Lake Mendocino on May 31 of any year exceeds 150,000 af or 90 percent of the estimated water supply storage capacity of the reservoirs, whichever is less:

From June 1 through August 31	185 cfs
From September 1 through March 31	150 cfs
From April 1 through May 31	185 cfs

(2) During normal water supply conditions and when the combined water in storage, including dead storage, in Lake Pillsbury and Lake Mendocino on May 31 of any year is between 150,000 af or 90 percent of the estimated water supply storage capacity of the reservoirs, whichever is less, and 130,000 af or 80 percent of the estimated water supply storage capacity of the reservoirs, whichever is less:

From June 1 through March 31	150 cfs
From April 1 through May 31	185 cfs
If from October 1 through December 31, storage in Lake Mendocino is less than 30,000 acre-feet	75 cfs

(3) During normal water supply conditions and when the combined water in storage, including dead storage, in Lake Pillsbury and Lake Mendocino on May 31 of any year is less than 130,000 af or 80 percent of the estimated water supply storage capacity of the reservoirs, whichever is less:

From June 1 through December 31	75 cfs
From January 1 through March 31	150 cfs
From April 1 through May 31	185 cfs

(4) During dry water supply conditions 75 cfs

(5) During critical water supply conditions 25 cfs

(C) The following minimum flows in the Russian River between its confluence with Dry Creek and the Pacific Ocean to the extent that such flows cannot be met by releases from storage at Lake Sonoma under Permit 16596 issued on Application 19351:

(1) During normal water supply conditions	125 cfs
(2) During dry water supply conditions	85 cfs
(3) During critical water supply conditions	35 cfs

For the purposes of the requirements in this term, the following definitions shall apply:

(1) Dry water supply conditions exist when cumulative inflow to Lake Pillsbury beginning on October 1 of each year is less than:

8,000 acre-feet as of January 1
39,200 acre-feet as of February 1
65,700 acre-feet as of March 1
114,500 acre-feet as of April 1
145,600 acre-feet as of May 1
160,000 acre-feet as of June 1

(2) Critical water supply conditions exist when cumulative inflow to Lake Pillsbury beginning on October 1 of each year is less than:

4,000 acre-feet as of January 1
20,000 acre-feet as of February 1
45,000 acre-feet as of March 1
50,000 acre-feet as of April 1
70,000 acre-feet as of May 1
75,000 acre-feet as of June 1

(3) Normal water supply conditions exist in the absence of defined dry or critical water supply conditions.

(4) The water supply condition designation for the months of July through December shall be the same as the designation for the previous June. Water supply conditions for January through June shall be predetermined monthly.

(5) Cumulative inflow to Lake Pillsbury is the calculated algebraic sum of releases from Lake Pillsbury, increases in storage in Lake Pillsbury, and evaporation from Lake Pillsbury.

(6) Estimated water supply storage space is the calculated reservoir volume below elevation 1,828.3 feet in Lake Pillsbury and below elevation 749.0 feet in Lake Mendocino. Both elevations refer to the National Geodetic Vertical Datum of 1929. The calculation shall use the most recent two reservoir volume surveys made by the U. S. Geological Survey, U. S. Army Corps of Engineers, or other responsible agency to determine the rate of sedimentation to be assumed from the date of the most recent reservoir volume survey.

Term 15 of both Permit 12949 and Permit 12950 require SCWA to allow sufficient water to bypass the points of diversion at the Wohler and Mirabel Park intakes on the Russian River to maintain the following minimum flows to the Pacific Ocean:

(1)	During normal water supply conditions	125 cfs
(2)	During dry water supply conditions	85 cfs
(3)	During critical water supply conditions	35 cfs

Term 13 of Permit 16596 sets forth the following minimum flows for Dry Creek and the Russian River:

(A) The following minimum flows in Dry Creek between Warm Springs Dam and its confluence with the Russian River:

(1) During normal water supply conditions:

75 cfs from January 1 through April 30
80 cfs from May 1 through October 31
105 cfs from November 1 through December 30

(2) During dry or critical water supply conditions:

25 cfs from April 1 through October 31
75 cfs from November 1 through March 31

(B) The following minimum flows in the Russian River between its confluence with Dry Creek and the Pacific Ocean, unless the water level in Lake Sonoma is below elevation 292.0 feet with reference to the National Geodetic Vertical Datum of 1929, or unless prohibited by the United States Government:

(1)	During normal water supply conditions	125 cfs
(2)	During dry water supply conditions	85 cfs
(3)	During critical water supply conditions	35 cfs

Permits 12949, 12950, and 16596 use the same water-year classification definitions as those listed in Permit 12947A. The water year classifications (Normal, Dry or Critically Dry) were established in State Water Board Decision 1610 (1986) and are based on cumulative inflow into Lake Pillsbury beginning October 1. Although Lake Mendocino storage is unusually low, cumulative inflow into Lake Pillsbury during this water year has been sufficiently high that, under Decision 1610, 2009 is currently classified as a normal year and will likely retain this classification for the remainder of 2009.

4.0 DIVISION OF WATER RIGHTS ISSUANCE OF ORDER WR 2009-0027-DWR APPROVING SCWA'S TEMPORARY URGENCY CHANGE PETITION AND PUBLIC NOTICE

Pursuant to Water Code section 1438, subdivision (a), the Division issued a temporary change order, Order WR 2009-0027-DWR, conditionally approving the Temporary Urgency Change petition.

The State Water Board issued and delivered to SCWA on April 10, 2009, a notice of the proposed change. Pursuant to Water Code section 1438, subdivision (b)(1), SCWA was required to publish the notice in a newspaper having a general circulation that is published within the counties where the points of diversion lie. The Notice was published in the Ukiah Daily Journal on April 14, 2009 and Santa Rosa's Press Democrat on April 17, 2009. The State Water Board mailed and emailed the Notice to the interested persons who had requested notice of proposed temporary urgency changes and to other known interested persons.

The State Water Board also provided notice of a public workshop scheduled for May 6, 2009, to receive comments regarding SCWA's Temporary Urgency Change Petition and Order WR 2009-0027 DWR. The State Water Board posted on its website (1) the notice of Order

WR 2009-0027-DWR, (2) the notice of the May 6, 2009 public workshop, (3) a copy of SCWA's petition for temporary urgency change, and (4) Order WR 2009-0027-DWR.

5.0 PUBLIC COMMENTS ON THE PETITION

The State Water Board received approximately 105 written comments on the petition and Order WR 2009-0027-DWR, including comments from the North Coast Regional Water Quality Control Board (North Coast Regional Water Board), the California Department Fish and Game (DFG), the National Marine Fisheries Service (NMFS), SCWA water contractors (i.e., SCWA customers), municipalities, local business owners, the California Landscape Contractors Association, the Association of California Water Agencies, environmental groups, and private citizens. The SCWA contractors expressed opposition to inclusion of a term in the order requiring a 25 percent reduction in Russian River diversions to the SCWA service area. The SCWA contractors, local business owners, and the California Landscape Contractors Association, also opposed inclusion of a term prohibiting irrigation of commercial turf grass within the SCWA service area during the term of the order. Additionally, these commenters requested that definitions be provided for commercial turf grass and residential water wasting devices, as referenced in Order WR 2009-0027-DWR.

DFG, environmental groups, and private citizens expressed concerns regarding impacts to water quality, community water systems, and fisheries as result of reduced Russian River flows. The North Coast Regional Water Board, environmental groups, and private citizens expressed support for the prohibition against irrigating commercial turf grass. These entities also called for increased water quality monitoring, public access to water quality data, and adaptive management of Russian River flow based on monitoring results. NMFS, environmental groups, and private citizens expressed support for the 25 percent mandatory reduction in Russian River diversions to the SCWA service area. Environmental groups and private citizens also requested that additional flow gages be established on the Russian River and that authorized and unauthorized water diversion be better accounted for to ensure compliance with flow objectives. Tourism and recreation based business owners commented that reduced summertime flows in the Russian River would hurt the local economy. The City of Ukiah commented that water conservation would reduce the City's revenue and its ability to deliver water to its customers.

6.0 PUBLIC WORKSHOP ON THE PETITION

The State Water Board held a public workshop on May 6, 2009, to receive comments regarding SCWA's Temporary Urgency Change Petition and Order WR 2009-0027 DWR. During the workshop the State Water Board heard comments from approximately 25 attendees, including representatives from SCWA, the SCWA Water Advisory Committee, Russian Riverkeeper, the County of Mendocino, the City of Petaluma, the City of Santa Rosa, the Association of California Water Agencies, Marin Municipal Water Distinct, Mendocino County Russian River Flood Control and Water Conservation Improvement District, the City of Ukiah, DFG, Friends of the Eel River, private business owners and private citizens. The oral comments were similar to those expressed in writing. In general, most of commenters recognized the need for conserving water in Lake Mendocino. Similar to the written comments, some expressed concerns that reduced flows would result in impacts to recreation and water quality in the lower Russian River and requested implementation of mandatory water conservation requirements along with improved flow and water quality monitoring. Other commenters objected to the prohibition against irrigating commercial turf grass and imposition of mandatory reductions in SCWA Russian River diversions.

At the State Water Board's public workshop, Division of Water Rights staff presented background information regarding the conditions leading up to approval of the temporary urgency change order and issuance of Order WR 2009-0027-DWR. Staff also presented a Russian River Flow Analysis prepared by SCWA at staff's request, which evaluated flow conditions in the lower Russian River under the reduced instream flow conditions specified in the temporary urgency change petition and Order WR 2009-0027-DWR. The staff presentation and the Russian River Flow Analysis demonstrated that a reduction in diversion at SCWA's Wohler/Mirabel pumping facilities is needed to achieve downstream minimum flows and a safe operating buffer, given the constraints on releases from Warm Spring Dam and anticipated inflows from the Upper Russian River. Based on the information contained in the SCWA Russian River Flow Analysis a 25 percent reduction in diversion at the Wohler/Mirabel pumping facilities will result in average flows of approximately 45 cfs at the Hacienda Bridge. This is 10 cfs more than the 35 cfs minimum flow requirement specified Order WR 2009-0027-DWR, but the analysis does not account for depletion (due to evapotranspiration and diversions) between the Hacienda Bridge and the Russian River Estuary or an operating buffer. Additionally, imposition of a 25 percent reduction in SCWA diversions will benefit water quality, recreation,

and fisheries, to the extent that such a reduction would provide flows in excess of the 35 cfs minimum requirement in the lower river.

During the workshop, Division of Water Rights staff also recommended the following modifications to Order WR 2009-0027-DWR that were intended to address some of the written comments received:

a. Clarify the terms of the Order by explicitly setting 2004 as the baseline year for purposes of measuring mandatory water diversion reduction and water conservation goals and providing definitions for commercial turf and residential water wasting devices;

b. Modify the water conservation measurement period to provide more time for water users to respond to the call for water conservation;

c. Extend the date on which critically dry year minimum instream flows could take effect until after the Fourth of July weekend to reduce impacts to recreation and water quality;

d. As requested by DFG, base the trigger for critically dry year flows on Lake Mendocino Storage, rather than inflows to Lake Mendocino;

e. Delete term 3 to allow releases from Warm Springs Dam for the purpose of providing increased flow in the lower river as requested by the NMFS;

f. Revise water quality monitoring requirements to consider comments from DFG and the North Coast Regional Water Board and define contingency actions;

g. Require a plan to monitor fish habitat and fish health conditions;

h. Revise ramping rates based on input from DFG and NMFS;

i. As requested by DFG, direct SCWA to request renewal of the Temporary Urgency Change Petition if increasing flow would otherwise impair the fishery; and

j. Require SCWA to develop a water right accounting procedure and a method for determining when the Russian River is being supplemented by project water.

7.0 COMPLIANCE WITH CALIFORNIA ENVIRONMENTAL QUALITY ACT

The State Water Board has determined that the petition qualifies for an exemption under CEQA. A Class 7 exemption "consists of actions taken by regulatory agencies as authorized by state law or local ordinance to assure the maintenance, restoration, or enhancement of a natural resource where the regulatory process involves procedures for protection of the environment." (Cal. Code Regs, tit. 14, § 15307.) The proposed action will assure the maintenance of a

natural resource, i.e., the instream resources of the Russian River. A Class 8 exemption "*consists of actions* taken by regulatory agencies, as authorized by state or local ordinance, to assure the maintenance, restoration, enhancement, or protection of the environment where the regulatory process involves procedures for protection of the environment." (Id., § 15308.) The proposed action will assure the maintenance of the environment, i.e., the instream environment of the Russian River.

On February 27, 2009, Governor Schwarzenegger declared a drought related state of emergency. Additionally, On March 23, 2009 the Mendocino County Board of Supervisors declared a local emergency and imminent threat of disaster due to drought conditions. Storage in Lake Mendocino is extremely low. Information provided by SCWA demonstrates that continued releases of water under *normal year operating rules* would prematurely drain remaining storage. If storage in Lake Mendocino is depleted, water will not be available to support threatened and endangered species, agriculture, and domestic/municipal water service. Approval of the Temporary Urgency Change Petition is therefore necessary to prevent and mitigate damage to the environment, fishery resources, property, public health, and essential public services. Accordingly the project is statutorily exempt from CEQA because it is necessary to prevent or mitigate an emergency. (Pub. Resources Code, §§ 21080, subd. (b)(4), 21172.)

8.0 LAW GOVERNING TEMPORARY URGENCY CHANGE PETITIONS

Water Code section 1435 provides that a permittee or licensee who has an urgent need to change the point of diversion, place of use, or purpose of use from that specified in the permit or license may petition the State Water Board for a conditional temporary change. The State Water Board's regulations set forth the filing and other procedural requirements applicable to petitions for temporary urgency changes. (Cal. Code Regs., tit. 23, §§ 805, 806.) The Board's regulations also clarify that a petition for a temporary urgency change in a permit or license other than a change in point of diversion, place of use, or purpose of use may be filed, subject to the same filing and procedural requirements that apply to changes in point of diversion, place of use, or purpose of use. (*Id.*, § 791, subd. (e).)

Before approving a temporary urgency change, the Board must make the following findings:

1. The permittee or licensee has an urgent need to make the proposed change;
2. The proposed change may be made without injury to any other lawful user of water;
3. The proposed change may be made without unreasonable effect upon fish, wildlife, or other instream beneficial uses; and
4. The proposed change is in the public interest.

(Wat. Code, § 1435, subd. (b)(1-4).)

8.1 Urgency of the Proposed Change

Under Water Code section 1435, subdivision (c), an urgent need to make a proposed change exists when the State Water Board concludes that the proposed temporary change is necessary to further the constitutional policy that the water resources of the State be put to beneficial use to the fullest extent of which they are capable and that waste of water be prevented. However, the State Water Board shall not find the need urgent if it concludes that the petitioner has failed to exercise due diligence in petitioning for a change pursuant to other appropriate provisions of the Water Code.

In this case, an urgent need exists for the proposed change because SCWA predicts full depletion of storage in Lake Mendocino in September 2009 unless the requested temporary urgency change is approved. Water supplies sufficient to support survival of listed Russian River salmonid fisheries, agricultural and municipal use, and recreation are threatened. Without the proposed change, SCWA would need to release additional stored water from Lake Mendocino, resulting in a reduction and likely elimination of water supplies for water users in Mendocino County, particularly in the Redwood Valley area, causing potential impacts to human health and welfare, in addition to a reduction of resources needed for fishery protection and more stable flows in the upper Russian River during the fall, when state and federally listed fish species are most sensitive to flows and temperatures. Further, if Water Year 2010 is a dry or critically dry year, as appears likely, extra storage in Lake Mendocino will be crucial for the continued survival of the Russian River fishery and for water supply reliability during 2010.

Water Code section 106 establishes that the use of water for domestic purposes is the highest use of water. SCWA predicts that without the proposed change Lake Mendocino would be drawn down to levels that jeopardize SCWA's ability to release water to the Russian River. In this event, water supplies for domestic and municipal uses of Russian River water would be severely impaired. Moreover, SCWA permits include terms requiring a 50 percent reduction in

deliveries to the Redwood Valley County Water District when Lake Mendocino storage drops below 30,000 acre feet in order to preserve Lake Mendocino Water Supply reliability. The purpose of this order is, in part, to prevent Lake Mendocino storage from dropping below 30,000 acre feet, which would otherwise occur in the absence of this order, based on information available to the State Water Board. SCWA forecasts indicate that Lake Mendocino Storage would drop below 30,000 acre-feet during June of 2009 unless the Temporary Urgency Change Petition is approved and conservation measures are implemented.

For the reasons stated above, an urgent need for the proposed change exists. The trigger for changing from dry-year to critically dry-year criteria should be based, however, on storage in Lake Mendocino, rather than inflow to Lake Mendocino, as proposed by SCWA. According to the California Data Exchange Center website (http://cdec.water.ca.gov/river/rivcond.html), Lake Mendocino storage as of July 1 has never dropped below 63,534 af for the period between June 1, 2004 and December 31, 2008 (i.e, Lake Mendocino Storage was 63,534 af on July 1, 2007).[1] The data also show that the maximum drawdown that occurred after July 1, 2007 was 35,630 af, which brought Lake Mendocino storage down to 27,904 acre feet on December 17, 2007. The State Water Board approved a temporary urgency change petition to preserve storage in Lake Mendocino during 2007, but minimum instream flows were never reduced below dry year criteria. Based on drawdown data from 2007, Lake Mendocino storage could fall below 30,000 acre feet this year if storage is less than 65,630 af on July 1, 2009. If Lake Mendocino storage exceeds 65,630 af on July 1, 2009, it is unlikely that storage would fall below 30,000 af, obviating the need to further reduce instream flows to critically dry year criteria. Therefore, the terms of Order WR 2009-0027-DWR will be modified to specify that critically dry year instream flow requirements may be implemented only if Lake Mendocino Storage is less than 65,630 af on July 1, 2009.

To ensure that the water resources of the State are put to beneficial use to the fullest extent of which they are capable and that waste of water be prevented, Order 2009-0027-DWR added terms requiring SCWA to (1) temporarily reduce diversions from the Russian River by 25 percent; (2) prohibit irrigation of commercial turf grass within the SCWA service; (3) submit a

[1] We take official notice of recorded storage levels for Lake Mendocino during the period from June 1, 2004 through December 31, 2008. Official notice is taken pursuant to California Code of Regulations, title 23, section 648.2 (authorizing the State Water Board to take official notice of matters that may be judicially noticed), and pursuant to Evidence Code section 452, subdivision (h) (authorizing judicial notice of facts and propositions that are not reasonably subject to dispute and are capable of immediate and accurate determination by resort to sources of reasonably indisputable accuracy).

plan detailing the actions that will be taken to work with Russian River water users to reach an overall water conservation goal of 25 percent in Sonoma County and 50 percent in Mendocino County during the period from April 6, 2009 to the expiration of this order, and (4) submit a report within one year identifying actions SCWA will take to maximize water conservation in its service area. Similar terms will be included as conditions of this approval, subject to several modifications based on comments received from interested persons, as described below. Including these terms as conditions of approval supports the determination that the proposed change will maximize the beneficial use of water resources and prevent the waste of water, and therefore an urgent need for the change exists, as defined by Water Code section 1435, subdivision (c).

Implementation of the diversion reduction requirement described above should be delayed due to unexpected rainfall in early May, which marginally improved hydrologic conditions in the Russian River watershed since issuance of Order WR 2009-0027-DWR. As a result of the rainfall, mean daily flow at the United States Geological Survey (USGS) Guerneville gage (USGS # 11467000) has remained above the normal year minimum instream flow requirement of 125 cfs for the lower Russian River. As of May 27, 2009, the USGS reported flows of 239 cfs at the Guerneville gage.[2] Recent data indicate that flow is steadily decreasing, but the data suggest that flow should remain above normal year minimum instream flow criteria until about June 15, 2009. As a result, the need to curtail diversion from the lower Russian River has been delayed and accordingly the period during which mandatory reduction in Russian River diversion to the SCWA service area may also be delayed. Order WR 2009-0027-DWR will be modified to change the start date for mandatory reduction in Russian River diversion to June 15, 2009 rather than April 6, 2009. The terms of this order also will be modified to clarify that 2004 should be used as the baseline for purposes of measuring the requirement that SCWA reduce its diversions by 25 percent.

The term prohibiting the irrigation of commercial turf grass should be modified to define "commercial turf" and to allow the irrigation of commercial turf in accordance with a water budget that meets certain criteria. Article X, section 2 of the California Constitution requires that "water resources of the State be put to beneficial use to the fullest extent to which they are capable, and that waste or unreasonable use or unreasonable method of use of water be

[2] We take official notice of reported daily average flow at the USGS Guerneville gage (USGS # 11467000) during May of this year pursuant to California Code of Regulations, title 23, section 648.2 and Evidence Code section 452, subdivision (h).

prevented, and that the conservation of such waters is to be exercised with a view to the reasonable and beneficial use thereof in the interest of the people and for the public welfare." The 2005 California Water Plan includes recommendations from the Landscape Task Force convened pursuant to Assembly Bill 2717 and signed into law in 2004. The Landscape Task Force recommendations include, in part, the following recommendations: (1) reduce the evapotranspiration (ET) Adjustment Factor in the Landscape Model Ordinance and review the ET Adjustment Factor every ten years for possible further reduction, (2) require dedicated landscape meters, (3) promote the use of recycled water in urban landscapes, and (4) increase the public's awareness of the importance of landscape water use efficiency.

The condition regarding commercial turf irrigation imposed in order WR 2009-0027-DWR, as modified herein, is necessary to comply with article X, section 2 of the California Constitution and Water Code section 1435, subdivision (c), taking into consideration (1) the competing demands for water in the Russian River watershed and the limited supply that exists, in part as a result of reduced inflow to the watershed due to operational changes at PG&E's Potter Valley Hydroelectric Project, which diverts water from the Eel River and discharges it to the East Fork of the Russian River, which is expected to continue to occur, (2) the presence of listed species who depend on instream flows in the Russian River for their continued survival, (3) the benefit to the economy of the state that results from the winegrape industry in the Sonoma and Mendocino areas, which depend on the waters of the Russian River, and (4) the benefits of reducing urban landscaping water use, consistent with the recommendations of the Landscape Task Force.

8.2 No Injury to Any Other Lawful User of Water

The SCWA is required to maintain specific flows in the Russian River from its most upstream point of diversion to the river's confluence with the ocean. Therefore, it is anticipated that all of the SCWA water contractors and other legal users of water will receive the water to which they are entitled during the reduced flows specified in this Order. Moreover, failure to implement the reduced instream flows could result in depletion of Lake Mendocino, which in turn could give rise to serious impacts to users of water downstream of Lake Mendocino later in the year.

According to the California Data Exchange Center website (http://cdec.water.ca.gov/cgi-progs/stages/FLOWOUT), as of May 11, 2009, the California Department of Water Resources estimated the unimpaired flow of the Russian River to be at 37 percent of average unimpaired

flow for the water year.[3] Although the water year ends September 30, most precipitation in the watershed falls between October and May. SCWA's reservoir release locations are located many miles upstream of the locations at which compliance with the instream flow requirements imposed by this order is determined. Considering the demand for water in the watershed and the short supply, there is a likelihood that other water users who do not have the legal right divert water, either because they have no water right or other legal entitlement that allows them to divert water from the Russian River or its tributaries, or because the right that they have is not of sufficiently high priority to allow them to divert and use water this year, will divert water released by SCWA and prevent it from being used for its intended purpose. The SCWA has informed the State Water Board that SCWA intends to submit additional change petitions in the future seeking revisions in instream flow conditions required by its water right permits. In order to better account for water diversion from the Russian River and ensure minimum instream flows are achieved in the future, a term will be added to the Order requiring SCWA to develop a water right accounting procedure and a method for determining when the Russian River is being supplemented by project water.

8.3 No Unreasonable Effect upon Fish, Wildlife, or Other Instream Beneficial Uses

Although flows downstream from Coyote Dam will be decreased upon approval of SCWA's petition, conservation of water in Lake Mendocino will allow enhanced management of the flows in early fall for the benefit of fish migration. Reduced flows in the Russian River may impair instream beneficial uses, including recreation. The potential for impairment to instream beneficial uses, however, is not unreasonable considering the potential impacts to fisheries, water supply, and recreation in Lake Mendocino that could occur if the petition is not approved.

As recommended during the May 6, 2009 public workshop, the date on which minimum instream flows could be reduced to critically dry year flows will be delayed until July 6, 2009 to reduce potential impacts to fish, wildlife, recreation, and water quality during the Fourth of July holiday. Based on comments received from the North Coast Regional Water Board and numerous members of the public, the water quality monitoring plan submitted by SCWA pursuant to WR 2009-0027-DWR has been updated. The revised water quality monitoring plan includes additional monitoring sites, increased frequency of monitoring, and provisions for public access to the data. In response to comments from NMFS, term 3 in Order WR 2009-0027-

[3] We take official notice of the California Department of Water Resources runoff data for water year 2009 pursuant to California Code of Regulations, title 23, section 648.2 and Evidence Code section 452, subdivision (h).

DWR will be deleted to provide SCWA with the flexibility to release water from Warm Springs Dam for the purpose of augmenting flows in the lower Russian River. As requested by DFG, SCWA has developed a fisheries monitoring plan in consultation with the DFG and NMFS. Accordingly, a term will be added to the Order requiring SCWA to implement the fisheries monitoring plan and consult with DFG on a weekly basis. Additionally, a term will be added directing SCWA to request renewal of the Temporary Urgency Change Petition no later than September 15, 2009, if DFG or NMFS determines that increasing flows on October 2, 2009 would adversely affect the Russian River fishery. Finally, the ramping rates specified in Order WR 2009-0027-DWR will be revised at the request of DFG.

8.4 The Proposed Change is in the Public Interest

The proposed change will help conserve water in Lake Mendocino so that it can be released for listed Russian River salmonid fisheries present in the Russian River during the fall Chinook salmon migration season. It is in the public interest to preserve water supplies for these beneficial uses when hydrologic circumstances cause severe reductions to water supplies.

Approval of SCWA's petition will help SCWA maintain the level in Lake Mendocino for a longer period of time. SCWA estimated in its Hydrologic Analysis that if the normal-year instream flow requirements remained in effect, Lake Mendocino would reach minimum pool by late August 2009 and would be completely drained by September. However, SCWA forecasted that Lake Mendocino storage would not drop below 22,000 af during the remainder of Water Year 2009 if the Temporary Urgency Change Petition is approved and 20 percent cumulative conservation is achieved.

On February 27, 2009, Governor Schwarzenegger proclaimed a state of emergency and ordered immediate action to manage the drought crisis. The Governor's proclamation requested that all urban water users immediately increase their water conservation activities in an effort to reduce their individual water use by 20 percent.

On September 27, 2006, Governor Schwarzenegger signed Assembly Bill 32, the Global Warming Solutions Act of 2006 (Nuñez, Chapter 488, Statutes of 2006). Pursuant to AB 32, the California Air Resources Board adopted a scoping plan on December 12, 2008, outlining the State's strategy to achieve greenhouse gas (GHG) emissions limits. The scoping plan recommended implementation of six greenhouse gas reduction measures targeted at the water

sector, largely to develop additional supply reliability to meet water demand. These measures include increased water use efficiency, and water recycling, and urban runoff re-use. In addition to reducing GHG emissions, these measures can have many co-benefits, including enhancing water supply reliability.

Given the severity of water supply conditions in the Russian River Watershed and the Governor's directives to implement water conservation measures, this order adds terms requiring immediate mandatory water conservation, and longer-term water conservation planning and reporting, including a plan to reduce the use of residential water wasting devices in the SCWA service area.

Approval of the petition, as conditioned, will be in the public interest and consistent with the overall goals of the Governor's drought emergency proclamation and AB 32.

9.0 CONCLUSIONS

The State Water Board has adequate information in its files to make the evaluation required by Water Code section 1435.

I conclude that, based on the available evidence:

1. The permittee has an urgent need to make the proposed change;
2. The petitioned change will not operate to the injury of any other lawful user of water;
3. The petitioned change will not have an unreasonable effect upon fish, wildlife, or other instream beneficial uses; and,
4. The petitioned change is in the public interest.

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ORDER

NOW, THEREFORE, IT IS ORDERED THAT: the petition filed by Sonoma County Water Agency for temporary change in Permits 12947A, 12949, 12950, and 16596 is approved, subject to the conditions set forth below.

All existing terms and conditions of the subject permits remain in effect, except as temporarily amended by the following provisions:

1. From the date of this Order until October 2, 2009, minimum flows in the Russian River, as specified in Term 20 of Permit 12947A, Term 17 of Permits 12949 and 12950, and Term 13 of Permit 16596, shall be modified as follows:

   Minimum instream flow in the **Russian River from its confluence with the East Fork of the Russian River to its confluence with Dry Creek** shall be as follows:

   a. From April 6, 2009 through July 5, 2009, minimum instream flow shall remain at or above 75 cubic feet per second (cfs).

   b. From July 6 through October 2, 2009, minimum instream flow shall remain at or above 75 cfs, if Lake Mendocino storage is equal to or greater than 65,630 acre feet on July 1, 2009;

   c. From July 6 through October 2, 2009, minimum instream flow shall remain at or above 25 cfs, if Lake Mendocino storage is less than 65,630 acre feet on July 1, 2009;

   Minimum instream flow in the **Russian River from its confluence with Dry Creek to the Pacific Ocean** shall be as follows unless the water level in Lake Sonoma is below 292.0 feet with reference to the National Geodetic Vertical Datum of 1929, or unless prohibited by the United States Government:

   a. From April 6, 2009 through July 5, 2009, 2009, minimum instream flow shall remain at or above 85 cubic feet per second (cfs).

   b. From July 6 through October 2, 2009, minimum instream flow shall remain at or above 85 cfs, if Lake Mendocino storage is equal to or greater than 65,630 acre feet on July 1, 2009;

   c. From July 6 through October 2, 2009, minimum instream flow shall remain at or above 35 cfs, if Lake Mendocino storage is less than 65,630 acre feet on July 1, 2009;

For purposes of compliance with this term, minimum instream flow requirements shall be met on an instantaneous flow basis.

2. SCWA shall immediately consult with the National Marine Fisheries Service (NMFS) and the Department of Fish and Game (DFG) after a cumulative seasonal total of 200 adult Chinook salmon move upstream past the SCWA Mirabel inflatable dam. Upon the written recommendation of NMFS and DFG, instream flow at the USGS gages at both Hopland (No.11462500) and Healdsburg (No. 11464000) on the Russian River shall be increased to 125 cfs after a cumulative seasonal total of 200 adult Chinook salmon move upstream past the SCWA Mirabel inflatable dam. A lag time of three to seven days for the higher flows to reach Healdsburg is appropriate.

3. To protect against stranding of fish when releases from Lake Mendocino are converted from normal-year to dry-year criteria, or from dry-year to critical-year criteria, flow in the East Fork Russian River immediately below Coyote Dam shall not be reduced by more than 15 cfs per hour.

4. SCWA shall monitor and record daily numbers of adult Chinook salmon moving upstream past the Mirabel inflatable dam beginning no later than August 15, 2009, and ending upon expiration of this Order. SCWA shall consult with NMFS and the DFG on a weekly basis regarding the status and findings of the monitoring effort. Chinook salmon monitoring requirements specified in this term may be revised at the direction of NMFS and DFG.

5. If operations pursuant to this Order result in sustained closure of the lagoon at the terminus of the Russian River at the Pacific Ocean, or numbers of adult salmon in the Russian River are determined by NMFS to be very low through September 30, 2009, then SCWA shall immediately consult with NMFS and DFG regarding possible measures to facilitate upstream movement of salmon. SCWA shall immediately implement measures required by NMFS and DFG to facilitate the movement of salmon.

6. SCWA shall implement the Fisheries Monitoring Plan dated May 24, 2009 that was developed in consultation with DFG and NMFS. SCWA shall consult with NMFS and DFG on a weekly basis regarding the status and findings of the monitoring effort.

7. SCWA shall implement the Temperature and Water Quality Monitoring Plan dated May 22, 2009 that was developed for monitoring the effects of the temporary urgency change after consultation with DFG and North Coast Regional Water Board staff.

8. If minimum instream flow requirements are reduced to critically dry year criteria, SCWA shall coordinate once weekly conference calls with Division of Water Rights, NMFS, DFG, and North Coast Regional Water Board staff to discuss the results of ongoing water quality, temperature and fisheries monitoring. Agency personnel may recommend to the Deputy Director for Water Rights actions required to alleviate water quality, public health, or fishery concerns that arise as a result of implementation of this Order.

9. This Order does not authorize any act that results in the taking of a threatened or endangered species, or any act that is now prohibited, or becomes prohibited in the future, under either the California Endangered Species Act (Fish and Game Code sections 2050 to 2097) or the federal Endangered Species Act (16 U.S.C.A. sections 1531 to 1544). If a "take" will result from any act authorized under this Order, the permittee shall obtain authorization for an incidental take permit prior to construction or operation. Permittee shall be responsible for meeting all requirements of the applicable Endangered Species Act for the temporary urgency change authorized under this Order.

10. The State Water Board reserves jurisdiction to supervise the temporary urgency change under this Order, and to coordinate or modify terms and conditions, for the protection of vested rights, fish, wildlife, instream beneficial uses and the public interest as future conditions may warrant.

11. The SCWA shall immediately notify the State Water Board if any significant change in storage conditions in Lake Mendocino occurs that warrants reconsideration of this Order.

12. SCWA shall make a 25 percent reduction in diversions from the Russian River to its service area from June 15, 2009 until expiration of this order (October 2, 2009). This reduction shall be calculated based on Permittee's actual diversion from the Russian River from June 15, 2009 through October 2, 2009 as compared to actual diversion from the Russian River from June 15, 2004 through October 2, 2004.

13. As a condition of water delivery to its customers, SCWA shall prohibit irrigation of commercial turf grass within the SCWA service area for the period of June 15, 2009 through October 2, 2009 unless irrigation is managed in conformance with water a budget designed to achieve the following maximum applied water allowance (MAWA):

    MAWA = (ETo) (0.75) (LA) (0.62)
    where:
    MAWA = Maximum applied water allowance (gallons per month)
    Eto = Reference Evapotranspiration (inches per month)
    0.75 = ET Adjustment Factor
    LA = Landscaped Area (square feet)
    0.62 = conversion factor (to gallons per square foot)

    This term shall not apply to commercial turf irrigated exclusively with municipal recycled water.

    For the purposes of this Order, commercial turf is defined as turf that is not used regularly by a significant number of people, including commercial and governmental ornamental turf located in median strips along streets, at public and private office buildings, business parks, out-of-bounds areas at golf courses, and unused areas in parks. Commercial turf does not include regularly used turf, such athletic fields, golf courses, and parks and other areas where turf is actually used by substantial numbers of people to walk, play, or sit on (as opposed to turf that is primarily ornamental).

14. On September 1, 2009, SCWA shall submit to the Division of Water Rights, DFG and NMFS, a forecast of storage in Lake Mendocino and an assessment of SCWA's ability to make releases in support of fall run Chinook salmon during the migration and spawning season. SCWA is directed to request in writing renewal of the temporary urgency change petition no later than September 15, 2009 if DFG or NMFS determines that increasing flows on October 2, 2009 will adversely affect the Russian River fishery.

15. By May 6, 2009, SCWA shall submit a plan to the State Water Resources Control Board to obtain the cooperation and participation of agricultural and municipal Russian River water users to reach a water conservation goal of 25 percent in Sonoma County and 50 percent in Mendocino County for the period of April 6, 2009 until the expiration of this order (October 2, 2009). In addition, the plan shall include measures to identify and prevent any waste, unreasonable use, unreasonable method of use, or unreasonable method of diversion of water. The plan shall include a detailed schedule with planned

completion dates for key events. The plan, including the schedule, is subject to approval by the State Water Board Deputy Director for Water Rights (Deputy Director) in regard to its completeness and inclusion of significant project milestones. SCWA shall submit any additional information or revisions to the schedule requested within the period specified by the Deputy Director. SCWA shall implement the schedule as approved by the Deputy Director. SCWA shall include the following information in the plan:

a. An explanation of SCWA's authority or other ability to impose mandatory water conservation measures and identification of the persons and entities subject to that authority.

b. Identification of Russian River water users who are not subject to SCWA's authority to impose mandatory water conservation measures.

c. Steps that SCWA will take to investigate the waste, unreasonable use, unreasonable method of use, or unreasonable method of diversion of water from the Russian River. SCWA shall submit monthly reports to the State Water Board on its progress.

d. Steps that SCWA will take to gain the cooperation and participation of water users in conserving water and preventing the waste, unreasonable use, unreasonable method of use, or unreasonable method of diversion of water from the Russian River. SCWA shall submit monthly reports to the State Water Board on its progress.

16. SCWA shall prepare a Water Conservation Status Report for SCWA's service area and other areas served by Lake Mendocino. The report shall specify the water conservation measures being implemented in the areas served by Lake Mendocino, and shall specify the water savings resulting from the measures during the term of this temporary urgency change. The report shall be submitted to the Deputy Director by December 31, 2009. The scope and content of the report shall be similar to the report submitted to comply with WR Order 2007-0022.

17. SCWA shall prepare a Water Conservation Plan for SCWA's service area and other areas served by Lake Mendocino. The Water Conservation Plan shall describe and quantify current water conservation efforts and the water conservation measures that can be implemented in the future, including measures to eliminate the use of residential water wasting devices. The Water Conservation Plan shall provide estimates of the quantity of water applied to commercial turf in the SCWA service area and provide recommendations for long-term reductions in water use on commercial turf. The Water Conservation Plan shall include a description of the authority or mechanisms that will be used to implement the identified conservation measures and a schedule for

implementation. The plan shall be submitted to the Deputy Director by April 6, 2010. For the purposes of this Order, residential water wasting devices are defined as indoor residential plumbing fixtures and appliances that use more water than readily available cost effective alternatives, including but not limited to showerheads, toilets, faucets, dishwashers, and clothes washing machines.

18. SCWA shall develop a water right accounting procedure and a method for determining when the Russian River is being supplemented by project water. SCWA shall submit a report to the Deputy Director by December 31, 2009 describing the proposed water right accounting procedure. Beginning December 31, 2009, SCWA shall post on its website notification of periods when the Russian River is being supplemented by project water for purposes of meeting minimum instream flow requirements or to satisfy downstream water demands other than those of SCWA.

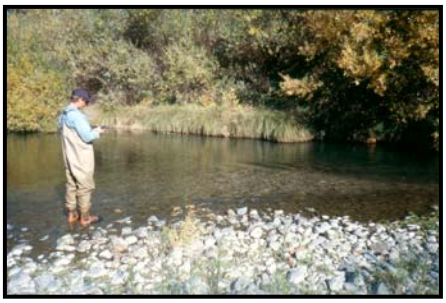
Dated: MAY 2 8 2009

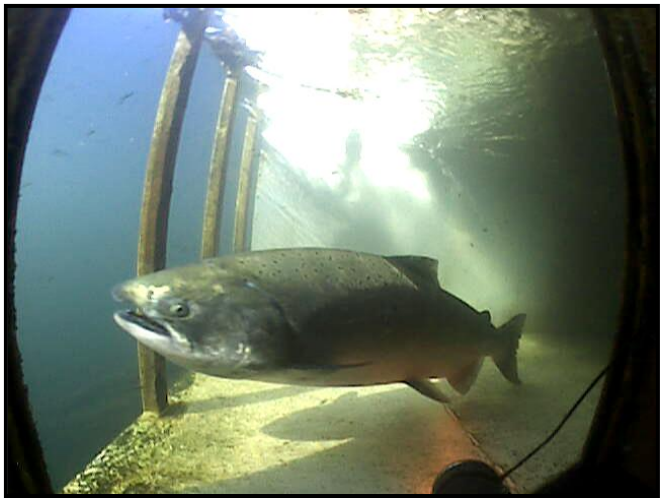
Arthur G. Baggett, Jr.
Board Member

Appendix B-4

Fisheries Monitoring Plan to meet Term 6, revised Order WR 2009-034_EXEC

Fisheries Monitoring Plan to Meet State Water Resources Control Board Order WR 2009-0027-DWR





Prepared by

Sonoma County Water Agency
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May 24, 2009

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1.0 PURPOSE AND INTRODUCTION

This plan has been prepared by the Sonoma County Water Agency (Agency) to fulfill the requirements of the State Water Resources Control Board (SWRCB) Order WR 2009-0027-DWR (Order).

1.1 Lake Mendocino Storage Levels

Unusual hydrologic conditions in the Russian River Valley, coupled with reductions in water imported to the Russian River basin via the Potter Valley Project, have warranted immediate action to avoid significant risks to the storage levels in Lake Mendocino, including the possibility of the lake going dry in September. In 2007, the Agency filed a similar petition to mitigate impacts resulting from anticipated low lake levels. The approval of that petition by the SWRCB was critical to protecting the Chinook salmon in the Russian River during their fall migration and spawning. This year, the storage projections for Lake Mendocino are far more severe and the lake will likely go dry without changes to the summer release requirements to maintain minimum instream flows.

In April 2009, the storage level in Lake Mendocino was approximately 53,000 acre-feet (AF). This is roughly 17,000 AF lower than Lake Mendocino was in April 2007. Although Lake Mendocino storage is unusually low, cumulative inflow into Lake Pillsbury during the 2009 water year has been sufficient enough that, under SWRCB Decision 1610 (D-1610), 2009 is classified as a "Normal" water year and will likely retain this classification for the remainder of the year.

1.2 Water Year Classifications

The water year classifications (Normal, Dry, or Critical) specified in D-1610 are based on cumulative inflow into Lake Pillsbury beginning October 1. Analyses recently prepared by Agency engineering staff indicate that if significant inflows into Lake Mendocino, either from storm events or diversions by PG&E from the Eel River by the Potter Valley Project do not occur between now and June 1, then releases from Lake Mendocino to meet normal demands on, and minimum instream flow requirements for, the Russian River under D-1610 Normal year requirements will drain Lake Mendocino.

1.3 Temporary Urgency Change Petition Filed

To try to prevent these grave impacts, the Agency filed a Temporary Urgency Change Petition (TUCP) with the SWRCB on April 6, 2009, seeking immediate approval to reduce the minimum instream flow requirements for the Russian River in the Agency's water-rights permits in order to maintain sufficient storage in Lake Mendocino so that it does not go dry in the Fall of 2009. In the TUCP, the

Agency requested the SWRCB make the following temporary changes to the D-1610 instream flow requirements:

a. For April 6 through June 30, the D-1610 requirements for Dry conditions will apply in the Russian River. These requirements are 75 cubic feet per second (cfs) in the Upper Russian River (from its confluence with the East Fork to its confluence with Dry Creek) and 85 cfs in the Lower Russian River (downstream of its confluence with Dry Creek);
b. If, during the period from April 1 through June 30, total inflow into Lake Mendocino is less than or equal to 25,000 AF, then, for July 1 to October 2, the D-1610 requirements for Critically Dry conditions will apply in the Russian River. These requirements are 25 cfs in the Upper Russian River (from its confluence with the East Fork to its confluence with Dry Creek) and 35 cfs in the Lower Russian River (downstream of its confluence with Dry Creek); and
c. If, during the period from April 1 to June 30, 2009, total inflow into Lake Mendocino is greater than 25,000 AF, then, for July 1 through October 2, the D-1610 requirements for Dry conditions will apply in the Russian River.

1.4 Temporary Urgency Change Order Issued

On April 6, 2009, SWRCB Deputy Director for Water Rights, Victoria Whitney, issued the Order which granted the Agency's petition, subject to certain terms and conditions. Terms 4, 5, 6, and 7 of the Order require monitoring activities and consultation with fishery management agencies to ensure the protection of Russian River fisheries.

1.5 Fisheries Monitoring Requirements

On April 20, 2009, the California Department of Fish and Game (DFG) submitted a comment letter to the SWRCB regarding the effects of the TUCP on Russian River fisheries (Attachment A). On April 30, 2009, the National Marine Fisheries Service (NMFS) also submitted a comment letter to the SWRCB (Attachement B). Biologists and engineers from the Agency, DFG, NMFS, and SWRCB held a meeting on April 30, 2009 to discuss fishery issues. At a May 6, 2009 workshop held at the SWRCB office in Sacramento, staff recommended that the Agency, DFG, and NMFS work cooperatively to develop a fisheries management plan to document and respond to River conditions during the implementation of the Order. The SWRCB, DFG, NMFS, and North Coast Regional Water Quality Control Board (NCRWQCB) have requested water quality monitoring to address the affects of reduced flow. The Agency has prepared a separate water quality monitoring plan to compliment planned fish and habitat monitoring activities (Attachment C). This fisheries monitoring plan includes the following elements:

a. Background about the Agency's Russian River (River) fisheries monitoring efforts.
b. Summer 2009 juvenile steelhead monitoring.
c. Summer 2009 habitat monitoring. Fall 2009 adult Chinook salmon monitoring.
d. Reporting to update and consult DFG, NMFS, and SWRCB regarding habitat conditions, fish abundance, and fish health.

2.0 PREVIOUS SCWA FISHERIES MONITORING EFFORTS

2.1 Steelhead Distribution and Habitat Studies

In summer and fall 2001, the Agency conducted a flow-related habitat study in collaboration with the U.S. Army Corps of Engineers, NMFS, DFG, NCRWQCB, and Entrix Inc. The study evaluated habitat value for steelhead along the River and Dry Creek at a range of high and low flows. Habitat observations indicated that spawning and summer rearing habitat for steelhead was present in the upper main stem of the Russian River.

To further examine the extent of steelhead rearing habitat, the Agency conducted extensive snorkel surveys in the upper River during August 2002 (Cook 2003). Steelhead distribution and abundance varied substantially throughout a 106 km reach from Ukiah to Healdsburg (Figure 1). A total of 12 native and non-native species were observed. Steelhead composed <1% to 5% of the total fish counted. Steelhead were most abundant in the Canyon (265 fish/km) and Ukiah Valley (37 fish/km) reaches. Relatively few steelhead were observed in the Alexander Valley (<1 fish/km) and Healdsburg (7 fish/km) reaches.

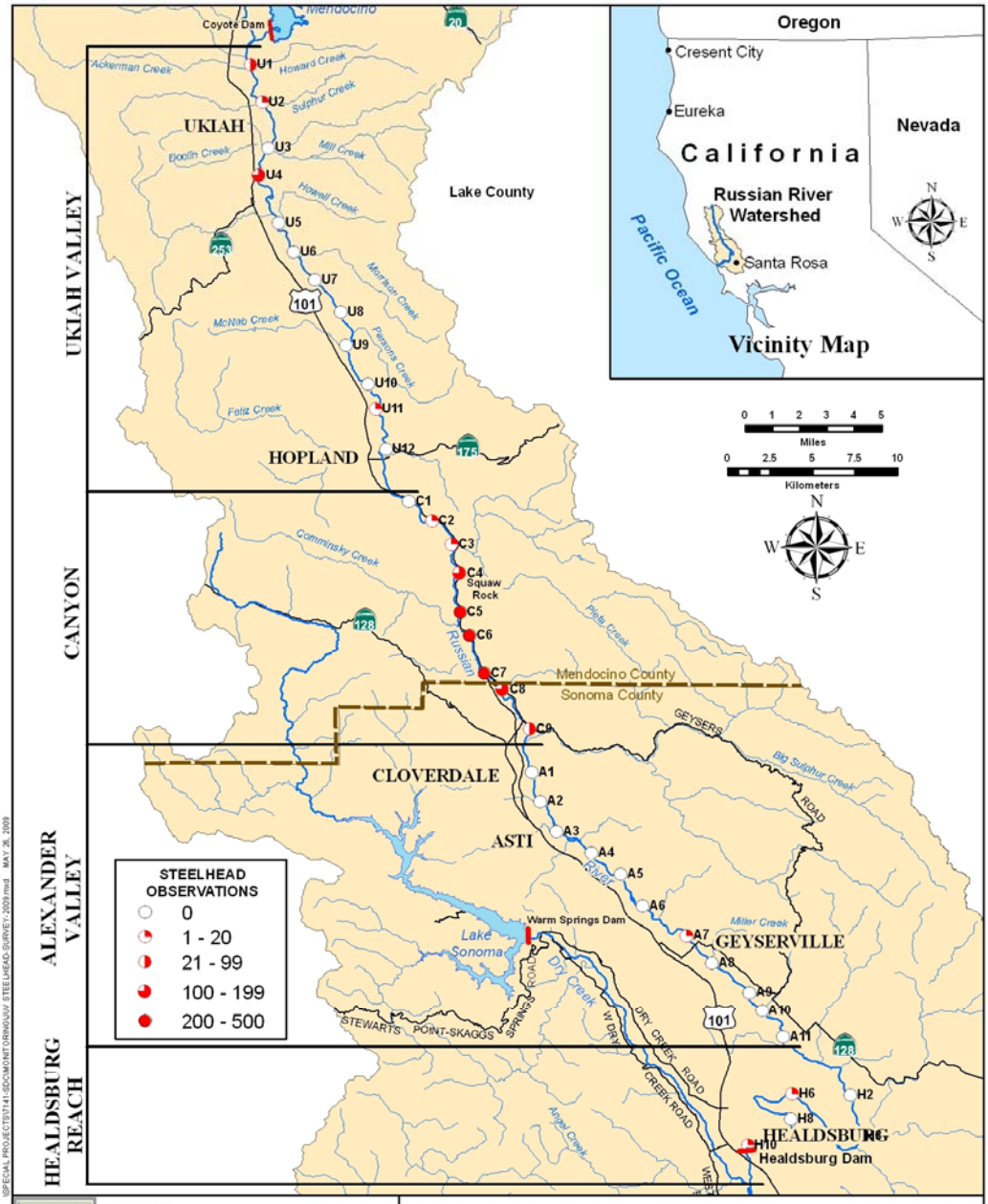

Figure 1
Upper Russian River Salmon Distribution Study
Steelhead Distribution and Relative Abundance

2.2 Mirabel Dam Video Counting Station

Underwater video cameras have been operated at the upstream ends of the Mirabel Inflatable Dam fish ladders since 2000. The video monitoring station is operated annually from August 15 until the dam is deflated with the onset of heavy rains (typically mid November to mid January). The station provides information on upstream migrating Chinook salmon. Steelhead typically migrate during winter after the dam is deflated, therefore, most of the steelhead run is not counted. Although Chinook salmon are observed in late August and September, the majority of the run passes the dam from mid-October to mid-November (Figure 2). Total annual counts of adult Chinook salmon have ranged from 1,101 fish in 2008 to 6,103 fish in 2003 (Table 1).

Figure 2. The cumulative percentage of adult Chinook salmon that passed Mirabel Dam from 2000 to 2008. The highlighted region indicates the period of most active fish passage.

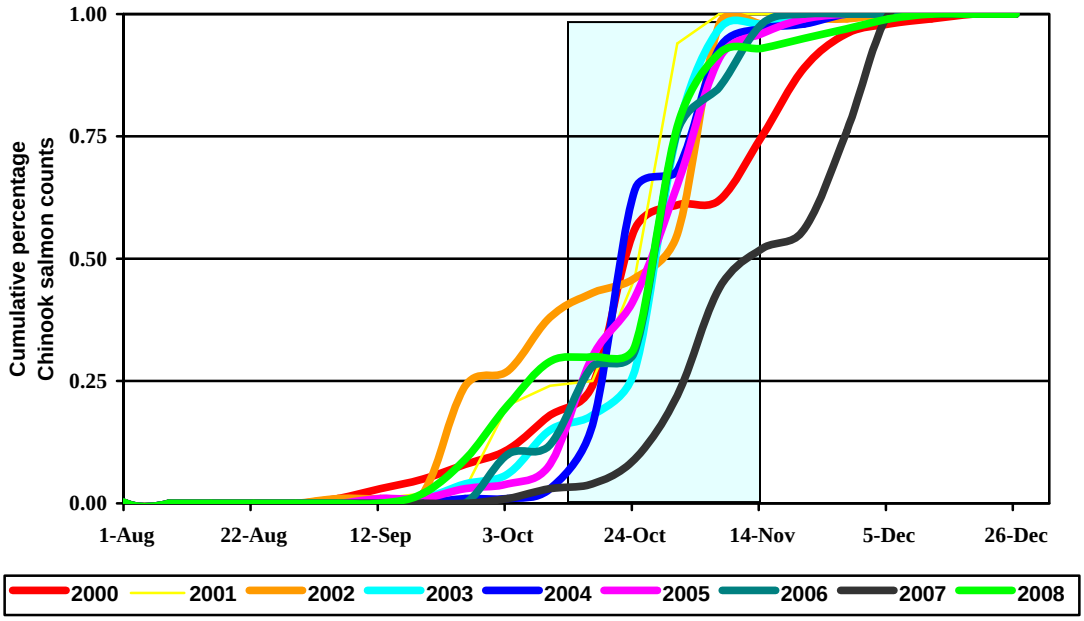

Table 1. Weekly Chinook salmon counts at the Mirabel Dam fish ladders from 2000 to 2008.

Week	2000	2001	2002	2003	2004	2005	2006	2007	2008
1-Aug	0	0	0	0	0	0	0		0
8-Aug	0	0	0	0	0	0	0		0
15-Aug	0	0	1	0	0	0	0	0	1
22-Aug	1	0	8	0	0	1	0	0	0
29-Aug	0	3	7	2	1	4	0	0	2
5-Sep	9	1	18	7	1	4	0	0	18
12-Sep	38	7	19	20	3	14	3	0	83
19-Sep	23	12	65	23	8	14	4	1	124
26-Sep	50	17	1,223	181	16	31	8	2	98
3-Oct	31	240	113	146	42	27	318	10	13
10-Oct	115	51	628	515	52	112	88	39	21
17-Oct	81	10	272	232	651	556	529	26	502
24-Oct	466	300	153	532	2,287	307	114	103	173
31-Oct	63	661	505	2,969	185	611	1,535	249	13
7-Nov	24	81	2,337	1,289	1,189	668	299	429	24
14-Nov	182		20	47	221	127	458	152	19
21-Nov	200		37	95	57	63	54	96	9
28-Nov	111		14	45	60	33		375	
5-Dec	19		54		16			477	
12-Dec	14							4	
19-Dec	17								
26-Dec	1								
2-Jan	0								
	1,445	**1,383**	**5,474**	**6,103**	**4,788**	**2,572**	**3,410**	**1,963**	**1,101**

2.3 Chinook Redd Surveys

To supplement the video count data, Chinook salmon redd surveys have been conducted from fall 2002 to 2008 in the upper Russian River and Dry Creek. The study area includes approximately 114 km of the Russian River mainstem from Riverfront Park (rkm 40) below Healdsburg upstream to the East and West Fork confluence (rkm 154) near Ukiah. Our previous investigations indicated that few spawning sites are present in the lower River. In 2003, the study area was expanded to include 22 km of Dry Creek below Warm Springs Dam (Lake Sonoma).

To determine the distribution and relative abundance of Chinook salmon spawning sites, the study area was surveyed once annually in November or December. The reach is kayaked by 2-3 observers over the course of several days. Coordinates of redds are recorded using a global positioning system (GPS)

and spawning site habitat characteristics (i.e., substrate size, water depth, and velocity, etc) are also noted.

2.4 Downstream Migrant Trapping

Since 2000, the Agency has collected data about juvenile salmonids emigrating past the Mirabel Dam Site. Multiple rotary screw traps provide information on species composition, size, relative abundance, and timing. Juvenile Chinook salmon emigrate from late February through June and peak numbers are observed from mid-April to mid-June (Table 2). Steelhead smolts also migrate past the dam site from March through June. Relatively few steelhead parr (age 1+) have been captured (Table 4). Young-of-the-year steelhead appear at the trap site in greatest numbers from late April to early June (Table 5). Coho salmon smolts have been captured in the current 2009 sampling season and their run timing appears to be similar to steelhead smolts

Table 2. Weekly numbers of juvenile Chinook salmon captured in rotary screw traps at the Mirabel Dam site from 2000 to 2008.

	2000	2001	2002	2003	2004	2005	2006	2007	2008
26-Feb			45	332					
5-Mar			74	841					
12-Mar			319	89					
19-Mar			181	169				257	114
26-Mar			797	346				940	80
2-Apr	41		908	377	82			730	224
9-Apr	158		757	176	115	446		564	100
16-Apr	154	122	2279	17	672	848		1011	866
23-Apr	204	720	2992	60	1911	618		759	1161
30-Apr	169	1338	4337	0	1845	353		1148	315
7-May	121	1154	1780	50	1631	132	69	782	258
14-May	174	226	2056	508	552	222	46	880	381
21-May	106	76	1755	690	158	35	217	698	91
28-May	92	64	704	1461	150	419	67	503	107
4-Jun	66	22	192	530	125	541		857	60
11-Jun	47		93	374	31	136		268	94
18-Jun	19		46	186	88	156		45	19
25-Jun	10		4	86	26	55		38	8
2-Jul				3					
	1,361	**3,722**	**19,319**	**6,295**	**7,386**	**3,961**	**399**	**9,480**	**3,878**

Table 3. Weekly number of steelhead smolts (age 2+) captured in rotary screw traps at the Mirabel Dam site from 2000 to 2008.

	2000	2001	2002	2003	2004	2005	2006	2007	2008
27-Feb			1	4					
5-Mar			1	3					
12-Mar			38	5					
19-Mar			15	3				24	0
26-Mar			24	39				99	1
2-Apr			31	39	3			24	3
9-Apr	19		33	18	14	0		25	0
16-Apr	24	7	30		11	18		43	4
23-Apr	24	16	23		14	9		61	8
30-Apr	21	16	23		10	7	9	14	12
7-May	8	9	7		3	3	10	17	4
14-May	14	4	9	26	1	1	5	11	0
21-May	9		9	16	1	3	6	3	1
28-May	6		3	6	1	0		2	0
4-Jun	1		0	2	2	3		1	0
11-Jun	4		1	1	1	2		0	0
18-Jun	2		0	0	2	1		0	0
25-Jun	2		0	0	0	1		0	0
	134	**52**	**248**	**162**	**63**	**48**	**30**	**324**	**33**

Table 4. Weekly number of steelhead parr (Age 1+) captured in rotary screw traps at the Mirabel Dam site from 2000 to 2008.

	2000	2001	2002	2003	2004	2005	2006	2007	2008
26-Feb		0	0	1					
5-Mar		0	0	0					
12-Mar		0	0	2					
19-Mar		0	2	1				1	0
26-Mar		0	0	0				10	0
2-Apr	0	0	1	0	0			0	0
9-Apr	0	0	0	0	0	0		0	0
16-Apr	0	0	0	0	1	1		3	1
23-Apr	0	0	0	0	2	0		9	0
30-Apr	0	0	1	0	0	0	0	2	0
7-May	0	0	1	0	0	0	0	1	0
14-May	0	0	0	0	0	0	0	0	0
21-May	0	0	0	2	0	2	0	0	0
28-May	0	0	0	0	1	0		0	0
4-Jun	0	0	1	0	0	1		0	1
11-Jun	0	0	0	0	0	0		4	2
18-Jun	0	0	1	1	8	1		1	0
25-Jun	0	0	0	0	7	2		0	0
	0	**0**	**7**	**7**	**19**	**7**	**0**	**31**	**4**

Table 5. Weekly number of young-of-the year steelhead captured at the Mirabel Dam site from 2000 to 2008.

	2000	2001	2002	2003	2004	2005	2006	2007	2008
26-Feb			0	0					
5-Mar			0	5					
12-Mar			1	1					
19-Mar			6	12				0	1
26-Mar			3	67				17	7
2-Apr	0		55	170	3			8	14
9-Apr	3		51	132	14	86		12	35
16-Apr	20	1	447	4	11	99		36	33
23-Apr	33	17	81	20	14	97		127	74
30-Apr	224	4	657	0	10	523	14	56	118
7-May	30	13	755	22	3	354	12	163	133
14-May	49	23	976	74	1	75	182	157	52
21-May	80	34	1315	244	1	23	26	185	101
28-May	74	32	806	223	1	110		173	59
4-Jun	102	26	466	55	2	135		684	75
11-Jun	40		164	29	1	40		172	48
18-Jun	58		59	27	2	28		4	26
25-Jun	50		1	2	0	7		22	10
	763	**150**	**5,843**	**1,087**	**63**	**1,577**	**234**	**1,816**	**786**

3.0 SUMMER 2009 JUVENILE STEELHEAD MONITORING

Objectives: Lower than normal summer flows, may alter the distribution and abundance of steelhead detected in the 2002 snorkel survey (Cook 2003). During August, 2009 we will conduct a snorkel survey to assess the distribution, relative abundance, and condition of juvenile steelhead between Mirabel Dam and Ukiah (Figure 3). Methods and sample sites will be similar to surveys conducted during the previously described 2002 study.

Methods: At ten 500-m-long sampling reaches (Figure 3), a crew of three biologists will simultaneously dive all available habitat units. To increase the accuracy of fish counts, each reach will be partitioned into 3 dive lanes. All fish observed during surveys will be identified to species when feasible. Several species of native minnows in the Russian River have similar characteristics and can be difficult to identify underwater. Divers will count all fish in three size classes (<100 mm TL, 101-300 mm TL, and >300 mm TL). In general, steelhead <100 mm TL are young-of-the-year, fish 101-300 mm in length are age 1-2, and fish greater than 300 mm are age 3+. At the end of a survey, fish data from all divers will be recorded on a data form for each segment (Attachment D). In addition, water temperature, transparency (Secchi depth), and dissolved oxygen will be recorded at each site (Attachment D).

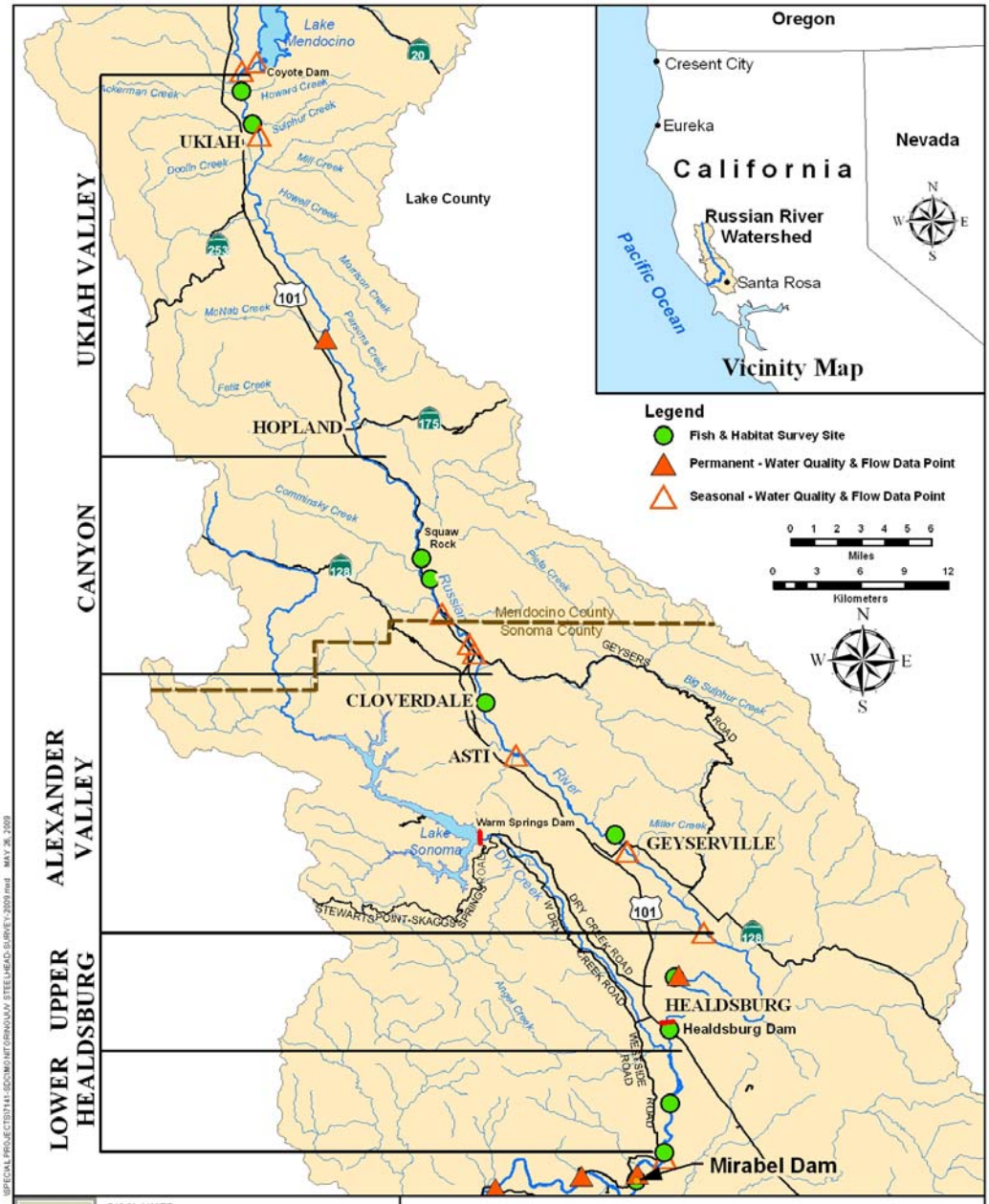

Figure 3
Juvenile Steelhead Snorkel Survey, Habitat Streamflow, and Water Quality Monitoring Sites

4.0 SUMMER 2009 HABITAT MONITORING

Objectives: Reduced River flow may impact fish through alterations to physical habitat characteristics such as stream width, depth, velocity, and shelter complexity. To document habitat conditions, we will measure habitat units at seven sites between Healdsburg and Ukiah on two separate occasions during late spring (June) and mid summer (August). The June and August sampling dates should allow us to characterize habitat conditions at flows of 75-100 cfs and 35-75 cfs, respectively. Specific sampling sites will correspond to juvenile steelhead monitoring locations in the Ukiah Valley, Canyon, Alexander Valley, Healdsburg, and Dry Creek to Wohler reaches (Figure 3).

Methods: Within each of the five reaches, two 500 m fish sampling sites will be established. The fish sampling sites in the Ukiah Valley, Canyon, and Dry Creek to Wohler reaches are in close proximity to each other. At these sites, a single habitat monitoring reach is sufficient to characterize the fish sampling sites. In the Alexander Valley and Healdsburg reaches, however, fish sampling sites are separated by a significant distance and we will establish two separate habitat monitoring sites. In all, habitat data will be collected at seven locations from 63 distinct habitat units.

Russian River mainstem habitat is composed primarily of pools, flatwaters (runs and glides), and riffles. Although each of these major habitat types can be subdivided into several categories (e.g., main channel and corner pools, high and low gradient riffles), higher level classification is sufficient to detect changes resulting from a reduction in flow. We will define habitat units using the methods of Flosi et al. (1998).

To collect information that can be related to fish abundance and distribution data, we will measure three habitat units of each type (i.e., 3 pools, 3 flatwaters, and 3 riffles) at each fish sampling site. Measurements will commence at the upstream boundary of a fish sampling site and progress downstream until three units of each type have been measured. At each unit we will measure length, width, average depth, maximum depth, average velocity, and instream shelter amount and type.

The length of each habitat unit will be measured using a hip-chain. Width, depth, and shelter type and quantity will be measured at cross-sections marked with rebar stakes at 10%, 25%, 50%, 75%, and 90% of the length of a unit. Marking transects with rebar will enhance consistency between the June and August sampling events but each site will also be marked using GPS.

Along each cross-section, wetted width and depth will be recorded at 0.5 m intervals. Shelter will be recorded for the area 5 m upstream and downstream of

each cross section. Water velocities will be collected at the 50 percent transect in flatwater and riffle habitats, and at the 10 percent transect in pools. Velocity measurements will be recorded at 0.5 m intervals at 0.6 percent of the water depth. Instream shelter within each habitat unit will be rated using the methods of Flosi et al. (1998). Shelter will be rated based on the percentage cover provided by boulders, large woody debris, overhanging vegetation, etc.

Permanent photo stations will also be established at each habitat unit. When possible, stations will be located at the top-of-bank or other elevated sites to provide an overall perspective of the habitat unit. Permanent sites will also be established at the upstream, middle, and at the downstream end of each unit. Photo monitoring stations will be marked using GPS.

5.0 ADULT CHINOOK SALMON MONITORING

Objectives: Adult Chinook salmon may become stressed or discouraged from migrating upstream due to warm or shallow water conditions resulting from lower than normal flow. We will monitor the abundance, distribution, and condition of Chinook salmon as they migrate upstream during early fall.

Methods: The previously described video counting station at Mirabel Dam will be operated beginning August 15. Starting September 1, fish presence in areas downstream and upstream of the Dam site will be evaluated at one and two week intervals by divers. During the early migration season from September 1 until 200 fish have passed the Dam site, three lower River sites will be sampled weekly; Johnson's Beach Dam, Vacation Beach Dam, and Mirabel Dam (Figure 4). To assess potential habitat conditions at lower flow, a site at Geyserville will also be sampled every two weeks during the early season. After 200 fish have passed Mirabel Dam, effort will shift to upstream sites at Mirabel Dam, Healdsburg Dam, Digger's Bend, and Geyserville (Figure 5). Snorkel survey sites and schedules may be adjusted after consultation with DFG and NMFS. Water temperature, visibility, and dissolved oxygen will be measured at each site. As in previous years, we will conduct a one-time spawning site distribution survey in the mainstem River and Dry Creek between October and December.

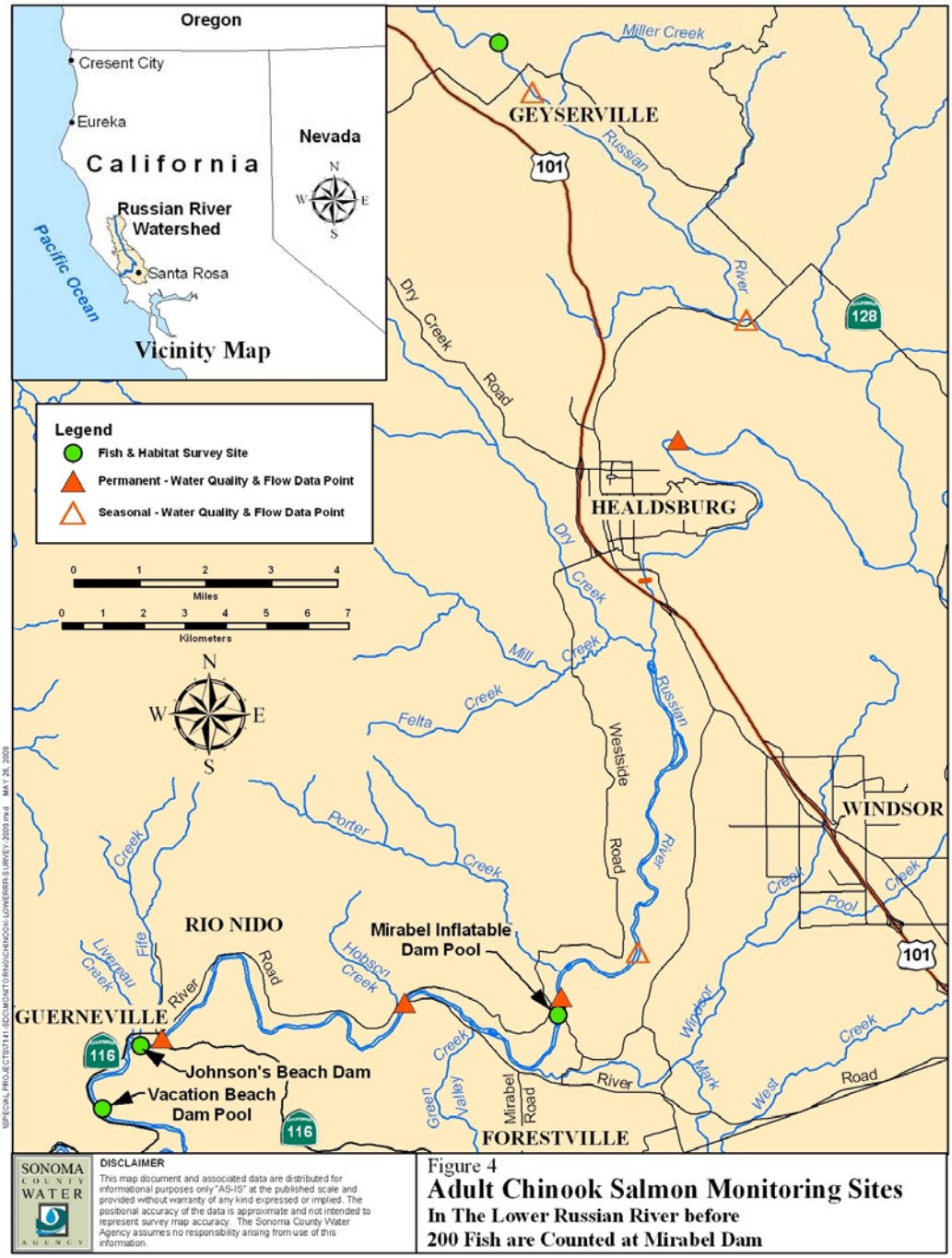

Figure 4
Adult Chinook Salmon Monitoring Sites
In The Lower Russian River before 200 Fish are Counted at Mirabel Dam

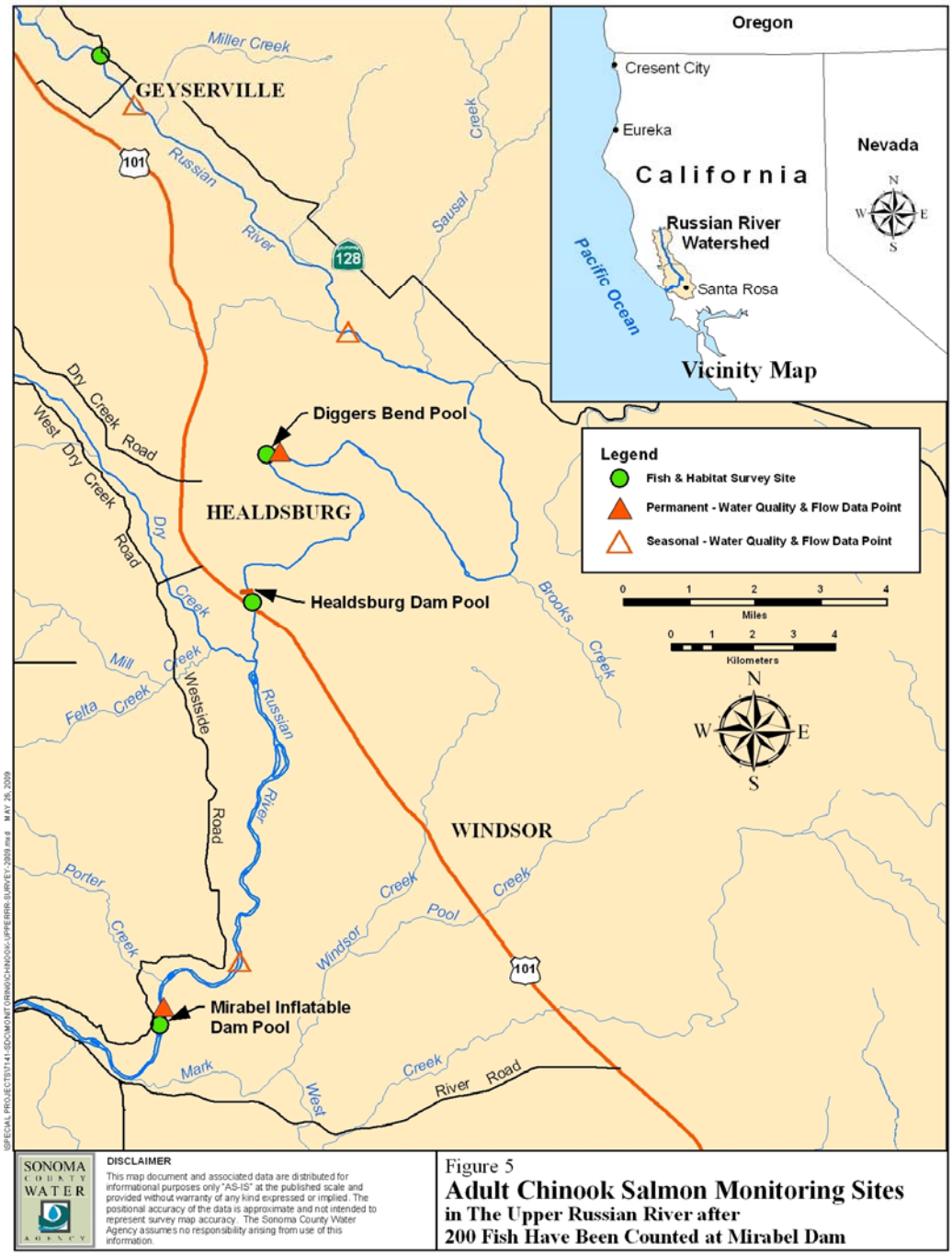

Figure 5
Adult Chinook Salmon Monitoring Sites in The Upper Russian River after 200 Fish Have Been Counted at Mirabel Dam

6.0 REPORTING

The Agency will update DFG, NMFS, SWRCB, and NCWRCB about fisheries and water quality monitoring weekly via pre-scheduled email and/or tele-conference calls. Weekly communications will commence on the morning of Tuesday, July 14 (one week after flow reduction to critical levels on July 6) and continue through Tuesday, October 13 (after termination of the Order on October 2). Summary data reports will be provided to the aforementioned agencies 30 days after the completion of the following milestones:

a. June habitat survey.
b. August juvenile fish and habitat survey.
c. September adult Chinook surveys.

A final report detailing all of the fish and habitat monitoring surveys will also be submitted to the aforementioned agencies by December 30 (90 days after termination of the Order).

7.0 REFERENCES

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ATTACHMENT A

DFG Comment Letter to SWRCB

State of California
Memorandum

Flex your POWER

Date: April 20, 2009

To: Ms. Victoria Whitney, Chief
State Water Resources Control Board
Division of Water Rights
Post Office Box 2000
Sacramento, CA 95812
Via e-mail: VWHITNEY@waterboards.ca.gov

From: Charles Armor, Regional Manager
Department of Fish and Game – Bay Delta Region, Post Office Box 47, Yountville, California 94599

Subject: Notice of State Water Resources Control Board, Division of Water Rights Order Approving a Temporary Urgency Change Petition by Sonoma County Water Agency Regarding Permits 12947A, 12949, 12950, and 16596 (Applications 12919A, 15736, 15737, 19351)

The California Department of Fish and Game (DFG) has reviewed Sonoma County Water Agency's (SCWA) petition to your agency for a temporary urgency change in their water rights permits. We have also reviewed the State Water Resources Control Board's (SWRCB) Order WR 2009-0027-DWR (Order). SCWA is requesting temporary changes to their water right permits because the combination of low precipitation during this past winter and the reductions in diversions from the Eel River at the Potter Valley Project (PVP) have resulted in low reservoir storage in Lake Mendocino. According to the Order, SCWA is requesting a reduction in flow from Lake Mendocino to the Russian River in order to "prevent depletion of storage which would severely impact threatened or endangered Russian River fish species, create serious water supply impacts in Mendocino County and in Sonoma County's Alexander Valley, and harm Lake Mendocino and Russian River recreation."

On April 6, the SWRCB issued the Order approving a Temporary Urgency Change Petition (TUCP) dated April 6, 2009, prepared by SCWA to temporarily reduce the Russian River instream flow requirements as follows:

1. From April 6 through June 30, 2009, instream flow requirements for the upper Russian River (from its confluence with the East Fork of the Russian River to its confluence with Dry Creek) be reduced from 185 cubic feet per second (cfs) to 75 cfs, and the requirements for the lower Russian River (downstream of its confluence with Dry Creek) be reduced from 125 cfs to 85cfs; and

2. Dry Year Criteria. From July 1 through October 2, 2009, instream flow requirements for the upper Russian River be reduced from 185 cfs to 75 cfs, and the requirements for the lower Russian River be reduced from 125 cfs to 85 cfs, if during the period from April 1 through June 30 total inflow to Lake Mendocino is greater than 25,000 acre feet; or

3. Critically Dry Year Criteria. From July 1 through October 2, 2009, instream flow requirements be further reduced to 25 cfs for upper Russian River and 35 cfs for the lower Russian River, if during the period from April 1 through June 30 total inflow to Lake Mendocino is less than or equal to 25,000 acre feet.

The Order cites a document prepared by SCWA titled "Hydrologic Analysis of Lake Mendocino Storage Under Dry 2009 Conditions" (Hydrologic Analysis) dated April 2009. The Hydrologic Analysis projects that Lake Mendocino will go dry by early October 2009 if no action is taken to reduce the instream flow requirements. The order also states that it is uncertain if water could be released from Lake Mendocino to the East Fork Russian River if water levels dropped below 10,000 acre feet.

In 2007 DFG supported SCWA's petitioning to temporarily change SCWA's water right permits due to low water storage levels in Lake Mendocino as well as reduced diversions from the Eel River at the PVP. DFG supported the petition because reducing flows to 75 cfs provided a sufficient quantity of cold water in Lake Mendocino to achieve a substantial benefit for Chinook salmon. The 2009 water year is different than previous years as reservoir storage in Lake Mendocino is approximately 20,000 acre feet less than what it was at this time in 2007. In addition, in the *Dry Year* and *Critical Dry Year Criteria*, the Hydrologic Analyses' projections of amount of water remaining in the Lake Mendocino this fall depend on assumptions that are uncertain. These assumptions include: 1) inflow from Lake Pillsbury, which does not appear to be a proven supply, and 2) water conservation restrictions that SCWA will impose on water users that are not within their jurisdiction and/or within their service area (e.g., agricultural users and other water districts).

The difference between current conditions and 2007 conditions may be significant. This year, the amount of water available may not be sufficient to sustain cold water enhancement flows throughout the Chinook spawning season. A substantial reduction in cold water flow after the start of fall migration could result in high mortality of Chinook due to a combination of pathogens, high water temperatures, adverse water quality, and high fish densities. Similar conditions resulted in the 2002 fish kill in the Klamath River. This occurred when an above average number of Chinook salmon entered the Klamath River in the early fall. During this time river flow and the volume of water in the fish-kill area were atypically low. Combined with the above average run of salmon, these low flows and river volumes resulted in high fish densities. Fish passage may have also been impeded by low flow depths over critical riffles or lack of cues for fish to migrate upstream. Warm water temperatures in the river created ideal conditions for pathogens to infect salmon. The presence of a high density of hosts and warm temperatures caused rapid amplification of pathogens, which ultimately results in the mortality event.

DFG makes the following recommendations that we believe SWRCB should condition as Temporary Changes in SCWA's water rights permits:

1) The Order mandates the change from the Dry Year Criteria to the Critically Dry Year Criteria on July 1 be based on 25,000 acre-feet of inflow to Lake Mendocino

from the PVP. The Order provides no justification for using the amount of inflow to Lake Mendocino as a metric for switching to the Critically Dry Year Criteria. If the switch from a Dry Year Criteria to a Critically Dry Year Criteria is to "bank" water in Lake Mendocino for Chinook salmon, then it would be prudent to use water storage in Lake Mendocino as the metric for switching or not switching from the Dry Flow Criteria on July 1.

2) SCWA shall consult with DFG and NMFS while developing and implementing a temperature monitoring plan and a water quality monitoring plan with the Regional Water Quality Control Board and Division of Water Rights.

3) The tributaries to the Russian River are generally the principal spawning and nursery areas for steelhead and coho salmon. This year, late rain fall resulted in limited connectivity of Russian River tributaries to the mainstem during the typical spawning season for steelhead. Consequently, rather than spawning in the tributaries, substantial numbers of adult steelhead may have spawned in the mainstem Russian River. If spawning was successful, we would suspect that juvenile steelhead may be rearing in the mainstem Russian River. Monitoring juvenile salmonids (i.e., age 0 and age 1) rearing in the Russian River will provide important information when considering revisions to D1610. No later than June 1, SCWA shall install, maintain and operate an out-migrant trap in the Russian River in the vicinity of the Healdsburg above the Healdsburg Memorial Dam to monitor juvenile salmonid emigration in mainstem Russian River. The trap should be employed until at least July 15. Trapping results for all species shall be included in a report that shall be submitted to DFG and NMFS by December 31, 2009.

4) SCWA shall conduct habitat mapping surveys in the mainstem Russian River that map riffle-pool continuity, riffle depth, temperature stratification in pools, and other habitat variables.

5) If flows are converted from Dry Year Criteria to Critically Dry Year Criteria, flow in the East Fork Russian River immediately below the Coyote Valley Dam shall not be reduced by more than 10% of the flow per hour.

6) Copies of all reports and plans that are required by this Order shall be provided to DFG.

7) Condition 1(d) should be revised to include other variables to consider besides Chinook salmon counts when increasing releases from Lake Mendocino. Variables such as results from water quality monitoring, temperature monitoring, and water storage level in Lake Mendocino should be evaluated in addition to Chinook salmon counts before increasing flows to 125 cfs. We recommend that SCWA consult with NMFS and DFG by September 1 to evaluate these variables to determine if flows should be increased to 125 cfs.

8) The expiration date for this Order is October 2; however, Lake Mendocino may not get sufficient recharge by October 2 to provide sustained adequate flow throughout the spawning season for Chinook salmon. Consequently, outflow from Lake Mendocino, beyond the expiration date of the Order, may need to be adaptively managed depending on the results of the required monitoring.

9) The SCWA is still required to comply with Fish and Game Code 5937 which states that the "owner of any dam shall allow sufficient water at all times to pass through a fishway, or in the absence of a fishway, allow sufficient water to pass over, around or through the dam, to keep in good condition any fish that may be planted or exist below the dam." Water quality conditions during the Critically Dry Year Criteria are uncertain, and such low flows may cause or exacerbate pathogens in fish populations residing in the Russian River, which in turn could spread to migrating Chinook salmon. The Order should include an assessment of overall condition of health in fish collected in representative reaches of the Russian River. If samples of fish appear to be in poor health, these fish shall be collected and tested for pathogens that maybe associated with poor water quality conditions.

Thank you for considering our comments. DFG staff is available to assist the SWRCB and SCWA in managing and monitoring the anadromous and resident fisheries in the Russian River. If you have any questions or wish to initiate consultation with DFG, please contact Eric Larson, Biological Programs Manager, at (707) 944-5528.

cc: See Next Page

cc: Mr. Gary Stacey, Regional Manager
Department of Fish and Game
Northern Region
601 Locust Street
Redding, CA 96001

Mr. Dick Butler
National Marine Fisheries Service
777 Sonoma Avenue, Room 325
Santa Rosa, CA 95404

Bill Hearn
National Marine Fisheries Service
william.hearn@noaa.gov

Rick Rodgers
National Marine Fisheries Service
rick.rodgers@noaa.gov

Mr. Randy Poole, Director
Sonoma County Water Agency
Post Office Box 11628
Santa Rosa, CA 95406

David Manning
david.manning@scwa.ca.gov

Mr. Mark Neeley
North Coast Regional Water Quality Control Board
5550 Skylane Boulevard, Suite A
Santa Rosa, CA 95403

Stephen Bargsten
sbargsten@waterboards.ca.gov

ATTACHMENT B

NMFS Comment Letter to SWRCB

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
777 Sonoma Ave., Room 325
Santa Rosa, CA 95404-4731

April 30, 2009

Jeanine Townsend
Clerk to the Board
State Water Resources Control Board
1001 I Street
Sacramento, California 95814

Dear Ms. Townsend:

NOAA's National Marine Fisheries Service (NMFS) has reviewed the Sonoma County Water Agency's (SCWA) petition to your agency for a Temporary Urgency Change in their water rights permits. NMFS has also reviewed the State Water Resources Control Board's (SWRCB) Order WR 2009-027-DWR (Order). SCWA has requested temporary changes to their water right permits because the combination of low precipitation during this past winter and reductions in diversions from the Eel River at the Potter Valley Project have resulted in extremely low reservoir storage in Lake Mendocino at the beginning of the low flow season. For this time of year, storage in Lake Mendocino is lower than it has been since records began in1965. Current projections indicate that, without action, Lake Mendocino will likely be entirely drained by late September. This would likely eliminate most of the surface flow in the Russian River upstream of Healdsburg except for water derived from minor seepage from the adjacent aquifer, percolation from waste discharge ponds, and a few relatively small tributaries until late fall or winter rains begin. This would have impacts to fall run Chinook salmon which enter the river primarily in October and November. It would also impact steelhead that reside in the upper mainstem and the ecological functions that support anadromous fisheries resources (*e.g.,* native fishes and aquatic invertebrates).

Juvenile anadromous salmonids migrate to the estuary and ocean during spring and early summer; therefore, to protect the spring 2009 migrants, it is prudent to maintain flows at dry year levels or even higher prior to July 1. If storage was not as low in Lake Mendocino, NMFS would argue that D1610 normal year criteria should be maintained at Healdsburg at least until mid-June.

NMFS is in favor of a plan to conserve water storage in Lake Mendocino because it is important to sustain flows that support the adult fall salmon run and steelhead summer rearing habitat in the river's mainstem. However, based on water supply analysis by SCWA, it may be that stream flow this year will be inadequate to support summer rearing habitat and fall salmon runs regardless of whether flows are immediately reduced to dry year levels and to proposed critically dry year levels beginning July 1. In Figure 3 of SCWA's Temporary Urgency Change Petition[1],

[1] Figure 3 within SCWA's document entitled: Hydrologic Analysis of Lake Mendocino Storage under 2009 Conditions.

SCWA projects storage of about 29,000 acre-feet in Lake Mendocino by mid-November if: 1) minimum flows in the Russian River are immediately reduced to dry year levels and further reduced to critically dry year levels[2] on July 1, and 2) there is a "*20% cumulative conservation of 2007 releases by both agricultural producers and water districts including the Agency* [SCWA] *on the Upper Russian River from May 15, the assumed end of the frost protection season, to November 15.*" In another graph that SCWA presented to NMFS and the Department of Fish & Game, Lake Mendocino storage was entirely exhausted by **mid-November** if: 1) minimum flows in the Russian River are immediately reduced to dry year levels and further reduced to critically dry year levels on July 1, and 2) there is **no** additional water conservation. Projections are even more dire if only a dry year scenario is maintained (*i.e.*, a summer minimum of 75 cfs at Healdsburg and 85 cfs at Hacienda Bridge) and there is no water conservation in the upper mainstem between Lake Mendocino and Healdsburg. Without the 20% water conservation in the upper mainstem throughout the summer and fall, a continuous dry year scenario throughout this summer and early fall would entirely empty Lake Mendocino by **mid-October**.

It is unclear how 20% cumulative conservation of 2007 releases by both agricultural producers and water districts can be achieved between May 15 and November 15 in the segment between Lake Mendocino and Healdsburg given that SCWA has very little or no leverage to force conservation by municipalities and agricultural operations in this area. SWRCB's Order Provision 15 states that SCWA will submit a plan for obtaining cooperation and participation from agricultural and municipal water users to reach conservation goals. It states that SCWA's plan shall include "*steps that SCWA will take to investigate the waste, unreasonable use, unreasonable method of use, or unreasonable method of diversion of water from the Russian River.*" Such efforts will clearly be needed to achieve conservation. However, it will also require both leadership and enforcement of state water law by the SWRCB. Without that leadership, enforcement of water code, and real efforts to promote water conservation, it may well be that Lake Mendocino will be effectively drained by early November, and without early seasonal rains the Russian River will run nearly dry.

The proposal to reduce flows to critically dry year levels (minimum of 25 cfs at Healdsburg and 35 cfs at the Hacienda Bridge in Forestville) will allow flows that have not been seen since the 1977 drought that preceded D1610. This introduces real uncertainty into the analysis of the impacts of reducing flows to critically dry levels. The human populations of Mendocino and Sonoma County have grown considerably since 1977. With that increased population there is increased potential pollution to the river from both rural and urban development. Therefore, reducing flows to critically dry levels will increase pollutant concentrations and possibly degrade water quality to the detriment of fisheries and other public uses (*e.g.*, swimming, boating, etc.). Yet not reducing flow to critically dry levels may well cause the complete draining of Lake Mendocino, if significant water conservation is not achieved in the upper river between the reservoir and Healdsburg. The water quality implications of a drained Lake Mendocino due to higher minimum flows and minimal conservation could be worse than a critically dry year scenario, which would likely sustain flows of about 40 cfs at Healdsburg (minimum flow of 25

[2] The petition calls for reduction to critically dry levels assuming inflow to Lake Mendocino is less than 25,000 acre-ft between April 1 and June 30; this has a very high probability.

cfs + 15 cfs compliance buffer) and 50 cfs at Hacienda Bridge (minimum flow of 35 cfs + 15 cfs compliance buffer).

The best short-term plan for this water supply problem may be to 1) achieve water conservation goals of 25%[3] in both Mendocino and Sonoma Counties, 2) continue to maintain Dry Year flow levels until July 1, and 3) adaptively manage flow releases between July 1 and the commencement of seasonal rains. With meaningful and substantial water conservation throughout the watershed, it may be possible to sustain minimum summer flows comparable to those referenced in NMFS Russian River biological opinion[4] (75 cfs at Healdsburg and 70 cfs at the Hacienda Bridge in Forestville) without draining Lake Mendocino. However, given that 1) it would be beneficial to the fall run salmon and future water supply to retain some water in Lake Mendocino by mid-October, and 2) the uncertainties regarding the likelihood that there will be sufficient resources to achieve necessary water conservation goals, it would be prudent to approve a minimum flow lower than 75 cfs at Healdsburg or 70 cfs at Hacienda Bridge. If a critically dry year minimum flow is adopted for the period July 1 through October 2, 2009, SCWA should be encouraged to maintain flows as near to those referenced in NMFS Russian River biological opinion as much as possible so as to limit impacts to water quality and other resources.

One purpose of temporarily reducing minimum flow requirements in the Russian River is to "bank" water in Lake Mendocino so that there would be ample storage to provide higher flows during the adult Chinook salmon migration in the Russian River. Therefore, it is important that SCWA release flows higher than the minimum dry year requirements (*e.g.*, 75 cfs at Healdsburg) when substantial numbers of Chinook salmon are in the Russian River (October through early December). We are concerned that low flows in the vicinity of 75 cfs in the middle and upper Russian River could limit movements of adult Chinook salmon with resulting potential losses to the fishery.

NMFS agrees and is supportive of the 17 conditions provided in Order WR 2009-0027-DWR, with only one exception. Condition 3 states, "*SCWA shall not release water from Lake Sonoma in excess of the flows required to satisfy existing water rights and the interim instream flow requirement established in this Order for the Russian River downstream of its confluence with Dry Creek.*" The release of up to 105 cfs from Lake Sonoma, while not providing optimal conditions, does support habitat for juvenile salmonids in Dry Creek. If appreciable water conservation (*e.g.*, 25%) can be achieved in Sonoma County with resulting reductions at SCWA's Mirabel/Wohler diversion site, then excess water associated with a release of 100 to 105 cfs from Lake Sonoma could contribute to higher sustained flows in the lower Russian River with resulting potential benefits to water quality, fisheries, and other resources.

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[3] reductions of 25% from usage during recent previous years (e.g., 2008 or perhaps the average annual usage during 2006-2008, etc.)

[4] NMFS. 2008. Biological opinion for water supply, flood control operations, and channel maintenance conducted by the U.S. Army Corps of Engineers, the Sonoma County Water Agency, and the Mendocino County Russian River Flood Control and Water Conservation Improvement District in the Russian River watershed. NMFS Santa Rosa Area Office, California. 366 pp.

Thank you for your consideration of this important matter. If you have questions concerning this letter please contact Dr. William Hearn at 707-575-6062.

Sincerely,

Dick Butler
Santa Rosa Area Office Supervisor
Protected Resources Division

cc: C. Armor, CDFG (Yountville)
R. Poole, SCWA
V. Whitney, SWRCB

ATTACHMENT C

SCWA Water Quality Monitoring Plan

SONOMA COUNTY WATER AGENCY

FILE:42-4.19&6.19-9 CORRESPONDENCE RELATED TO SWRCB ORDER APPROVING TEMPORARY URGENCY CHANGE IN PERMITS 12947A, 12949, 12950& 16596 (ORDER WR 2009-0027-DWR)

May 22, 2009

Ms. Victoria A Whitney
Deputy Director for Water Rights
State Water Resources Control Board
Division of Water Rights
P.O. Box 2000
Sacramento, CA 95812-2000

RE: Revised Water Quality and Temperature Monitoring Plan as Required by Water Rights Order 2009-0027-DWR

Dear Ms. Whitney:

Enclosed please find a revised Water Quality and Temperature Monitoring Plan (Plan) for the Russian River and Lake Mendocino. The Plan is submitted as meeting the requirements of the State Water Resources Control Board Division of Water Rights Order WR 2009-0027-DWR, Provisions 8 and 9. This plan was developed by the Sonoma County Water Agency (Agency) in consultation with the North Coast Regional Water Quality Control Board (NCRWQCB), NOAA National Marine Fishery Service (NMFS), the California Department of Fish and Game (DFG), the Sonoma County Environmental Health Department (DEH) and the State Water Resources Control Board Division of Water Rights (Division). The review of comments received and consultation with all parties noted above has resulted in this revised water quality sampling and monitoring plan.

The Plan incorporates many of the recommendations provided by staff from NCRWQCB, NMFS, DFG and DEH as discussed in consultation on May 14, 2009. However, based on rationale provided below, not all recommendations were included in the revised Plan.

Bacteria Monitoring

After review of the NCRWQCB recommendations, consultation with DEH, the Sonoma County Public Health Laboratory, aerial photography and Agency staff familiar with the recreational areas of the Russian River the Plan provides for bacteria monitoring at twelve sites in Sonoma and Mendocino Counties. Of the proposed twelve sites, eleven were recommended by the NCRWQCB. Several sites recommended by NCRWQCB staff have been excluded from the revised Plan based on the following reasons:

- Several of the sites are located on upper reaches of the river where flows will be at or near 100 cubic feet per second, well above the minimum in-stream flow requirements;
- Several of the sites have restricted or no legal public access and consequently lack high recreational use.
- Laboratory Resources – Discussions with staff at the Sonoma County Public Health Laboratory (Lab) indicate the number of samples proposed in the revised Plan is the maximum they are confident they will be able to process within the necessary reporting times, the Lab is under contract with the

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NCRWQCB, DEH and the Agency, is familiar with the seasonal pathogen program and has the necessary reporting protocols already in place;

The twelve proposed bacteria monitoring locations will be sampled on a weekly basis and during the Labor Day weekend.

Biostimulatory Response Water Quality Monitoring Program

On May 14, 2009, the recommended biostimulatory response water quality monitoring program was discussed to the extent that additional information was needed to determine an appropriate plan. Agency staff investigated adding chlorophyll-a probes to the Agency's sondes, however the probes only account for chlorophyll and not chlorophyll-a as was recommended. To correlate the chlorophyll results to chlorophyll-a, a specific site oriented calibration study would need to be conducted at each sampling location. Given that and the extraordinary cost of each probe the Agency determined that a grab sample program at numerous locations within the watershed would accomplish the goal of the NCRWQCB recommendations.

The Plan provides for sampling nutrients on a weekly basis at six locations from the outfall at Lake Mendocino to Johnson's Beach at Guerneville. As discussed on May 14, 2009, these locations should provide for an overall representation of water quality in the Russian River. In addition to the nutrients, chlorophyll-a will be sampled at five locations downstream of the outfall. The sites correspond with locations of permanent or seasonal sondes and bacteria sampling sites so correlations, if any, may be determined. One site was removed from the program due to restricted access and no recreational use.

Reporting

The Agency will provide results of all bacteria sample results as soon as made available to both the NCRWQCB and DEH so that the data can be provided on their respective websites for public review. The Agency will describe and provide links to both websites and upon written receipt of nutrient and chlorophyll-a results will update its website to include that data. A final written report will be submitted within three months following the end of the Order.

If you have any questions or comments, please do not hesitate to contact me directly.

Sincerely,

Don Seymour

Donald J. Seymour, P.E.
Water Agency Principal Engineer

c Pamela Jeane, Jim Zambenini, Ellen Simm, David Manning, Jeff Church, George Lincoln
Eric Oppenheimer, State Water Resources Control Board, Division of Water Rights
Catherine Kuhlman, Richard Fadness, North Coast Regional Water Quality Control Board
Walt Kruse, Christine Sosko, Jim Tyler, Sonoma County Department of Health Services
Alan Lilly, Bartkiewicz, Kronick & Shanahan

Enclosure: Revised Temperature and Water Quality Monitoring Plan

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Sonoma County Water Agency
Revised Temperature and Water Quality Monitoring Plan
For the Russian River during April – October 2009
May 22, 2009

Background

This revised Temperature and Water Quality Monitoring Plan (Plan) is submitted in accordance with State Water Resources Control Board (State Board) Division of Water Rights Order WR 2009-0027-DWR (Order), approving a Temporary Urgency Change in Permits 12947A, 12949, 12950, and 16596 for Sonoma County Water Agency (Agency). Provision 8 of the Order required the Agency to prepare a Temperature Monitoring Plan and Provision 9 required the Agency to prepare a Water Quality Monitoring Plan for the Russian River and Lake Mendocino. On April 20, 2009, the Agency submitted a plan to meet the requirements of Order WR 2009-0027-DWR. Following public comment during a public workshop on May 6, 2009 and comments relative to the original plan, the State Board asked the Agency to revise the plan in consultation with the North Coast Regional Water Quality Control Board (NCRWQCB), NOAA National Marine Fisheries Service (NMFS) and the California Department of Fish and Game (DFG).

On May 14, 2009, the Agency consulted with staff from the Sonoma County Environmental Health Department (DEH), NCRWQCB, NMFS, DFG with staff from the State Board and DFG also present via teleconference. The review of comments received and consultation with all parties noted above has resulted in this revised water quality sampling and monitoring plan.

Summary

The Plan incorporates the collection of data through permanent and seasonal instrumentation to collect both real time and baseline water quality information and provides for the analysis of water quality through sampling for public health guidance and overall water quality condition.

The revised water quality and temperature sampling locations are shown in Attachment A. A more detailed summary of the revised sampling program is provided in Attachment B. The individual components are explained below.

Agency Permanent and Seasonal Sondes

In coordination with the United States Geological Survey (USGS) the Agency maintains five multi-parameter water quality sondes on the Russian River located at Hopland, Diggers Bend in Healdsburg, the Agencies river diversion facility (RDS) at Mirabel, Hacienda Bridge and Johnson's Beach. These five sondes are referred to as "permanent" as the Agency maintains them as part of its early warning detection system. The sondes take real time readings of water pH, temperature, dissolved oxygen content (DO), specific conductivity, turbidity, and depth, every 15 minutes and transmit the raw data via telemetry to the Agencies operations center. In addition, the Hopland, Diggers Bend and Hacienda Beach data is provided in cooperation with the USGS on its "Real-time Data for California" website. For those interested in the complete

set of water quality data, the Agency offers an "email subscription" available to the public via the Agencies website.

In addition to the permanent sondes, the Agency seasonally deploys sondes at various locations within the watershed. This year the Agency in cooperation with the USGS is installing seasonal sondes with real-time telemetry at the USGS river gauge station north of Cloverdale at Commisky Station Road and at new gauge stations at the Alexander Valley Road Bridge and at Riverfront Park. However, the USGS is heavily burdened with ongoing activities in many of the coastal watersheds and these three sondes may not be installed until July. Once installed, the Agency will update its website links to include these three new seasonal stations.

In consultation with the NCRWQCB the Agency is deploying two seasonal sondes in the upper reach of the Russian River just below Coyote Dam. These sondes will be deployed at the Lake Mendocino outfall and just below the westfork confluence. The westfork confluence location is pending access over private property and thus collection of data will commence upon access and installation.

As part of its estuary monitoring program the Agency installs seasonal sondes in the lower portion of the Russian River below Duncans Mills. Sondes are deployed at Freezeout Creek, Heron Rookery, Sheephouse Creek, Bridgehaven, Patty's Rock and at the mouth of the Russian River at Jenner. These sondes take readings on water pH, temperature, DO, specific conductivity, salinity, and depth, every hour. Three of these sites are boat in only and thus data are stored in the unit until it can be retrieved by field personnel. SCWA personnel download the data in the field every two to three weeks.

Water Quality Sampling

The NCRWQCB in cooperation with the DEH conducts seasonal bacteriological and general water quality sampling at Russian River beaches which experience the greatest body contact recreation. In consultation with the NCRWQCB and DEH, the Agency will supplement the seasonal program with a bacteriological and biostimulatory response sampling program.

The NCRWQCB seasonal sampling locations consist of: Camp Rose; Memorial Beach; Steelhead Beach; Forestville Access Beach; Johnson's Beach; and Monte Rio Beach. In addition to the seasonal sampling locations noted above, the Agency will conduct supplemental weekly bacteriological sampling at: the Russian River near Commisky Station Road (aka Russian R NR Cloverdale); Cloverdale River Park; Geyserville Hwy 128 bridge; Alexander Valley Road bridge; and at the Hacienda Bridge, these locations were selected as additional public recreational sites. Bacteriological samples will be collected weekly beginning May 28, 2009 continuing until October 1, 2009 and during the Labor Day weekend. The samples will be analyzed using the Colilert-18 quantitray MPN method for total coliform and *E. coli* and the Enterolert quantitray method for Enterococcus. Daily sampling will be conducted following an acute exceedance of the California Department of Health Services – Draft Guidance for Fresh Water Beaches and continue until a "less than" result is confirmed.

In addition to the bacteriological sampling and in consultation with the NCRWQCB, NMFS and DFG, the Agency will conduct biostimulatory response water quality monitoring at the following locations: Lake Mendocino outfall; Russian River near Commisky Station Road (aka Russian R NR Cloverdale); Alexander Valley Road bridge; Healdsburg Veterans Memorial Beach; Hacienda bridge; and Monte Rio Beach. Water samples will be collected weekly and analyzed for: Ammonia-N; Nitrate-N; Total Organic Nitrogen; and Total Phosphorous. In addition, chlorophyll-a will be analyzed for at all stations except the Lake Mendocino outfall.

The Agency will also be conducting a separate but related estuary bacteriological and nutrient sampling program. Agency staff will collect bacteriological and nutrient samples once every three weeks at three locations in the estuary: (1) Freezeout Creek below Duncans Mills; (2) Bridgehaven; and (3) River mouth at Jenner. Similar to the previously described bacteriological and nutrient constituents the estuary samples will be analyzed for total coliform and *E.* coli using the Colilert-18 quantitray MPN method and Enterococcus using the Enterolert quantitray method for Enterococcus. Nutrients analyzed will be consistent as described previously.

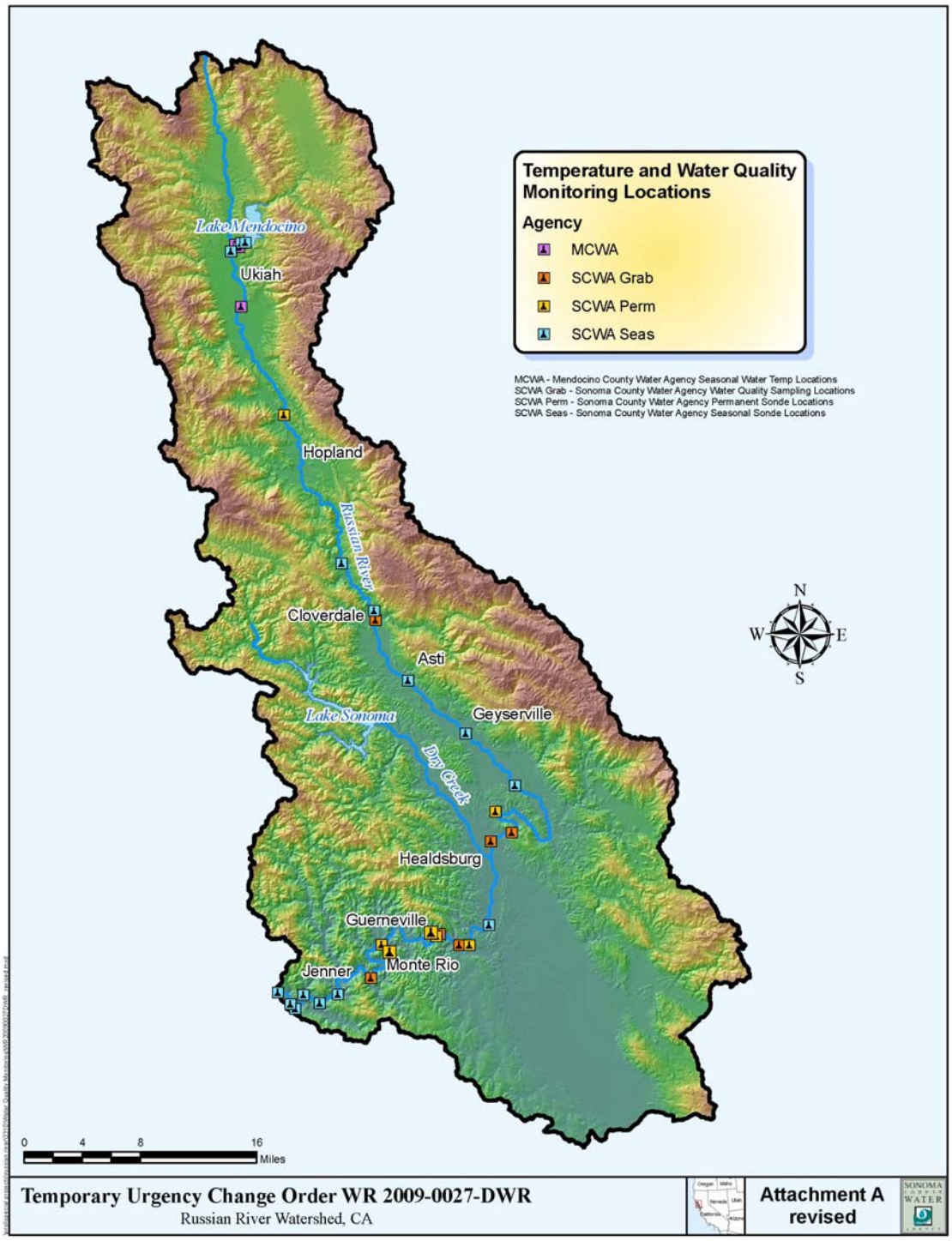
The NCRWQCB and the Agency will also collaborate on vertical profiling of Lake Mendocino water quality at or near the tower structure. The profiling will be conducted on a monthly basis and alternate between Agency and NCRWQCB staff.

Sonoma and Mendocino County Water Agency Seasonal Water Temperature Collection

In addition to temperature data collected by the sondes, the Agency will deploy seasonal water temperature sensors with data logging capabilities at Preston, Asti and Geyserville. The data will be downloaded and compiled every two to three weeks. The Mendocino County Water Agency deploys seasonal water temperature sensors with data logging capabilities at numerous locations throughout the watershed. In the Russian River they expect to deploy sensors in the East Fork of the Russian River below Coyote Dam, in the West Fork of the Russian River below Lake Mendocino Drive, in the Russian River at Talmage Road and in the Russian River at Commisky Station Road. The Mendocino County Water Agency has agreed to provide the raw data as downloads become available.

Data Analysis and Reporting

Results from bacteriological samples will be transmitted to both the DEH and NCRWQCB within one business day for posting to their respective websites and potential beach postings. The Agency will also update its website to include links to the DEH and NCRWQCB websites. The Agency will also submit results within one business day to the Mendocino County Environmental Health Department which expects to report exceedances on its beach hotline. Laboratory results from the nutrient and chlorophyll-a sampling will be posted on the Agencies website upon receipt of the written laboratory report. Online stream gauge and sonde data is evaluated by Agency staff multiple times daily and upon weekly consultation with DFG, NMFS, NCRWQCB and the DEH may result in the adaptive management of flows. A written report will be submitted to the NCRWQCB and DEH summarizing all collected data within three months of the end of the Order.


Temperature and Water Quality Monitoring Locations
Agency
MCWA
SCWA Grab
SCWA Perm
SCWA Seas
MCWA - Mendocino County Water Agency Seasonal Water Temp Locations
SCWA Grab - Sonoma County Water Agency Water Quality Sampling Locations
SCWA Perm - Sonoma County Water Agency Permanent Sonde Locations
SCWA Seas - Sonoma County Water Agency Seasonal Sonde Locations
Lake Mendocino
Ukiah
Hopland
Russian River
Cloverdale
Asti
Lake Sonoma
Geyserville
Dry Creek
Healdsburg
Guerneville
Monte Rio
Jenner
N
W
E
S
0
4
8
16
Miles
Temporary Urgency Change Order WR 2009-0027-DWR
Russian River Watershed, CA
Attachment A revised
SONOMA COUNTY WATER

Attachment B - revised

May 22, 2009

Summary of Water Quality and Temperature Monitoring for Order 2009-0027-DWR

Instrument or sensor based sampling

Location	depth	temperature	DO	pH	turbidity	specific conductance	salinity	sampling frequency	telemtry?	duration
SCWA Permanent and Seasonal Sonde YSI Water Quality Samplers										
Lake Mendocino Outfall	x	x	x	x		x	x	1 hour	n	May - Oct
Westfork Confluence***	x	x	x	x		x	x	1 hour	n	upon install - Oct
Hopland USGS site	x	x	x	x	x	x		15 min	y	permanent
RR near Cloverdale USGS site*	x	x	x	x	x	x		15 min	y	upon install - Oct
Alexander Valley Road Bridge*	x	x	x	x	x	x		15 min	y	upon install - Oct
Digger's Bend	x	x	x	x	x	x		15 min	y	permanent
Riverfront Park*	x	x	x	x	x	x		15 min	y	upon install - Oct
Mirabel (SCWA RDS Facility)	x	x	x	x	x	x		15 min	y	permanent
Hacienda Bridge	x	x	x	x	x	x		15 min	y	permanent
Johnson's Beach	x	x	x	x	x	x		15 min	y	permanent
Freezeout Creek	x	x	x	x		x	x	1 hour	n	April - Dec**
Heron Rookery	x	x	x	x		x	x	1 hour	n	April - Dec**
Sheephouse Creek	x	x	x	x		x	x	1 hour	n	April - Dec**
Bridgehaven	x	x	x	x		x	x	1 hour	n	May - Dec**
Patty's Rock	x	x	x	x		x	x	1 hour	n	April - Dec**
Mouth @ Jenner	x	x	x	x		x	x	1 hour	n	April - Dec**
***sondes at RR near Cloverdale, Alexander Valley Road Bridge and Riverfront Park are pending USGS installations**										
****Dec removal is storm and high river dependant**										
***** sonde at Westfork confluence is pending site access**										
SCWA Seasonal water temp locations										
Preston		x						15 min	n	June - Oct
Asti		x						15 min	n	June - Oct
Geyserville		x						15 min	n	June - Oct
MCWA Seasonal water temp locations										
EF Russian River below dam		x						90 min	n	June - Oct
WF Russian River		x						90 min	n	June - Oct
Russian River at Talmage Rd		x						90 min	n	June - Oct
Russian River at Commisky		x						90 min	n	June - Oct

Grab Sampling Program

Location	total coliform / E. coli	enterococcus	chlorophyll-a	temperature	DO	pH	turbidity	nutrients*	conductivity	Duration
SCWA Urgency Change Order Bacterialogical, Nutrient and Water Quality Grab Sampling										
Lake Mendocino Outfall								x		May 28 - Oct 1
RR near Cloverdale USGS site	x	x	x	x	x			x		May 28 - Oct 1
Cloverdale River Park	x	x		x	x					May 28 - Oct 1
Geyserville Hwy 128 Bridge	x	x		x	x					May 28 - Oct 1
Alexander Valley Road Bridge	x	x	x	x	x			x		May 28 - Oct 1
Camp Rose Rd. (Fitch Mountain)**	x	x		x	x					May 28 - Oct 1
Healdsburg Veterans Memorial Beach**	x	x	x	x	x			x		May 28 - Oct 1
Steelhead Beach**	x	x		x	x					May 28 - Oct 1
Forestville Access Beach**	x	x		x	x					May 28 - Oct 1
Hacienda Bridge	x	x	x	x	x			x		May 28 - Oct 1
Johnson's Beach**	x	x	x	x	x			x		May 28 - Oct 1
Monte Rio Beach (multiple sites)**	x	x		x	x					May 28 - Oct 1
***nutrients include Ammonia-N, Nitrate-N, Total Organic Nitrogen, Total Phosphorous**										
Note - SCWA samples Thursday weekly following Memorial Day until end of Order, and Labor Day weekend, daily sampling will follow acute exceedance of the California Department of Health Services - Draft Guidance for Fresh Water Beaches										
****The NCRWQCB and Sonoma County Environmental Health Department conduct seasonal bacterialogical sampling at these locations weekly from the Tuesday following Memorial Day until the Tuesday following Labor Day**										
SCWA Seasonal Estuary bacterial and nutrient grab sampling										
Freezeout Creek (below Duncans Mills)	x	x	x	x	x			x		June - Oct
Bridgehaven	x	x	x	x	x			x		June - Oct
Mouth @ Jenner	x	x	x	x	x			x		June - Oct
Note - SCWA samples once every three weeks for nutrients and total / *E. coli* and Enterococcus										
SCWA/NCRWQCB Vertical Temperature Profiles										
Lake Mendocino (2-4 locations)				x	x	x			x	May - September
Note - SCWA and NCRWQCB alternate conducting monthly vertical temperature profiles										

ATTACHMENT D

Snorkel Survey Data Sheet

SCWA: Snorkel Survey Data Sheet **Sheet of**

Date:	Begin Time:	Observers:	Input
Reach Location and GPS Coordinates:			
Weather: Clear Overcast Cloudy Drizzle			

Water Quality

Habitat Unit	Time	Surface (at 1m)		Mid-column			Bottom		Max. Depth (m)
		Temp (C)	DO (mg/l)	Temp (C)	DO (mg/l)	Depth (m)	Temp (C)	DO (mg/l)	

Dive Observations

Habitat Unit	Species	Divers	Time (min)	Fish Observations					Secchi (m)	Comments
				0	1-25	26-100	101-200	>200		

Appendix B-5

Temperature and Water Quality Monitoring Plan to meet Term 7, revised Order WR 2009-034_EXEC

Sonoma County Water Agency
Revised Temperature and Water Quality Monitoring Plan
For the Russian River during April – October 2009
May 22, 2009

Background

This revised Temperature and Water Quality Monitoring Plan (Plan) is submitted in accordance with State Water Resources Control Board (State Board) Division of Water Rights Order WR 2009-0027-DWR (Order), approving a Temporary Urgency Change in Permits 12947A, 12949, 12950, and 16596 for Sonoma County Water Agency (Agency). Provision 8 of the Order required the Agency to prepare a Temperature Monitoring Plan and Provision 9 required the Agency to prepare a Water Quality Monitoring Plan for the Russian River and Lake Mendocino. On April 20, 2009, the Agency submitted a plan to meet the requirements of Order WR 2009-0027-DWR. Following public comment during a public workshop on May 6, 2009 and comments relative to the original plan, the State Board asked the Agency to revise the plan in consultation with the North Coast Regional Water Quality Control Board (NCRWQCB), NOAA National Marine Fisheries Service (NMFS) and the California Department of Fish and Game (DFG).

On May 14, 2009, the Agency consulted with staff from the Sonoma County Environmental Health Department (DEH), NCRWQCB, NMFS, DFG with staff from the State Board and DFG also present via teleconference. The review of comments received and consultation with all parties noted above has resulted in this revised water quality sampling and monitoring plan.

Summary

The Plan incorporates the collection of data through permanent and seasonal instrumentation to collect both real time and baseline water quality information and provides for the analysis of water quality through sampling for public health guidance and overall water quality condition.

The revised water quality and temperature sampling locations are shown in Attachment A. A more detailed summary of the revised sampling program is provided in Attachment B. The individual components are explained below.

Agency Permanent and Seasonal Sondes

In coordination with the United States Geological Survey (USGS) the Agency maintains five multi-parameter water quality sondes on the Russian River located at Hopland, Diggers Bend in Healdsburg, the Agencies river diversion facility (RDS) at Mirabel, Hacienda Bridge and Johnson's Beach. These five sondes are referred to as "permanent" as the Agency maintains them as part of its early warning detection system. The sondes take real time readings of water pH, temperature, dissolved oxygen content (DO), specific conductivity, turbidity, and depth, every 15 minutes and transmit the raw data via telemetry to the Agencies operations center. In addition, the Hopland, Diggers Bend and Hacienda Beach data is provided in cooperation with the USGS on its "Real-time Data for California" website. For those interested in the complete

set of water quality data, the Agency offers an "email subscription" available to the public via the Agencies website.

In addition to the permanent sondes, the Agency seasonally deploys sondes at various locations within the watershed. This year the Agency in cooperation with the USGS is installing seasonal sondes with real-time telemetry at the USGS river gauge station north of Cloverdale at Commisky Station Road and at new gauge stations at the Alexander Valley Road Bridge and at Riverfront Park. However, the USGS is heavily burdened with ongoing activities in many of the coastal watersheds and these three sondes may not be installed until July. Once installed, the Agency will update its website links to include these three new seasonal stations.

In consultation with the NCRWQCB the Agency is deploying two seasonal sondes in the upper reach of the Russian River just below Coyote Dam. These sondes will be deployed at the Lake Mendocino outfall and just below the westfork confluence. The westfork confluence location is pending access over private property and thus collection of data will commence upon access and installation.

As part of its estuary monitoring program the Agency installs seasonal sondes in the lower portion of the Russian River below Duncans Mills. Sondes are deployed at Freezeout Creek, Heron Rookery, Sheephouse Creek, Bridgehaven, Patty's Rock and at the mouth of the Russian River at Jenner. These sondes take readings on water pH, temperature, DO, specific conductivity, salinity, and depth, every hour. Three of these sites are boat in only and thus data are stored in the unit until it can be retrieved by field personnel. SCWA personnel download the data in the field every two to three weeks.

Water Quality Sampling

The NCRWQCB in cooperation with the DEH conducts seasonal bacteriological and general water quality sampling at Russian River beaches which experience the greatest body contact recreation. In consultation with the NCRWQCB and DEH, the Agency will supplement the seasonal program with a bacteriological and biostimulatory response sampling program.

The NCRWQCB seasonal sampling locations consist of: Camp Rose; Memorial Beach; Steelhead Beach; Forestville Access Beach; Johnson's Beach; and Monte Rio Beach. In addition to the seasonal sampling locations noted above, the Agency will conduct supplemental weekly bacteriological sampling at: the Russian River near Commisky Station Road (aka Russian R NR Cloverdale); Cloverdale River Park; Geyserville Hwy 128 bridge; Alexander Valley Road bridge; and at the Hacienda Bridge, these locations were selected as additional public recreational sites. Bacteriological samples will be collected weekly beginning May 28, 2009 continuing until October 1, 2009 and during the Labor Day weekend. The samples will be analyzed using the Colilert-18 quantitray MPN method for total coliform and *E. coli* and the Enterolert quantitray method for Enterococcus. Daily sampling will be conducted following an acute exceedance of the California Department of Health Services – Draft Guidance for Fresh Water Beaches and continue until a "less than" result is confirmed.

In addition to the bacteriological sampling and in consultation with the NCRWQCB, NMFS and DFG, the Agency will conduct biostimulatory response water quality monitoring at the following locations: Lake Mendocino outfall; Russian River near Commisky Station Road (aka Russian R NR Cloverdale); Alexander Valley Road bridge; Healdsburg Veterans Memorial Beach; Hacienda bridge; and Monte Rio Beach. Water samples will be collected weekly and analyzed for: Ammonia-N; Nitrate-N; Total Organic Nitrogen; and Total Phosphorous. In addition, chlorophyll-a will be analyzed for at all stations except the Lake Mendocino outfall.

The Agency will also be conducting a separate but related estuary bacteriological and nutrient sampling program. Agency staff will collect bacteriological and nutrient samples once every three weeks at three locations in the estuary: (1) Freezeout Creek below Duncans Mills; (2) Bridgehaven; and (3) River mouth at Jenner. Similar to the previously described bacteriological and nutrient constituents the estuary samples will be analyzed for total coliform and *E.* coli using the Colilert-18 quantitray MPN method and Enterococcus using the Enterolert quantitray method for Enterococcus. Nutrients analyzed will be consistent as described previously.

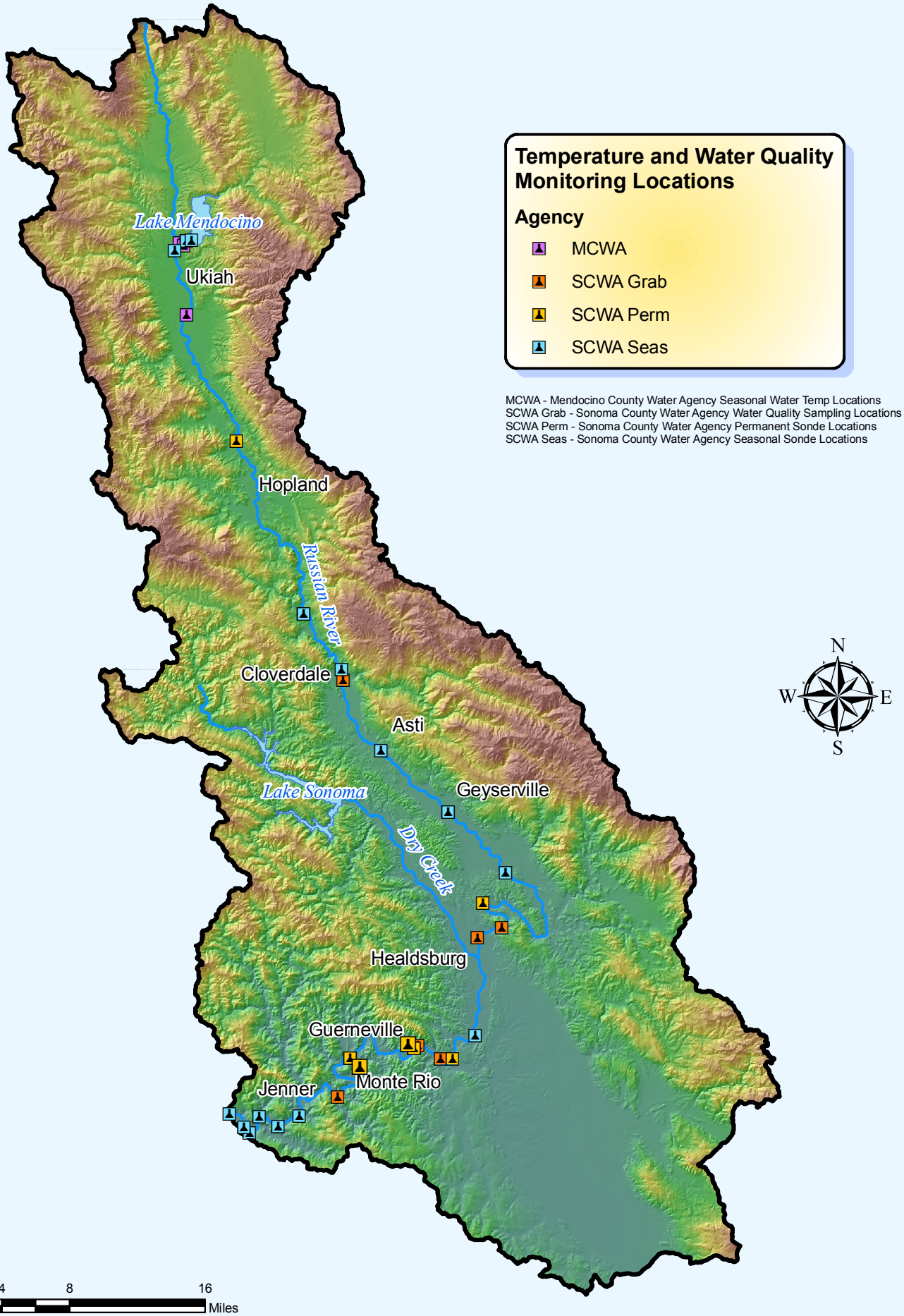
The NCRWQCB and the Agency will also collaborate on vertical profiling of Lake Mendocino water quality at or near the tower structure. The profiling will be conducted on a monthly basis and alternate between Agency and NCRWQCB staff.

Sonoma and Mendocino County Water Agency Seasonal Water Temperature Collection

In addition to temperature data collected by the sondes, the Agency will deploy seasonal water temperature sensors with data logging capabilities at Preston, Asti and Geyserville. The data will be downloaded and compiled every two to three weeks. The Mendocino County Water Agency deploys seasonal water temperature sensors with data logging capabilities at numerous locations throughout the watershed. In the Russian River they expect to deploy sensors in the East Fork of the Russian River below Coyote Dam, in the West Fork of the Russian River below Lake Mendocino Drive, in the Russian River at Talmage Road and in the Russian River at Commisky Station Road. The Mendocino County Water Agency has agreed to provide the raw data as downloads become available.

Data Analysis and Reporting

Results from bacteriological samples will be transmitted to both the DEH and NCRWQCB within one business day for posting to their respective websites and potential beach postings. The Agency will also update its website to include links to the DEH and NCRWQCB websites. The Agency will also submit results within one business day to the Mendocino County Environmental Health Department which expects to report exceedances on its beach hotline. Laboratory results from the nutrient and chlorophyll-a sampling will be posted on the Agencies website upon receipt of the written laboratory report. Online stream gauge and sonde data is evaluated by Agency staff multiple times daily and upon weekly consultation with DFG, NMFS, NCRWQCB and the DEH may result in the adaptive management of flows. A written report will be submitted to the NCRWQCB and DEH summarizing all collected data within three months of the end of the Order.



Temporary Urgency Change Order WR 2009-0027-DWR

Russian River Watershed, CA

Attachment A revised

SONOMA COUNTY WATER AGENCY

g:\r0\special projects\russian river\3310\Water Quality Monitoring\WR 2009\0027DWR_revised.mxd

Attachment B - revised

May 22, 2009

Summary of Water Quality and Temperature Monitoring for Order 2009-0027-DWR

Instrument or sensor based sampling

Location	depth	temperature	DO	pH	turbidity	specific conductance	salinity	sampling frequency	telemtry?	duration
SCWA Permanent and Seasonal Sonde YSI Water Quality Samplers										
Lake Mendocino Outfall	x	x	x	x		x	x	1 hour	n	May - Oct
Westfork Confluence***	x	x	x	x		x	x	1 hour	n	upon install - Oct
Hopland USGS site	x	x	x	x	x	x		15 min	y	permanent
RR near Cloverdale USGS site*	x	x	x	x	x	x		15 min	y	upon install - Oct
Alexander Valley Road Bridge*	x	x	x	x	x	x		15 min	y	upon install - Oct
Digger's Bend	x	x	x	x	x	x		15 min	y	permanent
Riverfront Park*	x	x	x	x	x	x		15 min	y	upon install - Oct
Mirabel (SCWA RDS Facility)	x	x	x	x	x	x		15 min	y	permanent
Hacienda Bridge	x	x	x	x	x	x		15 min	y	permanent
Johnson's Beach	x	x	x	x	x	x		15 min	y	permanent
Freezeout Creek	x	x	x	x		x	x	1 hour	n	April - Dec**
Heron Rookery	x	x	x	x		x	x	1 hour	n	April - Dec**
Sheephouse Creek	x	x	x	x		x	x	1 hour	n	April - Dec**
Bridgehaven	x	x	x	x		x	x	1 hour	n	May - Dec**
Patty's Rock	x	x	x	x		x	x	1 hour	n	April - Dec**
Mouth @ Jenner	x	x	x	x		x	x	1 hour	n	April - Dec**

***sondes at RR near Cloverdale, Alexander Valley Road Bridge and Riverfront Park are pending USGS installations**
****Dec removal is storm and high river dependant**
***** sonde at Westfork confluence is pending site access**

SCWA Seasonal water temp locations										
Preston		x						15 min	n	June - Oct
Asti		x						15 min	n	June - Oct
Geyserville		x						15 min	n	June - Oct

MCWA Seasonal water temp locations										
EF Russian River below dam		x						90 min	n	June - Oct
WF Russian River		x						90 min	n	June - Oct
Russian River at Talmage Rd		x						90 min	n	June - Oct
Russian River at Commisky		x						90 min	n	June - Oct

Grab Sampling Program

Location	total coliform / *E. coli*	enterococcus	chlorophyll-a	temperature	DO	pH	turbidity	nutrients*	conductivity	Duration
SCWA Urgency Change Order Bacterialogical, Nutrient and Water Quality Grab Sampling										
Lake Mendocino Outfall								x		May 28 - Oct 1
RR near Cloverdale USGS site	x	x	x	x	x			x		May 28 - Oct 1
Cloverdale River Park	x	x		x	x					May 28 - Oct 1
Geyserville Hwy 128 Bridge	x	x		x	x					May 28 - Oct 1
Alexander Valley Road Bridge	x	x	x	x	x			x		May 28 - Oct 1
Camp Rose Rd. (Fitch Mountain)**	x	x		x	x					May 28 - Oct 1
Healdsburg Veterans Memorial Beach**	x	x	x	x	x			x		May 28 - Oct 1
Steelhead Beach**	x	x		x	x					May 28 - Oct 1
Forestville Access Beach**	x	x		x	x					May 28 - Oct 1
Hacienda Bridge	x	x	x	x	x			x		May 28 - Oct 1
Johnson's Beach**	x	x	x	x	x			x		May 28 - Oct 1
Monte Rio Beach (multiple sites)**	x	x		x	x					May 28 - Oct 1

***nutrients include Ammonia-N, Nitrate-N, Total Organic Nitrogen, Total Phosphorous**
Note - SCWA samples Thursday weekly following Memorial Day until end of Order, and Labor Day weekend, daily sampling will follow acute exceedance of the California Department of Health Services - Draft Guidance for Fresh Water Beaches
****The NCRWQCB and Sonoma County Environmental Health Department conduct seasonal bacterialogical sampling at these locations weekly from the Tuesday following Memorial Day until the Tuesday following Labor Day**

SCWA Seasonal Estuary bacterial and nutrient grab sampling										
Freezeout Creek (below Duncans Mills)	x	x	x	x	x			x		June - Oct
Bridgehaven	x	x	x	x	x			x		June - Oct
Mouth @ Jenner	x	x	x	x	x			x		June - Oct

Note - SCWA samples once every three weeks for nutrients and total / *E. coli* and Enterococcus

SCWA/NCRWQCB Vertical Temperature Profiles										
Lake Mendocino (2-4 locations)				x	x	x			x	May - September

Note - SCWA and NCRWQCB alternate conducting monthly vertical temperature profiles

Appendix B-6

Plan to Meet Term 15 (Water Conservation), revised Order WR 2009-034_EXEC

Plan to Meet Requirements of Term 15 - State Water Resources Control Board Order WR 2009-0027-DWR

Lake Mendocino

Prepared by

Sonoma County Water Agency
404 Aviation Blvd
Santa Rosa, CA 95403

May 6, 2009

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1.0 PURPOSE AND INTRODUCTION

This plan has been prepared by the Sonoma County Water Agency (Agency) to fulfill the requirements of Term 15 of the State Water Resources Control Board (SWRCB) Order WR 2009-0027-DWR (Order) (Attachment A).

1.1 Lake Mendocino Storage Levels

Unusual hydrologic conditions in the Russian River Valley, coupled with reductions in water imported to the Russian River basin via the Potter Valley Project, have warranted immediate action to avoid significant risks to the storage levels in Lake Mendocino, including the possibility of the lake going dry in September. In 2007, the Agency filed a similar petition to mitigate impacts resulting from anticipated low lake levels. The approval of that petition by the SWRCB was critical to protecting the Chinook salmon in the Russian River during their fall migration and spawning. This year, the storage projections for Lake Mendocino are far more severe and the lake will likely go dry without changes to the summer release requirements to maintain minimum instream flows.

In April 2009, the storage level in Lake Mendocino was approximately 53,000 acre-feet (AF). This is roughly 17,000 AF lower than Lake Mendocino was in April 2007. Although Lake Mendocino storage is unusually low, cumulative inflow into Lake Pillsbury during the 2009 water year has been sufficient enough that, under SWRCB Decision 1610 (D-1610), 2009 is classified as a "Normal" water year and will likely retain this classification for the remainder of the year.

1.2 Water Year Classifications

The water year classifications (Normal, Dry, or Critical) specified in D-1610 are based on cumulative inflow into Lake Pillsbury beginning October 1. Analyses recently prepared by Agency engineering staff indicate that if significant inflows into Lake Mendocino, either from storm events or diversions by PG&E from the Eel River by the Potter Valley Project do not occur between now and June 1, then releases from Lake Mendocino to meet normal demands on, and minimum instream flow requirements for, the Russian River under D-1610 Normal year requirements will drain Lake Mendocino.

1.3 Temporary Urgency Change Petition Filed

To try to prevent these grave impacts, the Agency filed a Temporary Urgency Change Petition (TUCP) with the SWRCB on April 6, 2009, seeking immediate approval to reduce the minimum instream flow requirements for the Russian River in the Agency's water-rights permits in order to maintain sufficient storage in Lake Mendocino so that it does not go dry in the Fall of 2009. In the TUCP, the

Agency requested the SWRCB make the following temporary changes to the D-1610 instream flow requirements:

a. For April 6 through June 30, the D-1610 requirements for Dry conditions will apply in the Russian River. These requirements are 75 cubic feet per second (cfs) in the Upper Russian River (from its confluence with the East Fork to its confluence with Dry Creek) and 85 cfs in the Lower Russian River (downstream of its confluence with Dry Creek);
b. If, during the period from April 1 through June 30, total inflow into Lake Mendocino is less than or equal to 25,000 AF, then, for July 1 to October 2, the D-1610 requirements for Critical conditions will apply in the Russian River. These requirements are 25 cfs in the Upper Russian River (from its confluence with the East Fork to its confluence with Dry Creek) and 35 cfs in the Lower Russian River (downstream of its confluence with Dry Creek); and
c. If, during the period from April 1 to June 30, 2009, total inflow into Lake Mendocino is greater than 25,000 AF, then, for July 1 through October 2, the D-1610 requirements for Dry conditions will apply in the Russian River.

1.4 Temporary Urgency Change Order Issued

On April 6, 2009, SWRCB Deputy Director for Water Rights, Victoria Whitney, issued the Order which granted the Agency's petition, subject to certain terms and conditions. One of the conditions (Term 15 of the Order) requires the Agency to submit a plan to the SWRCB by May 6, 2009 to obtain the cooperation of agricultural and municipal Russian River water users to reach a water conservation goal of 25 percent in Sonoma County and 50 percent in Mendocino County.

1.5 Term 15 Report Requirements

As required by Term 15 of the Order, this plan provides the following:

a. An explanation of the Agency's authority or other ability to impose mandatory water conservation measures and identification of the persons and entities subject to that authority.
b. Identification of Russian River water users who are not subject to the Agency's authority to impose mandatory water conservation measures.
c. Steps that the Agency will take to investigate the waste, unreasonable use, unreasonable method of use, or unreasonable method of diversion of water from the Russian River. The Agency shall submit monthly reports to the State Water Board on its progress.

d. Steps that the Agency will take to gain the cooperation and participation of water users in conserving water and preventing the waste, unreasonable use, unreasonable method of use, or unreasonable method of diversion of water from the Russian River. The Agency shall submit monthly reports to the State Water Board on its progress.

2.0 AUTHORITY AND RESPONSIBILITIES OF AGENCY

The following subsections describe the Agency's service area, the role that Russian River water plays in the overall supply of the Agency's customers, and the Agency's authority and responsibilities related to water conservation, including the Agency's authority to impose mandatory conservation measures.

2.1 Agency Service Area and Retail Customers

The Agency's water service area covers a large part of Sonoma County, as well as the northern portion of Marin County (Figure 1). The Agency supplies water that is diverted from the Russian River to several categories of retail customers, including "contractors," "other Agency customers," and the Marin Municipal Water District. The "contractors" are the North Marin Water District, City of Petaluma, City of Rohnert Park, City of Santa Rosa, City of Sonoma, Valley of the Moon Water District, Town of Windsor, and City of Cotati. The "other Agency customers" are the Forestville Water District, the California-American Water Company, and several smaller water companies and public agencies. In addition, a few public water suppliers have contracts with the Agency authorizing them to divert water directly from the Russian River under the Agency's water rights. These suppliers are the Russian River County Water District, the Town of Windsor, the City of Healdsburg, and the Camp Meeker Parks and Recreation District. The relationship between the Agency, its contractors, other Agency customers, and Marin Municipal Water District is detailed in the Restructured Agreement for Water Supply (Restructured Agreement) dated June 2006 (Attachment B).

2.2 Composition of Water Supply in the Agency Service Area

Russian River supplies are not the only supplies of water utilized to meet water demand in the Agency's service area. Other supplies of water that are used include groundwater (provided by the Agency and by several of its retail customers), other surface water supplies (provided primarily by North Marin and Marin Municipal Water Districts), and recycled water (provided by several retail customers). These supplies are used by the Agency's customers in conjunction with Russian River water supplied by the Agency and water conservation practices (see Section 2.3) to meet their total water demands.

2.3 Authority of the Agency to Impose Mandatory Conservation

As a water wholesaler, the Agency does not have direct relationships with individuals and businesses that are end users of water, nor does it have the ability to directly impose water use restrictions on such end users. The Agency's authority is limited to its authority under its contracts with its customers to declare a water shortage and to apportion available water supplies among those customers. Any mandatory water conservation measures that apply to end users of water must be imposed by the Agency's customers.

As described in Section 2.2, Russian River water supplies provided by the Agency on a wholesale basis are only one source of water that is available to the municipal users of Russian River water. At their discretion, the municipal Russian River water users can provide other supplies of water, such as recycled water and their own groundwater, to be used in conjunction with conservation to offset the needs of their customers.

The rights and obligations of the Agency and its wholesale customers are primarily set forth in the Restructured Agreement between the Agency and its water contractors (Attachment B). Section 3.5(a) of the Restructured Agreement specifies the manner in which the Agency allocates water to its customers in the event of a water supply shortage, and Section 3.5(b) of the Restructured Agreement describes the manner in which the Agency allocates water to its customers in the event of a temporary impairment of the capacity of some or all of the Agency's transmission system. These provisions apply to "other Agency customers" through incorporation of the provisions in the Agency's Water Service Rules. The Agency's agreements with Marin Municipal Water District and the entities that may divert water directly from the Russian River under the Agency's water rights contain similar, although not identical, provisions.

Section 3.5(d) of the Restructured Agreement requires the Agency to "have an adopted water shortage allocation methodology sufficient to inform each Customer of the water that would be available to it pursuant to Section 3.5(a) in the event of reasonably anticipated shortages…." The Agency has adopted such a methodology, which is set forth in an appendix to the Agency's 2005 Urban Water Management Plan. The Restructured Agreement requires the Agency's customers to limit the amounts of water that they take from the transmission system to the allocations specified by the Agency under Section 3.5. The water contractors may also unanimously agree upon an alternative allocation of available supply.

These provisions give the Agency the ability to allocate the water it supplies (but not the Agency's customers' other supplies of water, such as local customer groundwater and surface water) among its customers if a shortage occurs. The

Agency has a number of methods available to it under the Restructured Agreement to ensure that its customers do not use more than the amounts of water allocated to them by the Agency, although the Agency has no ability to directly restrict the use of water by end users, or to impose financial penalties on end users for excessive use. The one exception is the Agency's few "surplus water" customers, who use water delivered directly by the Agency primarily for agricultural purposes. Under Section 3.5(a) of the Restructured Agreement, the Agency is required to terminate deliveries to surplus customers in the event of a shortage. The Agency notified its surplus customers on March 23, 2009 that it will temporarily suspend all deliveries to these surplus customers as of June 1, 2009, through September 2009.

Under Section 3.5(e) of the Restructured Agreement, a contractor taking more than its allocated amount of water from the transmission system during a shortage is subject to a liquidated damages surcharge equal to 50 percent of the then-current operations and maintenance charge for each acre-foot of water taken by the contractor in excess of its allocation. Section 3.5(e) also allows the Water Advisory Committee to request that the Agency physically limit the quantity of Agency-supplied water taken by a contractor or other Agency customer to the amounts authorized by Section 3.5, or to pursue all other available legal and equitable remedies applicable to such violations.

It is up to each Agency retail water contractor to reduce end user demands as necessary to reduce its deliveries from the transmission system to the amount allocated to it by the Agency. To accomplish this, the Agency's contractors have adopted ordinances placing limitations on the uses of water by end customers in the event of a water shortage. These ordinances were developed in consultation with the Agency and are described in detail in each contractor's individual Urban Water Management Plans. These ordinances impose mandatory water conservation measures on end users under certain specific conditions. In addition, as noted in Section 2.2, the Agency's customers also have other sources of water to meet some of the needs of their end-user customers.

In addition to the provisions in Section 3.5, Section 1.12 of the Restructured Agreement requires the Agency's regular customers to "implement or use their best efforts to secure the implementation of any water conservation requirements that may be added as terms or conditions of the Agency's appropriative water rights permits or licenses, or with which the Agency must comply under compulsion of regulation or law." The Agency's regular customers are thus required to use their "best efforts" to comply with any water conservation requirements adopted by the SWRCB in connection with the Agency's water right permits. The Agency's Water Contractors, acting through the "Water Advisory Committee" created by the Restructured Agreement, determine

whether the Agency's regular customers are acting in compliance with Section 1.12. The Agency itself has no control over the actions taken by its customers to comply with Section 1.12.

The Agency has no authority to impose mandatory water conservation measures on, or to limit the diversions of, agricultural diverters or municipal diverters of Russian River water that do not have contractual relationships with the Agency.

In summary, the Agency has only an indirect, limited ability to impose mandatory water conservation measures related to the water it supplies to its retail customers and no ability to limit use of its customers' alternative supplies. During a shortage, the Agency can only allocate the specific amounts of water it supplies to each of its customers, but restrictions on end users of water must be imposed by the Agency's customers themselves. The Agency has no authority to impose mandatory conservation measures or to limit the diversions of any user of Russian River water other than those with whom the Agency has contractual relationships.

3.0 OTHER RUSSIAN RIVER WATER USERS OUTSIDE OF AGENCY'S AUTHORITY

Although the Agency has no authority to impose mandatory conservation measures on Russian River water users outside its service area, the Agency will continue to provide guidance and technical support.

3.1 Description of Other Russian River Water Users

In addition to the Agency and its retail water customers, there are numerous other water users in the Russian River watershed. Figure 1 shows the boundary of the watershed relative to the Agency's Service Area. These users are comprised of agricultural operations such as vineyards, orchards, and family farms, some of which are supplied by various private and public water supply systems.

Water supply systems providing water for human consumption range in size from single households and small wineries to large industrial and municipal systems. Cities such as Ukiah, Cloverdale, Healdsburg, and the Sweetwater Springs Water District (serving the communities of Guerneville and Monte Rio), serve potable water to tens of thousands of people. Attachment C is a list of the approximately 300 public water systems within the Russian River watershed that was developed from a database maintained by the California Department of Public Health (CDPH). This database represents the best available inventory of regulated water users in the Russian River watershed, but it does not include

water users such as single family residential households or other systems that do not meet the CDPH criteria for public water systems.

4.0 WASTE, UNREASONABLE USE, UNREASONABLE METHOD OF USE AND DIVERSION OF WATER

To comply with the Order, the Agency will work with its retail customers and other Russian River municipal water users to identify and prevent any waste, unreasonable use, unreasonable method of use, and unreasonable method of diversion in its service area. This type of prevention is usually the result of Water Waste Ordinances. Water waste ordinances prohibit the waste of water and provide specific examples of such waste. The following provisions are typical of water waste ordinances:

> No water shall be wasted. All water shall be put to reasonable beneficial use. Prohibited water uses include, but are not limited to, the following:
> - Use of any ornamental fountain using potable or makeup water for operation.
> - Car washing except at commercial car washes that recycle water.
> - Use of potable water from hydrants for non-potable uses.
> - Washing of sidewalks, streets, decks or driveways (except for public health and safety).
> - Pressure washing of buildings (possible exemption for building rehabilitation projects-painting).
> - Gutter flooding.
> - Sprinkler irrigation whose spray pattern hits paved areas.

The Agency will:

- Request and compile copies of ordinances and resolutions adopted by the Agency's customers to reduce water use this summer, and
- Summarize their enforcement plans and actions monthly in our reports to the SWRCB.

As noted above, however, the Agency has no direct authority to prohibit or penalize unreasonable use by end users of water.

5.0 COOPERATIVE CONSERVATION PLANS TO ACHIEVE 25% (SONOMA COUNTY) AND 50% (MENDOCINO COUNTY) CONSERVATION GOALS

Agency staff immediately began to implement the SWRCB Order to obtain the cooperation and participation of agricultural and municipal Russian River water

users to reach the water conservation goals for Sonoma and Mendocino Counties. Direct mail letters and emails were sent to advise the municipal users of the SWRCB Order and to provide assistance in interpreting the terms of the Order. For example the Agency assumes that the SWRCB would like to use 2004 as a base year, to be consistent with the 2007 SWRCB Order. The Agency interprets the commercial turf irrigation prohibition as requiring the retail water agencies to prohibit their customers from irrigating turf that is not used regularly by a significant number of people. This prohibition would apply to commercial and governmental uses such as ornamental turf in median strips along streets, at public and private office buildings, business parks, out-of-bounds areas at golf courses, and unused areas in parks. The prohibition would not apply to regularly used turf, such as baseball, soccer, and other recreational fields, golf courses, parks and other areas where turf is actually used by substantial numbers of people to walk, play or sit upon. Of course, on any irrigated turf area, the Agency expects that a smart weather track controller is being used to minimize the use of water. The Agency is taking a number of actions to implement the Order's conservation goals, as described below. The Agency will provide information about these activities to the SWRCB as part of the monthly reports described in Section 6.

5.1 Outreach and Education

1. The Agency is working with the retail water agencies in Marin, Sonoma and Mendocino Counties. A water conservation meeting with 22 water conservation representatives from the three counties was held at the Agency on April 14, 2009. The purpose of the meeting was to discuss the SWRCB Order and start planning regionally. Agency staff also updated local water agencies staff on statewide water conservation activities in an effort to ensure that everyone has the most up to date information. The Agency will host monthly meetings with the municipal Russian River water users through the term of the Order. The following items were also on the agenda:

    - California Urban Water Conservation Council Update: gallons per capita per day option for best management practice compliance and best management practice new guidebooks which will describe marketing, implementation and calculating water savings estimates for water conservation measures.
    - Department of Water Resources' "20 by 2020" plan and draft legislation.
    - California Energy Commission hearing on performance standards and labeling requirement for landscape irrigation devices, and valves to reduce consumption of energy or water.
    - Graywater Update: The California Department of Housing and Community Development is developing new regulations on graywater.

2. The Agency is developing its annual water conservation campaign for 2009. The multi-media campaign is centered on Governor Schwarzenegger's "Save Our Water" campaign. SCWA is partnering with the Governor's Office, the Department of Water Resources and the Association of California Water Agencies to implement the campaign in its service area, including portions of Mendocino, Sonoma and Marin counties. The media campaign, estimated to be approximately $100,000 including production costs, will include television, radio, print and online advertisements. Campaign materials will also be available at a multitude of community events and locations including the local malls and movie theaters. SCWA will work with its contractors and all government agencies and non-governmental organizations to implement the campaign.

3. Agency staff met with the Mendocino County Water Agency and the Mendocino County Russian River Flood Control and Water Conservation Improvement District on April 23, 2009 to discuss coordinating the efforts of both counties. Agency staff will be attending monthly urban water purveyor meetings held in Mendocino County through the duration of the order. Agency staff will provide technical assistance regarding water conservation through meetings, phone calls, emails and outreach events.

4. The Agency is discussing an agreement with the Russian River Property Owners Association for the purposes of conserving water in the Alexander Valley of the Russian River Watershed. A working committee comprised of representatives from the Russian River Property Owners Association and the Agency will meet monthly to determine the terms of the agreement. The working committee will need to assess existing data and conduct additional studies that inform future decisions around the impacts of agriculture water use, water conservation and water demands on the main stem of the Russian River.

5. Because urban water use almost doubles in the summertime due to the watering of landscapes, the Agency is working with the landscape industry. A Landscape Water Advisory Group meeting (LWAG) was held on April 16, 2009, with the landscape community and retail water agencies to discuss the SWRCB Order, including the prohibition on irrigation of commercial turf grass, with the goal of working cooperatively with the landscape community to reduce landscape water waste throughout the region. The Agency sponsored and staffed a water conservation table and spoke at the April 21, 2009 North Coast California Landscape Contractors Association (CLCA) Chapter Water Conservation Expo & dinner meeting. After discussing the SWRCB Order, the landscape contractors attending the meeting were invited to work with the Agency to reduce and monitor water use at their clients'

sites and report monthly to the Agency staff on sites that did not fall under the irrigation prohibition in Term 14. CLCA developed the Water Management Certification Program that assists landscape contractors and other green industry professionals in helping their customers cut water use and save money. CLCA-certified water managers must pass a written test to become provisionally certified, and must demonstrate proficiency at required levels for one year on actual landscape sites prior to achieving full certification status. Currently there are over 450 certified Water Managers in California.

6. Because there are significant areas of turf grass and other high water use plants at commercial sites, Agency staff is working with the business community to educate and inform property owners of water-wise alternatives. Agency staff participated in meetings with the Sonoma County Economic Development Board, Sonoma Commercial Business Park Coalition, and the Agency's retail water agencies to discuss best management practices for water conservation and a menu of water conservation options that commercial sites can implement in the short- and long-term.

7. The Agency developed the Qualified Water Efficient Landscaper (QWEL) training program and will be adding additional classes this summer. QWEL is comprised of 12 classes for a total of 20 hours of hands-on education that focuses on all aspects of the landscape as they relate to water conservation (irrigation equipment, design, plant selection, soil types, irrigation audits, water budgets, irrigation scheduling, etc.). The program has been very successful in Sonoma and Marin Counties resulting in over 250 graduates in its first year. This training is recognized by the U.S. EPA and graduates of this course are eligible to become Water Sense Irrigation Partners.

8. The Agency is sponsoring a series of Green*Plumbers*® Training. Green*Plumbers*® is a national training and accreditation program that assists plumbers in understanding their role in the environment, water conservation, and the reduction of GHG emissions. Their focus is on changing consumer and plumbing behavior through the use of energy-saving technologies. The following five Green Plumbing courses are scheduled:

   May 27, 2009: Caring for our Water
   June 25, 2009: Climate Care
   July 16, 2009: Water Efficient technologies
   August 20, 2009: Solar Hot Water and Inspection Report Services

5.2 Water Shortage Reduction Plans

Agency staff is working to compile water shortage plans, ordinances and resolutions from the municipal water users and providing technical assistance. Water shortage ordinances contain plans to achieve water use reductions such as the 25% and 50% conservation goals in the SWRCB Order. The Agency supports the State of California Department of Water Resources Urban Drought Guidebook 2008 Updated Edition that stresses that successful programs are commonly the result of a cooperative effort between water suppliers and their customers. To date, six of the Agency's retail water contractors' Boards and Councils have declared a water emergency (North Marin and Valley of the Moon Water Districts; the Cities of Santa Rosa, Cotati and Sonoma; and the Town of Windsor).

5.3 Agricultural Water Users

Agricultural water use within the approximately 1,500 square-mile Russian River watershed is dominated by vineyards, but there are also farms and ranches that produce a variety of crops and products. Because the majority of agricultural water is used by vineyards, the Agency has contracted with a viticultural expert to work cooperatively with the agricultural community to achieve water savings.

5.3.1 Agricultural Outreach Campaign

In 2006, the Agency embarked upon an outreach campaign targeting agricultural water users. The Agency entered into agreement with viticulture expert Mark Greenspan to provide outreach to the agricultural community, and in particular to the grape growing industry. Since 2006, the Agency has developed best management practices for irrigation and cooling methods in vineyards. The Agency has also developed and conducted vineyard irrigation and conservation surveys to evaluate water use technologies and management practices in vineyards in the Russian River watershed. The Agency and its consultant have presented informational briefs and presentations to a variety of agricultural associations and organizations focusing on water conservation. Currently, the Agency is sponsoring a vineyard irrigation water conservation demonstration project. The project will utilize the best management practices developed over the past two years and put them to use in a vineyard in Alexander Valley. The demonstration project will create awareness among agricultural water users on how to best irrigate and cool vineyards by adopting best management practices and using new irrigation technologies.

5.3.2 Agricultural Frost Protection

Agency staff attended the Sonoma County Collaborative Effort to Protect Water, Agriculture and Salmon Population meeting on April 28, 2009. This coalition is

developing best management practices that will reduce the impact on fishery resources of diversions made by grape growers for frost protection.

Additionally, Agency staff will continue to participate in the Russian River Frost Protection Task Force. Like the above coalition, the goal of this task force is to develop solutions that will reduce the impact on fishery resources of diversions made by growers for frost protection. To date, the focus of this group has been limited to Mendocino County. That focus may be expanded in the future.

6.0 PROJECT MILESTONES & REPORTING SCHEDULE

The Agency is conducting or completing specified water conservation, per the following Milestones.

6.1 Milestones

Milestone 1: April – June 30, 2009 reporting period

Milestone 1.1 Work with Agency's Retail Water Customers and Russian River Water Users

- Meetings: North Coast Water Conservation Group, Agency's Water and Technical Advisory Committees and Mendocino County urban water purveyors
- Compile water shortage contingency and water waste reduction plans, ordinances and resolutions
- Report on water waste reduction enforcement actions taken
- Report on public outreach campaign in Sonoma and Mendocino Counties
- Report on additional actions taken by retail water agencies
- Report on 2009 metered water consumption compared to 2004 metered water consumption

Milestone 1.2 Work with Businesses and Landscape Industry

- Meetings: California Landscape Contractors Association, Landscape Water Advisory Committee and Business Collation
- Green Plumbing Courses: May 27th: Caring For our Water and June 25th: Climate Care
- Hospitality event promoting conservation in the hotel industry
- Bottom Line newsletter set out discussing SWRCB Order and conservation

- Report water savings achieved through CLCA's Water Management Certification Program
- Report on additional Qualified Water Efficient Landscaper Training Programs

Milestone 1.3 Work with Vintners

- Meeting: Sonoma County Collaborative Effort to Protect Water, Agriculture and Salmon Population
- Vineyard Irrigation and Cooling Water Conservation Demonstration Program
- Vineyard consultant services and outreach to growers in the Russian River Watershed
- Development of vineyard best management practices

Milestone 2: July 1 – July 31, 2009 reporting period

Milestone 2.1 Work with Agency's Retail Water Customers and Russian River Water Users

- Meetings: North Coast Water Conservation Group, Agency's Water and Technical Advisory Committees and Mendocino County urban water purveyors
- Report on water waste reduction enforcement actions taken
- Report on public outreach campaign in Sonoma and Mendocino Counties
- Report on additional actions taken by retail water agencies
- Report on 2009 metered water consumption compared to 2004 metered water consumption

Milestone 2.2 Work with Businesses and Landscape Industry

- Meetings: California Landscape Contractors Association, Landscape Water Advisory Committee and Business Collation
- Green Plumbing Courses: July 16th: Water Efficient Technologies
- Report water savings achieved through CLCA's Water Management Certification Program
- Report on additional Qualified Water Efficient Landscaper Training Programs

Milestone 2.3 Work with Vintners

- Meeting: Sonoma County Collaborative Effort to Protect Water, Agriculture and Salmon Population
- Vineyard Irrigation and Cooling Water Conservation Demonstration Program
- Vineyard consultant services and outreach to growers in the Russian River Watershed
- Report on development of vineyard best management practices

Milestone 3: August 1 – August 31, 2009 reporting period

Milestone 3.1 Work with Agency's Retail Water Customers and Russian River Water Users

- Meetings: North Coast Water Conservation Group, Agency's Water and Technical Advisory Committees and Mendocino County urban water purveyors
- Report on water waste reduction enforcement actions taken
- Report on public outreach campaign in Sonoma and Mendocino Counties
- Report on additional actions taken by retail water agencies
- Report on 2009 metered water consumption compared to 2004 metered water consumption

Milestone 3.2 Work with Businesses and Landscape Industry

- Meetings: Landscape Water Advisory Committee and Business Collation
- Green Plumbing Courses: August 20th: Solar Hot Water and Inspection report Services
- Report water savings achieved through CLCA's Water Management Certification Program
- Report on additional Qualified Water Efficient Landscaper Training Programs

Milestone 3.3 Work with Vintners

- Meeting: Sonoma County Collaborative Effort to Protect Water, Agriculture and Salmon Population

- Vineyard Irrigation and Cooling Water Conservation Demonstration Program
- Vineyard consultant services and outreach to growers in the Russian River Watershed
- Report on outreach and consultation services

Milestone 4: September 1 – October 2,, 2009 reporting period

Milestone 4.1 Work with Agency's Retail Water Customers and Russian River Water Users

- Meetings: North Coast Water Conservation Group, Agency's Water and Technical Advisory Committees and Mendocino County urban water purveyors
- Report on water waste reduction enforcement actions taken
- Report on public outreach campaign in Sonoma and Mendocino Counties
- Report on additional actions taken by retail water agencies
- Report on 2009 metered water consumption compared to 2004 metered water consumption

Milestone 4.2 Work with Businesses and Landscape Industry

- Meetings: Landscape Water Advisory Committee and Business Collation
- Report water savings achieved through CLCA's Water Management Certification Program
- Report on additional Qualified Water Efficient Landscaper Training Programs

Milestone 4.3 Work with Vintners

- Meeting: Sonoma County Collaborative Effort to Protect Water, Agriculture and Salmon Population
- Vineyard Irrigation and Cooling Water Conservation Demonstration Program
- Vineyard consultant services and outreach to growers in the Russian River Watershed
- Development of vineyard best management practices
- Report on outreach and consultation services

6.2 Schedule

The following documents will be submitted to the SWRCB as directed in the Order:

Milestone 1	**July 15, 2009: Term 15 Monthly Status Report**
Milestone 2	**August 15, 2009: Term 15 Monthly Status Report**
Milestone 3	**September 15, 2009: Term 15 Monthly Status Report**
Milestone 4	**October 18, 2009: Term 15 Monthly Status Report**

Figure 1. Sonoma County Water Agency Russian River Water Users and Agency Service Area

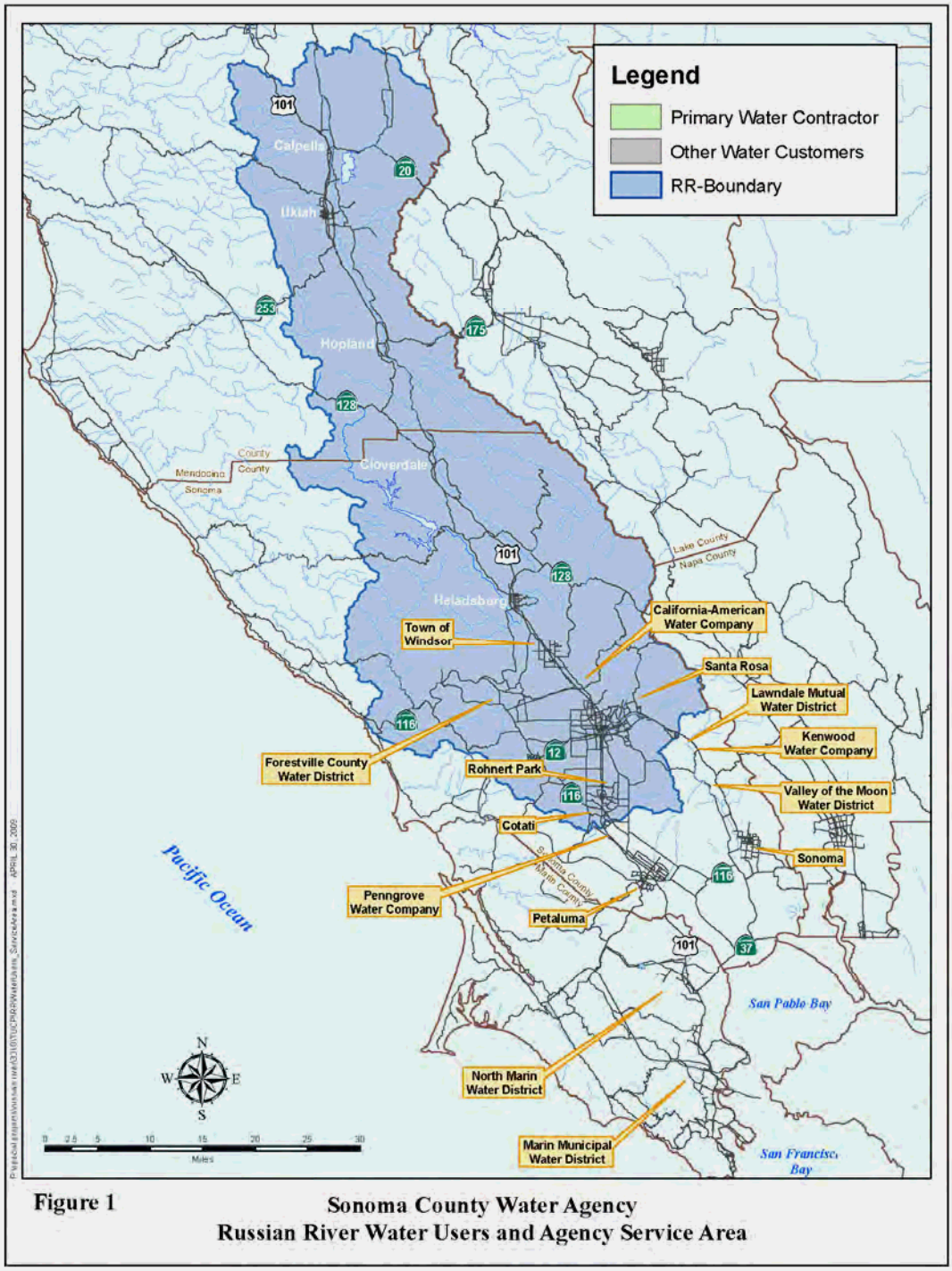

Figure 1

Sonoma County Water Agency
Russian River Water Users and Agency Service Area

Attachment A

SWRCB Order WR 2009-0027-DWR (April 6, 2009)

STATE OF CALIFORNIA
CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
STATE WATER RESOURCES CONTROL BOARD

DIVISION OF WATER RIGHTS

ORDER WR 2009-0027-DWR

In the Matter of Permits 12947A, 12949, 12950, and 16596
(Applications 12919A, 15736, 15737, 19351)

Sonoma County Water Agency

SOURCES: Dry Creek and Russian River

COUNTIES: Sonoma and Mendocino Counties

ORDER APPROVING TEMPORARY URGENCY CHANGE IN PERMITS 12947A, 12949, 12950, AND 16596

1.0 SUBSTANCE OF PETITION

On April 6, 2009, Sonoma County Water Agency (SCWA) filed a petition with the State Water Resources Control Board (State Water Board) requesting approval of a Temporary Urgency Change to the subject permits pursuant to California Water Code section 1435. The petition requests the following temporary reductions to the Russian River instream flow requirements:

(1) From April 6 through June 30, 2009, instream flow requirements for the upper Russian River (from its confluence with the East Fork of the Russian River to its confluence with Dry Creek) be reduced from 185 cubic feet per second (cfs) to 75 cfs, and the requirements for the lower Russian River (downstream of its confluence with Dry Creek) be reduced from 125 cfs to 85 cfs; and

(2) From July 1 through October 2, 2009, instream flow requirements for the upper Russian River be reduced from 185 cfs to 75 cfs, and the requirements for the lower Russian River be reduced from 125 cfs to 85 cfs, if during the period from April 1 through June 30 total inflow to Lake Mendocino is greater than 25,000 acre feet; or

(3) From July 1 through October 2, 2009, instream flow requirements be further reduced to 25 cfs for upper Russian River and 35 cfs for the lower Russian River, if during the period from April 1 through June 30 total inflow to Lake Mendocino is less than or equal to 25,000 acre feet.

The petition, in effect, requests that minimum flows for the Russian River be established based on dry-year criteria for the period from April 6 to October 2, 2009 and critical year criteria for the period from July 1 to October 2, 2009 in the event that cumulative inflow to Lake Mendocino is less than or equal to 25,000 acre feet from April 1 through June 30. No changes to the instream flow requirements for Dry Creek are requested. The request is made to prevent depletion of storage in Lake Mendocino which would severely impact threatened or endangered Russian River fish species, create serious water supply impacts in Mendocino County and in Sonoma County's Alexander Valley, and harm Lake Mendocino and Russian River recreation.

2.0 BACKGROUND

SCWA's petition involves the following permits:

- Permit 12947A is for direct diversion of 92 cubic feet per second (cfs) from the East Fork Russian River and storage of 122,500 acre-feet per annum (afa) in Lake Mendocino from January 1 through December 31 of each year.

- Permit 12949 is for direct diversion of 20 cfs year-round from the Russian River at the Wohler and Mirabel Park Intakes near Forestville.

- Permit 12950 is for direct diversion of 60 cfs from the Russian River at the Wohler and Mirabel Park Intakes from April 1 through September 30 of each year.

- Permit 16596 is for year-round direct diversion of 180 cfs from the Russian River and storage of 245,000 afa in Lake Sonoma from October 1 of each year to May 1 of the succeeding year.

SCWA submitted with the petition a document prepared by its staff titled, "Hydrologic Analysis of Lake Mendocino Storage Under Dry 2009 Conditions" (Hydrologic Analysis) dated April 2009. The Hydrologic Analysis indicates that projections for Lake Mendocino water levels in 2009 are far more severe than they were in water year 2007, the last time the State Water Board approved a temporary urgency change reducing the Russian River instream flow requirements. As of April 1, 2009, storage level in Lake Mendocino was approximately 53,000 acre-feet. This is roughly 20,000 acre-feet less than Lake Mendocino storage was in 2007 at this time. During water years 2002, 2004, and 2007 hydrologic conditions in the Eel River and Russian River watersheds caused Lake Mendocino storage levels to decline to dangerously low levels by the end of the dry season. Recreation at Lake Mendocino was severely impaired, and serious risks existed for water supply and state and federally listed Russian River salmonid fishery resources, particularly adult Chinook salmon. The storage levels in Lake Mendocino dropped to a low of 24,400 acre-feet in December 2002. Water year 2004 and 2007 presented similar risks that were mitigated by SCWA filing for, and the State Water Board approving, a temporary urgency change petition that reduced the minimum instream flow requirements on the Russian River, thereby allowing more water to remain in Lake Mendocino for a longer period of time.

In June 2004, the Federal Energy Regulatory Commission directed Pacific Gas and Electric Company to reduce the amount of water diverted through the Potter Valley Project (PVP) tunnel into the Russian River, further reducing inflow to Lake Mendocino. Since October 2008, approximately 27,000 acre-feet less water has flowed through the PVP tunnel and into Lake Mendocino than during the same period during water year 2007, the last time the State Water Board approved a Temporary Urgency Change to reduce the Russian River instream flow requirements.

Without the requested reductions in the instream flow requirements, Lake Mendocino storage is predicted to drop to 10,000 acre-feet by mid August 2009 and go dry by the end of September according to SCWA's Hydrologic Analysis. Lake Mendocino has never dropped below 12,000 af since it was first filled in 1959, and it is uncertain whether water could continue to be released from Lake Mendocino into the East Fork Russian River if lake storage were to drop to 10,000 af. If water cannot be released from Lake Mendocino during October and November 2009, there most likely will be severe impacts on the fishery and recreation resources that depend on the upper Russian River, and on water users that rely on the upper Russian River for their water supplies. On March 23, 2009 the Mendocino County Board of Supervisors declared a local emergency and imminent threat of disaster due to drought conditions.

Following is the language contained in SCWA's permits regarding minimum instream flow requirements:

Term 18 of SCWA's Permit 12947A states:

For the protection of fish and wildlife, and for the maintenance of recreation in the Russian River, permittee shall pass through or release from storage at Lake Mendocino sufficient water to maintain:

(A) A continuous streamflow in the East Fork Russian River from Coyote Dam to its confluence with the Russian River of 25 cfs at all times.

(B) The following minimum flows in the Russian River between the East Fork Russian River and Dry Creek:

(1) During normal water supply conditions when the combined water in storage, including dead storage, in Lake Pillsbury and Lake Mendocino on May 31 of any year exceeds 150,000 af or 90 percent of the estimated water supply storage capacity of the reservoirs, whichever is less:

From June 1 through August 31	185 cfs
From September 1 through March 31	150 cfs
From April 1 through May 31	185 cfs

(2) During normal water supply conditions and when the combined water in storage, including dead storage, in Lake Pillsbury and Lake Mendocino on May 31 of any year is between 150,000 af or 90 percent of the estimated water supply storage capacity of the reservoirs, whichever is less, and 130,000 af or 80 percent of the estimated water supply storage capacity of the reservoirs, whichever is less:

From June 1 through March 31	150 cfs
From April 1 through May 31	185 cfs
If from October 1 through December 31, storage in Lake Mendocino is less than 30,000 acre-feet	75 cfs

(3) During normal water supply conditions and when the combined water in storage, including dead storage, in Lake Pillsbury and Lake Mendocino on May 31 of any year is less than 130,000 af or 80 percent of the estimated water supply storage capacity of the reservoirs, whichever is less:

From June 1 through December 31	75 cfs
From January 1 through March 31	150 cfs
From April 1 through May 31	185 cfs

(4) During dry water supply conditions	75 cfs
(5) During critical water supply conditions	25 cfs

(C) The following minimum flows in the Russian River between its confluence with Dry Creek and the Pacific Ocean to the extent that such flows cannot be met by releases from storage at Lake Sonoma under Permit 16596 issued on Application 19351:

(1) During normal water supply conditions	125 cfs
(2) During dry water supply conditions	85 cfs
(3) During critical water supply conditions	35 cfs

For the purposes of the requirements in this term, the following definitions shall apply:

(1) Dry water supply conditions exist when cumulative inflow to Lake Pillsbury beginning on October 1 of each year is less than:

8,000 acre-feet as of January 1
39,200 acre-feet as of February 1
65,700 acre-feet as of March 1
114,500 acre-feet as of April 1
145,600 acre-feet as of May 1
160,000 acre-feet as of June 1

(2) Critical water supply conditions exist when cumulative inflow to Lake Pillsbury beginning on October 1 of each year is less than:

4,000 acre-feet as of January 1
20,000 acre-feet as of February 1
45,000 acre-feet as of March 1
50,000 acre-feet as of April 1
70,000 acre-feet as of May 1
75,000 acre-feet as of June 1

(3) Normal water supply conditions exist in the absence of defined dry or critical water supply conditions.

(4) The water supply condition designation for the months of July through December shall be the same as the designation for the previous June. Water supply conditions for January through June shall be predetermined monthly.

(5) Cumulative inflow to Lake Pillsbury is the calculated algebraic sum of releases from Lake Pillsbury, increases in storage in Lake Pillsbury, and evaporation from Lake Pillsbury.

(6) Estimated water supply storage space is the calculated reservoir volume below elevation 1,828.3 feet in Lake Pillsbury and below elevation 749.0 feet in Lake Mendocino. Both elevations refer to the National Geodetic Vertical Datum of 1929. The calculation shall use the most recent two reservoir volume surveys made by the U. S. Geological Survey, U. S. Army Corps of Engineers, or other responsible agency to determine the rate of sedimentation to be assumed from the date of the most recent reservoir volume survey.

Term 15 of both Permit 12949 and Permit 12950 require SCWA to allow sufficient water to bypass the points of diversion at the Wohler and Mirabel Park Intakes on the Russian River to maintain the following minimum flows to the Pacific Ocean:

(1)	During normal water supply conditions	125 cfs
(2)	During dry water supply conditions	85 cfs
(3)	During critical water supply conditions	35 cfs

Term 13 of Permit 16596 sets forth the following minimum flows for Dry Creek and the Russian River:

(A) The following minimum flows in Dry Creek between Warm Springs Dam and its confluence with the Russian River:

(1) During normal water supply conditions:

75 cfs from January 1 through April 30
80 cfs from May 1 through October 31
105 cfs from November 1 through December 30

(2) During dry or critical water supply conditions:

25 cfs from April 1 through October 31
75 cfs from November 1 through March 31

(B) The following minimum flows in the Russian River between its confluence with Dry Creek and the Pacific Ocean, unless the water level in Lake Sonoma is below elevation 292.0 feet with reference to the National Geodetic Vertical Datum of 1929, or unless prohibited by the United States Government:

(1)	During normal water supply conditions	125 cfs
(2)	During dry water supply conditions	85 cfs
(3)	During critical water supply conditions	35 cfs

Note: Permits 12949, 12950, and 16596 use the same water-year classification definitions as those listed in Permit 12947A. The water year classifications (Normal, Dry or Critically Dry) were established in State Water Board Decision 1610 (D1610) and are based on cumulative inflow into Lake Pillsbury beginning October 1. Although Lake Mendocino storage is unusually low, cumulative inflow into Lake Pillsbury during this water year has been sufficiently high that, under D1610, 2009 is currently classified as a *Normal* year and will likely retain this classification for the remainder 2009.

3.0 COMPLIANCE WITH CALIFORNIA ENVIRONMENTAL QUALITY ACT

The State Water Board, Division of Water Rights has determined that the petition qualifies for an exemption under CEQA. A Class 7 exemption "consists of actions taken by regulatory agencies as authorized by state law or local ordinance to assure the maintenance, restoration, or enhancement of a natural resource where the regulatory process involves procedures for protection of the environment." (Cal. Code Regs, tit. 14, § 15307.) The proposed action will assure the maintenance of a natural resource, i.e., the instream resources of the Russian River. A Class 8 exemption "consists of actions taken by regulatory agencies, as authorized by state or local ordinance, to assure the maintenance, restoration, enhancement, or protection of the environment where the regulatory process involves procedures for protection of the environment." (*Id.*, § 15308.) The proposed action will assure the maintenance of the environment, i.e., the instream environment of the Russian River.

On February 27, 2009, Governor Schwarzenegger declared a drought related state of emergency. Additionally, On March 23, 2009 the Mendocino County Board of Supervisors declared a local emergency and imminent threat of disaster due to drought conditions. Storage in Lake Mendocino is extremely low. Information provided by SCWA demonstrates that continued releases of water under normal year operating rules would prematurely drain remaining storage. If storage in Lake Mendocino is depleted, water will not be available to support threatened and endangered species, agriculture, and domestic/municipal water service. Approval of the Temporary Urgency Change Petition is therefore

necessary to prevent and mitigate damage to the environment, fishery resources, property, public health, and essential public services. Accordingly the project is statutorily exempt from CEQA because it is necessary to prevent or mitigate an emergency. (Pub. Resources Code, §§ 21080, subd. (b)(4), 21172.)

4.0 PUBLIC NOTICE OF THE PETITION

The State Water Board will issue and deliver to SCWA as soon as practicable, a notice of the temporary urgency change order pursuant to Water Code section 1438(a). Pursuant to Water Code section 1438(b)(1), SCWA is required to publish the notice in a newspaper having a general circulation, and that is published within the counties where the points of diversion lie. The State Water Board will also mail the notice to the interested parties who have requested notice of proposed temporary urgency changes and to other known interested parties. The State Water Board will post the notice of the temporary urgency change and a copy of the petition for temporary urgency change (and accompanying materials) on its website.

5.0 CRITERIA FOR APPROVING THE PROPOSED TEMPORARY URGENCY CHANGE

Chapter 6.6 of part 2, division 2, of the Water Code, commencing at section 1435, provides that any permittee or licensee who has an urgent need to change a point of diversion, place of use, or purpose of use from that specified in the permit or license may petition for a conditional temporary change order. The State Water Board's regulation, at California Code of Regulations, title 23, section 791(e), provides that the State Water Board shall follow as nearly as possible the procedures for changes in point of diversion, place of use, or purpose of use when processing petitions for other types of changes in water right permits and licenses. Accordingly, the procedures under Water Code section 1435 are applicable to changes to terms and conditions of water right permits and licenses.

The State Water Board must make the findings specified in section 1435(b) when issuing a temporary change order pursuant to chapter 6.6. The required findings are:

1. The permittee or licensee has an urgent need to make the proposed change;
2. The proposed change may be made without injury to any other lawful user of water;
3. The proposed change may be made without unreasonable effect upon fish, wildlife, or other instream beneficial uses; and
4. The proposed change is in the public interest, including findings to support change order conditions imposed to ensure that the change is in the public interest, and may be made without injury to any other lawful user of the water, and without unreasonable effect upon fish, wildlife, and other instream beneficial uses.

5.1 Urgency of the Proposed Change

Under Water Code section 1435 (c), an urgent need to make a proposed change exists when the State Water Board concludes that the proposed temporary change is necessary to further the constitutional policy that the water resources of the State be put to beneficial use to the fullest extent of which they are capable and that waste of water be prevented. However, the State Water Board shall not find the need urgent if it concludes that the petitioner has failed to exercise due diligence in petitioning for a change pursuant to other appropriate provisions of the Water Code.

In this case, an urgent need exists for the proposed change because SCWA predicts full depletion of storage in Lake Mendocino in September 2009 unless the requested temporary urgency change is approved. Water supplies sufficient to support survival of listed Russian River salmonid fisheries, agricultural and municipal use, and recreation are threatened. Without the proposed change, SCWA would need to release additional stored water from Lake Mendocino, resulting in a reduction in water

resources needed for fishery protection and more stable flows in the upper Russian River during the fall, when state and federally listed fish species are most sensitive to flows and temperatures. Further, if Water Year 2010 is a dry or critically dry year, extra storage in Lake Mendocino will be crucial for the continued survival of the Russian River fishery and for water supply reliability during 2010.

Water Code Section 106 establishes that the use of water for domestic purposes is the highest use of water. SCWA predicts that without the proposed change Lake Mendocino would be drawn down to levels that jeopardize SCWA's ability to release water to the Russian River. In this event, water supplies for domestic and municipal uses of Russian River water would be severely impaired. Moreover, SCWA permits include terms requiring a 50 percent reduction in deliveries to the Redwood Valley County Water District when Lake Mendocino storage drops below 30,000 acre feet in order to preserve Lake Mendocino Water Supply reliability. SCWA forecasts indicate that Lake Mendocino Storage would drop below 30,000 acre-feet during June of 2009 unless the Temporary Urgency Change Petition is approved and conservation measures are implemented.

To ensure that the water resources of the State are put to beneficial use to the fullest extent of which they are capable and that waste of water be prevented, this order adds terms requiring SCWA to (1) temporarily reduce diversions from the Russian River by 25 percent; (2) temporarily prohibit irrigation of commercial turf grass within the SCWA service area; (3) submit a plan detailing the actions that will be taken to work with Russian River water users to reach an overall water conservation goal of 25 percent in Sonoma County and 50 percent in Mendocino County during the term of the Order, and (4) submit a report within one year identifying actions SCWA will take to maximize water conservation in its service area. Including these terms as conditions of approval supports the determination that the proposed change will maximize the beneficial use of water resources and prevent the waste of water, and therefore an urgent need for the change exists, as defined by Water Code section 1435 (c).

5.2 No Injury to Any Other Lawful User of Water

The SCWA is required to maintain specific flows in the Russian River from its most upstream point of diversion to the river's confluence with the ocean. Therefore, it is anticipated that all of the SCWA water contractors and other legal users of water will receive the water to which they are entitled during the reduced flows specified in this Order. Moreover, failure to implement the reduced instream flows could result in depletion of Lake Mendocino, which in turn could give rise to serious impacts to legal users of water downstream of Lake Mendocino later in the year.

5.3 No Unreasonable Effect upon Fish, Wildlife, or Other Instream Beneficial Uses

Although flows downstream from Coyote Dam will be decreased upon approval of SCWA's petition, conservation water in Lake Mendocino will allow enhanced management of the flows in early fall for the benefit of fish migration. Reduced flows in the Russian River may impair instream beneficial uses, including recreation. The potential for impairment to instream beneficial uses, however, is not unreasonable considering the potential impacts to fisheries, water supply, and recreation in Lake Mendocino that could occur if the petition were not approved.

5.4 The Proposed Change is in the Public Interest

The proposed change will help conserve water in Lake Mendocino so that it can be released for listed Russian River salmonid fisheries present in the Russian River during the fall Chinook salmon migration season. It is in the public interest to preserve water supplies for these beneficial uses when hydrologic circumstances cause dangerous reductions to water supplies.

Approval of SCWA's petition will help SCWA maintain the level in Lake Mendocino for a longer period of time. According to SCWA estimates in its Hydrologic Analysis, if the "normal-year" water releases remain in effect, Lake Mendocino will reach minimum pool by late August 2009 and be completely drained by September. However, SCWA forecasts that Lake Mendocino storage will not drop below 22,000 af

during the remainder of Water Year 2009 if the Temporary Urgency Change Petition is approved and 20% cumulative conservation is achieved.

On September 27, 2006, Governor Schwarzenegger signed Assembly Bill 32, the Global Warming Solutions Act of 2006 (Núñez, Chapter 488, Statutes of 2006). Pursuant to AB 32, the California Air Resources Board adopted a scoping plan December 12, 2008, outlining the State's strategy to achieve greenhouse gas (GHG) emissions limits. The scoping plan recommended implementation of six greenhouse gas reduction measures targeted at the water sector, largely to develop additional supply reliability to meet water demand. These measures include increased water use efficiency, water recycling and urban runoff re-use. In addition to reducing GHG emissions, these measures can have many co-benefits, including enhancing water supply reliability.

On February 27, 2009, Governor Schwarzenegger proclaimed a state of emergency and ordered immediate action to manage the drought crisis. The Governor's proclamation requested that all urban water users immediately increase their water conservation activities in an effort to reduce their individual water use by 20 percent.

Given the severity of water supply conditions in the Russian River Watershed and the Governor's directives to implement water conservation measures, this order adds terms requiring immediate mandatory water conservation and longer-term water conservation planning and reporting, including a plan to reduce residential water waste in the SCWA service area.

Approval of the petition, as conditioned, will be in the public interest and consistent with the overall goals of AB 32 and the Governor's drought emergency proclamation.

6.0 CONCLUSIONS

The State Water Board has adequate information in its files to make the evaluation required by Water Code section 1435.

I conclude that, based on the available evidence:

1. The permittee has an urgent need to make the proposed change;

2. The petitioned change will not operate to the injury of any other lawful user of water;

3. The petitioned change will not have an unreasonable effect upon fish, wildlife, or other instream beneficial uses; and,

4. The petitioned change is in the public interest.

ORDER

NOW, THEREFORE, IT IS ORDERED THAT: the petition filed by Sonoma County Water Agency for temporary change in Permits 12947A, 12949, 12950, AND 16596 is approved, in part.

All existing terms and conditions of the subject permits remain in effect, except as temporarily amended by the following provisions:

1. From the date of this Order until October 2, 2009, minimum flows in the Russian River, as specified in Term 20 of Permit 12947A, Term 17 of Permits 12949 and 12950, and Term 13 of Permit 16596, shall be modified as follows:

Minimum instream flow in the **Russian River from its confluence with the East Fork of the Russian River to its confluence with Dry Creek** shall be as follows:

a. From April 6, 2009 through June 30, 2009, minimum instream flow shall remain at or above 75 cubic feet per second (cfs).

b. From July 1 through October 2, 2009, minimum instream flow shall remain at or above 75 cfs, if during the period from April 1 through June 30 total inflow to Lake Mendocino is greater than 25,000 acre feet;

c. From July 1 through October 2, 2009, minimum instream flow shall remain at or above 25 cfs, if during the period from April 1 through June 30 total inflow to Lake Mendocino is less than or equal to 25,000 acre feet;

d. Instream flow at the USGS gages at both Hopland (No.11462500) and Healdsburg (No. 11464000) on the Russian River shall be not less than 125 cfs, after a cumulative seasonal total of 200 adult Chinook salmon move upstream past the SCWA Mirabel inflatable dam, unless otherwise directed by National Marine Fisheries Service (NMFS) and the Department of Fish and Game (DFG). A lag time of three to seven days for the higher flows to reach Healdsburg is appropriate.

Minimum instream flow in the **Russian River from its confluence with Dry Creek to the Pacific Ocean** shall be as follows unless the water level in Lake Sonoma is below 292.0 feet with reference to the National Geodetic Vertical Datum of 1929, or unless prohibited by the United States Government:

a. From April 6, 2009 through June 30, 2009, minimum instream flow shall remain at or above 85 cubic feet per second (cfs).

b. From July 1 through October 2, 2009, minimum instream flow shall remain at or above 85 cfs, if during the period from April 1 through June 30 total inflow to Lake Mendocino is greater than 25,000 acre feet;

c. From July 1 through October 2, 2009, minimum instream flow shall remain at or above 35 cfs, if during the period from April 1 through June 30 total inflow to Lake Mendocino is less than or equal to 25,000 acre feet;

For purposes of compliance with this term, minimum instream flow requirements shall be met on an instantaneous flow basis.

2. To protect against stranding of fish when releases from Lake Mendocino are converted from normal-year to dry-year criteria, or from dry-year to critical-year criteria, flow in the East Fork Russian River immediately below Coyote Dam shall not be reduced by more than 25 cfs per hour. Ramping rates specified in this term may be revised at the direction of the NMFS and the DFG.

3. SCWA shall not release water from Lake Sonoma in excess of the flows required to satisfy existing water rights and the interim instream flow requirement established in this Order for the Russian River downstream of its confluence with Dry Creek.

4. SCWA shall monitor and record daily numbers of adult Chinook salmon moving upstream past the Mirabel inflatable dam beginning no later than August 15, 2009, and ending upon expiration of this Order. SCWA shall consult with NMFS and the DFG on a weekly basis regarding the status and findings of the monitoring effort. Chinook salmon monitoring requirements specified in this term may be revised at the direction of the NMFS and the DFG.

5. SCWA shall monitor numbers of adult Chinook salmon in representative deep pools in the lower Russian River downstream of the Mirabel inflatable dam on a weekly basis beginning September 8, 2009 and ending when sustained flows in the Russian River at Healdsburg are greater than 125 cfs or upon expiration of this Order. SCWA shall consult with NMFS and DFG on a weekly basis regarding the status and findings of the monitoring effort. Chinook salmon monitoring requirements specified in this term may be revised at the direction of the NMFS and the DFG.

6. If operations pursuant to this Order result in sustained closure of the lagoon at the terminus of the Russian River at the Pacific Ocean, or numbers of adult salmon in the Russian River are determined by NMFS to be very low through September 30, 2009, then SCWA shall immediately consult with NMFS and DFG regarding possible measures to facilitate upstream movement of salmon. SCWA shall immediately implement measures required by NMFS and DFG to facilitate the movement of salmon.

7. SCWA shall monitor numbers of adult Chinook salmon in representative deep pools in the upper Russian River (Lake Mendocino to Healdsburg) on a weekly basis on the same schedule as salmon monitoring operations required under Term 5. SCWA shall consult with NMFS and DFG on a weekly basis regarding the status and findings of the monitoring effort.

8. SCWA shall submit a Temperature Monitoring Plan for Lake Mendocino and the Russian River within two weeks after the adoption of this Order. The Plan shall provide a detailed description of temperature monitoring efforts necessary for determining the temperature impacts resulting from changes approved by this Order. SCWA shall implement the Plan immediately upon its approval by the Division.

9. SCWA shall prepare a Water Quality Monitoring Plan for the Russian River in consultation with: (1) the North Coast Regional Water Quality Control Board, (2) the United States Geological Survey, and (3) the Division of Water Rights. The purpose of the Plan shall be to determine the water quality effects of the temporary urgency change approved herein. The Plan shall be submitted to the State Water Board Deputy Director for Water Rights (Deputy Director) for approval within two weeks of the date of this Order. SCWA shall implement the Plan immediately upon approval of the Plan by the Deputy Director.

10. This Order does not authorize any act that results in the taking of a threatened or endangered species, or any act that is now prohibited, or becomes prohibited in the future, under either the California Endangered Species Act (Fish and Game Code sections 2050 to 2097) or the federal Endangered Species Act (16 U.S.C.A. sections 1531 to 1544). If a "take" will result from any act authorized under this Order, the permittee shall obtain authorization for an incidental take permit prior to construction or operation. Permittee shall be responsible for meeting all requirements of the applicable Endangered Species Act for the temporary urgency change authorized under this Order.

11. The State Water Board reserves jurisdiction to supervise the temporary urgency change under this Order, and to coordinate or modify terms and conditions, for the protection of vested rights, fish, wildlife, instream beneficial uses and the public interest as future conditions may warrant.

12. The SCWA shall immediately notify the State Water Board if any significant change in storage conditions in Lake Mendocino occurs that warrants reconsideration of this Order.

13. SCWA shall make a 25 percent reduction in diversions from the Russian River to its service area from April 6, 2009 until expiration of this order (October 2, 2009). This reduction shall be calculated based on permittee's actual diversion from the Russian River from April 6, 2009 through October 2, 2009.

14. As a condition of water delivery to its customers, SCWA shall prohibit irrigation of commercial turf grass within the SCWA service area for the period of May 1, 2009 until the expiration of this order (October 2, 2009).

15. Within 30 days of the date of this Order, the SCWA shall submit a plan to the State Water Resources Control Board to obtain the cooperation and participation of agricultural and municipal Russian River water users to reach a water conservation goal of 25 percent in Sonoma County and 50 percent in Mendocino County for the period of April 6, 2009 until the expiration of this order (October 2, 2009). In addition, the plan shall include measures to identify and prevent any waste, unreasonable use, unreasonable method of use, or unreasonable method of diversion of water. The plan shall include a detailed schedule with planned completion dates for key events. The plan, including the schedule, is subject to approval by the State Water Board Deputy Director for Water Rights (Deputy Director) in regard to its completeness and inclusion of significant project milestones. SCWA shall submit any additional information or revisions to the schedule requested within the period specified by the Deputy Director. SCWA shall implement the schedule as approved by the Deputy Director. SCWA shall include the following information in the plan:

    a. An explanation of SCWA's authority or other ability to impose mandatory water conservation measures and identification of the persons and entities subject to that authority.

    b. Identification of Russian River water users who are not subject to SCWA's authority to impose mandatory water conservation measures.

    c. Steps that SCWA will take to investigate the waste, unreasonable use, unreasonable method of use, or unreasonable method of diversion of water from the Russian River. SCWA shall submit monthly reports to the State Water Board on its progress.

    d. Steps that SCWA will take to gain the cooperation and participation of water users in conserving water and preventing the waste, unreasonable use, unreasonable method of use, or unreasonable method of diversion of water from the Russian River. SCWA shall submit monthly reports to the State Water Board on its progress.

16. SCWA shall prepare a Water Conservation Status Report for SCWA's service area and other areas served by Lake Mendocino. The report shall specify the water conservation measures being implemented in the areas served by Lake Mendocino, and shall specify the water savings resulting from the measures during the term of this temporary urgency change. The report shall be submitted to the Deputy Director for Water Rights by December 31, 2009. The scope and content of the report shall be similar to the report submitted to comply with WR Order 2007-0022.

17. SCWA shall prepare a Water Conservation Plan for SCWA's service area and other areas served by Lake Mendocino. The Water Conservation Plan shall describe and quantify current water conservation efforts and the water conservation measures that can be implemented in the future, including measures to eliminate the use of residential water wasting devices. The Water Conservation Plan shall include a description of the authority or mechanisms that will be used to implement the identified conservation measures and a schedule for implementation. The plan shall be submitted to the Deputy Director for Water Rights within one year of the Date of this Order.

STATE WATER RESOURCES CONTROL BOARD

Victoria A. Whitney

Victoria A. Whitney
Deputy Director for Water Rights

Dated: April 6, 2009

Attachment B

Restructured Agreement for Water Supply (May 2006)

RESTRUCTURED AGREEMENT FOR WATER SUPPLY

by and between

SONOMA COUNTY WATER AGENCY
CITY OF COTATI
CITY OF PETALUMA
CITY OF ROHNERT PARK
CITY OF SANTA ROSA
CITY OF SONOMA
FORESTVILLE WATER DISTRICT
NORTH MARIN WATER DISTRICT
VALLEY OF THE MOON WATER DISTRICT
TOWN OF WINDSOR

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RESTRUCTURED AGREEMENT FOR WATER SUPPLY

THIS AGREEMENT is made on _____ by and between the following public entities:

SONOMA COUNTY WATER AGENCY, herein called "Agency",
CITY OF COTATI, herein called "Cotati",
CITY OF PETALUMA, herein called "Petaluma",
CITY OF ROHNERT PARK, herein called "Rohnert Park",
CITY OF SANTA ROSA, herein called "Santa Rosa",
CITY OF SONOMA, herein called "Sonoma",
FORESTVILLE WATER DISTRICT, herein called "Forestville",
NORTH MARIN WATER DISTRICT, herein called "North Marin",
VALLEY OF THE MOON WATER DISTRICT, herein called "Valley of the Moon", and
TOWN OF WINDSOR, herein called "Windsor",

The parties hereto hereby mutually covenant and agree as follows:

PART 1 - GENERAL

1.1 Recital of Purposes

Among the purposes of this Agreement are to provide a water supply or a supplemental water supply for each of the Water Contractors, to encourage water conservation and recycled water use that reduces potable water use, to provide environmental improvements and enhancements to allow for sustainable and continued use of Russian River Project water, to encourage the development of local supply projects to offset potable water use, and to provide for payment to the Agency for water delivered hereunder sufficient to enable it to pay the capital costs of major replacements and additions to the Transmission System and to meet its Revenue Bond Obligations and its expenses of operating and maintaining the Transmission System.

1.2 Definitions

When used herein, unless otherwise distinctly expressed or manifestly incompatible with the intent of this Agreement, the terms:

(a) "Acre feet" and "AF" mean one acre-foot or 325,850 gallons of water.

(b) "Additional Facilities" means the additional facilities that must be constructed or acquired after the completion of the Russian River-Cotati Intertie in order for the Agency to be able to make the deliveries authorized by Sections 3.1 and 3.2, including, but not limited to: an aqueduct generally paralleling the Intertie Aqueduct; an aqueduct generally paralleling the south part of the Petaluma Aqueduct from the Intertie Aqueduct to Kastania Reservoir; an aqueduct generally paralleling the Sonoma Aqueduct; an aqueduct connecting the Kawana Springs and Ralphine reservoirs; the transmission line pumping plants necessary to regulate flows to Storage Facilities; 55.5 million gallons of reservoir storage; 56.9 mgd of Russian River water production capacity; water-treatment facilities; and Emergency Wells.

(c) "Aqueduct Facilities" means the pipelines of the Intertie, Petaluma, Santa Rosa and Sonoma Aqueducts, an additional pipeline to be constructed generally paralleling the Intertie Aqueduct, a pipeline to be constructed generally paralleling the south part of the Petaluma Aqueduct from the Intertie Aqueduct to Kastania Reservoir, and a pipeline to be constructed or acquired generally paralleling the Sonoma Aqueduct.

(d) "Capital Cost" means the total funds expended for capital improvements, major replacements, or portions thereof, as context requires, including, but not limited to, planning, engineering, environmental impact analysis, right of way, financial and legal fees, interest during construction, and materials, construction, and replacement costs.

(e) "Common Facilities" means all Transmission System facilities except Storage Facilities and Aqueduct Facilities, but including additional facility aqueduct capacity constructed specifically to make the deliveries that have been authorized by Section 3.12, and including the Potter Valley Project or portion thereof if acquired pursuant to Section 2.4.

(f) "Corporate Territory" means the boundary from time to time existent of a city, agency, district or other governmental entity with powers to accept and distribute water.

(g) "Customer" means any of the following customers of the Agency:

(1) "Water Contractor" means a party signatory to this Agreement except the Agency and Forestville.

(2) "Other Agency Customer" means the Agency, the County of Sonoma, California-American Water Company (with respect to the Larkfield Water District), Forestville Water District, Lawndale Mutual Water Company, Kenwood Village Water Company, Penngrove Water Company, the City of Sebastopol, the State of California, and Santa Rosa Junior College.

(3) "Marin Municipal" means the Marin Municipal Water District.

(4) "Russian River Customer" means any Agency customer within Sonoma County who has or in the future will have contracts with the Agency to divert or redivert water directly from the Russian River or Dry Creek without the use of the Transmission System.

(5) "Regular Customer" means the any of the Water Contractors or the Other Agency Customers.

(h) "Emergency Wells" means auxiliary groundwater production wells that may be utilized to provide additional delivery capacity when necessary due to drought, equipment failure, or other transmission capacity impairment, inability to divert Russian River Project water (for water quality reasons or otherwise), or any other reason beyond the control of the Agency.

(i) "Entitlement" means the quantity of water a Regular Customer shall from time to time require at such rates of flow as are necessary to meet its peak day's demand, subject to the delivery limitations set forth in Sections 2.2, 3.1, 3.2, and 3.5.

(j) "Entitlement Limits" means the maximum amounts of water the Agency is obligated to deliver to any Regular Customer from the Transmission System, as specified in Sections 3.1(a), 3.2(a), 3.2(c), and 3.2(d).

(k) "Fiscal Year" (abbreviated FY) means the period from July 1 through the following June 30.

(l) "Forestville Aqueduct" means the existing pipeline from the Santa Rosa Aqueduct to Forestville, the existing booster pumping plant, the existing 300,000-gallon reservoir, and all other facilities financed with the proceeds of the sale of Series E of the Agency's 1955 Bonds.

(m) "Intertie Aqueduct" means the existing 48-inch inside diameter pipeline extending from the Mirabel Park intake facilities on the Russian River to the Petaluma Aqueduct in the vicinity of Cotati with appurtenances thereto including turnouts to serve Forestville, Santa Rosa, Cotati and Rohnert Park. The Intertie Aqueduct consists of three reaches: "Reach 1" from the Mirabel intake facilities to Forestville, "Reach 2" from Forestville to the extension of Hall Road and "Reach 3" from the extension of Hall Road to the junction with the Petaluma Aqueduct at Cotati. Reach 3 is further divided into "Reach 3a" from the extension of Hall Road to Occidental Road, "Reach 3b" from Occidental Road to the Cotati reservoirs and "Reach 3c" from the Cotati reservoirs to the Petaluma Aqueduct.

(n) "Kawana Pipeline" means the pipeline connecting the Reach 3a of the Intertie Aqueduct with Kawana Springs Reservoirs.

(o) "Local Supply Project" means a water supply project undertaken by one or more Water Contractors, which reduces demand on the Transmission System during the months of June, July, August, or September.

(p) "Marin Municipal" means the Marin Municipal Water District.

(q) "mgd" means a million gallons of water per day.

(r) "Oakmont Pipeline" means that certain pipeline and appurtenances generally parallelling the Sonoma Aqueduct that were constructed by the Agency pursuant to an agreement between the City of Santa Rosa and Agency dated April 29, 1986.

(s) "Operation and Maintenance Costs" means the Agency's costs of operating the Transmission System including its power costs, costs of maintaining the Transmission System in a good state of repair, payments made to the owner of the Potter Valley Project to insure the continued operation of the Potter Valley Project provided they are annually approved by the Water Advisory Committee, regardless of whether or not such payments result in the ultimate transfer of title to all or part of the Potter Valley Project to the Agency, and costs of administering the Transmission System and furnishing the water supplies pursuant to this Agreement; provided, however, that costs relating to the use of Transmission System facilities for public recreation purposes, except (1) costs to permit limited passive public recreation on Transmission System lands not in conflict with operational or water quality requirements, or (2) necessary

costs associated with land ownership, shall not constitute "Operation and Maintenance Costs."

(t) "Ordinance No. 1" means Ordinance No. 1 of the Agency adopted on December 28, 1970, providing for the issuance of the Revenue Bonds, together with any other ordinances of the Agency supplemental thereto or amendatory thereof.

(u) "Other Agency Customer" means the Agency, the County of Sonoma, California-American Water Company (with respect to the Larkfield Water District), Forestville Water District, Lawndale Mutual Water Company, Kenwood Village Water Company, Penngrove Water Company, the City of Sebastopol, the State of California, and Santa Rosa Junior College.

(v) "Petaluma Aqueduct" means the existing pipeline and appurtenances, including turnouts, from the Santa Rosa Aqueduct to Petaluma. The "south part" of the Petaluma Aqueduct means the portion thereof south of the junction thereof with the Intertie Aqueduct and the "north part" means the portion north of said junction to Scenic Avenue.

(w) "Potter Valley Project" means Federal Energy Regulatory Commission Project No. 77.

(x) "Recycled Water" means wastewater treated to applicable standards set forth in Title 22 of the California Code of Regulations, Division 4 Environmental Health, as may be amended from time to time.

(y) "Recycled Water and Local Supply Sub-Charge" and "Recycled Water and Local Supply Fund" mean the sub-charge and fund established by the Agency under Section 4.15.

(z) "Recycled Water Project" means any programs, projects, or facilities that produce or deliver recycled water, provided that the recycled water produced or delivered by such projects or facilities (1) results in a reduction in use of potable water from the Transmission System, (2) reduces the amount of water diverted from the Russian River or its tributaries, (3) provides an environmental benefit which increases or avoids reduction to the water supply or Transmission System capacity available to the Water Contractors, or reduces the cost of providing such supply or capacity, or (4) assists the Agency to comply with the federal or state Endangered Species Act or any other environmental law or regulation, which compliance is required for the Agency to

provide the water supply or Transmission System capacity to the Water Contractors as provided in this Agreement.

(aa) "Regular Customer" means the any of the Water Contractors or the Other Agency Customers.

(bb) "Remaining Facilities" means those portions of the Russian River-Cotati Intertie authorized to be constructed or acquired by the Tenth Amended Agreement For Water Supply and Construction of the Russian River-Cotati Intertie Project, dated November 14, 1997, which have not been constructed or acquired on the effective date of this Agreement, including, but not limited to, 20 mgd of standby pump and collector capacity; the Wohler-Forestville pipeline; the Eldridge-Madrone pipeline; Collector No. 6, and the Oakmont Pipeline.

(cc) "Revenue Bond Obligations" means the payment of principal of and interest on the Revenue Bonds and all other obligations and covenants of the Agency with respect to the Revenue Bonds, including specifically any covenant to establish and maintain rates and charges to provide revenue coverage in excess of a specified amount.

(dd) "Revenue Bonds" means any of the following if issued or entered into for sole purpose of financing the Capital Cost of Transmission System facilities or other facilities authorized to be constructed, acquired, or funded under this Agreement: (1) all series or issues of revenue bonds issued pursuant to ordinances and resolutions of the Agency or of any joint powers authority of which the Agency is a member or (2) any loan agreement, grant agreement, lease-purchase agreement, certificate of participation agreement, note, commercial paper, or other debt or financing agreement entered into by the Agency or by any joint powers authority of which the Agency is a member. As used in this Agreement, the term "issue Revenue Bonds" includes entering into any of the agreements set forth in clause (2) of the preceding sentence, and the term "holders of Revenue Bonds" includes any holders of or counterparties to any such agreements.

(ee) "Russian River Conservation Charge" means the charge established in Subsection (a) of Section 4.18 of this Agreement.

(ff) "Russian River-Cotati Intertie" means the Intertie Aqueduct and associated intake facilities on the Russian River, including the diversion dam, intake works, infiltration ponds, collectors, water treatment facilities, groundwater wells having a minimum production capacity of 7 mgd, a Russian River water quality monitoring system,

pumps, telemetry equipment and related buildings and appurtenances, and associated storage facilities.

(gg) "Russian River Customer" means any Agency customer within Sonoma County who has or in the future will have contracts with the Agency to divert or redivert water directly from the Russian River or Dry Creek without the use of the Transmission System.

(hh) "Russian River Project" means Coyote Valley Dam/Lake Mendocino on the Russian River, Warm Springs Dam/Lake Sonoma on Dry Creek, and related works as contemplated by House Document Number 585, 81st Congress, 2nd Session, House Document Number 547, Eighty-Seventh Congress, Agency Board of Directors Resolutions No. 6847 adopted May 24, 1955, No. 7798 adopted September 27, 1955, No. DR00793-1 adopted September 25, 1961 and Resolution No. DR68485 adopted December 23, 1980, or any agreement between the Agency and the United States related to Coyote Valley Dam or Warm Springs Dam.

(ii) "Russian River Projects Charge" means the charge established in Subsection (b) of Section 4.18.

(jj) "Russian River Projects Fund" means the fund established by the Agency to pay or partially pay for: (1) carrying out the Agency's Coyote Valley Dam Project and Warm Springs Dam Project channel-stabilization works obligations to the United States Government and the State of California under Agency Board of Directors Resolutions No. 6847 adopted May 24, 1955, No. 7798 adopted September 27, 1955, No. DR00793-1 adopted September 25, 1961 and Resolution No. DR68485 adopted December 23, 1980; (2) securing and defending appropriative water rights which are necessary for the realization of the full benefits of the Coyote Valley Dam and Warm Springs Dam Projects; (3) the Agency's share of the United States Government's investment, operation and maintenance, and major replacement costs associated with the Coyote Valley Dam and Warm Springs Dam Projects; (4) the acquisition of all or part of the Potter Valley Project or contributions made to the Project owner to insure the continued operation of all or part of the Project; and (5) fishery mitigation and enhancement projects undertaken by the Agency in the Russian River and Eel River and their tributaries.

(kk) "Santa Rosa Aqueduct" means the existing pipeline and appurtenances, including turnouts, from the collector wells at Wohler to the Ralphine Tank farm on the east extension, and to Scenic Avenue on the south extension.

(ll) "Sonoma Aqueduct" means the existing pipeline and appurtenances, including turnouts, from the Ralphine reservoirs to Sonoma. The Sonoma Aqueduct consists of two reaches: "Reach 1" from the Ralphine reservoirs to Pythian Road and "Reach 2" from Pythian Road to the Sonoma reservoirs.

(mm) "Storage Facilities" means all reservoirs on the Transmission System, the pipeline connecting the Kawana Springs Reservoirs with the Intertie Aqueduct; the pipeline connecting the Kawana Springs and Ralphine reservoirs; the Oakmont Pipeline; the pipeline connecting the Kastania reservoir with the Petaluma Aqueduct; the existing booster pumping plant and the existing 300,000-gallon reservoir components of the Forestville Aqueduct; and transmission line pumping plants necessary to regulate flows to storage facilities.

(nn) "Surplus Customer" means any person or entity who, as of the date of this agreement, was being served Surplus Water by the Agency.

(oo) "Surplus Water" has the meaning defined in subsection (a) of Section 3.4 of this Agreement.

(pp) "Transmission System" means the Agency's water production, storage, treatment and transmission facilities, including but not limited to the Santa Rosa, Petaluma, and Sonoma Aqueducts, the Russian River-Cotati Intertie, Emergency Wells, the Warm Springs Hydroelectric Project, future water production, storage, treatment and transmission facilities to be constructed as set forth in Sections 2.2 and 2.3, and the Potter Valley Project, if acquired by the Agency pursuant to Section 2.4.

(qq) "Trustee" means the Trustee or Trustees for the Agency (or for any joint powers authority of which the Agency is a member) and the holders of the Revenue Bonds appointed pursuant to ordinances or resolutions of the Agency relating to Revenue Bonds, or any successor(s) or assignee(s) thereof.

(rr) "Warm Springs Dam Project" means that certain project authorized for the Russian River, Dry Creek, California, by the Flood Control Act of 1961, enacted October 23, 1962 (Public Law 874, 87th Congress).

(ss) "Warm Springs Hydroelectric Project" means Federal Energy Regulatory Commission Project No. 3351.

(tt) "Water Advisory Committee" means the advisory committee established in Part 5 of this Agreement.

(uu) "Water Conservation Project" means (1) any program, project, or activity that will reduce potable water use within a Regular Customer's service area (including, but not limited to, activities undertaken pursuant to Section 1.12 of this Agreement, but excluding Recycled Water Projects or Local Supply Projects approved after the date of this Agreement), or (2) any materials, supplies, Agency staff time, or contractor services provided by the Agency in support of any Regular Customer's Water Conservation Project.

(vv) "Water Contractor" means a party signatory to this Agreement except the Agency and Forestville.

1.3 Term of Agreement

This Agreement shall become effective upon its execution by all the parties hereto and shall remain in effect until June 30, 2040, or, if any Revenue Bonds are outstanding on June 30, 2040, until such date as all Revenue Bonds shall have been paid in full and all obligations and covenants of the Agency with respect to any Revenue Bonds shall have been discharged. The Agency shall enter into renewal agreements for periods not to exceed forty years each with any or all of the Water Contractors requesting the same for water supplies within the delivery capabilities of the Agency's Transmission System, at a cost no greater than the Agency's Operation and Maintenance Costs and unreimbursed Capital Costs allocated on a proportionate use basis, it being understood that such renewal agreements shall provide for Entitlements and Entitlement Limits for each customer as set forth herein.

1.4 Previous Agreements Terminated or Modified

(a) The Eleventh Amended Agreement for Water Supply, dated January 26, 2001, between the Agency and the Water Contractors is terminated as of the effective date of this Agreement and superseded by this Agreement.

(b) Existing agreements between the Agency and Windsor are terminated and amended as follows, effective as of the effective date of this Agreement:

(1) All prior agreements between the Agency and Windsor for water deliveries from the Transmission System are terminated as of the effective date of this

Agreement, including the Application for Water Service, dated April 1, 1987. All water deliveries to Windsor from the Transmission System shall be made in accordance with this Agreement.

(2) The Agreement for the Sale of Water between the Sonoma County Water Agency and the Windsor Water District, dated June 8, 1991, is amended as follows:

(i) By deleting the text of Section 4 ("Shortage of Water and Apportionment") thereof and replacing it with the following: "In the event of a shortage in the quantity of water available to its customers, including the Town of Windsor, the Agency shall apportion water as provided in the Restructured Agreement for Water Supply, dated _____. In such event, (1) the Town of Windsor shall limit its total diversions and rediversions of water from the Russian River, including both diversion and rediversions pursuant to this agreement and all of its other diversions and rediversions, to the amounts of water that the Agency allocates to the Town of Windsor, and (2) in determining the amount of water available for allocation, the Agency shall include the amount of water available for diversion or rediversion by the Town of Windsor under its water rights in addition to the amount available to the Agency under its own water rights."

(ii) By adding at the end of Section 10 ("Payment") the following: "The Town of Windsor shall also pay any charges required by the Restructured Agreement for Water Supply, dated _____, including the charges required by Section 4.17(b) of that agreement."

1.5 Enforcement

The failure of any Water Contractor to perform its obligations hereunder shall not excuse the remaining Water Contractors from performing their obligations hereunder nor excuse the Agency from performing its obligations hereunder to said remaining Water Contractors. Each and all of the provisions of this Agreement shall be enforceable by action brought by any party hereto for specific performance or any other appropriate action at law for damages or in equity for other appropriate relief to the end that no party hereto shall suffer from the default of any other party. Nothing in this Agreement shall preclude any Water Contractor from seeking unilateral redress under the law from the Agency, or any other party, Customer, or entity. Any owner or holder

of Revenue Bonds may also enforce any provision of this Agreement inuring to the benefit of the holders of the Revenue Bonds.

1.6 Amendments

(a) Except as hereafter provided, this Agreement may be amended only with the consent of all the parties hereto.

(b) Any annual delivery limit contained in Section 3.1 may be modified by written Agreement between the Agency and the Water Contractor to which such annual delivery limit applies without the consent of the other parties to this Agreement for the purpose of conforming such annual delivery limits to a general plan which is applicable to the service area of such Water Contractor. Copies of any such written agreements shall be provided to all the parties to this Agreement.

(c) As of the effective date of this Agreement, Forestville is no longer a Water Contractor, and this Agreement may be amended without the consent of Forestville, provided, however, that Forestville's consent shall only be required for any amendment that impairs or affects any then-existing obligation of the Agency to supply water to Forestville from the Transmission System.

(d) If any amendment to this Agreement reduces the revenues to be received by the Agency or otherwise impairs the ability of the Agency to meet its Revenue Bond Obligations, then such amendment shall be effective only with the consent of the Trustee. The Trustee shall give such consent if the Trustee determines that, following such amendment, the Water Contractors will be obligated under this Agreement to make payments to the Agency sufficient to enable the Agency to pay principal of and interest on the Revenue Bonds and to meet all its other Revenue Bond Obligations. In making such determination, the Trustee may rely upon such certificates or opinions from qualified attorneys, engineers or accountants as the Trustee may deem necessary and obtain from the Agency.

1.7 Pledge of Revenues

Each party hereto acknowledges that anything herein to the contrary notwithstanding, all sums paid to the Agency pursuant to this Agreement are "Revenues of the Transmission System" of the Agency as defined in Ordinance No. 1, except (a) the payments and credits set forth in Section 4.4, (b) the payments of the Russian River Conservation Charge and the Russian River Projects Charge made

pursuant to Section 4.11 and 4.18, (c) the payments of the Water Management Planning Sub-Charge made pursuant to Section 4.13, (d) the payments of the Watershed Planning and Restoration Sub-Charge made pursuant to Section 4.14, (e) the payments of the Recycled Water and Local Supply Sub-Charge made pursuant to Section 4.15, and (f) the payments of the Water Conservation Sub-Charge made pursuant to Section 4.16, and are pledged to the payment of the Agency's Transmission System Revenue Bond Obligations. All said sums shall be received, allocated and paid out pursuant to and consistent with Ordinance No. 1 and other obligations and covenants of the Agency with respect to Revenue Bonds. All references in this Agreement to the accounting for, allocating, paying, and crediting of monies are subject to the priority established by Ordinance No. 1 on all such revenues.

The parties hereto recognize that the Revenue Bonds are to be paid from revenues, as provided herein, and that it is the intention of the parties that the charges set forth herein will be sufficient to pay the Revenue Bonds and to meet the Revenue Bond Obligations not met from other sources of funds. The Water Contractors, therefore, agree to pay promptly such charges notwithstanding any deficiency in the quantity or quality of water to which they or any of them would be entitled pursuant to this Agreement. The provisions of this Agreement are made for the benefit of the owners and holders from time to time of the Revenue Bonds and may be enforced by or on behalf of any such owner or holder.

1.8 Books, Records and Accounts

The Agency shall keep or cause to be kept, proper books, records and accounts in which complete and accurate entries shall be made of all monies received from all entities, including the Agency's Regular Customers, and of the basis for and application of said money, including detailed sub accounts showing expenditures made from Operation and Maintenance Charge revenues for Water Conservation Projects, Recycled Water Projects, Local Supply Projects, water management planning, and watershed planning and restoration. Said books, records and accounts will be available during normal business hours for inspection by the Water Contractors or their authorized representatives. The Agency will transmit to the Water Contractors two reports each year of the receipts and expenditures of the Transmission System. The first report will be issued no later than February 1 and shall be accompanied by a preliminary budget for the following Fiscal Year, and will show expenditures for the first half of the Fiscal Year together with estimated year-end expenditures and estimated expenditures for the following Fiscal Year. The second report will be issued after the end of each Fiscal Year and will contain a budgetary accounting of Transmission System expenditures,

revenues and balances for the Fiscal Year. Each month the Agency shall supply each Water Contractor with a summary showing the amount of water delivered during the preceding month to each Regular Customer and Surplus Customer.

1.9 Water Contractors' Duty to Provide Funds

Each Water Contractor shall use any and all means legally available to it (including, without limitation, the enactment and maintenance in effect of legislation establishing fees, tolls, rates and charges pertaining to the operation of its water distribution system) so as to produce monies sufficient in amount to meet the monetary obligations incurred by it pursuant to this Agreement and to enable it to maintain its water distribution system in good working order.

1.10 Severability

If any one or more sections, provisions, promises, or conditions of this Agreement is declared void or voidable for any reason by a final judgment or order of a court of competent jurisdiction, it is hereby declared to be the intention of each party and agreed that each and all of the other sections, provisions, promises and conditions of this Agreement shall be and remain in full force and effect.

1.11 Third Party Beneficiaries

Except for the holders of the Revenue Bonds, no third party beneficiaries are intended or established by this Agreement.

1.12 Water Conservation Requirements

(a) The Regular Customers of the Agency, and the Agency, shall (1) become members of the California Urban Water Conservation Council ("CUWCC") within six months of the effective date of this Agreement and remain as members in good standing; (2) sign the "Memorandum of Understanding Regarding Urban Water Conservation in California" ("MOU") maintained by the CUWCC and implement the Best Management Practices ("BMPs") of water conservation as are promulgated by CUWCC from time to time, or implement alternative water conservation measures that secure at least the same level of water savings, and shall complete and file the annual CUWCC report form; and (3) implement or use their best efforts to secure the implementation of any water conservation requirements that may be added as terms or conditions of the Agency's appropriative water rights permits or licenses, or with which the Agency must

comply under compulsion of regulation or law. In addition to and notwithstanding the foregoing, all Regular Customers of the Agency shall require metered billing of all customer accounts they serve.

(b) Should the Water Advisory Committee determine and so notify any Water Contractor that its efforts to achieve compliance with the water conservation practices required by this Section 1.12 are unsatisfactory, then such Water Contractor shall bring its water conservation program into compliance within six months after such notice, or within such additional time as may be granted by the Water Advisory Committee. Should such Water Contractor's noncompliance as determined by the Water Advisory Committee continue for six months after such notice of noncompliance, or beyond such additional time as may be granted by the Water Advisory Committee, then the Water Contractor shall thereafter pay a surcharge on all water delivered by the Agency pursuant to this Agreement equal to ten percent of the Operation and Maintenance Charge until the Water Advisory Committee determines that such Water Contractor is in compliance. The proceeds of any surcharge paid pursuant to this section shall be deposited and paid out in the same manner as the proceeds of the Water Conservation Fund.

(c) The Agency shall use its best efforts to modify its rules and regulations and existing contracts with Other Agency Customers to implement the water conservation requirements set forth in Section 1.12(a) and the default provisions set forth in Section 1.12(b). With respect to Russian River Customers, the Agency shall use its best efforts to encourage and, where and when possible, require said customers to sign the "MOU" maintained by the CUWCC and implement the "BMPs" of water conservation as are promulgated by CUWCC from time to time.

(d) Nothing in this section shall limit Regular Customers to implementing only those Water Conservation Projects contemplated by the CUWCC BMPs. Regular Customers are encouraged to implement Water Conservation Projects that go beyond the CUWCC BMPs.

1.13 Recycled Water and Local Supply Project Requirements

Within ten (10) years from the effective date of this Agreement, the Water Contractors shall use their best efforts to carry out or participate in Recycled Water or Local Supply Projects capable of delivering Recycled Water or potable water sufficient to reduce the Water Contractors' collective deliveries from the Transmission System (including, in the case of Windsor, reductions in withdrawals from Windsor's Russian

River wells), by at least 7,500 acre-feet per year, with approximately 50% of such reduction resulting from Recycled Water Projects.

1.14 Transitional Provisions Applicable to Forestville

As of the effective date of this Agreement, the Agency's right, title, and interest in facilities comprising the Forestville Aqueduct shall be transferred as follows:

(a) The existing Forestville pipeline from the Santa Rosa Aqueduct to Forestville and the storage building at the existing booster pumping plant shall be transferred to Forestville.

(b) The existing booster pumping plant and the existing 300,000-gallon reservoir shall become Storage Facilities.

(c) Subject to the limitation in subsection (d) of this section, the Agency shall provide funding to Forestville for the Capital Costs of an 8" pipeline to be constructed by Forestville from the Intertie Aqueduct at the extension of Templeman Road, west on Templeman Road to State Highway 116, then north on State Highway 116 West to Kay Lane. The pipeline shall be funded as a common facility. Forestville shall commence construction on the pipeline within five years of the effective date of this Agreement; provided, however, that if the commencement of construction is delayed due to the application to Forestville of any circumstance specified in the second paragraph of Section 2.2 of this Agreement, then the Agency's General Manager/Chief Engineer may authorize an extension of the commencement date.

(d) The Agency's funding obligation under this section shall be limited to $690,000, increased by the change in the ENR Construction Cost Index between the effective date of this Agreement and the date of commencement of construction of the pipeline.

1.15 Local Production Capacity Goal

In order to mitigate against drought, earthquakes, spills, temporary impairments, and other events impacting the quantity or quality of water available from the Transmission System, and other emergencies that can befall an urban water supply system, it is highly desirable that each Water Contractor achieve and maintain local water production capacity capable of satisfying approximately forty percent (40%) of the Water Contractor's average day of the maximum month demand.

PART 2 - PLANNING, FINANCING, ACQUISITION, CONSTRUCTION, OPERATION AND MAINTENANCE

2.1 Financing Additions to the Existing Transmission System

The Agency will, subject to all applicable limitations specified in this Agreement and all applicable legal and regulatory limitations, finance additions to the Transmission System with cash available pursuant to Sections 3.6, 4.2, 4.6, 4.7, 4.8, 4.12, payments made by Marin Municipal pursuant to Section 4.11, payments made by North Marin pursuant to Section 4.4 and 4.9, any state, federal, or other grants or loans which may become available, and, if the Agency decides to issue new series or issues of Revenue Bonds, proceeds from the sale of Revenue Bonds.

2.2 Scheduling of Additions and Replacements to the Existing Transmission System

Subject to the availability of sufficient cash or proceeds from the sale of Revenue Bonds (if the Agency decides to issue new series or issues of Revenue Bonds) and any state, federal, or other grants or loans which may become available, and subject to all applicable limitations specified in this Agreement, the Agency will (1) construct or acquire additions to the existing Transmission System sufficient to meet the delivery Entitlements set forth in Section 3.1 and 3.2 at such times as may be necessary to enable it to reliably deliver to each of the Water Contractors such Entitlements at the time that each contractor shall require the same and to make the deliveries authorized pursuant to Section 3.12; (2) construct additional Russian River water production facilities (up to a total capacity of 168.9 mgd) so that the total water production capacity available at all times is not less than the average daily delivery to the Regular Customers and Marin Municipal (excluding Surplus Water and water in excess of Entitlement Limits) during the month of highest historical use plus 20 mgd; (3) construct, acquire, or lease Emergency Wells with capacities which are from time to time determined by the Water Advisory Committee; (4) construct Additional Facilities (up to a total capacity of 174.3 million gallons) to the extent necessary to maintain a quantity of water in storage equal to 1.5 times the average daily delivery to the Regular Customers except North Marin during the month of highest historical use; and (5) replace existing facilities and construct Additional Facilities, related buildings and appurtenances as necessary to insure the reliable and efficient operation of the Transmission System and to insure that the quality of the water delivered complies with all applicable state and federal water quality requirements.

The time within which the Agency shall be obligated to construct such additions and replacements to the existing Transmission System shall be extended, however, as a result of any delays caused by fire, earthquake, other acts of God, acts of the public enemy, riots, insurrections, governmental regulations on the sale or transportation of materials or supplies, strikes affecting such construction or transportation of materials or supplies in connection therewith, any State or Federal environmental regulations or restrictions, shortages and/or delay in the obtaining of materials, shortages of or allocations of fuel and other sources of energy, litigation resulting in court orders restraining the construction of such additions and replacements, inability of Agency for any reason to deliver the Revenue Bonds or any series thereof, or any other causes beyond the control of Agency or any contractor constructing any part of such additions and replacements.

2.3 Further Modifications to Transmission System

(a) With the approval of the Water Advisory Committee and subject to the availability of sufficient funds, the Agency may undertake studies, and prepare technical reports, financial plans, and environmental documents for Transmission System facilities in addition to those authorized to be constructed by this Agreement. If such activities are undertaken pursuant to this paragraph, the cost thereof shall be considered to be costs of Common Facilities and shall be paid from funds available pursuant to subsection (c) of Section 4.2, or from the proceeds of Revenue Bonds and payments made by North Marin pursuant to Section 4.4. If the cost is paid from the proceeds of Revenue Bonds and payments made by North Marin, the cost shall be allocated as provided in subsection (b), paragraph 9 of Section 4.3 and Section 4.9.

(b) Except for the facilities described in Section 2.2, the Agency will not construct or acquire additions to the Transmission System that would increase the charges payable by, or diminish or impair the water available to, any of the Water Contractors except on such terms and conditions as may be agreed upon in writing by the Agency and each Water Contractor who would be required to make any additional payment by reason of such construction or whose water supply might be diminished or impaired by such construction. If such addition is a booster pump or any other device, method, or system that would enlarge or increase the capacity of any one customer to the detriment of other users, then such addition or alteration shall not be made by Agency except by amendment to this Agreement. If a question arises as to whether an addition or alteration to the Transmission System requires an amendment of this Agreement pursuant to this section, then such question shall be submitted to the Water Advisory Committee and its decision shall be conclusive.

2.4 Potter Valley Project

(a) All or part of the Potter Valley Project may be acquired upon a determination by the Board of Directors of the Agency that such acquisition is necessary to insure the Agency's continued ability to make the water deliveries authorized by this Agreement and maintain fisheries and other incidental benefits to the Russian River basin, provided, however, that no part nor all of the Potter Valley Project shall be acquired without the affirmative vote of at least six (6) representatives of the Water Contractors on the Water Advisory Committee representing at least two-thirds of the total weighted votes as calculated pursuant to Section 5.3(a). The Agency shall not be liable to any of its Customers for any damage resulting from any Agency decision regarding the acquisition or non-acquisition of any part or all of the Potter Valley Project.

(b) The Agency shall commence a process upon the effective date of this Agreement to evaluate the water supply and fisheries benefits provided by the Potter Valley Project within the Russian River watershed, the economic and operational feasibility of acquiring the Potter Valley Project, and whether alternative actions could reduce the need for the Agency to acquire the Potter Valley Project. Alternative actions to be evaluated may include the increased use of recycled water to reduce agricultural and other diversions from the Russian River and its tributaries; the modification of instream flow requirements in the Russian River; and the completion of state and/or federal recovery plans for salmonid species listed as threatened or endangered in the Russian River watershed. The cost of such evaluations shall be paid from Watershed Planning and Restoration Sub-Charge funds available pursuant to subsection 4.14; however, the Agency shall use its best efforts to obtain the agreement of other interested parties who divert water from the Russian River or its tributaries (including municipal and agricultural diverters) to pay for a portion of such costs and to participate in the implementation of such alternative actions. Before acquiring the Potter Valley Project, the Agency shall conduct an environmental analysis of the acquisition pursuant to CEQA, which analysis may include an evaluation of alternative flow regimes from the Potter Valley Project into the Russian River and the Eel River.

(c) Upon determination by Agency that alternative actions could reduce the need for the Agency to acquire the Potter Valley Project, the Agency and the Water Contractors shall engage in a cooperative process to implement said other actions.

2.5 Water Conservation Projects

Subject to the restrictions set forth in Section 4.16, the Agency may undertake or fund any cost-effective Water Conservation Project that has been approved by the Water Advisory Committee.

2.6 Recycled Water and Local Supply Projects

Subject to the approval of the Water Advisory Committee, the Agency may (a) construct, fund, or partially fund studies or investigations or the Capital Cost of local Recycled Water Projects and Local Supply Projects, or (b) enter into agreements for the acquisition and sale of Recycled Water (or the rights to Recycled Water). The Agency and the Water Contractors shall seek financial contributions for local Recycled Water and Local Supply Projects funded under this section from benefitted wastewater treatment plant owners, sanitation districts, and other benefitted parties. Projects constructed, funded, or partially funded by the Agency under this section shall not be part of the Transmission System, and the operation and maintenance cost of such projects shall be the responsibility of the Water Contractors or other parties carrying out, sponsoring, or participating in such projects. The benefits from any Recycled Water Project shall be apportioned equitably based upon the respective financial contributions to the Recycled Water Project by the parties funding such project. The Capital Costs (including Revenue Bond Obligations, if any) of Local Supply Projects or Recycled Water Projects or of acquiring Recycled Water or the rights thereto shall be paid or partially paid from the Recycled Water and Local Supply Fund.

2.7 Water Management Planning

The Agency shall periodically prepare a draft regional Urban Water Management Plan pursuant to the Water Code for consideration by the Water Contractors. Each Water Contractor shall provide the Agency with all information and data the Agency reasonably determines to be necessary to allow the Agency to prepare the draft regional Urban Water Management Plan. The Agency shall use its best efforts to prepare a draft regional Urban Water Management Plan that meets the requirements of the Water Code. Each Water Contractor shall either adopt the draft regional Urban Water Management Plan prepared by the Agency as its Urban Water Management Plan, or prepare and adopt its own Urban Water Management Plan pursuant to the Water Code. Before adopting the Urban Water Management Plan prepared by the Agency, a Water Contractor shall evaluate the Plan, and adoption of the Plan by a Water

Contractor shall constitute a determination by that Water Contractor that the Plan meets the requirements of the Water Code as to that Water Contractor.

2.8 Watershed Planning and Restoration

(a) The Agency may undertake any action, study, or project approved by the Water Advisory Committee related to (1) the development or implementation of watershed restoration and maintenance plans and projects (including, but not limited to, stream restoration projects, water quality monitoring studies and projects, public education and outreach activities, and funding of third-party studies and projects) or (2) groundwater studies and investigations. Before undertaking any such action, study or project: (1) the Agency shall consider suggestions received from the public, Water Contractors, and interested parties and organizations such as the Russian River Watershed Association as to the actions, studies, and projects to be undertaken by the Agency hereunder; and (2) the Agency and the Water Contractors shall identify and use their best efforts to obtain funding contributions from other parties that would benefit from the actions, studies, or projects authorized hereunder, including but not limited to federal and state loans and grants, municipalities (including Russian River Customers, county and special district governments), and urban and industrial development, gravel mining, agriculture, forest harvesting, recreation, and sport and commercial fishing interests.

(b) The authority granted to the Agency under this Section 2.8 is permissive and not mandatory, and that nothing in this Section 2.8 shall (1) require the Agency to undertake any action or project unless such action or project is approved by the Agency, (2) impair or affect the Agency's right to undertake any action or project not funded under this Agreement, or (3) require the Agency to engage in any regulatory activity.

(c) The Agency may carry out projects and activities within the scope of subsection (a) above that primarily or exclusively benefit one or more Water Contractors, provided (1) each such project and activity is approved by the Water Advisory Committee and the benefitted Water Contractors, and (2) some or all benefitted Water Contractors enter into an agreement with the Agency for such project or activity and agree to pay supplemental charges as approved by the Agency and the Water Advisory Committee to defray all or a portion of the cost of the project or activities.

2.9 Planning Coordination

(a) The parties to this Agreement shall consult with agencies that have planning and zoning powers within their water service territories in the manner set forth in California Government Code Section 65352.5 in order to promote close coordination and consultation between water supply agencies and land use approval agencies to ensure that proper water supply planning occurs in order to accommodate projects that will result in increased demands on water supplies.

(b) The parties to this Agreement shall consult with agencies that have building regulatory powers pursuant to the Government Code and Health and Safety Code to promote use of water conservation equipment, fixtures, appliances, devices and techniques.

2.10 Operation and Maintenance

The Agency shall operate and maintain the Transmission System in a good state of repair.

PART 3 - WATER SUPPLY

3.1 Delivery Entitlements of Water Contractors

Subject to Section 3.5, the Agency shall deliver to each Water Contractor at the points of delivery hereinafter set forth such quantities of water as the Water Contractor shall from time to time require at such rates of flow as are necessary to meet its peak day's demand, subject to the following:

(a) The Agency shall not be obligated to deliver water in excess of the following:

Water Contractor/Aqueduct	Average Daily Rate of Flow During Any Month	Annual Amount During Fiscal Year (excluding Surplus Water)
Santa Rosa		
From Reach 1, 2, and 3a of the Intertie Aqueduct	40.0 mgd	
From the Santa Rosa Aqueduct	40.0 mgd	
From the Sonoma Aqueduct	4.0 mgd	
Maximum combined total from all aqueducts	56.6 mgd	29,100 AF
North Marin		
From Petaluma Aqueduct	19.9 mgd	14,100 AF
Petaluma		
From Petaluma Aqueduct	21.8 mgd	13,400 AF
Rohnert Park		
From Petaluma Aqueduct or Reach 3 of Intertie Aqueduct	15.0 mgd	7,500 AF

Valley of the Moon		
From Sonoma Aqueduct	8.5 mgd	3,200 AF
Sonoma		
From Sonoma Aqueduct	6.3 mgd	3,000 AF
Cotati		
From Petaluma Aqueduct or Reach 3 of Intertie Aqueduct	3.8 mgd	1,520 AF
Windsor		
From Santa Rosa Aqueduct	1.5 mgd	900 AF
From Russian River Diversions	7.2 mgd	4,725 AF

The delivery limits for Windsor include both water delivered by the Agency through the Transmission System and water diverted by Windsor through facilities owned by Windsor under its own water rights and under the Agency's water rights pursuant to the agreement between the Agency and Windsor dated January 8, 1991. Windsor shall not divert any water under the Agency's water rights through its own facilities except and to the extent that water is unavailable for diversion under any of Windsor's available water rights, as such rights currently exist or may exist in the future. Windsor shall act with diligence to take all actions necessary to obtain and retain any water rights to which Windsor may be entitled. For purposes of allocations pursuant to Section 3.5(a), (1) Windsor shall be considered to be a "Russian River Customer" with respect to its direct Russian River diversions, and (2) in determining the amount of water available for allocation under Section 3.5(a), the Agency shall include the amount of water available for diversion by Windsor under Windsor's water rights in addition to the amount available to the Agency under its own water rights. For purposes of allocations pursuant to Section 3.5(b), Windsor's average daily rate of flow during any month Entitlement Limit shall be 1.5 mgd.

(b) North Marin shall not take delivery of water at an instantaneous delivery rate greater than its average delivery rate for such day, if such instantaneous delivery rate would increase the Agency's cost of electrical energy. North Marin shall not take delivery of water at a rate of more than 19.9 mgd during more than 14 days of any month, nor at a rate of more than 20.9 mgd during any day of any month. Irrespective of its delivery Entitlement, North Marin shall nevertheless have the right to a flow rate of 14.8 mgd in the Petaluma Aqueduct.

(c) No Water Contractor shall take delivery of water at an average rate during any month that is greater than 2.0 times the average rate of delivery to that contractor during the preceding 12 months. The Agency also shall adopt this requirement as a service rule applicable to Other Agency Customers. However, if any Regular Customer was during the preceding 12 months subject to a curtailment in deliveries pursuant to Section 3.5, then the limit prescribed by this subsection shall be 2.0 times the average rate of delivery that such customer would have received in the absence of such curtailment. This rule shall not apply to Water Contractors who utilize local sources of supply to reduce demand on the Transmission System during the peak summer period of June 1 through September 30, and whose average production rate for said period from all of the contractor's local sources is equal to at least 2.0 times the average production rate of all of that contractor's local sources during the eight months immediately preceding the peak summer period.

(d) No Water Contractor shall take delivery of water during any month at an average rate that is greater than 1.3 times the average rate of delivery to that contractor during the peak month of the prior three calendar years without the written consent of the Agency. The Agency also shall adopt this requirement as a service rule applicable to Other Agency Customers. Such consent shall be given by the Agency if and only if sufficient transmission capacity exists to make such increased deliveries and the deliveries to the other Water Contractors required to be made pursuant to this section. However, if any Water Contractor was during the preceding three calendar years subject to a curtailment in deliveries pursuant to Section 3.5, then the limit prescribed by this subsection shall be 1.3 times the average rate of delivery that such contractor would have received during the peak month of the prior three calendar years in the absence of such curtailment.

(e) For purposes of determining Santa Rosa's average daily rate of flow during any month Entitlement Limit under this subsection, all water delivered to Santa Rosa from the Kawana Pipeline or from the pipeline connecting the Kawana Springs and Ralphine reservoirs shall be deemed delivered from Reach 3a of the Intertie Aqueduct.

3.2 Conditions on Other Agency Customer Deliveries

The Agency may furnish water from the Transmission System to Other Agency Customers subject, however, to the following conditions:

(a) The total quantity of water delivered to all the Other Agency Customers shall not exceed an average of 2.7 million gallons per day during any month.

(b) The Agency shall not enter into contracts to furnish water to any Other Agency Customer except itself or the County of Sonoma for use on land within two miles of the Corporate Territory of a Water Contractor or Forestville except with the prior written consent of such Water Contractor or Forestville, which consent will be subject to the condition that the Agency shall cease delivering water to such customer whenever a Water Contractor or Forestville is willing and able to furnish water to such customer. Water delivered by the Agency from the Transmission System to the Agency or the County of Sonoma shall not be used for residential, commercial, or private industrial purposes.

(c) The Agency shall not deliver more than an average of 0.5 million gallons per day during any month from the south part of the Petaluma Aqueduct to Other Agency Customers.

(d) The Agency shall not deliver more than an average of 1.5 million gallons per day during any month from Reach 1 of the Intertie Aqueduct to Forestville.

(e) The Agency shall not sell water from the Transmission System except as expressly authorized by this Agreement.

3.3 Deliveries in Excess of Entitlement Limits

(a) No Regular Customer may take delivery of water in excess of its average daily rate of flow during any month Entitlement Limit as set forth in Sections 3.1 or 3.2, except upon the following conditions:

first, that such excess delivery does not impair or delay the delivery to any other Regular Customer of its Entitlements; and

second, that the Regular Customer taking the excess delivery is then proceeding in good faith, with plans and funding to develop a reliable water supply, sufficient to supply its needs in excess of its Entitlement Limits; and

third, that either

(1) all the Water Contractors approve such excess delivery; or

(2) such excess delivery is made during a period when deliveries to another Water Contractor are less than its Entitlement Limits, such excess delivery does not exceed the unused amounts of said contractor's Entitlement Limits, and said contractor has notified the Agency in writing of its consent to said delivery.

(b) Any Water Contractor may transfer any portion of its annual amount during any fiscal year Entitlement Limit to any other Water Contractor for such periods of time and pursuant to such terms as agreed to by the transferor Water Contractor and the transferee Water Contractor, subject to the following:

(1) Such transfer shall not impair or delay the delivery to any other Regular Customer of its Entitlements.

(2) Notice of a proposed transfer, including adequate information to identify any impacts to deliveries of water to other Water Contractors, shall be provided to all the other Water Contractors individually, to the Water Advisory Committee, and to the Agency. Upon request of any other Water Contractor, the transferor and transferee Water Contractors shall promptly meet to identify and resolve any potential impacts of the proposed transfer. If any Water Contractor determines that the proposed transfer will impair or delay the delivery of its Entitlements, such Water Contractor may file a written objection to the proposed transfer with the Water Advisory Committee, with a copy to the Agency. Such objection must be filed no later than 45 days after the Water Contractor receives notice of the proposed transfer. Thereafter, the Water Advisory Committee shall determine whether the proposed transfer will impair or delay the delivery of the objecting Water Contractor's Entitlements, and whether there are measures that will eliminate such impairment or delay. In the absence of an objection to a proposed transfer by any Water Contractor, the approval of the Water Advisory Committee is not required.

(3) The average daily rate of flow during any month Entitlement Limit of the transferee Water Contractor as set forth in Sections 3.1 or 3.2 and the other delivery limitations applicable to the transferee Water Contractor shall not be affected by, and shall remain applicable notwithstanding, any transfer under this subsection.

(4) Payments to the Agency for delivery of the transferred water to the transferee Water Contractor shall be based upon the Aqueduct rate applicable to the transferee Water Contractor pursuant to this Agreement.

(5) The transferor and transferee Water Contractors shall be responsible for all regulatory compliance relating to the transfer, including compliance with the provisions of the California Environmental Quality Act. To the greatest extent permitted by law, the transferor and transferee Water Contractors shall indemnify and defend each of the other Water Contractors and the Agency from any claims, damages, or judicial or administrative proceedings arising out of any actions related to this Subsection 3.3(b), whether or not there is concurrent negligence on the part of the other Water Contractors or the Agency or each of them, but excluding liability due to the sole active negligence or willful misconduct of any of the other Water Contractors, the Agency, or each of them. The latter exclusion shall operate only as to the particular Water Contractor or Agency whose sole active negligence or willful misconduct caused the exclusion.

3.4 Surplus Water

(a) Surplus Water is water that from time to time may be available for delivery from the Transmission System in excess of the amounts required to meet the Agency's contractual obligations and the requirements of all the Agency's Regular Customers for uses other than those described in subdivision (b) of this section.

(b) Surplus Water may be used only for the following purposes:

(1) replenishment of surface water supply reservoirs or recreational lakes, including but not limited to Ralphine, Spring, and Stafford Lakes, or

(2) replenishment of groundwater basins;

provided, however, that Surplus Water also may be provided for use for irrigation of land used for commercial production of food or fiber if such provision of water is required by any agreement in existence on the effective date of this Agreement.

(c) The Agency shall deliver Surplus Water only from separate metered turnouts on the Transmission System or the North Marin Aqueduct.

(d) The Water Contractors shall have first priority on deliveries of Surplus Water.

(e) The Agency desires to transfer all of its Surplus Customers to the Water Contractors. The parties to this Agreement shall cooperate in the voluntary permanent transfer of Surplus Customers from the Agency to the party whose corporate territory encompasses the site of a given Surplus Customer or whose corporate territory boundary is within two miles of the turnout(s) serving said customer. Should a given Surplus Customer lie within two miles of more than one party, the parties shall meet and confer with the Agency and by mutual agreement determine who is best suited to take over said Surplus Customer. Nothing in this subsection shall require a Water Contractor to take over service of any Agency Surplus Customer. Should a given party opt not to take over Surplus Customers who lie within their corporate territory or within two miles of the boundary of same, then any other party to this Agreement whose corporate territory lies within Sonoma County may apply to the Agency to take over said Surplus Customers. Parties who agree to take on such service shall be known as Surplus Water providers.

(f) Surplus Water providers agree to interrupt delivery of Surplus Water upon notification by Agency if Agency determines, in its sole discretion, that there exists an immediate or pending problem involving loss of Transmission System storage, inadequate pumping capacity, a valid complaint from any Regular Customer that they are not receiving their appropriate Entitlement as a result of Surplus Water deliveries, or any other problem impacting the delivery capability of the Transmission System. Surplus Water providers shall notify their customers of Agency's right to require such delivery interruptions. Notwithstanding the right of the Agency to notify and cause the interruption of delivery of Surplus Water, a Surplus Water provider may also interrupt delivery of Surplus Water at any time it determines it is necessary or prudent to do so in order to satisfy the demands of its non-Surplus Customers; or for water system maintenance, repair, or planned or unplanned outage of any nature whatsoever, including but not limited to a perceived, threatened or actual water shortage. Deliveries of Surplus Water shall not be deemed to be included as part of any Regular Customer's Entitlement or Entitlement Limit.

3.5 Shortage of Water and Apportionment

(a) (1) The Agency shall use its best efforts to obtain, perfect, and maintain appropriative water rights in amounts sufficient to be able to make the water deliveries provided for in this Agreement. In its operation of the Russian River Project, the Agency shall use all reasonable means to prevent a deficiency in the

quantity of water that is available to the Agency for diversion and rediversion under the Agency's water rights. However, nothing in the preceding two sentences shall be construed to limit the Agency's discretion to take appropriate actions in good faith to resolve any issue that may arise under the federal Endangered Species Act or any other federal or state law affecting the Agency's water rights or operation of the Russian River Project.

(2) If by reason of drought, environmental laws or regulations, other causes beyond the control of the Agency, or any change in the amounts of water imported by the Potter Valley Project into the Russian River watershed (whether or not such change is caused by any action or inaction of the Agency) a deficiency does occur, the Agency shall not be liable to any of its customers for any damage arising therefrom.

(3) In the event of a deficiency pursuant to subsection 3.5(a)(2), the Agency first shall cease all deliveries of Surplus Water to other than the Water Contractors; second, shall cease deliveries of all Surplus Water; third, shall cease deliveries to Regular Customers in excess of their respective annual Entitlement Limits; and fourth, shall apportion the available supply of water as follows:

(i) first, deliver to each of its Regular Customers, not in excess of their respective Entitlement Limits, authorize Agency's Russian River Customers to divert or redivert not in excess of the amounts for which those customers have contracted to purchase from the Agency, and deliver to Marin Municipal not in excess of the amounts, if any, that are required to be delivered pursuant to the Third Amended Offpeak Water Supply Agreement dated January 25, 1996, the Amended Agreement for the Sale of Water between the Sonoma County Water Agency and the Marin Municipal Water District dated January 25, 1996, amendments to these agreements that have been approved by the Water Advisory Committee, or subsequent agreements between the Agency and Marin Municipal that have been approved by the Water Advisory Committee, the quantities of water required by each such customer for human consumption, sanitation, and fire protection as determined by the Agency after taking into consideration all other sources of potable water then available to said customer, including, for Russian River Customers, water available under their own water rights;

(ii) second, to the extent additional water is available to the Agency, allocate that water proportionately as follows: deliver such water to Agency's Regular Customers based upon their respective average daily rate of flow during any month Entitlement Limits, authorize the Agency's Russian River Customers to divert or redivert such water based upon the delivery limits set forth in the agreements between the Agency and its Russian River Customers, and deliver such water to Marin Municipal pursuant to and to the extent required by the Third Amended Offpeak Water Supply Agreement dated January 25, 1996, the Amended Agreement for the sale of Water between the Sonoma County Water Agency and the Marin Municipal Water District dated January 25, 1996, amendments to these agreements that have been approved by the Water Advisory Committee, or subsequent agreements between the Agency and Marin Municipal that have been approved by the Water Advisory Committee;

(iii) provided, however, that no Customer shall receive under subsections 3.5(a)(3)(i) and 3.5 (a)(3)(ii) a total quantity of water in excess of its reasonable requirements or its said Entitlement Limits or contracted amount, whichever is less.

(b) (1) In the event of a temporary impairment of the capacity of the Transmission System by reason of natural disaster, sabotage or other causes beyond the control of the Agency, the Agency shall not be liable to any of its customers for any damage arising therefrom.

(2) In the event of a Section 3.5(b)(1) impairment, the Agency shall:

(i) first, deliver to each of its Regular Customers the quantity of water, not in excess of the respective average daily rate of flow during any month Entitlement Limit, required by it for human consumption, sanitation, and fire protection as determined by the Agency after taking into consideration all other sources of potable water then available to said customer;

(ii) second, to the extent additional Transmission System capacity is available to the Agency, deliver a quantity of water to the Regular Customers in proportion to their respective average daily rate of flow during any month Entitlement Limits, provided, however, that no Regular

Customer shall receive under subsections 3.5 (b)(2)(i) and (b)(2)(ii) a total quantity of water in excess of its reasonable requirements or its average daily rate of flow Entitlement Limit, whichever is less;

(iii) third, to the extent additional Transmission System capacity is available, deliver water to Regular Customers in excess of their average daily rate of flow Entitlement Limits pursuant to Section 3.3;

(iv) fourth, to the extent additional Transmission System capacity is available, deliver water to Marin Municipal not in excess of the delivery limitations in Section 3.12;

(v) fifth, to the extent additional Transmission System capacity is available, deliver Surplus Water to the Water Contractors;

(vi) sixth, to the extent additional Transmission System capacity is available, deliver Surplus Water to other than the Water Contractors.

(3) However, deliveries to Marin Municipal shall not be reduced or curtailed under this Section 3.5(b) because of inadequate capacity in the new aqueduct to be constructed generally paralleling the portion of the Petaluma Aqueduct that extends from the Ely Pumping Plant to Kastania Reservoir, if such new aqueduct is paid for and dedicated to the Agency pursuant to Section 13 of the Amended Agreement for the Sale of Water between the Sonoma County Water Agency and the Marin Municipal Water District dated January 25, 1996.

(c) (1) In determining "human consumption, sanitation, and fire protection" amounts pursuant to this Section 3.5, the Agency shall take into account the level of water conservation achieved by the Customer and the resulting decrease in end user ability to reduce water use (the hardening of demand) resulting from such conservation. The allocations pursuant to subsection 3.5(a)(3)(i) shall be determined using a methodology which rewards and encourages water conservation; avoids cutbacks based upon a percentage of historic consumption, and, among other things, bases the amounts necessary for "human consumption, sanitation, and fire protection" upon no greater than average indoor per capita water use determined from recent retail billing records for winter water use by all of the Water Contractors; and, if necessary or appropriate for equitable purposes, considers commercial, industrial and institutional water uses separately and determines that element of the subsection 3.5(a)(3)(i) allocation

based on winter water use from recent retail billing records for commercial, industrial, and institutional uses.

(2) The fundamental purpose of the "reasonable requirements" limitation is to ensure that no Customer receives more water during a shortage than that Customer reasonably needs. In determining "reasonable requirements" pursuant to this Section 3.5, the Agency may take into account the hardening of demand resulting from the level of conservation achieved by the Customer; the extent to which the Customer has developed Recycled Water Projects and Local Supply Projects; and the extent to which the Customer has implemented water conservation programs (including conservation required pursuant to the provisions of Section 1.12 of this Agreement). It is the intention of the parties to this Agreement that the Agency make its "reasonable requirements" determinations so as to encourage Customers to implement water conservation, Recycled Water, and Local Supply Projects.

(d) The Agency shall at all times have an adopted water shortage allocation methodology sufficient to inform each Customer of the water that would be available to it pursuant to Section 3.5(a) in the event of reasonably anticipated shortages, which methodology shall be consistent with this Section 3.5 and shall be included in the Urban Water Management Plan prepared pursuant to Section 2.7.

(e) The parties agree that it is extremely difficult and impractical to determine the damage caused to the Agency or other Customers as a result of the taking of water by any Customers in excess of the limitations contained in this Section 3.5. If any Customer takes delivery of water from the Transmission System or otherwise from the Russian River system in violation of this Section 3.5, then it shall pay the Agency, in addition to all other applicable charges, liquidated damages in an amount equal to 50 percent of the applicable Operation and Maintenance Charge (including all sub-charges) times the amount of water taken in violation of the provisions of this Section 3.5. The Agency shall use its best efforts to incorporate this liquidated damages provision into its agreements with Other Agency Customers, Russian River Customers, Marin Municipal Water District, and into the Agency's rules and regulations for the provision of water service, and impose liquidated damages pursuant to this Section 3.5(e). The existence of this liquidated damage provision shall not limit or restrict the Agency from physically limiting the quantity of water taken to the amounts authorized by this Section 3.5 or from pursuing all other available legal and equitable remedies applicable to such violations. By affirmative vote, the Water Advisory Committee may request that the Agency physically limit the quantity of water taken by a Regular

Customer to the amounts authorized by this Section 3.5 or that the Agency pursue all other available legal and equitable remedies applicable to such violations. The proceeds of any liquidated damages assessed pursuant to this subsection shall be deposited and paid out in the same manner as the proceeds of the Operation and Maintenance Charge.

(f) Notwithstanding subsections (a) and (b) above, as an alternative method for allocation under this Section 3.5 during a period of water deficiency or temporary Transmission System impairment, the Water Advisory Committee (or, in the event of a Transmission System temporary impairment affecting fewer than all of the Water Contractors, the Water Advisory Committee representatives of the Water Contractors affected by the temporary impairment) may, by unanimous vote, determine how water shall be allocated among the affected Water Contractors. The Agency shall provide a calculation methodology or other information adequate to enable the determination, in a manner consistent with this Section 3.5, of the volume of water to which (i) the Water Contractors as a group, and (ii) all other Customers would be respectively entitled. Any alternative method for allocation determined by the Water Advisory Committee pursuant to this subsection shall apply only to the volume of water to which the Water Contractors are entitled as a group.

(g) In the event that Transmission System capacity is expanded by the construction of facilities other than those authorized by this Agreement, then notwithstanding anything in this Section 3.5 to the contrary, any allocations made pursuant to this section to Forestville that are based upon the average daily rate of flow during any month Entitlement Limits shall not use a denominator greater than 133.4 mgd.

3.6 Fire Fighting Service

Anything herein to the contrary notwithstanding, the Agency may furnish water for fire fighting from hydrants or standpipes on the Transmission System, provided, however, that such service within two miles of the Corporate Territory of a Water Contractor may be furnished only if and during the period of time said Water Contractor consents thereto in writing. The Agency shall set fees sufficient to recover the full cost of installing and maintaining and supplying water to fire hydrants. All revenue from such fees shall be treated the same as money received from the Operation and Maintenance Charge and shall be deposited and paid out as set forth in Section 1.7 and subdivision (b) of Section 4.1. Agency shall adopt service rules limiting hydrant water usage to fire suppression, fire training and limited temporary uses such as providing metered construction water.

3.7 Quality of Water

(a) The Agency warrants that it will use its best efforts to insure that all water delivered hereunder shall be of such purity and quality required to meet minimum standards for human domestic consumption from time to time established by the state and federal governments. The Agency shall not be liable to any of its Customers for any damage arising from the quality of water that it delivers under this Agreement, except for damages based on any breach of the warranty described in the preceding sentence.

(b) The payment obligations of the Water Contractors set forth in Part 4 shall not be affected in any manner by the quality of the water delivered by the Agency hereunder.

3.8 Points of Delivery

All water furnished to each Water Contractor hereunder shall be delivered at the discharge flange of meters at turnouts owned and maintained by the Agency. Turnouts in addition to those now existing shall be constructed from time to time at such locations as shall be agreed upon by the Agency and the Water Contractors involved. Water delivered to Petaluma and North Marin at the McNear meter station shall be delivered at a hydraulic gradient of not less than 175 feet mean sea level. Turnouts installed for Regular Customers shall be not less than 8 inches in diameter. Turnout installation charges shall be determined from time to time by resolution of the Board of Directors of the Agency and shall be payable by the Customer prior to turnout installation by Agency.

3.9 Risk of Loss and Responsibility

Title and risk of loss with respect to all water delivered hereunder shall pass from the Agency to the Water Contractor at the point of delivery thereof as set forth in Section 3.8. The Agency shall not be responsible for the control, transmission, distribution, handling or use of water beyond the point of delivery thereof. Each Water Contractor shall be responsible for installing and maintaining any device it deems necessary to reduce or regulate the pressure under which the water may be delivered hereunder.

3.10 Place of Use of Water Delivered to North Marin

(a) North Marin may exchange water delivered under this Agreement for an equal amount of water delivered to it by Marin Municipal.

(b) Except as provided in subdivision (a) of this section, North Marin shall not permit any water delivered under this Agreement to be used outside of its own distribution system service areas.

3.11 Measurement

All water delivered by the Agency from the Transmission System shall be measured by meters installed and maintained by the Agency. The Agency shall test the accuracy of each meter not less frequently than annually and provide each Water Contractor with a report of such test. Each Water Contractor shall have the right at any time and at its expense to make additional tests of any meter. If a meter is found to be reading 2 percent or more fast or slow, it shall immediately be repaired to bring it within 2 percent accuracy or be replaced by the Agency.

3.12 Marin Municipal Water Deliveries

The Agency, pursuant to the Third Amended Offpeak Water Supply Agreement dated January 25, 1996 and the Amended Agreement For The Sale Of Water Between The Sonoma County Water Agency and the Marin Municipal Water District dated January 25, 1996, amendments to these agreements that have been approved by the Water Advisory Committee, or subsequent agreements between the Agency and Marin Municipal that have been approved by the Water Advisory Committee, may deliver water to Marin Municipal when and to the extent that the Transmission System has capacity in excess of that required by Agency to supply its Regular Customers the Entitlements set forth in Sections 3.1 and 3.2. However, deliveries to Marin Municipal shall not be reduced or curtailed because of inadequate capacity in the new aqueduct to be constructed generally paralleling the portion of the Petaluma Aqueduct that extends from the Ely Pumping Plant to Kastania Reservoir, if such new aqueduct is paid for by Marin Municipal and dedicated to the Agency pursuant to Section 13 of the Amended Agreement for the Sale of Water between the Sonoma County Water Agency and the Marin Municipal Water District dated January 25, 1996.

The maximum delivery rate to Marin Municipal between May 1 and October 31 shall not exceed 12.8 mgd. The total quantity of water delivered to Marin Municipal in any Fiscal Year shall not exceed 14,300 Acre Feet. Deliveries of water to Marin Municipal shall be made either through a separately metered turnout or through North Marin's metered turnout(s). If water is delivered through North Marin's metered turnout(s), then North Marin shall maintain in good repair and calibration metered turnouts at points of delivery from its system into Marin Municipal's system and shall

read such meters on or about the end of each month and provide to Agency an accounting of water delivered during the preceding month to Marin Municipal. In making such accounting, North Marin shall deduct from the total of water delivered to Marin Municipal any exchange water as provided in Section 3.10 of this Agreement and any water produced by North Marin and delivered to Marin Municipal.

3.13 Damages for Peaking on the Transmission System or Taking Water in Excess of Average Daily Rate of Flow Entitlement Limits in Violation of Section 3.3

The parties to this Agreement recognize that the Agency will have increased costs, in amounts that will be difficult to determine, if any Regular Customer takes water in violation of subsection (b), (c) or (d) of Section 3.1 or subsection (a) of Section 3.3. Accordingly, if any Regular Customer takes delivery of water from the Transmission System in violation of subsection (b), (c) or (d) of Section 3.1 or subsection (a) of Section 3.3, then it shall pay the Agency, in addition to all other applicable charges, liquidated damages in an amount equal to twenty-five percent (25%) of the applicable Operation and Maintenance Charge (including all sub-charges) times the amount of water taken in violation of these provisions. The assessment of liquidated damages pursuant to this section for a violation by a Regular Customer of subsection (b), (c) or (d) of Section 3.1 or subsection (a) of Section 3.1 may be waived by the Agency upon a showing by the contractor that the taking of delivery of water in violation thereof resulted from an act of God or other unforeseeable circumstances over which the Regular Customer had no control. The existence of this liquidated-damage provision shall not limit or restrict the Agency from physically limiting the quantity of water taken to the amounts authorized by this Agreement or from pursuing all other available legal and equitable remedies applicable to such violations. The proceeds of any liquidated damages assessed pursuant to this subsection shall be deposited and paid out in the same manner as the proceeds of the Operation and Maintenance Charge.

PART 4 - CHARGES AND PAYMENTS

4.1 Separate Charges and Funds

(a) On or before April 30 preceding each Fiscal Year during which any of the following charges are payable, the Agency will establish the amount of the following charges for the ensuing Fiscal Year:

(1) the Operation and Maintenance Charge, including
  (a) the Water Management Planning Sub-Charge,
  (b) the Watershed Planning and Restoration Sub-Charge,
  (c) the Recycled Water and Local Supply Sub-Charge,
  (d) the Water Conservation Sub-Charge,
(2) the Aqueduct Facilities Capital Charges, including
  (a) the Santa Rosa Aqueduct Capital Sub-Charge,
  (b) the Sonoma Aqueduct Capital Sub-Charge,
  (c) the Petaluma Aqueduct Capital Sub-Charge,
(3) the Storage Facilities Capital Charge,
(4) the Common Facilities Capital Charge, and
(5) the North Marin Capital Charge.

In determining the amount of these charges, the Agency shall include a reasonable allowance for usual contingencies and errors in estimation, and to maintain a prudent reserve in an amount determined from time to time by the Water Advisory Committee.

(b) All monies received in payment of said charges shall be received, allocated, and paid out consistent with the obligations and covenants of the Agency with respect to Revenue Bonds.

(c) In establishing each of said charges, the Agency shall assume that the quantity of water (other than Surplus Water) to be delivered from each aqueduct of the Transmission System shall be the same as the amount of water delivered from said aqueduct during the twelve months preceding such establishment, or the average annual amount of water delivered during the preceding 36 months, whichever is less.

If because of drought or other water-supply reduction, state or federal order, or other similar condition, the Agency anticipates that any such quantities will not be predictive of future usage, the Agency may use a different amount with the prior approval of the Water Advisory Committee.

4.2 Operation and Maintenance Charge

(a) The Operation and Maintenance Charge shall be a uniform annual charge per acre foot and shall be paid by all Regular Customers for all water delivered from the Transmission System.

(b) The aggregate amount of money to be received by the Agency from the Operation and Maintenance Charge for each Fiscal Year shall be sufficient to produce water sale revenues to cover the Agency's estimate of its Operation and Maintenance Costs for such Fiscal Year, to produce water sale revenues as required by Sections 4.13, 4.14, 4.15, and 4.16, and to produce additional revenues in amounts determined from time to time by the Water Advisory Committee to pay the Capital Costs of Common Facilities and Storage Facilities pursuant to subdivision (c) of this section.

(c) All money received by the Agency in payment of the Operation and Maintenance Charge shall be deposited and paid out as set forth in Section 1.7, and subdivision (b) of Section 4.1. After making the payments required by Section 1.7, remaining money received from the Operation and Maintenance Charge may be used to pay the Agency's operation and maintenance expenses, to make the deposits required by Sections 4.13, 4.14(g), 4.15, and 4.16(a), and to fund a prudent reserve for those expenses. Money received from the Operation and Maintenance Charge in excess of that necessary for operation and maintenance expenses, to make the deposits required by Sections 4.13, 4.14(g), 4.15, and 4.16(a), and to maintain a prudent reserve may from time to time be disbursed as provided in Section 4.5 to pay Capital Costs of Common Facilities and Storage Facilities. If money received from the Operation and Maintenance Charge is appropriated for expenditure for Storage Facilities, the funds shall be transferred to the Storage Facilities capital fund referred to in subsection (c) of Section 4.7. At the time of the transfer, an amount shall also be transferred to North Marin's account established pursuant to subsection (c) of Section 4.4, which amount shall bear the same proportion to the amount transferred to the Storage Facilities capital fund that the total amount payable by North Marin for the Operation and Maintenance Charge, exclusive of sub-charges, in the prior Fiscal Year bears to the total operation and maintenance revenue, exclusive of revenue from sub-charges, received by the Agency from sources other than North Marin during the prior Fiscal Year.

4.3 Allocation of Capital Costs to North Marin

(a) The Capital Costs of Remaining Facilities shall be allocated to North Marin in proportion to the following ratios:

	Facility	Ratio
1.	Storage Facilities	-0-
2.	Common Facilities	11.2/90.4

(b) The portions of the Capital Costs of the Additional Facilities, replacement facilities, and the Potter Valley Project, or the portion thereof that is to be acquired pursuant to Section 2.4 hereof, shall be allocated to North Marin are as follows:

Facility	Ratio
1. 2nd pipeline, generally paralleling Intertie Aqueduct Reach 1	8.7/55.8
2. 2nd pipeline, generally paralleling Intertie Aqueduct Reach 2	8.7/55.8
3. 2nd pipeline, generally paralleling Intertie Aqueduct Reach 3a	8.7/55.8
4. 2nd pipeline, generally paralleling Intertie Aqueduct Reach 3b and 3c	8.7/42.4
5. 2nd pipeline, generally paralleling Petaluma Aqueduct from its junction with Intertie Aqueduct to Kastania Reservoir	5.1/38.8
6. 2nd pipeline, generally paralleling Sonoma Aqueduct	-0-
7. Storage Facilities	-0-
8. Russian River Water Production Facilities	8.7/55.8

9. All Common Facilities except Russian River Water Production Facilities, but including the Potter Valley Project 19.9/146.2

4.4 Remaining Facility, Additional Facility and Replacement Facility Capital Cost Payments by North Marin

The portion of the Capital Costs of the facilities allocated to North Marin pursuant to Section 4.3 shall be recovered by the Agency as follows:

(a) Each time the Agency decides to issue further series or issues of Revenue Bonds to finance the Capital Costs of constructing or acquiring any Remaining Facilities, Additional Facilities, or replacement facilities, or acquiring all or part of the Potter Valley Project, the Agency shall, prior to initiating the procedures for the issuance of such Revenue Bonds, notify North Marin of the Agency's estimate of the total cost of the Remaining Facilities, replacement facilities, Additional Facilities, or Potter Valley Project acquisition proposed to be financed by said series or issues of Revenue Bonds and of North Marin's portion of the cost allocated in accordance with Section 4.3. North Marin shall have the right, at its election, to pay North Marin's portion, or any part or parts thereof, of the cost of such Remaining Facilities, replacement facilities, Additional Facilities, or Potter Valley Project acquisition in cash, provided, however, that North Marin shall make its election on or before such date as the Agency shall specify, which date will give the Agency sufficient time to determine the amount of Revenue Bonds to be sold, but shall not be earlier than 30 days after said notification. If North Marin elects to make a cash payment, it shall do so on the date the Revenue Bonds are sold or on such later date as the Agency may agree upon and which will nevertheless enable the Agency to meet its obligations for said construction or acquisition. If North Marin elects to make a cash payment, the amount payable shall exclude interest during construction and financing charges.

(b) Upon completion of the construction or acquisition referred to in subdivision (a) of this section, any deficiency in the amount theretofore paid or credited and the actual amount of North Marin's portion thereof shall be paid by North Marin to the Agency.

(c) All payments made by North Marin pursuant to subdivisions (a) and (b) of this section shall be deposited in a separate account from which the Agency will make disbursements only to make payments that otherwise must be made by revenues received from the North Marin Capital Charge, or for the Agency's expenses in constructing the Remaining Facilities, Additional Facilities, and replacement facilities or

in acquiring all or part of the Potter Valley Project, up to the proportionate amounts allocated to North Marin utilizing the ratios contained in Section 4.3. The balance of the account shall earn interest at the Sonoma County Treasurer's pooled investment fund rate, which interest income shall be credited to the account on June 30 of each year. Any surplus funds in the account shall be paid to North Marin within 30 days of receipt of a written request therefor.

(d) If the Agency decides to levy one or more Aqueduct Capital Charges to produce revenue to fund, without issuing Revenue Bonds, (a) major replacements of portions or all of any aqueduct facility pursuant to Section 4.6(e) of this Agreement or (b) capital improvements to existing Aqueduct Facilities, then North Marin shall pay its portion of the Capital Costs of such replacements or improvements to the Agency in cash at the time such Capital Costs are incurred by the Agency. The Capital Costs of major replacements to the facilities specified in Subsection 4.3(b) shall be allocated to North Marin based upon the ratios set forth in Subsections 4.3(b). The Capital Costs of major replacements to the Intertie Aqueduct shall be allocated to North Marin based on the following cost distribution ratios:

Intertie Aqueduct Reach 1	11.2/70.4
Intertie Aqueduct Reach 2	11.2/68.9
Intertie Aqueduct Reach 3	11.2/58.9

4.5 Payment of Remaining Facilities, Additional Facilities, Replacement Facilities, and Potter Valley Project Capital Costs

(a) The Capital Costs of Remaining Facilities, Additional Facilities, replacement facilities and Potter Valley Project, except the portions thereof paid by North Marin pursuant to Section 4.4, shall be paid by the Agency with cash available pursuant to Sections 4.2, 4.6, 4.7 and 4.8, subdivision (b) of Section 4.11, and, if the Board of Directors of the Agency decides to issue Revenue Bonds, with the proceeds from the sale of Revenue Bonds. The Agency may sell Revenue Bonds to the extent necessary to pay for said Capital Costs, to establish bond reserves and to pay all expenses incurred in the issuance of such bonds.

(b) From time to time the Agency shall determine the percentage of the Revenue Bonds that are attributable to Aqueduct Facilities, Storage Facilities, Common Facilities, and North Marin's Capital Costs. In making these calculations, the Agency shall not include in the portions of the Revenue Bonds that are attributable to Aqueduct Facilities, Storage Facilities and Common Facilities, the portions of the Revenue Bonds, if any, that

are attributable to North Marin's Capital Costs. The Agency shall not include in these calculations any Capital Costs for which North Marin paid cash pursuant to Section 4.4, or the costs of any major replacement facilities financed by the imposition of Aqueduct Facilities Capital Charges without the issuance of Revenue Bonds pursuant to subdivision (e) of Section 4.6.

4.6 Aqueduct Facilities Capital Charges

(a) Aqueduct Facilities Capital Charges consist of the Santa Rosa Aqueduct Capital Sub-Charge, the Sonoma Aqueduct Capital Sub-Charge, and the Petaluma Aqueduct Capital Sub-Charge. The Aqueduct Facilities Capital Charges shall be annual charges per acre foot set for each aqueduct as provided in subdivision (b) of this section and shall be paid by all Regular Customers of the Agency except North Marin for all water delivered from the Transmission System except Surplus Water. All water delivered to Santa Rosa and Windsor shall be deemed to be delivered from the Santa Rosa Aqueduct, all water delivered to Rohnert Park, Cotati, and Petaluma shall be deemed to be delivered from the Petaluma Aqueduct, and all water delivered to Sonoma and Valley of the Moon shall be deemed to be delivered from the Sonoma Aqueduct.

(b) The aggregate amount to be received by the Agency from the various Aqueduct Facilities Capital Charges for each Fiscal Year shall be sufficient to produce water sale revenues to pay the Agency's Revenue Bond Obligations (after crediting any projected payments to be made pursuant to subdivision (e) of Section 4.6) for such Fiscal Year times the percentage for Aqueduct Facilities determined pursuant to subdivision (b) of Section 4.5, and to produce additional revenues in amounts determined from time to time by the Water Advisory Committee to pay the Capital Costs of Aqueduct Facilities pursuant to subdivision (c) of this section. The aggregate amount shall be allocated to the respective aqueducts based on the following cost distribution ratios applied to the estimated, or when known, actual Capital Costs for the various Aqueduct Facilities:

Facility	Ratio
2nd pipeline, generally paralleling Intertie Aqueduct, Reach 1, Reach 2 and Reach 3a	
Santa Rosa Aqueduct	6.6/55.8
Petaluma Aqueduct	20.9/55.8
Sonoma Aqueduct	6.8/55.8

2nd pipeline, generally paralleling Intertie Aqueduct, Reach 3b and 3c

Santa Rosa Aqueduct	-0-
Petaluma Aqueduct	20.9/42.4
Sonoma Aqueduct	-0-

2nd pipeline, generally paralleling Petaluma Aqueduct from its junction with the Intertie Aqueduct to Kastania Reservoir

Santa Rosa Aqueduct	-0-
Petaluma Aqueduct	20.9/38.8
Sonoma Aqueduct	-0-

2nd pipeline, generally paralleling Sonoma Aqueduct

Santa Rosa Aqueduct	-0-
Petaluma Aqueduct	-0-
Sonoma Aqueduct	6.8/6.8

(These ratios are determined with the allocations in Sections 4.3 and 4.4 of Capital Costs to North Marin, and with the following allocations to Common Facilities:

2nd pipeline generally paralleling Reaches 1, 2 and 3a of the Intertie Aqueduct: 12.8/55.8

2nd pipeline generally paralleling Reach 3b and 3c of the Intertie Aqueduct: 12.8/42.4

2nd pipeline generally paralleling the Petaluma Aqueduct from its junction with the Intertie Aqueduct to Kastania Reservoir: 12.8/38.8)

(c) All money received by the Agency in payment of Aqueduct Facilities Capital Charges shall be deposited and paid out as set forth in Section 1.7 and subdivision (b) of Section 4.1. After making the payments required to satisfy the Agency obligations and covenants with respect to the Revenue Bonds used to finance the Capital Cost of the Aqueduct Facilities, remaining money received from the Aqueduct Facilities Capital

Charges may be disbursed from time to time to pay pursuant to subdivision (a) of Section 4.5 the portions of the Capital Costs of the Remaining Facilities and Additional Facilities which are also Aqueduct Facilities that are not allocated to North Marin in Section 4.3.

(d) If at the end of any Fiscal Year the balance in the Aqueduct Facilities Capital Charge fund is insufficient to meet said Revenue Bond Obligations for the ensuing Fiscal Year attributed to the Aqueduct Facilities, Agency will determine the deficits in the payment received by it for deliveries from the Santa Rosa, Petaluma, and Sonoma Aqueducts respectively. Before August 1 of the following Fiscal Year:

(1) Additional charges for water delivered in amounts equal to the deficits with respect to the Santa Rosa Aqueduct shall be paid by Santa Rosa and Windsor in the following manner: The share of such additional charge to be paid by each of said Water Contractors shall be proportionate to the difference between the base share component and the sum of the Aqueduct Facilities Capital Charge payments made by said Water Contractor during said Fiscal Year. The base share component allocated to a Water Contractor is the number obtained by multiplying the said total principal and interest payment for said Fiscal Year by said Water Contractor's average daily rate of flow during any month Entitlement Limit set forth in subdivision (a) of Section 3.1 and by dividing by the total of said average daily rate of flow during any month Entitlement Limits for all Water Contractors being served from the Santa Rosa Aqueduct.

(2) Additional charges for water delivered in an amount equal to the deficit with respect to the Sonoma Aqueduct shall be paid by Sonoma and Valley of the Moon in the following manner: The share of such additional charge to be paid by each of said Water Contractors shall be proportionate to the difference between the base share component and the sum of the Aqueduct Facilities Capital Charge payments made by said Water Contractor during said Fiscal Year. The base share component allocated to a Water Contractor is the number obtained by multiplying the said total principal and interest payment for said Fiscal Year by said Water Contractor's average daily rate of flow during any month Entitlement Limit set forth in subdivision (a) of Section 3.1 and by dividing by the total of said average daily rate of flow during any month Entitlement Limits for all Water Contractors being served from the Sonoma Aqueduct.

(3) Additional charges for water delivered in an amount equal to the deficit with respect to the Petaluma Aqueduct shall be paid by Rohnert Park, Cotati and Petaluma in the following manner excluding North Marin and Marin Municipal: The share of such additional charge to be paid by each of said Water Contractors shall be

proportionate to the difference between the base share component and the sum of the Aqueduct Facilities Capital Charge payments made by said Water Contractor during said Fiscal Year. The base share component allocated to a Water Contractor is the number obtained by multiplying said total principal and interest payment for said Fiscal Year by said Water Contractor's average daily rate of flow during any month Entitlement Limit set forth in subdivision (a) of Section 3.1 and by dividing by the total of all said average daily rate of flow during any month Entitlement Limits for all Water Contractors being served from the Petaluma Aqueduct.

(e) If the Agency decides to issue a new series or issue of Revenue Bonds to finance major replacements of portions or all of any aqueduct facility or if, with the approval of the Water Advisory Committee, the Agency decides to levy one or more Aqueduct Facilities Capital Charges to produce revenue to finance major replacements of portions or all of any aqueduct facility, then the aggregate amount to be received by the Agency from the respective Aqueduct Facilities Capital Charges for each Fiscal Year shall be sufficient to produce water sales revenues, in addition to those required by subdivision (b) of this section, in amounts determined from time to time by the Water Advisory Committee to pay the Capital Costs of such major replacements. The Capital Costs of major replacements to the facilities specified in Subsection 4.6(b) above shall be allocated based upon the ratios set forth in Subsection 4.6(b). The Capital Costs of major replacements to the Intertie Aqueduct shall be allocated to the respective aqueducts based on the following cost distribution ratios:

Intertie Aqueduct Reach 1:

Santa Rosa Aqueduct	31.5/70.4
Petaluma Aqueduct	19.7/70.4
Sonoma Aqueduct	8.0/70.4

Intertie Aqueduct Reach 2:

Santa Rosa Aqueduct	30.0/68.9
Petaluma Aqueduct	19.7/68.9
Sonoma Aqueduct	8.0/68.9

Intertie Aqueduct Reach 3:

Santa Rosa Aqueduct	20.0/58.9
Petaluma Aqueduct	19.7/58.9
Sonoma Aqueduct	8.0/58.9

4.7 Storage Facilities Capital Charge

(a) The Storage Facilities Capital Charge shall be a uniform annual charge per acre foot and shall be paid by all Regular Customers of the Agency for all water delivered from the Transmission System except Surplus Water, provided however, that North Marin shall not be obligated to pay any Storage Facilities Capital Charge if North Marin maintains potable storage reservoirs within its system with a total capacity equal to or greater than one and one-half times the average daily volume of water delivered by the Agency to North Marin during the previous July with the highest water delivery to North Marin.

(b) The aggregate amount to be received by the Agency from the Storage Facilities Capital Charge for each Fiscal Year shall be sufficient to produce water sale revenues to pay the Agency's Revenue Bond Obligations for such Fiscal Year (after crediting any projected payments to be made pursuant to subdivision (e) of Section 4.6) times the percentage for Storage Facilities determined pursuant to subdivision (b) of Section 4.5, and to produce additional revenues in amounts determined from time to time by the Water Advisory Committee to pay the Capital Costs of Storage Facilities pursuant to subdivision (c) of this section.

(c) All money received by the Agency in payment of the Storage Facilities Capital Charge shall be deposited and paid out as set forth in Section 1.7, and subdivision (b) of Section 4.1. After making the payments from the Storage Facilities capital fund required by Section 1.7, remaining money in said fund may be disbursed from time to time to pay Capital Costs of Remaining Facilities, Additional Facilities and replacement facilities that also are Storage Facilities, pursuant to Section 4.5.

(d) If at the end of any Fiscal Year the balance in the Storage Facilities capital fund is insufficient to meet said Revenue Bond Obligations for such Fiscal Year attributed to the Storage Facilities, each Water Contractor except North Marin will, before August 1, pay to the Agency an additional charge per acre foot for all water delivered to it during the Fiscal Year which additional charge when multiplied by all Acre Feet sold to Regular Customers except North Marin shall be equal to said deficit.

4.8 Common Facilities Capital Charge

(a) The Common Facilities Capital Charge shall be a uniform annual charge per acre foot and shall be paid by all Regular Customers of the Agency except North Marin for all water delivered from the Transmission System except Surplus Water.

(b) The aggregate amount to be received by the Agency from the Common Facilities Capital Charge for each Fiscal Year shall be sufficient to produce water sale revenues to pay the Agency's Revenue Bond Obligations for such Fiscal Year (after crediting any projected payments to be made pursuant to subdivision (e) of Section 4.6) times the percentage for Common Facilities determined pursuant to subdivision (b) of Section 4.5.

(c) All money received by the Agency in payment of the Common Facilities Capital Charge shall be deposited and paid out as set forth in Section 1.7 and subdivision (b) of Section 4.1. After making the payments required by Section 1.7, additional money received from the Common Facilities Capital Charge may be disbursed from time to time pursuant to subdivision (a) of Section 4.5 to pay the portions of the Capital Costs of Remaining Facilities, Additional Facilities, replacement facilities and the Potter Valley Project that also are Common Facilities and that are not allocated to North Marin in Section 4.3, and to satisfy the requirements of Section 6.04 of Ordinance No. 1 if the amount of money received from the charge established by Section 4.2 is insufficient in any Fiscal Year.

(d) If at the end of any Fiscal Year the balance in the Common Facilities capital fund is insufficient to meet the Agency's Revenue Bond Obligations for such Fiscal Year on the Revenue Bonds attributed to Common Facilities, each Water Contractor except North Marin shall, before August 1, pay to the Agency an additional charge per acre foot for water delivered to it during the Fiscal Year, which additional charge when multiplied by all Acre Feet sold to the Water Contractors shall be equal to said deficit.

4.9 North Marin Capital Charge

(a) The North Marin Capital Charge shall be a uniform annual charge per acre foot and shall be paid by North Marin for all water delivered to it from the Transmission System except Surplus Water.

(b) The aggregate amount to be received by the Agency from the North Marin Capital Charge for each Fiscal Year shall be sufficient to produce water sale revenues to pay the Agency's Revenue Bond Obligations for such Fiscal Year (after crediting any projected

payments to be made pursuant to subdivision (e) of Section 4.6) times the percentage for North Marin's Capital Costs determined pursuant to subdivision (b) of Section 4.5.

(c) All money received by the Agency in payment of North Marin Capital Charge shall be deposited and paid out as set forth in Section 1.7 and subdivision (b) of Section 4.1. After making any payments required by Section 1.7, additional money received from the North Marin Capital Charge shall be deposited in the separate account described in subdivision (c) of Section 4.4.

(d) If at the end of any Fiscal Year the balance in the separate fund described in subdivision (c) of Section 4.4 is insufficient to meet the portion of the Agency's Revenue Bond Obligations for such Fiscal Year on the Revenue Bonds attributed to North Marin's Capital Costs, North Marin will, before August 1, pay to the Agency an additional charge per acre foot for water delivered to it during the Fiscal Year, which additional charge when multiplied by all Acre Feet sold to North Marin shall be equal to said deficit.

(e) If any money received pursuant to the Common Facilities Capital Charge is used pursuant to subdivision (c) of Section 4.8 to satisfy the requirements of Section 6.04 of Ordinance No. 1, then the North Marin Capital Charge shall be increased by the appropriate amount so that North Marin pays its appropriate share of such requirements.

(f) If North Marin has not maintained storage reservoirs within its system with at least the capacity required by subdivision (a) of Section 4.7, and if, as a result, the Agency constructs additional storage, then the North Marin Capital Charge shall be increased by an amount sufficient to pay for the Capital Costs or Revenue Bonds costs of such additional storage.

4.10 Power; Revenues

All power from the Warm Springs Hydroelectric Project and the Potter Valley Project shall be applied to the operation of the Transmission System or shall be sold, as the Agency shall from time to time determine. All revenues arising from the operation of these projects shall be treated the same as money received from the Operation and Maintenance Charge and shall be deposited and paid out as set forth in Section 1.7 and subdivision (b) of Section 4.1.

4.11 Payment for Surplus Water and Water Sold To Marin Municipal

(a) The Agency will sell Surplus Water at a price per acre foot of not less than 120% of the then current Operation and Maintenance Charge. All revenue from the sale of Surplus Water shall be treated the same as money received from the Operation and Maintenance Charge and shall be deposited and paid out as set forth in Section 1.7 and subdivision (b) of Section 4.1.

(b) Water delivered to Marin Municipal shall be sold at a per acre foot price that shall not be less than the sum of the Operation and Maintenance Charge determined pursuant to Section 4.2, the Russian River Conservation and Russian River Projects Charges determined pursuant to Section 4.18, and a capital charge. For the Third Amended Offpeak Water Supply Agreement dated January 25, 1996, or any amendment to that agreement that has been approved by the Water Advisory Committee, the capital charge shall be the total of all charges paid to Agency by Marin Municipal minus the sum of the Operation and Maintenance Charge and the Russian River Conservation and Russian River Projects Charges. For the Amended Agreement For The Sale of Water Between the Sonoma County Water Agency and Marin Municipal Water District dated January 25, 1996, or any amendment to that agreement that has been approved by the Water Advisory Committee, the capital charge shall be the charge established by paragraph b. of Section 10 of that agreement. Any subsequent agreement between the Agency and Marin Municipal for the sale of water to be transported through the Transmission System pursuant to Section 3.12 shall specify the capital charge that applies to this section of this Agreement. All money received by the Agency from the Operation and Maintenance Charge on water sold to Marin Municipal shall be credited to the operation and maintenance fund. All money received by the Agency from the Russian River Conservation and Russian River Projects Charges on water sold to Marin Municipal shall be credited to the Russian River Projects Fund and shall be used only for the purposes set forth in subsection (jj) of Section 1.2. The balance of the money received by the Agency from water sold to Marin Municipal shall be deposited and paid out as set forth in Section 1.7, and subdivision (b) of Section 4.1. After making the payments required by Section 1.7 and Ordinance No. 1, additional money received may be disbursed from time to time to pay the Capital Costs of Storage Facilities or Common Facilities authorized to be constructed in Section 2.2, provided, however, that only the money received from $31.50 per acre foot of the capital charge (which rate is based on the Agency's past and projected future capital investment in Storage Facilities) may be used to pay the Capital Costs of new Storage Facilities.

4.12 Minimum Payments by Other Agency Customers

Anything herein to the contrary notwithstanding, the Agency will not sell any water to be delivered through the Transmission System (other than Surplus Water) to any Other Agency Customer at a total price per acre foot that is less than 120% of the highest price per acre foot then currently being paid by any Water Contractor; provided, however, that this limitation shall not apply to water sold to Forestville. The respective components of said price shall be credited to the appropriate fund referred to in subdivision (a) of Section 4.1 and the excess shall be credited to the aqueduct capital fund for the aqueduct from which service is taken. Forestville's charge shall be the same as the total charge for Water Contractors for water delivered from the Santa Rosa Aqueduct, except that during the first ten (10) full Fiscal Years following execution of this Agreement, Forestville shall not pay the Santa Rosa Aqueduct Capital Sub-Charge.

4.13 Operations and Maintenance Charge – Water Management Planning

The Agency shall calculate and collect as a part of the Operations and Maintenance Charge a Water Management Planning Sub-Charge. The aggregate amount of money to be received by the Agency from the Water Management Planning Sub-Charge in each Fiscal Year shall be sufficient to produce water sale revenues to cover the Agency's reasonable estimate of its costs for such Fiscal Year to carry out the provisions of Section 2.7. All money received by the Agency in payment of the Water Management Planning Sub-Charge shall be deposited by the Agency into a Water Management Planning Fund and used to pay the Agency's costs in carrying out the provisions of Section 2.7.

4.14 Operations and Maintenance Charge – Watershed Planning and Restoration

(a) The Agency shall calculate and collect as a part of the Operations and Maintenance Charge a Watershed Planning and Restoration Sub-Charge.

(b) The aggregate amount of money to be received by the Agency from the Watershed Planning and Restoration Sub-Charge in each Fiscal Year shall be sufficient to produce water sale revenues to cover the Agency's reasonable estimate of costs for such Fiscal Year (net of funding provided by other sources, including the Russian River Projects Fund and the Agency's General Fund) of carrying out: (1) fishery mitigation, enhancement, and environmental compliance activities and projects undertaken by the Agency, including the Agency's costs of complying with the Endangered Species Act or any other applicable federal, state, or local environmental statute or regulation, if such

activities, projects, and costs are reasonably necessary, to enable the Agency to provide water to Regular Customers under this Agreement; (2) the evaluations undertaken pursuant to Section 2.4(b); and (3) actions, studies or projects authorized pursuant to Section 2.8 of this Agreement that are not covered by other funding sources and contributions. The Agency shall not use proceeds from the Watershed Planning and Restoration Sub-Charge to pay for the capital cost or operation and maintenance cost of recreation facilities.

(c) Notwithstanding Subsection 4.14(b) above, during the first five full Fiscal Years following the effective date of this Agreement, the Watershed Planning and Restoration Sub-Charge shall not exceed $35.00 per acre-foot.

(d) To assist in determining the appropriate share of fishery mitigation, enhancement, and environmental compliance activities and projects undertaken by the Agency to be paid by the Water Contractors under the Watershed Planning and Restoration Sub-Charge, the Agency shall, from time to time as reasonably necessary, prepare an analysis that (1) identifies planned fishery mitigation, enhancement, and environmental compliance activities and projects, (2) identifies the costs and beneficiaries of such activities and projects, (3) proposes an allocation of costs among all benefitted parties, and (4) recommends sources of funding for such activities and projects.

(e) The Agency shall use its best efforts to amend its existing contracts with Russian River Customers to require Russian River Customers to pay the Watershed Planning and Restoration Sub-Charge or fund or implement watershed planning and restoration projects at a level equivalent to that funded by the Agency under this Agreement.

(f) In addition to the Watershed Planning and Restoration Sub-Charge, the Agency may assess against the Water Contractors such supplemental charges as are authorized and agreed to under Section 2.8(c). Supplemental charges under this subsection shall not be included in determining the minimum payments by Other Agency Customers pursuant to Section 4.12 or by Windsor pursuant to Section 4.17.

(g) All money received by the Agency in payment of the Watershed Planning and Restoration Sub-Charge shall be deposited by the Agency into a Watershed Planning and Restoration Fund and used for the purposes set forth in Section 4.14(b). All money received by the Agency in payment of any supplemental charges pursuant to Section 4.14(d) shall be deposited into separate account(s) and used to pay the costs of projects authorized and agreed to pursuant to Section 2.8(c).

4.15 Operations and Maintenance Charge – Recycled Water and Local Supply

The Agency shall calculate and collect as a part of the Operations and Maintenance Charge a Recycled Water and Local Supply Sub-Charge. The Recycled Water and Local Supply Sub-Charge shall be a uniform charge per acre-foot and shall be paid by all Regular Customers and Russian River Customers for all water taken from the Transmission System or under the Agency's water rights. The aggregate amount of money to be received by the Agency from the Recycled Water and Local Supply Sub-Charge in each Fiscal Year shall be sufficient to produce water sale revenues to cover the Agency's estimate of its costs for such Fiscal Year to carry out the provisions of Section 2.6; provided, however, that during the first five full Fiscal Years following the effective date of this Agreement, the Recycled Water and Local Supply Sub-Charge shall not exceed $35.00 per acre-foot. The Agency shall use its best efforts to amend its existing contracts with Russian River Customers to require Russian River Customers to pay the Recycled Water and Local Supply Sub-Charge. Monies collected from the Recycled Water and Local Supply Sub-Charge shall be deposited in a Recycled Water and Local Supply Fund created by the Agency. The Recycled Water and Local Supply Fund shall be used only to pay or partially pay for the costs of Recycled Water Projects or the acquisition of Recycled Water or the rights thereto pursuant to Section 2.6 of this Agreement. Notwithstanding the foregoing sentence, revenue from the Recycled Water and Local Supply Sub-Charge collected by the Agency from Windsor pursuant to Section 4.17(b) shall be placed in a separate account and made available to Windsor for funding Windsor's local or regional Recycled Water Projects.

4.16 Operations and Maintenance Charge – Water Conservation

(a) The Agency shall calculate and collect as a part of the Operations and Maintenance Charge a Water Conservation Sub-Charge. Monies collected from the Water Conservation Sub-Charge shall be deposited in a Water Conservation Fund created by the Agency. The Water Conservation Fund shall be used only to pay or partially pay for the cost of Water Conservation Projects. The aggregate amount of money to be received by the Agency from the Water Conservation Sub-Charge for each Fiscal Year shall be sufficient to cover the Agency's estimate of the total cost of all Water Conservation Projects for such Fiscal Year. From and after July 1, 1998, a total of fifteen million dollars ($15,000,000) shall be expended to implement Water Conservation Projects pursuant to the Water Conservation Plan dated June 29, 1998. The $15,000,000 shall be allocated as follows: Cotati 2.10%, Petaluma 18.53%, Rohnert Park 10.37%, Santa Rosa 40.25%, Sonoma 4.15%, Forestville 0.66%, North Marin 19.50%, Valley of the Moon 4.43%. Until the total of $15,000,000 has been expended as set forth above, the

Agency shall not fund Water Conservation Projects for or on behalf of Windsor. The Water Conservation Projects for which said $15,000,000 is to be expended, have been approved by the Water Advisory Committee.

(b) The Agency shall use its best efforts to amend its existing contracts with Russian River Customers to require Russian River Customers to fund or implement Water Conservation Projects at a level equivalent to that funded by the Agency under this Agreement. Notwithstanding the penultimate sentence in Section 4.16(a), revenue from the Water Conservation Sub-Charge collected by the Agency from Windsor pursuant to Section 4.17(b) shall be placed in a separate account and made available to Windsor for funding Windsor's Water Conservation Projects.

4.17 Payments by Town of Windsor

(a) Notwithstanding anything in this Agreement to the contrary, for the first fifteen (15) full Fiscal Years following execution of this Agreement, the amount payable by Windsor for water delivered by the Agency through the Transmission System shall be 120% of the highest price per acre foot then currently being paid by any Water Contractor receiving water from the Santa Rosa Aqueduct. The respective components of said price shall be credited to the appropriate fund referred to in subdivision (a) of Section 4.1 and the excess shall be credited to the aqueduct capital fund for the aqueduct from which service is taken. Beginning with the sixteenth (16th) full Fiscal Year following execution of this Agreement and thereafter, all water delivered to Windsor by Agency through the Transmission System will be deemed delivered from the Santa Rosa Aqueduct and the amount payable by Windsor for said water determined accordingly.

(b) For all water diverted directly by Windsor from the Russian River using its own facilities, whether under the Agency's water rights or Windsor's water rights, Windsor shall pay only the charges set forth in the Agreement for Sale of Water between the Agency and Windsor dated January 8, 1991, as amended, including the sub-charges set forth in Sections 4.13, 4.14, 4.15, and 4.16.

4.18 Payment of Russian River Conservation Charge and Russian River Projects Charge by North Marin

In addition to the other charges provided for in this Part, North Marin shall pay the following additional per-acre-foot charges:

(a) A Russian River Conservation Charge shall be paid in lieu of the property taxes levied by the Agency on property in Sonoma County, to pay the capital, Operation and Maintenance Costs associated with the Warm Springs Dam Project. The Russian River Conservation Charge shall be a charge per acre foot of water delivered to North Marin hereunder, except Surplus Water. The charge shall be determined annually on or before April 30 preceding each Fiscal Year and shall be payable by North Marin during the ensuing Fiscal Year. The Russian River Conservation Charge shall be determined by multiplying the tax rate levied by the Agency in the then current Fiscal Year to pay the costs associated with the Warm Springs Dam Project times the assessed value of secured and unsecured property situated within Cotati, Petaluma, Rohnert Park, Santa Rosa, Sonoma, Forestville and Valley of the Moon and dividing the product by the total number of Acre Feet of water delivered to Cotati, Petaluma, Rohnert Park, Santa Rosa, Sonoma, Forestville and Valley of the Moon pursuant to Section 3.1 and 3.3 during the twelve month period ending on March 31. All money received by the Agency from the Russian River Conservation Charge on water sold to North Marin shall be credited to the Russian River Projects Fund and shall be used only for the purposes set forth in subsection (jj) of Section 1.2.

(b) A Russian River Projects Charge shall be paid in lieu of the property taxes levied on property in Sonoma County and other Agency general fund monies which are transferred to the Agency's Russian River Projects Fund and expended for the purposes enumerated in subsection (jj) of Section 1.2. The Russian River Projects Charge shall be effective on the first day of the first month following the effective date of this Agreement and shall thereafter be determined annually on or before April 30 preceding each Fiscal Year and shall be payable by North Marin during the ensuing Fiscal Year. The Russian River Projects Charge shall be determined by dividing the total amount of Agency monies expended from the Agency's Russian River Projects Fund in the preceding ten Fiscal Years, exclusive of the funds contributed to the Fund by North Marin and Marin Municipal Water District, and interest earnings attributable to funds contributed by North Marin and Marin Municipal Water District, by the sum of the total acre-feet of water delivered by the Agency to Cotati, Petaluma, Rohnert Park, Santa Rosa, Sonoma, Forestville and Valley of the Moon pursuant to Sections 3.1 and 3.3 of this Agreement during the preceding ten Fiscal Years and multiplying the quotient by the ratio that the assessed value of secured and unsecured property situated within Cotati, Petaluma, Rohnert Park, Santa Rosa, Sonoma, Forestville and Valley of the Moon bears to the assessed value of all secured and unsecured property within Sonoma County, provided, however, in no event shall the Russian River Projects Charge exceed $20.00 per acre-foot. The Agency shall keep proper books, records and accounts in which complete and accurate entries shall be made of all Agency general fund monies

transferred to the Agency's Russian River Projects Fund and all expenditures made from the fund for the purposes set forth in subsection (jj) of Section 1.2. The Agency shall maintain a separate account within the Russian River Projects Fund for Russian River Projects Charges paid by North Marin and Marin Municipal Water District. Monies expended from the Russian River Projects Fund shall be deemed to have been expended from the North Marin and Marin Municipal Water District account in the proportion that the balance of that account bears to the total Russian River Projects Fund balance at the end of the Fiscal Year quarter preceding the expenditure. All money received by the Agency from the Russian River Projects Charge on water sold to North Marin shall be credited to the Russian River Projects Fund and shall be used only for the purposes set forth in subsection (jj) of Section 1.2.

4.19 Billing and Time of Payment

Except as otherwise expressly provided herein, all charges payable to the Agency shall be billed each month and paid within 30 days after receipt of bill. Notwithstanding any dispute between the Agency and a Water Contractor, such Water Contractor will pay all its bills when due and shall not withhold all or any part of any payment pending the final resolution of such dispute. If the resolution of the dispute results in a refund to the Water Contractor, the Agency shall make such refund plus any interest earned by investment of the disputed funds as promptly as it is able to do so, consistent with its meeting its Revenue Bond Obligations.

PART 5 - Water Advisory Committee/Technical Advisory Committee

5.1 Purpose

(a) There is hereby created the Water Advisory Committee and the Technical Advisory Committee.

(b) The purpose of the Water Advisory Committee is to perform the functions specified herein and to review all proposals set forth by the Agency which involve a significant capital outlay for the Transmission System or any other project which would significantly change the level of service or add significantly to the operations and maintenance expense of the Transmission System or other expense to be borne by the Water Contractors. The purpose of the Technical Advisory Committee is to advise the Water Advisory Committee.

5.2 Powers

Except as provided herein to the contrary, the power of the Water Advisory Committee is limited to that of collective spokesperson for the Water Contractors and shall be advisory only in nature. Nothing shall preclude a Water Contractor from setting forth a view contrary to that of the majority of the Committee. No action of the Committee limits or impairs any right or power of any Water Contractor. The Technical Advisory Committee shall have no powers other than the power to make recommendations to the Water Advisory Committee.

5.3 Composition and Voting

(a) The Water Advisory Committee shall be composed of one representative and one alternate who shall serve in absence of the representative, to be selected by each Water Contractor. The representative and alternate shall be elected members of and appointed by the governing board of the Water Contractor. The Water Advisory Committee shall generally meet quarterly as it determines necessary, which shall include at least one meeting per calendar year with a liaison from the Board of Directors of the Agency who is a member of and appointed by said Board. Each Water Contractor's representative will be allocated a weighted vote proportional to the average daily rate of flow during any month Entitlement Limit from the Transmission System applicable to such Water Contractor. An affirmative vote of said Committee shall be recorded and require both of the following: (1) the affirmative vote of more than fifty percent (50%) of the total weighted votes as defined above; and (2) the

affirmative vote of at least five (5) representatives. If the Water Advisory Committee does not affirmatively vote to approve any matter before it for a decision, then the matter shall be deemed not approved. A representative or alternate appointed by the Board of Directors of the Marin Municipal Water District, each of which must be members of said board, may attend and participate, debate, express opinions and present information at meetings of the Water Advisory Committee but shall not have a vote. If the approval, determination, or consent of the Water Advisory Committee is authorized or required on any non-advisory matter pursuant to this Agreement, the vote of the Water Advisory Committee on such matter shall be evidenced by a writing, executed by the chairperson or secretary, evidencing (a) the vote of each member, (b) whether the vote of the Committee was in the affirmative, and (c) if the vote was in the affirmative, a description of the approval, determination, or consent given by the Committee.

(b) The Technical Advisory Committee shall be composed of one non-elected representative selected by each Water Contractor. The Technical Advisory Committee shall generally meet monthly as it determines necessary. Each Water Contractor's representative will be allocated the same weighted vote applicable to that Water Contractor under Section 5.3(a). An affirmative vote of said Committee shall require both of the following: (1) the affirmative vote of more than fifty percent (50%) of the total weighted votes as defined above; and (2) the affirmative vote of at least five (5) representatives. A representative or alternate appointed by the Marin Municipal Water District Board of Directors may attend and participate, debate, express opinions and present information at meetings of the Water Advisory Committee but shall not have a vote. The Water Advisory Committee may require the Technical Advisory Committee to create subcommittees and ad hoc committees. Persons serving on such committees shall be elected officials, staff or contract staff of the Water Contractor they represent.

(c) The Technical Advisory Committee shall create a standing Water Conservation Subcommittee. The Water Conservation Subcommittee shall make recommendations to the Technical Advisory Committee with respect to any determination of the Water Advisory Committee contemplated under Section 1.12 of this Agreement, and shall perform other such duties with respect to Water Conservation Projects as may be requested by the Technical Advisory Committee.

(d) Once every two years, on a date selected by the Water Advisory Committee, the Water Advisory Committee shall elect from among its members two officers: a chairperson and vice chairperson. Officers shall serve for the ensuing two Fiscal Years. An officer may serve a second or subsequent consecutive two-year terms only if each

such term is approved by a unanimous vote of the Water Contractors. Furthermore, an officer can be removed and replaced at any meeting called by five Water Advisory Committee members provided all Water Advisory Committee members are notified in writing a minimum of five working days prior to the meeting. In the event an officer either: (1) loses his/her status as a duly elected local official serving on the governing board of the Water Contractor they represent or (2) loses his/her appointment as representative of the Water Contractor on the Water Advisory Committee, the officer position held shall be vacated. The Water Advisory Committee shall elect a new officer who shall fill out the balance of the vacated term. Voting for officers shall be as provided in subsection (a) of this section.

(e) By November of each year, subject to the limitations in Section 4.16(a), the Water Advisory Committee shall review proposed Water Conservation Projects, Recycled Water Projects, and Local Supply Projects and approve and report to the Agency those projects that are to receive funding in the next or later fiscal years. It is the intent of the parties to this Agreement that over the term of the Agreement, Regular Customers shall receive funding support for Water Conservation Projects, Recycled Water Projects, and Local Supply Projects in proportion to the amounts paid by Regular Customers under Sections 4.15 and 4.16.

(f) Commencing with the first Fiscal Year following the effective date of this Agreement, the Agency shall include in its operating budget the amount of $30,000 which the Agency shall expend as the Water Advisory Committee directs for purposes associated with the orderly implementation and operation of the provisions of this Agreement and other associated purposes deemed appropriate by the Committee. The annual amount may be fixed at a higher or lower amount in subsequent Fiscal Years as determined by vote of the Committee pursuant to subsection (a) of this section. The Water Advisory Committee shall decide which, if any, consultant or consultants, firm or firms shall be hired to carry out this work.

IN WITNESS WHEREOF, the parties have executed this Agreement on the date first above written.

SONOMA COUNTY WATER AGENCY

By: Paul L. Kelley Date: 6/23/06

ATTEST:

Eve T. Lewis

CITY OF COTATI

By: Janet Orchard Date: 5.9.06
Mayor

ATTEST:

Lauri L. Hubbard Date: 5-10-06
City Clerk

CITY OF PETALUMA

By: David Glass Date: 5-15-06
Mayor

ATTEST:

Katie Crump
Deputy City Clerk

CITY OF ROHNERT PARK

By: _____ Date: 06-05-06
Tim Smith Mayor

ATTEST:

Judy Hauff
City Clerk

CITY OF SANTA ROSA

By: Jane Bender
Mayor

Date: 5/31/06

ATTEST:

Bertha Anderson
Deputy City Clerk

CITY OF SONOMA

By: [illegible]
Mayor

Date: 4-19-06

ATTEST:

Gay Rainsbarger
City Clerk

FORESTVILLE COUNTY WATER DISTRICT

Date: 5/12/06

By: [illegible]
President

ATTEST:

Secretary

NORTH MARIN WATER DISTRICT

Date: 5/22/06

By: _____
President

ATTEST:

_____ Acting Secretary

TOWN OF WINDSOR

Date: 5-17-06

_____
Mayor

ATTEST:

_____
Deputy Town Clerk

VALLEY OF THE MOON WATER DISTRICT

Date: 5-25-06

By: _____
President

ATTEST:

_____
Deputy Secretary

Attachment C

List of Public Water Systems within the Russian River Watershed

	System Number	System Name
1	2300507	River Estates Mutual Water Company
2	2300605	Lake View Mutual Water Co.
3	2300606	Ridgewood Water System
4	2300708	City of 10,000 Buddhas
5	2300731	Potter Valley School District
6	2300755	Yokayo Water System
7	2300837	Retech Water
8	2300838	Mariposa Institute
9	2300840	Fetzer Vineyards
10	2300852	U.S. Army Corps-Lake Mendo (Bushay Site)
11	2300853	U.S. Army Corps-Lake Mendo (Kyen Cmpgrd)
12	2300854	U.S. Army Corps-Lake Mendo(Marina Site)
13	2300855	U.S. Army Corps-Lake Mendo(Pomo Site)
14	2300856	Black Oak Facility
15	2300858	Rogina Water Company Inc.
16	2310002	Ukiah, City of
17	2310003	Willow County Water District
18	2310005	Millview County Water District
19	2310006	Redwood Valley County Water District
20	2310008	Hopland Public Utility District
21	2310010	Washoe House
22	4900033	Alexander Valley Store & Bar
23	4900107	Cazadero Water Company
24	4900508	South Cloverdale Water Company
25	4900510	Happy Acres Mutual Benefit Water System
26	4900512	Madrone Mutual Water Company
27	4900513	Rancho Del Paradiso-Cal Water Svc (PUC)
28	4900514	Gill Creek Mutual Water Company
29	4900521	Sonoma County CSA 41-Jenner
30	4900532	Occidental Community Services District
31	4900536	Branger Mutual Water Company, Inc.
32	4900545	Hawkins Water Co-Cal Water Service (PUC)
33	4900546	End-O-Valley Mutual Water Company
34	4900547	Holland Heights Mutual Water Company
35	4900548	Melita Heights Mutual Water Company
36	4900551	Michele Mutual Water Company
37	4900552	Park Royal Mutual Water
38	4900553	Belmont Terrace Mutual Water Company

	System Number	System Name
39	4900558	Fircrest Mutual Water Company
40	4900559	Kelly Mutual Water Company
41	4900560	Willowside Mutual Water Company
42	4900561	Palomino Lakes Mutual Water Co.
43	4900570	Wilshire Heights Mutual Water Company
44	4900573	Rio Lindo Adventist Academy
45	4900577	Sonoma Mountain County Water District
46	4900580	Bennett Ridge Mutual Water Company
47	4900585	Bennett Ridge Mutual Water Company
48	4900587	Brand Water Company
49	4900599	Randal's Ranchette Mutual Water Co.
50	4900600	Rincon Valley Mobile Estates
51	4900603	Riebli Mutual Water Company
52	4900604	Twin Hills Mutual Water Company
53	4900605	Twin Hills Mutual Water Company
54	4900608	Mark West Acres MWC
55	4900611	Six Acres Water Company
56	4900612	Rains Creek Water District
57	4900618	Heights Mutual Water Company
58	4900620	Rural Canyon Mutual Water Company
59	4900629	Austin Acres Mutual Water Company
60	4900630	East Austin Creek Mutual Water Company
61	4900634	Austin Creek Mutual (Springhill)
62	4900637	Huckleberry Mutual Water Company
63	4900639	Magic Mountain Mutual Water Company
64	4900640	Redwood Heights Mutual Water Company
65	4900641	Sonoma County Mutual Water Company
66	4900643	Sunrise Mountain Mutual Water Company
67	4900644	Mount Weske Estates Mutual Water Company
68	4900646	Bridgehaven Park
69	4900653	Alexander Valley Acres Water Company
70	4900660	Lone Pine Mutual Water Company
71	4900665	Yulupa Mutual Water Company
72	4900669	Russian River Mutual Water Co.
73	4900673	Wendell Water Company (PUC)
74	4900674	Athena Terrace Mutual Water Company
75	4900675	Pine Hill Terrace Mobile Home Park
76	4900676	Roseland Mobile Home Park
77	4900677	Village Park Mobile Home Park
78	4900684	Sequoia Gardens Mobile Home Park
79	4900686	#N/A
80	4900687	Cafe Saint Rose
81	4900688	KOA - Cloverdale
82	4900693	Brookwood Mobile Home Park

	System Number	System Name
83	4900694	Journey's End Mobile Home Park
84	4900695	Bellevue Union Sch Dist-Bellevue School
85	4900699	Wright Elementary School
86	4900700	Piner Elementary School
87	4900702	Olivet Elementary School
88	4900703	Nonesuch Farm School
89	4900704	Pacific Christian Academy
90	4900705	Oak Grove School
91	4900707	Alexander Valley Union School District
92	4900708	Geyserville Educational Park
93	4900710	Twin Hills School Dist-Twin Hills School
94	4900711	Gravenstein School District-Gravenstein
95	4900719	Twin Hills School Dist-Apple Blossom Sch
96	4900720	Gravenstein School District-Hillcrest
97	4900721	West Side Union School District
98	4900722	Mobile Home Estates
99	4900723	Shamrock Mobile Home Park
100	4900728	Colonial Park
101	4900736	URJ Camp Newman
102	4900743	Shamrock Mobile Home Park
103	4900745	Evergreen Mobile Estates
104	4900748	Clear Creek Water Company
105	4900774	La Cantera Racquet Club
106	4900784	River Bend Resort
107	4900785	Casini Ranch Campground
108	4900786	Cloverleaf Ranch Summer Camp
109	4900787	Windsor Mobile Country Club
110	4900788	Noel Heights-Cal Water Service (PUC)
111	4900789	Rancho Santa Rosa MHP
112	4900791	Plaza Mobile Home Park
113	4900792	El Crystal Mobile Home Park
114	4900793	Blue Spruce Mobile Home Park
115	4900794	Western Mobile Home Park
116	4900795	Wayside Gardens Mobile Home Park
117	4900796	Vinehill Vista Mutual Water Company
118	4900797	Sunset Trailer Park
119	4900798	Stonegate Mobile Home Park
120	4900799	Santa Rosa Mobile Estates
121	4900800	North Star Mobile Home Park
122	4900801	Mountain View Mobile Estates, LLC
123	4900812	El Portal Mobile Estates
124	4900813	Mark West Estates
125	4900815	Shady Lane Mobile Home Park
126	4900817	Friedman Brothers Hardware
127	4900820	Midgley's Country Flea Market

	System Number	System Name
128	4900822	Days Inn
129	4900832	Casa Del Mar
130	4900844	Monte Vista Motel
131	4900846	Mount Taylor Mobile Home Park
132	4900847	Leisure Mobile Home Park
133	4900855	Francis Coppola Winery
134	4900859	Rolling Oaks Road Association
135	4900873	Richardson Water System
136	4900878	Duncans Mills Trading Company
137	4900883	Lancelot Mobile Home Park
138	4900890	Sonoma West Holdings North Plant
139	4900893	Richardson Water System
140	4900897	Santa Rosa Golf & Country Club
141	4900898	Windsorland Mobile Home Park
142	4900904	Redwood Adventist Academy
143	4900905	West Water Company (PUC)
144	4900907	Rodney Strong Vineyards
145	4900913	Hilton Park Family Campground
146	4900916	J Vineyards & Winery
147	4900934	Mark West Meadows Mutual Water
148	4900935	Summerfield Waldorf School
149	4900936	Robin Way Water System
150	4900943	Mill Creek Vineyards
151	4900946	Restaurant Eloise
152	4900949	Geyser Peak Winery
153	4900956	Country Inn
154	4900962	Union Hotel
155	4900968	Alliance Redwoods Conference Grounds
156	4900974	Trentadue Winery
157	4900975	Saints Peter & Paul Russian Church
158	4900981	#N/A
159	4900982	CazSonoma Inn
160	4900994	Field Stone Winery
161	4900998	Russian River Vineyards & Restaurant
162	4900999	Vimark - Trione Winery
163	4901001	Pedroncelli Winery
164	4901004	Foppiano Vineyards
165	4901005	Westside Winery
166	4901008	Hessel Church
167	4901016	De Loach Winery
168	4901017	Korbel Brothers Winery
169	4901024	Wine Country RV Park
170	4901025	Calpine (West Field Office)
171	4901030	Todd Road Mutual Water Company

System Number		System Name
172	4901038	Hessel Church
173	4901042	Sequoia Water Company
174	4901044	Naco West - Russian River Preserve
175	4901060	Dry Creek Store
176	4901063	Johnson's Beach Resort
177	4901068	Calpine (Geysers Administration Center)
178	4901073	Passalacqua Winery
179	4901082	Michel Schlumberger Fine Wine Estate
180	4901084	Triple S Ranch
181	4901086	Duncan Mills Camping Club
182	4901090	Campobello
183	4901093	Alderbrook Winery
184	4901095	Za Zu's
185	4901098	Mazzocco Winery
186	4901101	Jordan Vineyard & Winery
187	4901105	Kendall-Jackson Wine Center
188	4901107	Preston Winery
189	4901110	Martinelli Ranch
190	4901111	Westminster Woods Camp
191	4901112	Thunderbird Ranch
192	4901113	Mount Gilead Bible Conference
193	4901115	Camp Royaneh-Boy Scouts of America
194	4901118	Cazadero Performing Arts Camp
195	4901119	Camp Cazadero
196	4901122	Bellevue Union Sch Dist-Kawana School
197	4901130	Lake Sonoma Marina
198	4901135	Mom s Apple Pie
199	4901141	Russian River Winery
200	4901147	Andy s Produce Market, Inc.
201	4901150	Dry Creek Vineyard
202	4901152	Sonoma Wine Company
203	4901153	Gravenstein Business Park
204	4901156	Hoot Owl Creek/Alex. Valley Vineyards JV
205	4901161	Occidental Arts & Ecology Center
206	4901162	Traditional Medicinals, Inc.
207	4901164	Alphabet Soup Preschool & Day Care
208	4901165	Clos du Bois Winery
209	4901170	Jimtown Store
210	4901172	College Avenue Building
211	4901175	Willowside Hall
212	4901179	Willowside School
213	4901181	Vino Farms, Inc. - Wasson Ranch
214	4901189	Quivira Vineyards
215	4901190	Woods Resort, The (Guerneville)
216	4901191	Jehovah s Witnesses Hall

	System Number	System Name
217	4901195	New Directions Adolescent Services
218	4901197	#N/A
219	4901200	Willowside Hall
220	4901201	Redwood Empire Sawmill
221	4901202	Hanna Vineyards
222	4901203	Azure Acres CD Recovery Center
223	4901205	Lieto Water System (Sunridge School)
224	4901206	Paradise Ridge Winery
225	4901208	Moorland Avenue Apartments
226	4901212	Silver Oak Wine Cellars L.P.
227	4901213	Dimensions/Perler
228	4901215	Vinwood Cellars
229	4901220	Ferrari-Carano Winery
230	4901221	Fosters Wine Estates-Asti Winery
231	4901222	U.S. Army Corps-Liberty Glen Campground
232	4901232	Armida Winery
233	4901236	Valley of the Moon Plaza Shopping Center
234	4901244	Sonoma County Pub Works-Central Landfill
235	4901245	Lytton Adult Rehabilitation Center
236	4901246	Plumfield Academy (Occidental Rd.)
237	4901248	Lytton Springs Winery
238	4901250	Graton Mutual (Green Valley HOA)
239	4901251	Sonoma County Parks-Vet. Memorial Beach
240	4901252	La Crema Winery
241	4901253	Vino Farms, Inc. - Preston Ranch
242	4901257	Humane Society of Sonoma County
243	4901259	Ledson Winery and Vineyards
244	4901261	Downtown Graton Mutual Water System
245	4901263	Matanzas Creek Winery
246	4901265	Sonoma West Holdings Industrial Park
247	4901266	Safari West
248	4901267	E & J Gallo Winery-Sonoma
249	4901269	C. Donatiello Winery
250	4901272	Capital Lumber Company
251	4901277	Stonestreet Winery
252	4901282	Stryker Sonoma Winery & Vineyards
253	4901283	Matrix Winery
254	4901284	Fairfield Osborn Preserve
255	4901287	Seghesio Farms
256	4901291	True to Life
257	4901298	United Rentals
258	4901299	Wildwood Retreat
259	4901301	Bucher Water Company
260	4901305	Manzana Products Company, Inc.

System Number		System Name
261	4901307	Fritz Winery and Vineyard
262	4901309	Mauritson Family Winery
263	4901311	Rochioli Winery
264	4901312	Verite Winery
265	4901313	Lynmar Winery
266	4901316	Petrified Forest
267	4901317	Moshin Vineyards
268	4901321	Truett & Hurst Winery
269	4901323	Sonoma County Golf Park
270	4901324	Hilton Mutual Water Company
271	4901330	Mark West Neighborhood Church
272	4901331	Balletto Vineyards
273	4901333	Sebastopol Vineyards
274	4901334	Rued Vineyards
275	4901335	Zichichi Winery
276	4901337	Sunce Winery
277	4901338	Fulton Processors, Inc.
278	4901343	Fritsch Industrial Park
279	4901344	Madrona Manor
280	4901346	Hawkes Winery
281	4901348	Forestville Veterinary Hospital
282	4901356	Amista Winery
283	4901359	Williams Selyem Winery
284	4910002	Alexander Valley RV Park & Campground
285	4910004	Wilson Winery
286	4910005	Stuhlmuller Vineyards
287	4910008	Giorgio s Restaurant
288	4910009	Delores Lane Water System
289	4910010	Hop Kiln Winery
290	4910011	Gary Farrell Winery
291	4910012	River s Edge Kayak & Canoe Trips
292	4910014	Cloverdale, City of
293	4910016	Sweetwater Springs CWD - Guerneville
294	4910017	Healdsburg, City of
295	4910018	Russian River County Water District
296	4910019	Santa Rosa, City of
297	4910020	Sonoma County CSA 41-Fitch Mountain
298	4910022	Sebastopol, City of
299	4910023	Sonoma, City of
300	4910024	Rohnert Park, City of
301	4910026	Cotati, City of
302	4910027	Windsor, Town of
303	4910028	Armstrong Valley-Cal Water Service (PUC)
304	4910029	Forestville County Water District
305	4910306	Sonoma County Water Agency

	System Number	System Name
306	4910307	Canon Manor Water System
307	4910313	California-American Larkfield (PUC)
308	4910702	Geyserville Water Works (PUC)

Attachment D

Letters to Agency Water Contractors and
to Russian River Water Users Outside Agency's Service Area

April 9, 2009

Members of the Water Advisory Committee

RE: TEMPORARY URGENCY CHANGE ORDER

The State Water Resources Control Board has issued Order 2009-0027-DWR, copy enclosed, approving the petition filed by the Water Agency to amend Russian River minimum flows this summer and fall. The purpose of the Agency's petition was to prevent Lake Mendocino from going dry and preserve storage necessary for survival of listed Russian River salmonid fisheries and the agricultural and municipal uses that depend on Lake Mendocino.

Section 1.12 of the Restructured Agreement for Water Supply requires that the Agency and each water contractor "implement or use their best efforts to secure the implementation of any water conservation requirements that may be added as terms or conditions of the Agency's appropriative water rights permits or licenses, or with which the Agency must comply under compulsion of regulation or law." The State Water Board has broad authority to condition water rights orders to prevent waste of water. Order 2009-0027-DWR contains findings and restrictions under that authority that require your attention and, under Section 1.12, your action.

The Order requires that the Agency temporarily reduce diversions from the Russian River by 25%, temporarily prohibit irrigation of commercial turf grass, and, within 30 days, submit and implement a water conservation plan by which Russian River water users reach a water conservation goal of 25% in Sonoma County and 50% in Mendocino County. We must also submit a Water Conservation Status Report by December 31 and a Water Conservation Plan within one year.

We will be discussing the scope and content of the Report and Plan with your staff in the near future. However, we must take immediate action to implement the 25% diversion reduction and the commercial turf irrigation prohibition and achieve the 25% and 50% water conservation goals. I'm sending this letter to give you the Agency's views on how those elements of the Order should be implemented.

Page Two

We will use 2004 as our base year for both the 25% diversion reduction and the 25% water conservation goal, as we did in 2007. We interpret the commercial turf irrigation prohibition as requiring you to prohibit your customers from irrigating turf that is not used regularly by a significant number of people. This prohibition would apply to commercial and governmental uses such as ornamental turf in median strips along streets, at public and private office buildings, business parks, out-of-bounds areas at golf courses, and unused areas in parks. The prohibition would not apply to regularly used turf, such as baseball, soccer, and other recreational fields, golf courses, and park and other areas where turf is actually used by substantial numbers of people to walk, play, or sit on (as opposed to turf that is primarily ornamental). Of course, any turf area irrigated, we do expect that a smart weather track controller is being used to minimize the use of water. Most of you are probably already using recycled water on many of those areas. Because the Order is for the purpose of preserving potable Russian River water, in our view the prohibition would also not apply to irrigation with recycled water or to irrigation from groundwater wells that are either private or, if public, not connected to a municipal water supply system served by the Water Agency. Please feel free to call me if you would like to talk about any specific situations.

California is in its third consecutive year of drought and, as Order 2009-0027-DWR recognizes, Governor Schwarzenegger has asked all urban water users to reduce their water use by 20%. I am confident that the residents of our region can outperform the rest of the state and that the cities, town and water districts that use Agency water will be able to achieve the 25% goal.

I have directed my staff to be available to answer any of your questions about the Order and to attend meetings of the Water Advisory Committee or Technical Advisory Committee, if you would like to have them. In addition, we will, as we have done in the past, hold public meetings in areas affected by the Order.

Please call me if you have any questions.

Sincerely,

/s/

Randy D. Poole
General Manager/Chief Engineer

c: Victoria A. Whitney, Deputy Director for Water Rights - SWRCB
Members of the Technical Advisory Committee
Board of Directors, Sonoma County Water Agency

[DATE 04-17-09]

To: Russian River Watershed Purveyors

Re: State Water Resources Control Board Water Conservation Requirements

Dear Water Purveyor/Business:

As you may know, the Sonoma County Water Agency filed a petition with the State Water Resources Control Board on April 6, 2009 requesting approval of a Temporary Urgency Change to its water rights permits. The petition requested that in-stream flow requirements be reduced to prevent Lake Mendocino from going dry and preserve storage necessary for survival of listed Russian River salmonid fisheries and the agricultural and municipal uses that depend on Lake Mendocino. On the same day, the State Board issued Order WR 2009-0027-DWR, conditionally approving the change petition.

Order WR 2009-0027-DWR requires that the Water Agency:

- Temporarily reduce diversions from the Russian River by 25%,
- Temporarily prohibit irrigation of commercial turf grass within its service area, and
- Within 30 days, submit and implement a water conservation plan by which Russian River water users reach a water conservation goal of 25% in Sonoma County and 50% in Mendocino County.

The purpose of this letter is to enlist your cooperation with the Agency in meeting these extremely challenging goals for water conservation, and begin gathering usage and conservation savings data from your utility or business.

Term 15 of Order WR 2009-0027-DWR requires the Water Agency, within 30 days of the date of the Order, to submit a plan to the State Board to obtain cooperation and participation of municipal Russian River water users <u>not</u> supplied by the Water Agency to reach a water conservation goal of 25% in Sonoma County and 50% in Mendocino County for the period of April 6, 2009 to October 2, 2009, when the order expires. Term 15 also requires the Water Agency to identify and prevent waste, unreasonable methods of use, or unreasonable methods of diversion of water. Monthly progress reports are to be submitted to the State Board by the Water Agency with regard to progress being made both in gaining your utility/business's cooperation and investigating waste.

Additionally, Term 16 of Order WR 2009-0027-DWR requires the Water Agency to prepare a Water Conservation Status Report for the Water Agency's service areas and other areas served by Lake Mendocino. This report is due to the State Board by December 31, 2009.

To comply with Terms 15 and 16, the Water Agency will need to gather usage and conservation savings information from your utility or business.

Please share with us how you plan to achieve the 25% (Sonoma County) or 50% (Mendocino County) water conservation goals. For example, which CUWCC BMPs are you practicing? Are you implementing a commercial turf irrigation ban? How do you enforce your water waste ordinances? What types of water conservation programs do you have in place and what conservation measures are you planning to start?

We need to begin gathering information about your utility/business now, because the plan required under Term 15 is due to the State Board on May 6, 2009.

Please provide the following information **by April 28, 2009** to help us respond to the State Board's Order:

1. Your actual diversion volumes in 2004 for the months of July, August, September, and October;
2. A description of how your utility/business will achieve a 25% or 50% reduction in the use of water during the period from April 6, 2009 to October 2, 2009;
3. The savings (volume of water) that you estimate will be realized from these measures; and
4. Your plan to identify and prevent any water waste and unreasonable use.

We realize that we are asking for this information in a very short amount of time, and for that we apologize. The Water Agency truly appreciates your prompt attention to this urgent matter.

If you have any questions, please call Heather Bauman at 707-547-1910 or Lynn Florey at 707-547-1909.

Sincerely,
/s/
Lynn Florey
Sonoma County Water Agency
Principal Program Specialist

Encl. SWRCB Order WR 2009-0027-DWR

Appendix B-7

Term 18, revised Order WR 2009-034_EXEC

SONOMA COUNTY WATER AGENCY

DELIVERY VIA EMAIL:
VWHITNEY@WATERBOARD.CA.GOV
SHERRERA@WATERBOARD.CA.GOV

FILE:CF/42-0.19-9 SWRCB Order Approving Temporary Urgency Change in Permits 12947A, 12949, 12950 & 16596 (Order WR 2009-0027-DWR)

December 30, 2009

Victoria Whitney, Deputy Director
State Water Resources Control Board
Division of Water Rights
P.O. Box 2000
Sacramento, CA 95812-2000

Dear Ms. Whitney:

Re: TEMPORARY URGENCY CHANGE PETITION-ORDER WR 2009-0034-EXEC TERM 18 REPORT

The Sonoma County Water Agency (Agency) has prepared this letter report to fulfill the requirements of Term 18 of the State Water Resources Control Board (SWRCB) Order WR 2009-0034-EXEC.

The Agency filed a temporary urgency change petition with the SWRCB on April 6, 2009. This petition requested temporary changes to the minimum instream flow requirements specified in water-rights Decision 1610. The Agency asked for these changes so that it could conserve stored water in Lake Mendocino to maintain lake levels into the fall so that sufficient releases could be made to support Chinook salmon migration and spawning. On April 6, 2009, you approved the petition by issuing Order WR 2009-0027-DWR. This order was amended on May 28, 2009 by Order WR 2009-0034-EXEC. One of the amendments was the addition of Term 18, which requires the Agency to report when project water releases are being made to the Russian River.

Term 18 states:

"SCWA shall develop a water right accounting procedure and a method for determining when the Russian River is being supplemented by project water. SCWA shall submit a report to the Deputy Director by December 31, 2009 describing the proposed water right accounting procedure. Beginning December 31, 2009, SCWA shall post on its website notification of periods when the Russian River is being supplemented by project water for purposes of meeting instream flow requirements or to satisfy downstream water demands other than those of SCWA."

Agency Water-Right Permits

The Agency is authorized to divert Russian River water under four water-right permits. Permit 12947A (Application 12919A) authorizes diversions to storage of up to 122,500 ac-ft per year in Lake Mendocino and diversions and rediversions of stored water of up to 92 cfs and 37,544 ac-ft per year. Permit 16596 (Application 19351) authorizes diversions to storage of up to 245,000 ac-ft per year from October 1st through May 1st in Lake Sonoma and diversions and rediversions of stored water of up to 180 cfs. Permit 12949 (Application 15736) authorizes direct diversions of up to 20 cfs. Permit 12950 (Application 15737) authorizes direct diversions of up to 60 cfs from April 1st through September 30th.

Other Water-Rights in the Russian River

In addition to supporting Agency diversions, Lake Mendocino project water also serves other water-rights holders in the watershed. Specifically, project water released from Lake Mendocino supports diversions in Mendocino County of up to 8,000 ac-ft/yr under water-right Permit 12947B (Application 12919B), which is administered by the Mendocino County Russian River Flood Control and Water Conservation Improvement District, and diversions in Sonoma County of up to 10,000 ac-ft/yr under the reservation for Russian River diversions in Sonoma County that was created by water-rights Decision 1030. Additionally, reservoir operations must pass through enough Lake Mendocino inflow (when available) to satisfy pre-1949 water-rights on the Russian River.

Reservoir Operations

Lake Mendocino and Lake Sonoma are U.S. Army Corps of Engineers (USACE) projects that provide both flood protection and water supply benefits. The Agency is the local sponsor of these projects and shares operations of these facilities with the USACE. When lake levels rise above the water supply pool, water storage encroaches into the flood control pool and the USACE has operational control of the reservoir. The USACE maintains control and determines the amounts of releases while reservoir storage is within the flood control pool. When reservoir storage levels are below the flood control pool, the Agency has operational control of the reservoir and determines the amounts of water to be released.

The flood control and water supply pool elevations for these reservoirs are documented in the USACE water control manuals.

For Lake Mendocino, the *Coyote Valley Dam and Lake Mendocino, Russian River California, Water Control Manual (Appendix I)* of the *Master Water Control Manual, Russian River Basin,California* describes the pool elevations, which vary over the course of the year, in the *Water Control Diagram (Plate A-10)*. This diagram was last revised in January 2004. A copy of the water control diagram is included with this letter as Attachment 1, and a data table of the values in this diagram is included as Attachment 2. During the winter season, starting approximately November 1, the elevation of the top of the water supply pool is 737.5 feet above mean sea level. During the summer season, the elevation of the top of the water supply pool is 761.8 feet above mean sea level. The transition from the higher to lower level for the top of the water supply pool in the fall occurs over a one month period starting October 1. The start date for the period of transition from the lower to higher level for the top of the water supply pool in the spring is discretionary based on an assessment of hydrologic and meteorological conditions. This transition may start on either March 1 or April 1. The rate of transition for the March 1 start date is more gradual than for the April 1 start date, but for either start date the top of the water supply pool reaches the higher elevation by mid-May.

For Lake Sonoma, the *Warm Springs Dam and Lake Sonoma, Dry Creek, California, Water Control Manual (Appendix II)* of the *Master Water Control Manual, Russian River Basin, California* describes the pool elevations, on the *Flood Control Diagram (Chart A-12)*. The elevation of the top of the water supply pool is maintained year-round at 451.1 feet above mean sea level.

Water stored in either reservoir's water supply pool for future release is project water. Storage and releases that occur for flood control purposes are not storage or releases of project water, because their purpose is to regulate high flows in the river and to minimize downstream flooding. Project

water is water that is stored in Lake Mendocino under either the Agency's water rights or the Mendocino District's Permit 12947B, that then is released to supplement the natural flows in the Russian River to provide water for water supply, recreation or aquatic habitat. During the periods when the reservoir is not operating in the flood control regime, releases from the reservoir can be categorized as being of either 'pass-through water' or 'project water'.

Methodology

A water balance model of each reservoir was developed to assess the status of reservoir operations. When the Agency is responsible for operational control of a reservoir, the Agency monitors real-time streamflows on a continual basis and sets reservoir releases in response to changing conditions. For project water releases to be occurring to satisfy minimum instream flow requirements or non-Agency diversions, several conditions all must be satisfied. First, the Agency must be in control of releases from the reservoir. Second, the Agency must be making releases of water that is project water. Third, the streamflow at each compliance point upstream of Agency diversions must be less than the sum of the applicable requirement and the applicable operational buffer. A map showing the minimum instream flow requirements that are specified in Decision 1610 and the USGS stream gage locations that are the compliance points for these requirements is included as Attachment 3. Agency Operations staff utilize an operational buffer when making release decisions to ensure compliance with minimum instream flow requirements. The magnitude of the operational buffer varies with seasonal conditions and the associated uncertainties of river diversion estimates.

Lake Mendocino

The Agency analyzes the reservoir operations status of Lake Mendocino every day. The following equation describes the water balance model of the reservoir:

[Inflow] = [Change in Storage] + [Evaporation] – [Precipitation] + [Release] + [Redwood Valley CWD Diversion]

Inflow: value calculated by Agency
Change in Storage: derived from calculated values of reservoir storage (based on a bathymetric survey completed in 2001), using water surface elevations measured by USACE;
Evaporation: derived from value of pan evaporation measured by USACE
Precipitation: value measured by USACE
Release: measured value of streamflow, as recorded at USGS Station 11462000 (EF RUSSIAN R NR UKIAH CA)
Redwood Valley CWD Diversion: value measured by Redwood Valley County Water District of diversions directly from Lake Mendocino

This equation makes the following assumptions in the calculation of reservoir inflow:

- Storage loss to seepage is negligible
- Diversions of stored water for on-site use by USACE is negligible

The amounts of project water releases will be determined with the following equation:

[Project Water] = [Release] – [Inflow].

Project Water: value calculated by Agency
Inflow: calculated as described in previous equation
Release: measured value of streamflow as recorded at USGS Station 11462000 (EF RUSSIAN R NR UKIAH CA)

If [Release] > [Inflow], and if the Agency is controlling reservoir operations, then project water is being released. If project water is being released, then the Agency will assess whether the project water releases are being made to meet the the minimum instream flow requirements. The following USGS stream gages are monitored by Agency Operations staff for upper Russian River compliance:

- East Fork - USGS Station 11462000
- Hopland - USGS Station 11462500
- Cloverdale - USGS Station 11463000
- Digger Bend - USGS Station 11463980
- Healdsburg - USGS Station 11464000

If the measured streamflow at any of these locations is less than the sum of the applicable minimum instream flow requirement plus the operational buffer (and if project water is being released), then project water is being released to meet instream flow requirements and this condition will be reported on the Agency website.

Lake Sonoma

The Agency analyzes the reservoir operations status of Lake Sonoma every day. The following equation describes the water balance model of the reservoir:

[Inflow] = [Change in Storage] + [Evaporation] – [Precipitation] + [Release]

Inflow: value calculated by Agency
Change in Storage: derived from calculated values of reservoir storage (based on a bathymetric survey completed in 1983), using water surface elevations measured by USACE
Evaporation: derived from value of pan evaporation measured by USACE
Precipitation: value measured by USACE
Release: value measured by USACE

The amounts of project water releases will be determined with the following equation:

[Project Water] = [Release] – [Inflow]

Project Water: value calculated by Agency
Inflow: calculated as described in previous equation
Release: value measured by USACE

If [Release] > [Inflow], and if the Agency is controlling reservoir operations, then project water is being released. If project water is being released, then the Agency will assess whether the project water releases are being made to meet the minimum instream flow requirements. The following USGS stream gages are monitored by Agency Operations staff for Dry Creek compliance:

- Dry Creek Mouth - USGS Station 11465350
- Dry Creek Geyserville - USGS Station 11465200

If the measured streamflow at either of these locations is less than the sum of the applicable minimum instream flow requirement and the operational buffer (and if project water is being released), then project water is being released to meet instream flow requirements and this condition will be reported on the Agency website.

Lower Russian River

There are two checks on river operation conditions in the Lower Russian River reach between the confluence with Dry Creek and the Hacienda Bridge in Guerneville. Both of these checks will be used to determine whether project water is being released from either reservoir to meet instream flow requirements in this reach. If project water releases have already been determined to be occurring, based on the above calculations for either Lake Mendocino and Lake Sonoma, and either of the checks described below for the Lower Russian River reach is met, then the Agency is releasing project water to met instream flow requirements in the Lower Russian River, and this condition will be reported the Agency's website.

The first check determines whether the total of the flows in Dry Creek and the Russian River at the Healdsburg gages is less than the sum of the applicable minimum instream flow requirements plus the applicable operational buffer minus the Agency's diversions at its Wohler and Mirabel Water Production Facilities. This check will be made as follows:

If [Dry Crk Flow] + [Russian Flow] – [Agency Diversions] < [Minimum Instream Flow] + [Operational Buffer] , then project water is being released to meet the instream flow requirement.

Dry Crk Flow: as measured by USGS at the Dry Creek gage (the Dry Creek Mouth stream gage will be used during low flows; the Dry Creek Geyserville stream gage will be used during high flows)
Russian Flow: as measured by USGS at the Healdsburg gage
Agency Diversions: as measured by Agency at its Wohler and Mirabel facilities
Minimum Instream Flow: minimum instream flow requirements specified in Decision 1610
Operational Buffer: as determined by Agency operators based on current conditions

The second check on river operation conditions evaluates the reach flows downstream of the Agency's diversions at the Wohler and Mirabel Water Production Facilities. This check determines whether river flows in this reach are less than the sum of the applicable minimum instream flow requirement and the applicable operational buffer. The Lower Russian River has the following USGS stream gage that is monitored by Agency Operations staff for minimum instream flow compliance:

- Hacienda Bridge - USGS Station 11467000

If this check is satisfied while project water is being released, then project water is being released to meet this instream flow requirement, and this condition will be reported on the Agency's website.

Public Notification of River System Operations

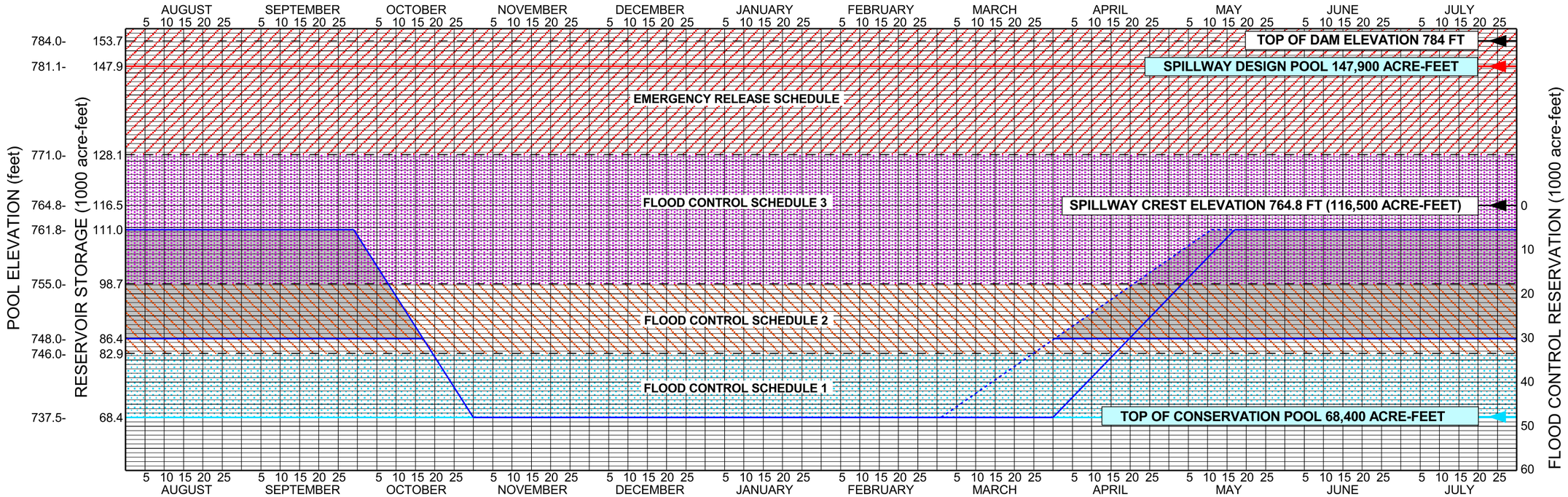
Commencing on December 31, 2009, Agency staff will use the above-described methodology to determine "periods when the Russian River is being supplemented by project water for purposes of meeting instream flow requirements or to satisfy downstream water demands other than those of SCWA," as required by Term 18 of Order WR 2009-0034-EXEC. As required by this term, this status will be posted on the internet at the Agency's website—http://www.scwa.ca.gov/ each day. Specifically, this information will be posted in the *Daily Reservoir Operations Status* section of the *Current Water Supply Conditions* webpage that is accessible from the Agency's homepage via the pull-down menu found under *Water Supply*. The URL for this webpage is http://www.scwa.ca.gov/current-water-supply-levels/. A copy of a sample webpage is included as Attachment 4.

Sincerely,

Pamela Jeane for
Randy D. Poole, P.E.
General Manager / Chief Engineer

Attachments
(1) Lake Mendocino Water Control Diagram
(2) Lake Mendocino Water Control Flood Pool Designation Table
(3) Streamflow Requirements
(4) Sample of *Current Water Supply Conditions* Webpage from Sonoma County Water Agency Website

c: Todd Schram, Donald Seymour, Pamela Jeane, James Zambenini – Sonoma County Water Agency
Steve Shupe – Sonoma County Counsel
Alan Lilly – Bartkiewicz, Kronick & Shanahan



RELEASE SCHEDULES

WATER SUPPLY SCHEDULE
As directed by the Sonoma County Water Agency

FLOOD CONTROL SCHEDULE 1, Pool elevations reached between 737.5 and 746.0 feet
Release up to a max of 4,000 cfs depending on antecedent ground conditions and time of year; subject to Limitations 1 thru 4, shown hereon.

FLOOD CONTROL SCHEDULE 2, Pool elevations reached between 746.0 and 755.0 feet
Release up to a maximum of 4,000 cfs subject to Limitations 1 thru 4, shown hereon.

FLOOD CONTROL SCHEDULE 3, Pool elevations reached greater than 755.0 feet
Release up to a maximum of 6,400 cfs subject to Limitations 1 thru 4, shown hereon.

EMERGENCY RELEASE SCHEDULE

Pool Elevation (feet)	Gate Releases (cfs)
764.8 - 771.0	0
771.0 - 771.3	800
771.3 - 771.5	1,700
771.5 - 771.8	2,500
771.8 - 772.0	3,300
772.0 - 772.3	4,200
772.3 - 772.5	5,000
772.5 - 772.8	5,800
772.8 - 773.0	6,600
773.0 and above	7,500 (gates 100% open)

NOTES:

1. Gates may be used when the pool is above spillway crest (elevation 764.8 feet) for Flood Control Schedule 3 releases; however, the sum of the spill and the releases must not exceed 6,400 cfs (i.e. - outlet discharge is reduced as spillway discharge increases), and should not exceed Limitations 1 thru 4, shown hereon, to the extent possible.
2. The Corps of Engineers will reduce the flood control space on the 1st of March if it is determined the flood control functions of the project will not be impaired.
3. Normally, the summer pool elevation will be kept at 748.0 feet to maximize recreational opportunities at the lake; however, Sonoma County Water Agency retains the right to raise the summer pool elevation to 761.8 feet based on demonstrated demand and NEPA criteria being met.
4. Pertinent reservoir pool elevations correspond to the following reservoir storages:

737.5 ft	68,400 acre-feet	Top of Conservation Pool
746.0 ft	82,900 acre-feet	
748.0 ft	86,400 acre-feet	Summer Pool
755.0 ft	98,700 acre-feet	
761.8 ft	111,000 acre-feet	
764.8 ft	116,500 acre-feet	Spillway Crest
771.0 ft	128,100 acre-feet	
781.1 ft	147,900 acre-feet	Spillway Design Pool
784.0 ft	153,700 acre-feet	Top of Dam

LIMITATIONS

1. The rate of change for flood releases will be as follows when the pool elevation is at or below 764.8 ft:

Flow Range	Max Rate (cfs/hr) falling	rising
minimum - <250	25	1000
250 - <1000	250	1000
1000 - 6400	1000	2000

2. When flow at the Russian River near Ukiah gage exceeds 2,500 cfs and is rising, flows in the Russian River will be monitored hourly so that reductions in releases from Coyote Valley Dam can be made to ensure dam operations will adhere to all other limitations and operating criteria.
3. Flood releases which contribute to flows greater than 8,000 cfs at the Russian River near Hopland gage, will not be made, insofar as possible. Also, releases will be limited to the discharge that results in flow at the Russian River near Hopland gage being less than that reached during the previous storm or storm series. The previous storm or storm series is defined as an event(s) separated by no more than 10 days, which caused the highest flow at the specified gage location above.
4. When the National Weather Service QPF is 1 inch or more for the next 24 hours or 1/2 inch or more for any 6-hour period in the next 24 hours, flows in the Russian River will be monitored hourly so that reductions in releases from Coyote Valley Dam can be made to ensure dam operations will adhere to all other limitations and operating criteria.

USE OF DIAGRAM

1. Releases from the lake will be made in accordance with the highest schedule reached during the current or previous storm or storm series, shown hereon, subject to the applicable limitations.
2. Depending on conditions prevailing at the time, the Corps of Engineers District may direct that flood releases be increased or decreased from those required by this diagram without requiring a deviation.

Developed by PEP/BJA - Prepared by JSM

COYOTE VALLEY DAM - LAKE MENDOCINO
RUSSIAN RIVER, CALIFORNIA

WATER CONTROL DIAGRAM

U.S. ARMY CORPS OF ENGINEERS
SAN FRANCISCO DISTRICT
(Water Management by Sacramento District)

Lake Mendocino Water Control Flood Pool Designation

No. 1: March 1st
No. 2: April 1st

	(ft amsl)		(ac-ft)	
Date	**No. 1**	**No. 2**	**No. 1**	**No. 2**
01-Oct	761.80	761.80	111,000	111,000
02-Oct	760.99	760.99	109,580	109,580
03-Oct	760.18	760.18	108,160	108,160
04-Oct	759.37	759.37	106,740	106,740
05-Oct	758.56	758.56	105,320	105,320
06-Oct	757.75	757.75	103,900	103,900
07-Oct	756.94	756.94	102,480	102,480
08-Oct	756.13	756.13	101,060	101,060
09-Oct	755.32	755.32	99,640	99,640
10-Oct	754.51	754.51	98,220	98,220
11-Oct	753.70	753.70	96,800	96,800
12-Oct	752.89	752.89	95,380	95,380
13-Oct	752.08	752.08	93,960	93,960
14-Oct	751.27	751.27	92,540	92,540
15-Oct	750.46	750.46	91,120	91,120
16-Oct	749.65	749.65	89,700	89,700
17-Oct	748.84	748.84	88,280	88,280
18-Oct	748.03	748.03	86,860	86,860
19-Oct	747.22	747.22	85,440	85,440
20-Oct	746.41	746.41	84,020	84,020
21-Oct	745.60	745.60	82,600	82,600
22-Oct	744.79	744.79	81,180	81,180
23-Oct	743.98	743.98	79,760	79,760
24-Oct	743.17	743.17	78,340	78,340
25-Oct	742.36	742.36	76,920	76,920
26-Oct	741.55	741.55	75,500	75,500
27-Oct	740.74	740.74	74,080	74,080
28-Oct	739.93	739.93	72,660	72,660
29-Oct	739.12	739.12	71,240	71,240
30-Oct	738.31	738.31	69,820	69,820
31-Oct	737.50	737.50	68,400	68,400
01-Nov	737.50	737.50	68,400	68,400
02-Nov	737.50	737.50	68,400	68,400
03-Nov	737.50	737.50	68,400	68,400
04-Nov	737.50	737.50	68,400	68,400
05-Nov	737.50	737.50	68,400	68,400
06-Nov	737.50	737.50	68,400	68,400
07-Nov	737.50	737.50	68,400	68,400
08-Nov	737.50	737.50	68,400	68,400
09-Nov	737.50	737.50	68,400	68,400
10-Nov	737.50	737.50	68,400	68,400
11-Nov	737.50	737.50	68,400	68,400
12-Nov	737.50	737.50	68,400	68,400
13-Nov	737.50	737.50	68,400	68,400
14-Nov	737.50	737.50	68,400	68,400
15-Nov	737.50	737.50	68,400	68,400
16-Nov	737.50	737.50	68,400	68,400
17-Nov	737.50	737.50	68,400	68,400
18-Nov	737.50	737.50	68,400	68,400
19-Nov	737.50	737.50	68,400	68,400
20-Nov	737.50	737.50	68,400	68,400
21-Nov	737.50	737.50	68,400	68,400
22-Nov	737.50	737.50	68,400	68,400
23-Nov	737.50	737.50	68,400	68,400
24-Nov	737.50	737.50	68,400	68,400
25-Nov	737.50	737.50	68,400	68,400
26-Nov	737.50	737.50	68,400	68,400
27-Nov	737.50	737.50	68,400	68,400
28-Nov	737.50	737.50	68,400	68,400
29-Nov	737.50	737.50	68,400	68,400
30-Nov	737.50	737.50	68,400	68,400
01-Dec	737.50	737.50	68,400	68,400
02-Dec	737.50	737.50	68,400	68,400

	(ft amsl)		(ac-ft)	
Date	**No. 1**	**No. 2**	**No. 1**	**No. 2**
01-Apr	747.96	737.50	86,742	68,400
02-Apr	748.30	738.04	87,333	69,347
03-Apr	748.64	738.58	87,925	70,293
04-Apr	748.97	739.12	88,517	71,240
05-Apr	749.31	739.66	89,108	72,187
06-Apr	749.65	740.20	89,700	73,133
07-Apr	749.99	740.74	90,292	74,080
08-Apr	750.32	741.28	90,883	75,027
09-Apr	750.66	741.82	91,475	75,973
10-Apr	751.00	742.36	92,067	76,920
11-Apr	751.34	742.90	92,658	77,867
12-Apr	751.67	743.44	93,250	78,813
13-Apr	752.01	743.98	93,842	79,760
14-Apr	752.35	744.52	94,433	80,707
15-Apr	752.69	745.06	95,025	81,653
16-Apr	753.02	745.60	95,617	82,600
17-Apr	753.36	746.14	96,208	83,547
18-Apr	753.70	746.68	96,800	84,493
19-Apr	754.04	747.22	97,392	85,440
20-Apr	754.37	747.76	97,983	86,387
21-Apr	754.71	748.30	98,575	87,333
22-Apr	755.05	748.84	99,167	88,280
23-Apr	755.39	749.38	99,758	89,227
24-Apr	755.72	749.92	100,350	90,173
25-Apr	756.06	750.46	100,942	91,120
26-Apr	756.40	751.00	101,533	92,067
27-Apr	756.74	751.54	102,125	93,013
28-Apr	757.07	752.08	102,717	93,960
29-Apr	757.41	752.62	103,308	94,907
30-Apr	757.75	753.16	103,900	95,853
01-May	758.09	753.70	104,492	96,800
02-May	758.42	754.24	105,083	97,747
03-May	758.76	754.78	105,675	98,693
04-May	759.10	755.32	106,267	99,640
05-May	759.44	755.86	106,858	100,587
06-May	759.77	756.40	107,450	101,533
07-May	760.11	756.94	108,042	102,480
08-May	760.45	757.48	108,633	103,427
09-May	760.79	758.02	109,225	104,373
10-May	761.12	758.56	109,817	105,320
11-May	761.46	759.10	110,408	106,267
12-May	761.80	759.64	111,000	107,213
13-May	761.80	760.18	111,000	108,160
14-May	761.80	760.72	111,000	109,107
15-May	761.80	761.26	111,000	110,053
16-May	761.80	761.80	111,000	111,000
17-May	761.80	761.80	111,000	111,000
18-May	761.80	761.80	111,000	111,000
19-May	761.80	761.80	111,000	111,000
20-May	761.80	761.80	111,000	111,000
21-May	761.80	761.80	111,000	111,000
22-May	761.80	761.80	111,000	111,000
23-May	761.80	761.80	111,000	111,000
24-May	761.80	761.80	111,000	111,000
25-May	761.80	761.80	111,000	111,000
26-May	761.80	761.80	111,000	111,000
27-May	761.80	761.80	111,000	111,000
28-May	761.80	761.80	111,000	111,000
29-May	761.80	761.80	111,000	111,000
30-May	761.80	761.80	111,000	111,000
31-May	761.80	761.80	111,000	111,000
01-Jun	761.80	761.80	111,000	111,000
02-Jun	761.80	761.80	111,000	111,000

	(ft amsl)		(ac-ft)	
Date	**No. 1**	**No. 2**	**No. 1**	**No. 2**
03-Dec	737.50	737.50	68,400	68,400
04-Dec	737.50	737.50	68,400	68,400
05-Dec	737.50	737.50	68,400	68,400
06-Dec	737.50	737.50	68,400	68,400
07-Dec	737.50	737.50	68,400	68,400
08-Dec	737.50	737.50	68,400	68,400
09-Dec	737.50	737.50	68,400	68,400
10-Dec	737.50	737.50	68,400	68,400
11-Dec	737.50	737.50	68,400	68,400
12-Dec	737.50	737.50	68,400	68,400
13-Dec	737.50	737.50	68,400	68,400
14-Dec	737.50	737.50	68,400	68,400
15-Dec	737.50	737.50	68,400	68,400
16-Dec	737.50	737.50	68,400	68,400
17-Dec	737.50	737.50	68,400	68,400
18-Dec	737.50	737.50	68,400	68,400
19-Dec	737.50	737.50	68,400	68,400
20-Dec	737.50	737.50	68,400	68,400
21-Dec	737.50	737.50	68,400	68,400
22-Dec	737.50	737.50	68,400	68,400
23-Dec	737.50	737.50	68,400	68,400
24-Dec	737.50	737.50	68,400	68,400
25-Dec	737.50	737.50	68,400	68,400
26-Dec	737.50	737.50	68,400	68,400
27-Dec	737.50	737.50	68,400	68,400
28-Dec	737.50	737.50	68,400	68,400
29-Dec	737.50	737.50	68,400	68,400
30-Dec	737.50	737.50	68,400	68,400
31-Dec	737.50	737.50	68,400	68,400
01-Jan	737.50	737.50	68,400	68,400
02-Jan	737.50	737.50	68,400	68,400
03-Jan	737.50	737.50	68,400	68,400
04-Jan	737.50	737.50	68,400	68,400
05-Jan	737.50	737.50	68,400	68,400
06-Jan	737.50	737.50	68,400	68,400
07-Jan	737.50	737.50	68,400	68,400
08-Jan	737.50	737.50	68,400	68,400
09-Jan	737.50	737.50	68,400	68,400
10-Jan	737.50	737.50	68,400	68,400
11-Jan	737.50	737.50	68,400	68,400
12-Jan	737.50	737.50	68,400	68,400
13-Jan	737.50	737.50	68,400	68,400
14-Jan	737.50	737.50	68,400	68,400
15-Jan	737.50	737.50	68,400	68,400
16-Jan	737.50	737.50	68,400	68,400
17-Jan	737.50	737.50	68,400	68,400
18-Jan	737.50	737.50	68,400	68,400
19-Jan	737.50	737.50	68,400	68,400
20-Jan	737.50	737.50	68,400	68,400
21-Jan	737.50	737.50	68,400	68,400
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23-Jan	737.50	737.50	68,400	68,400
24-Jan	737.50	737.50	68,400	68,400
25-Jan	737.50	737.50	68,400	68,400
26-Jan	737.50	737.50	68,400	68,400
27-Jan	737.50	737.50	68,400	68,400
28-Jan	737.50	737.50	68,400	68,400
29-Jan	737.50	737.50	68,400	68,400
30-Jan	737.50	737.50	68,400	68,400
31-Jan	737.50	737.50	68,400	68,400
01-Feb	737.50	737.50	68,400	68,400
02-Feb	737.50	737.50	68,400	68,400
03-Feb	737.50	737.50	68,400	68,400
04-Feb	737.50	737.50	68,400	68,400
05-Feb	737.50	737.50	68,400	68,400
06-Feb	737.50	737.50	68,400	68,400
07-Feb	737.50	737.50	68,400	68,400

	(ft amsl)		(ac-ft)	
Date	**No. 1**	**No. 2**	**No. 1**	**No. 2**
03-Jun	761.80	761.80	111,000	111,000
04-Jun	761.80	761.80	111,000	111,000
05-Jun	761.80	761.80	111,000	111,000
06-Jun	761.80	761.80	111,000	111,000
07-Jun	761.80	761.80	111,000	111,000
08-Jun	761.80	761.80	111,000	111,000
09-Jun	761.80	761.80	111,000	111,000
10-Jun	761.80	761.80	111,000	111,000
11-Jun	761.80	761.80	111,000	111,000
12-Jun	761.80	761.80	111,000	111,000
13-Jun	761.80	761.80	111,000	111,000
14-Jun	761.80	761.80	111,000	111,000
15-Jun	761.80	761.80	111,000	111,000
16-Jun	761.80	761.80	111,000	111,000
17-Jun	761.80	761.80	111,000	111,000
18-Jun	761.80	761.80	111,000	111,000
19-Jun	761.80	761.80	111,000	111,000
20-Jun	761.80	761.80	111,000	111,000
21-Jun	761.80	761.80	111,000	111,000
22-Jun	761.80	761.80	111,000	111,000
23-Jun	761.80	761.80	111,000	111,000
24-Jun	761.80	761.80	111,000	111,000
25-Jun	761.80	761.80	111,000	111,000
26-Jun	761.80	761.80	111,000	111,000
27-Jun	761.80	761.80	111,000	111,000
28-Jun	761.80	761.80	111,000	111,000
29-Jun	761.80	761.80	111,000	111,000
30-Jun	761.80	761.80	111,000	111,000
01-Jul	761.80	761.80	111,000	111,000
02-Jul	761.80	761.80	111,000	111,000
03-Jul	761.80	761.80	111,000	111,000
04-Jul	761.80	761.80	111,000	111,000
05-Jul	761.80	761.80	111,000	111,000
06-Jul	761.80	761.80	111,000	111,000
07-Jul	761.80	761.80	111,000	111,000
08-Jul	761.80	761.80	111,000	111,000
09-Jul	761.80	761.80	111,000	111,000
10-Jul	761.80	761.80	111,000	111,000
11-Jul	761.80	761.80	111,000	111,000
12-Jul	761.80	761.80	111,000	111,000
13-Jul	761.80	761.80	111,000	111,000
14-Jul	761.80	761.80	111,000	111,000
15-Jul	761.80	761.80	111,000	111,000
16-Jul	761.80	761.80	111,000	111,000
17-Jul	761.80	761.80	111,000	111,000
18-Jul	761.80	761.80	111,000	111,000
19-Jul	761.80	761.80	111,000	111,000
20-Jul	761.80	761.80	111,000	111,000
21-Jul	761.80	761.80	111,000	111,000
22-Jul	761.80	761.80	111,000	111,000
23-Jul	761.80	761.80	111,000	111,000
24-Jul	761.80	761.80	111,000	111,000
25-Jul	761.80	761.80	111,000	111,000
26-Jul	761.80	761.80	111,000	111,000
27-Jul	761.80	761.80	111,000	111,000
28-Jul	761.80	761.80	111,000	111,000
29-Jul	761.80	761.80	111,000	111,000
30-Jul	761.80	761.80	111,000	111,000
31-Jul	761.80	761.80	111,000	111,000
01-Aug	761.80	761.80	111,000	111,000
02-Aug	761.80	761.80	111,000	111,000
03-Aug	761.80	761.80	111,000	111,000
04-Aug	761.80	761.80	111,000	111,000
05-Aug	761.80	761.80	111,000	111,000
06-Aug	761.80	761.80	111,000	111,000
07-Aug	761.80	761.80	111,000	111,000
08-Aug	761.80	761.80	111,000	111,000

	(ft amsl)		(ac-ft)	
Date	**No. 1**	**No. 2**	**No. 1**	**No. 2**
08-Feb	737.50	737.50	68,400	68,400
09-Feb	737.50	737.50	68,400	68,400
10-Feb	737.50	737.50	68,400	68,400
11-Feb	737.50	737.50	68,400	68,400
12-Feb	737.50	737.50	68,400	68,400
13-Feb	737.50	737.50	68,400	68,400
14-Feb	737.50	737.50	68,400	68,400
15-Feb	737.50	737.50	68,400	68,400
16-Feb	737.50	737.50	68,400	68,400
17-Feb	737.50	737.50	68,400	68,400
18-Feb	737.50	737.50	68,400	68,400
19-Feb	737.50	737.50	68,400	68,400
20-Feb	737.50	737.50	68,400	68,400
21-Feb	737.50	737.50	68,400	68,400
22-Feb	737.50	737.50	68,400	68,400
23-Feb	737.50	737.50	68,400	68,400
24-Feb	737.50	737.50	68,400	68,400
25-Feb	737.50	737.50	68,400	68,400
26-Feb	737.50	737.50	68,400	68,400
27-Feb	737.50	737.50	68,400	68,400
28-Feb	737.50	737.50	68,400	68,400
01-Mar	737.50	737.50	68,400	68,400
02-Mar	737.84	737.50	68,992	68,400
03-Mar	738.18	737.50	69,583	68,400
04-Mar	738.51	737.50	70,175	68,400
05-Mar	738.85	737.50	70,767	68,400
06-Mar	739.19	737.50	71,358	68,400
07-Mar	739.53	737.50	71,950	68,400
08-Mar	739.86	737.50	72,542	68,400
09-Mar	740.20	737.50	73,133	68,400
10-Mar	740.54	737.50	73,725	68,400
11-Mar	740.88	737.50	74,317	68,400
12-Mar	741.21	737.50	74,908	68,400
13-Mar	741.55	737.50	75,500	68,400
14-Mar	741.89	737.50	76,092	68,400
15-Mar	742.23	737.50	76,683	68,400
16-Mar	742.56	737.50	77,275	68,400
17-Mar	742.90	737.50	77,867	68,400
18-Mar	743.24	737.50	78,458	68,400
19-Mar	743.58	737.50	79,050	68,400
20-Mar	743.91	737.50	79,642	68,400
21-Mar	744.25	737.50	80,233	68,400
22-Mar	744.59	737.50	80,825	68,400
23-Mar	744.93	737.50	81,417	68,400
24-Mar	745.26	737.50	82,008	68,400
25-Mar	745.60	737.50	82,600	68,400
26-Mar	745.94	737.50	83,192	68,400
27-Mar	746.27	737.50	83,783	68,400
28-Mar	746.61	737.50	84,375	68,400
29-Mar	746.95	737.50	84,967	68,400
30-Mar	747.29	737.50	85,558	68,400
31-Mar	747.62	737.50	86,150	68,400

	(ft amsl)		(ac-ft)	
Date	**No. 1**	**No. 2**	**No. 1**	**No. 2**
09-Aug	761.80	761.80	111,000	111,000
10-Aug	761.80	761.80	111,000	111,000
11-Aug	761.80	761.80	111,000	111,000
12-Aug	761.80	761.80	111,000	111,000
13-Aug	761.80	761.80	111,000	111,000
14-Aug	761.80	761.80	111,000	111,000
15-Aug	761.80	761.80	111,000	111,000
16-Aug	761.80	761.80	111,000	111,000
17-Aug	761.80	761.80	111,000	111,000
18-Aug	761.80	761.80	111,000	111,000
19-Aug	761.80	761.80	111,000	111,000
20-Aug	761.80	761.80	111,000	111,000
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22-Aug	761.80	761.80	111,000	111,000
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27-Aug	761.80	761.80	111,000	111,000
28-Aug	761.80	761.80	111,000	111,000
29-Aug	761.80	761.80	111,000	111,000
30-Aug	761.80	761.80	111,000	111,000
31-Aug	761.80	761.80	111,000	111,000
01-Sep	761.80	761.80	111,000	111,000
02-Sep	761.80	761.80	111,000	111,000
03-Sep	761.80	761.80	111,000	111,000
04-Sep	761.80	761.80	111,000	111,000
05-Sep	761.80	761.80	111,000	111,000
06-Sep	761.80	761.80	111,000	111,000
07-Sep	761.80	761.80	111,000	111,000
08-Sep	761.80	761.80	111,000	111,000
09-Sep	761.80	761.80	111,000	111,000
10-Sep	761.80	761.80	111,000	111,000
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12-Sep	761.80	761.80	111,000	111,000
13-Sep	761.80	761.80	111,000	111,000
14-Sep	761.80	761.80	111,000	111,000
15-Sep	761.80	761.80	111,000	111,000
16-Sep	761.80	761.80	111,000	111,000
17-Sep	761.80	761.80	111,000	111,000
18-Sep	761.80	761.80	111,000	111,000
19-Sep	761.80	761.80	111,000	111,000
20-Sep	761.80	761.80	111,000	111,000
21-Sep	761.80	761.80	111,000	111,000
22-Sep	761.80	761.80	111,000	111,000
23-Sep	761.80	761.80	111,000	111,000
24-Sep	761.80	761.80	111,000	111,000
25-Sep	761.80	761.80	111,000	111,000
26-Sep	761.80	761.80	111,000	111,000
27-Sep	761.80	761.80	111,000	111,000
28-Sep	761.80	761.80	111,000	111,000
29-Sep	761.80	761.80	111,000	111,000
30-Sep	761.80	761.80	111,000	111,000

Cumulative inflow to Lake Phillsbury (Acre Feet) as of	1/1	2/1	3/1	4/1	5/1	6/1	
NORMAL	≥8,000	≥39,200	≥65,700	≥114,500	≥145,600	≥160,000	Water Supply Conditions Prevailing on 6/1 Apply Through 12/31
DRY	<8,000	<39,200	<65,700	<114,500	<145,600	<160,000	
CRITICAL DRY	<4,000	<20,000	<45,000	<50,000	<70,000	<75,000	

LEGEND

All flows are minimums, expressed in cubic feet per second.

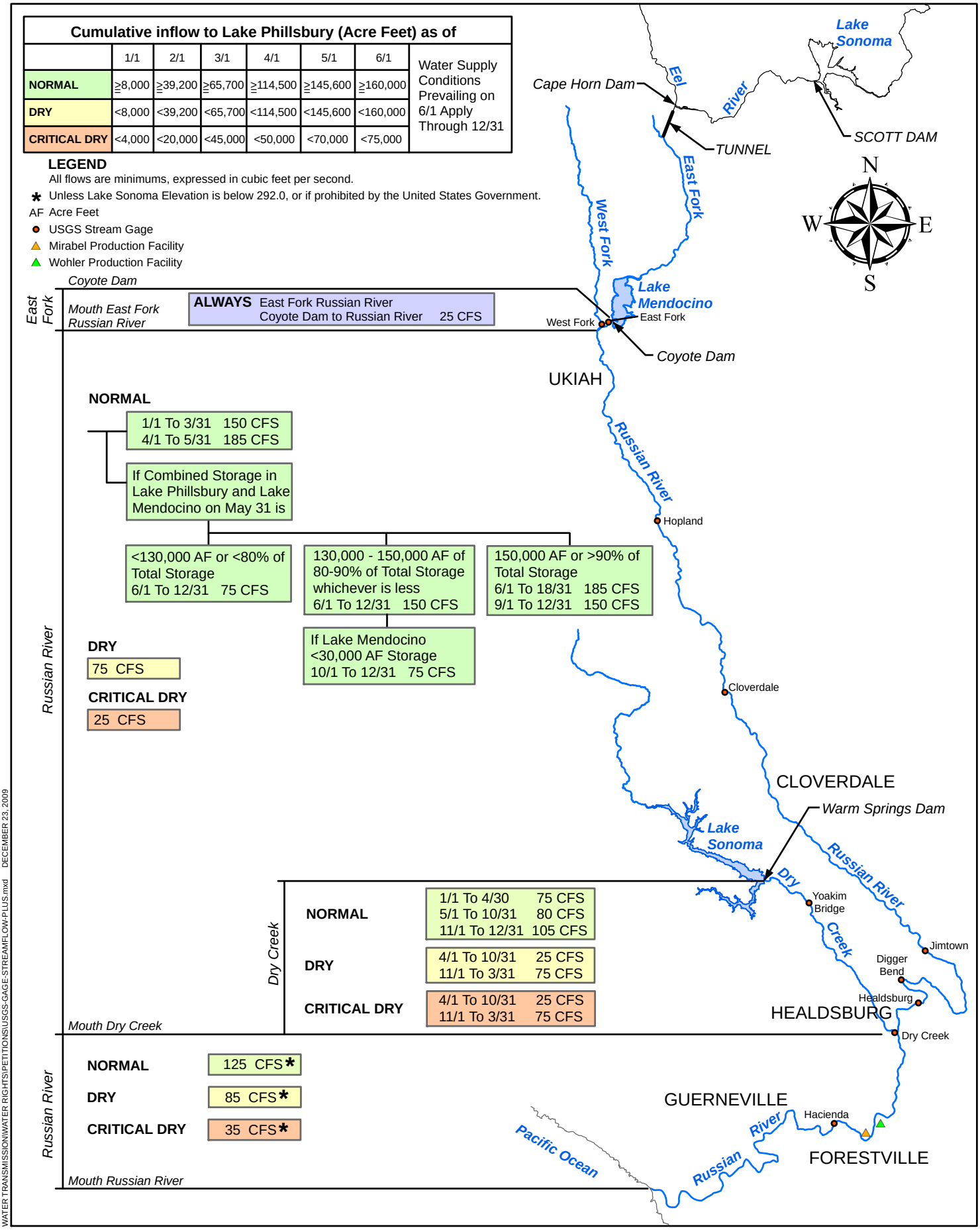
* Unless Lake Sonoma Elevation is below 292.0, or if prohibited by the United States Government.

AF Acre Feet

USGS Stream Gage

Mirabel Production Facility

Wohler Production Facility



Coyote Dam

East Fork

Mouth East Fork Russian River

ALWAYS East Fork Russian River Coyote Dam to Russian River 25 CFS

Russian River

NORMAL

1/1 To 3/31 150 CFS
4/1 To 5/31 185 CFS

If Combined Storage in Lake Phillsbury and Lake Mendocino on May 31 is

<130,000 AF or <80% of Total Storage
6/1 To 12/31 75 CFS

130,000 - 150,000 AF of 80-90% of Total Storage whichever is less
6/1 To 12/31 150 CFS

If Lake Mendocino <30,000 AF Storage
10/1 To 12/31 75 CFS

150,000 AF or >90% of Total Storage
6/1 To 18/31 185 CFS
9/1 To 12/31 150 CFS

DRY

75 CFS

CRITICAL DRY

25 CFS

Dry Creek

NORMAL

1/1 To 4/30 75 CFS
5/1 To 10/31 80 CFS
11/1 To 12/31 105 CFS

DRY

4/1 To 10/31 25 CFS
11/1 To 3/31 75 CFS

CRITICAL DRY

4/1 To 10/31 25 CFS
11/1 To 3/31 75 CFS

Mouth Dry Creek

Russian River

NORMAL 125 CFS*

DRY 85 CFS*

CRITICAL DRY 35 CFS*

Mouth Russian River

WATER TRANSMISSION\WATER RIGHTS\PETITIONS\USGS-GAGE-STREAMFLOW-PLUS.mxd DECEMBER 23, 2009

Russian River Basin
Streamflow Requirements

Per State Water Resources Control Board Decision 1610, April 1986

- Home > Water Supply > **Current Water Supply Conditions**

Current Water Supply Conditions

Daily Reservoir Operation Status

Sonoma County Water Agency (SCWA) is the local cost-sharing partner for Lake Mendocino and Lake Sonoma, and determines the amount of water to be released when the lake level is in the water supply pools. The US Army Corps of Engineers determines the amount of water to be released when the lake level is above the water supply pools and in the flood control pools.

The Russian River is a managed river system with reservoir releases controlling river flows, especially throughout most of the summer and fall. When tributary stream flows are low, SCWA releases water stored in the reservoirs to supplement the natural flows in the Russian River to provide adequate flows for water supply, recreation and aquatic habitat. A release from a reservoir can be categorized as being of 'pass-through water' or 'stored water'. The term 'project water' is often used instead of stored water and is used to describe water that is present because of the dam and reservoir project. Pass-through water is water flowing into the reservoir that is not stored in, but passes through, the reservoir. Project water releases to supplement the natural flows in the Russian River and Dry Creek are necessary to meet mandatory minimum streamflow requirements that exist for both of these watercourses.

Current status of reservoir and river operations:

Last Update: 12/30/2009 @ 10:00	Operational Control	Agency is Releasing Project Water to Meet Instream Flow Requirements
Lake Mendocino	Water Agency	No
Lake Sonoma	Water Agency	No
Lower Russian River (Dry Creek to Hacienda Bridge)	-	No

Monthly Summary Data

Reservoir Levels and Releases

Last Update: 12/29/2009 @ 10:00	Water Supply Pool Capacity (acre-feet)	Current Water Supply Pool Storage (acre-feet)	Water Supply Storage % Full	Reservoir Release (cfs)	Required Minimum Instream Flow (cfs)	Instream Flow Regulatory Region
Lake Mendocino	68,400	33,337	49%	102	75	Upper Russian River
Lake Sonoma	245,000	182,306	74%	115	105	Lower Dry Creek

*cfs—cubic feet per second

- Real-time Data for Lake Sonoma Reservoir
- Real-time Data for Lake Mendocino Reservoir

Russian River Flow Data

Last Update: 12/28/2009 @ 10:00	Flow (cfs)	Required Minimum Instream Flow (cfs)	Instream Flow Regulatory Region
Hacienda Bridge	392	125	Lower Russian River

*cfs—cubic feet per second

- Real-time Flow Data for Russian River

PG&E Potter Valley Project Data

Last Update: 12/28/2009 @ 24:00	Water Supply Pool Capacity (acre-feet)	Current Water Supply Pool Storage (acre-feet)	Water Supply Storage % Full	Reservoir Release (cfs)	Cumulative Inflow as of Oct 1st (acre-feet)
Lake Pillsbury (Eel River Watershed)	78,901	27,235	36%	209	14138

Last Update: 12/28/2009 @ 24:00	Reservoir Release to Eel River (cfs)	Potter Valley Project Diversion (cfs)
Lake Van Arsdale	172	46

*cfs—cubic feet per second

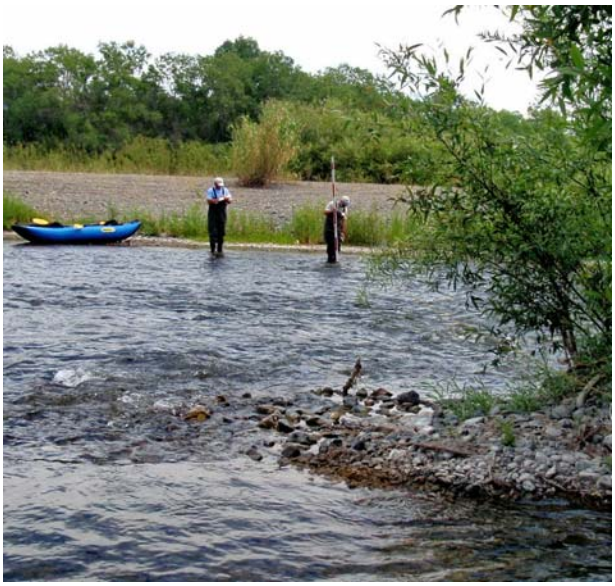
- Real-time Data for Potter Valley Project

Disclaimer: The above data is based on provisional data that is subject to revision.

Appendix B-8

Results of the Fisheries Monitoring Plan to Meet State Water Resources Control Board Order WR 2009 – 0034 EXEC

RESULTS OF THE FISHERIES MONITORING PLAN TO MEET STATE WATER RESOURCES CONTROL BOARD ORDER WR 2009 – 0034 EXEC



December 9, 2009

Prepared by

David J. Manning, Principal Environmental Specialist

Shawn Chase - Senior Environmental Specialist – Fisheries

Dave Cook - Senior Environmental Specialist – Fisheries

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Executive Summary

During summer and early fall 2009, Sonoma County Water Agency biologists conducted habitat, juvenile fish, and adult fish surveys in the mainstem Russian River to document the effects of flow reduction per State Board Order WR 2009 – 0034 EXEC. Sampling locations and methods were guided by a monitoring plan that was approved by the National Marine Fisheries Service and California Department of Fish and Game.

The timing of the flow reduction (early July to early October) occurred after most steelhead, coho salmon, and Chinook salmon smolts outmigrated to the ocean. Therefore, our data collection efforts during summer focused on rearing habitat for juvenile fish. We sought to document changes to physical habitat in seven reaches of the mainstem Russian River between Ukiah and Mirabel. Specific locations overlapped spatially with fish monitoring sites. Habitat surveys were conducted in June, before flow reduction, and in August when the Order was being implemented. Average wetted width, depth, and cross sectional area were measured at 179 transects in 63 discrete habitat units. Stream velocity was also measured at 21 habitat units.

Snorkeling using multiple divers in 500-m-long reaches was used to assess fish populations. A total of 12 sites were surveyed between August 17 and 25, 2009. Snorkel survey methods implemented during 2009 were similar to techniques used during a prior study in 2002. Eight of the survey sites sampled in 2002 were re-sampled in 2009 to allow comparisons between years.

Starting September 1, 2009, Chinook salmon presence in areas downstream and upstream of Mirabel Dam was evaluated by divers. These dive surveys were to continue until 200 adult Chinook salmon passed Mirabel Dam or until the Fisheries Monitoring Plan expired on October 2, 2009. During the early migration season, three lower River sites were sampled weekly, including Vacation Beach Dam, Johnson's Beach Dam, and Mirabel Dam. To assess potential habitat conditions at lower flow, a site at Geyserville was sampled every two weeks during the early season. After 200 salmon passed Mirabel Dam, effort was to shift to upstream sites at Mirabel Dam, Healdsburg Dam, Digger's Bend, and Geyserville. However, this sampling scheme was not implemented because 200 adult salmon did not pass Mirabel Dam prior to October 2, 2009. Water temperature, visibility, and dissolved oxygen were measured at each site.

During the June pre-flow reduction sampling period, discharge ranged from 115-187 cubic feet per second (cfs) and declined to 63-146 cfs in August. Overall, flow declined by an average of 33 cfs at the sampling reaches between the pre- and post flow reduction surveys. Flow reduction was most pronounced at three downstream sites above and below Healdsburg where flow declined between 41 and 74 cfs. In upstream reaches from Ukiah to Geyserville, average wetted width, depth, cross sectional area (width x depth), and velocity in pools and flatwater habitats generally changed little between surveys. Cross sectional area is a general measure of available living space for fish. In shallow riffle habitats, cross sectional area decreased by as much as 29 percent. In downstream reaches near Healdsburg, the cross sectional area of pool and flatwater habitats declined by 13 to 29 percent and by 20 to 40 percent in riffles.

A total of 16,384 fish of 13 species were counted during August dive surveys. Most of these fish consisted of native and non-native warm water species. Only 18 juvenile steelhead were detected at our 12 survey sites. These steelhead were found at artificial cascade habitats (Norgard Dam in Ukiah Valley and Healdsburg Dam at in Healdsburg), a boulder riffle in the Canyon Reach above Comminsky Station, and at the confluence of Dry Creek. The largest concentration of steelhead was observed at the Dry Creek confluence. In comparison to the eight sites previously sampled during 2002, there were 8 steelhead detected during 2009 and 788 steelhead during 2002.

Water visibility was poor in upper Ukiah Valley and was fair to good in reaches farther downstream. Water temperatures ranged from 16.0 degrees C in upper Ukiah Valley and gradually increased to 23.3 degrees C in Healdsburg. River water temperature below Dry Creek was 15.6 degrees C. All of the eight comparison study sites were 1-4 degrees C cooler in 2009 than in 2002.

Overall, steelhead abundance appeared to be very low during summer 2009 in the upper Russian River. Rearing steelhead were found in relatively large numbers in the Canyon Reach in summer 2002, but few were present this year even though water conditions in the Canyon Reach appeared suitable for steelhead rearing. In fact, water temperatures were cooler in 2009 than in 2002. The low abundance of rearing steelhead is most likely due to poor returns of adult spawners. Russian River steelhead hatchery returns were the lowest on record during winter 2008-2009.

No adult Chinook salmon were observed during fall dive surveys from September 1 to 29. There were likely few adult Chinook salmon migrating through the lower Russian River during September 2009. The Russian River estuary was closed from September 6 to October 5, preventing salmon from entering the river during the early migration season. The first salmon was recorded at the Mirabel Dam video counting station on October 7 after the estuary was breached. A supplemental dive survey was conducted on October 22, 2009 upstream of the Healdsburg dam and approximately 10 adult Chinook salmon were observed. As of November 21, more than 1,771 Chinook salmon have passed the video counting station.

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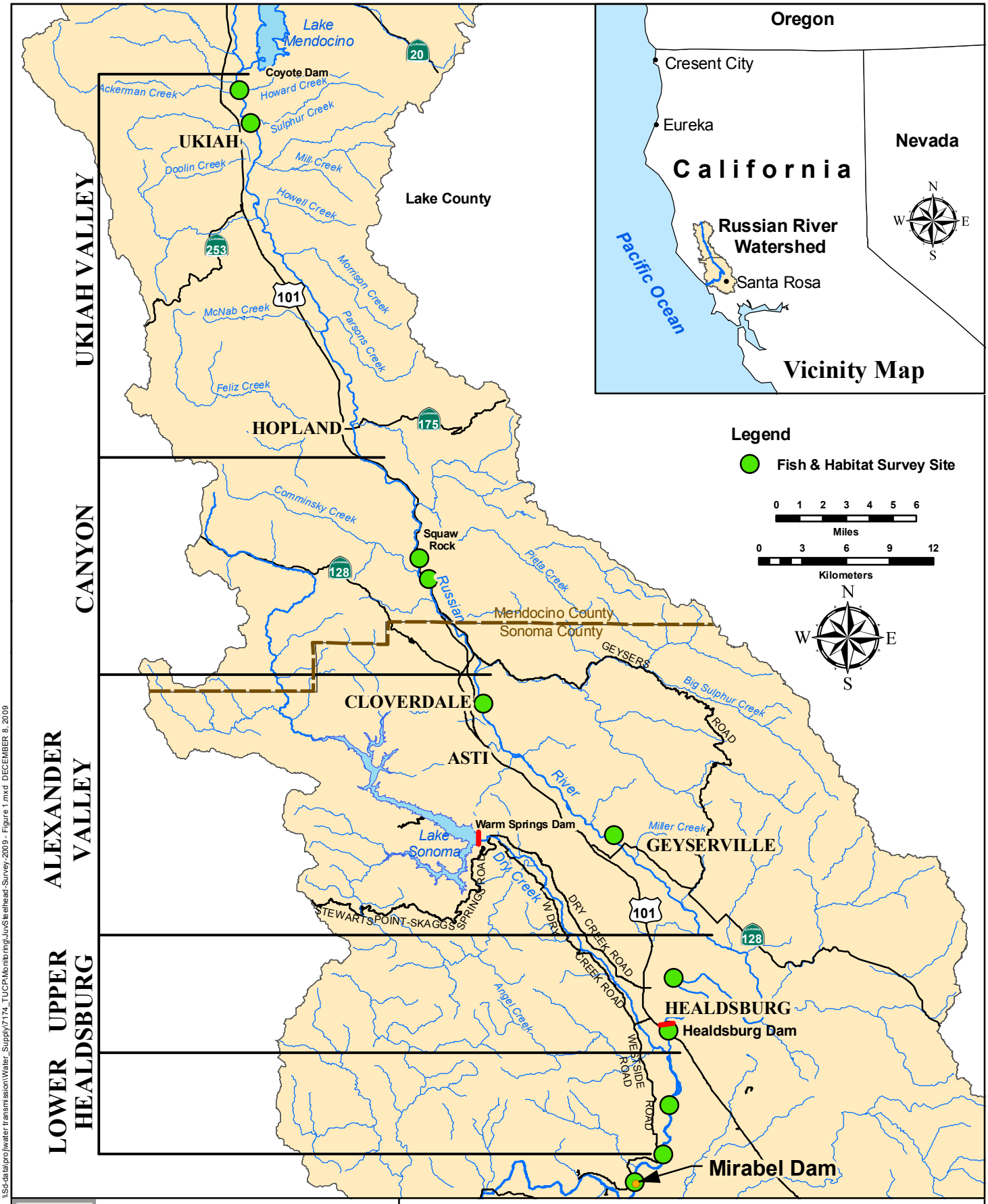
INTRODUCTION

On April 6, 2009, the Sonoma County Water Agency filed a petition with the State Water Resources Control Board requesting a Temporary Urgency Change in the flow requirements for the Russian River. The request was made to prevent depletion of storage in Lake Mendocino which would severely impact threatened or endangered Russian River fish species, create serious water supply impacts in Mendocino County and in Sonoma County's Alexander Valley, and affect Lake Mendocino and Russian River recreation.

From April 6 through June 30, 2009, the Petition allowed instream flow requirements in the upper Russian River (from its confluence with the East Fork of the Russian River to its confluence with Dry Creek) to be reduced from 185 cubic feet per second (cfs) to 75 cfs, and the requirements for the lower Russian River (downstream of its confluence with Dry Creek) to be reduced from 125 cfs to 85 cfs. After July 1 through October 2, 2009, flows would be further reduced based on inflow to Lake Mendocino. If total inflow into Lake Mendocino was greater than or equal to 25,000 acre feet (AF), then flows would not be changed. However, if inflow into Lake Mendocino was less than the 25,000 AF a further reduction in the minimum instream flow requirements for the upper Russian River to 25 cfs (measured at Healdsburg) and 35 cfs in the lower River (measured at Hacienda Bridge) from July to October.

Species of concern during the period of reduced flow include rearing juvenile steelhead in the upper Russian River (primarily above Cloverdale), and native species such as Sacramento sucker, Sacramento pikeminnow, and Russian River tule perch. Juvenile salmonids emigrate to the ocean from approximately March through June (primarily mid-April through mid-May). Adult Chinook salmon are the earliest returning salmonids, migrating from approximately September through December, and may also have been affected by the reduction in flow. Reduced summer flows may impact fish through altering physical habitat. Reduced flows were anticipated to result in a reduction in stream width, depth, cross sectional area, and velocity. We sought to document changes to physical habitat and fish habitat use in five reaches of the mainstem Russian River between Ukiah and the upstream end of the Wohler Pool. Habitat sampling locations overlapped spatially with fish monitoring sites (Figure 1).



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SONOMA COUNTY WATER AGENCY

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Figure 1

Fish and Habitat Monitoring Locations

METHODS

HABITAT SURVEYS

The River between Ukiah and the Wohler Pool was divided into five segments based on features of the river channel. Physical habitat data were collected to characterize the fish sampling sites and to assess changes associated with a reduction in summer stream flow. The fish sampling sites in the Ukiah Valley, Canyon, and Dry Creek to Wohler reaches are in close proximity, and a single habitat monitoring reach was surveyed to assess the effects of a reduction in stream flow. In the Alexander Valley and Healdsburg reaches, the fish sampling sites were spatially isolated, and two habitat monitoring reaches were measured. In all, physical data were collected at seven reaches in 63 distinct habitat units.

Primary habitat types in Russian River are pool, riffle, and flatwater (runs and glides). Although each of the major habitat types can be subdivided into several categories (e.g., main channel and corner pools, high and low gradient riffles, etc.), the larger categories (pool, riffle, flatwater) were deemed sufficient to assess overall changes to physical habitat resulting from a reduction in flow. Definitions of the three habitat types followed standard protocols (following Flosi et al. 1998 and Bisson et al. 1982).

Within each reach, physical data were collected on 3 pools, 3 riffles, and 3 flatwaters. Habitat selection began at the upstream end of each fish sampling site and progressed downstream until the required units were measured. At all sampling locations, the physical habitat monitoring extended beyond the 500-meter-long fish sampling stations.

The length of each habitat unit was measured using a laser range finder. Transects were established at intervals to capture the average width, depth, cross sectional area, velocity profiles, and shelter rating of each unit. Each site was marked with GPS and flagged. In most habitat units, physical data were collected at two to three transects in riffles, three transects in flatwaters, and four transects in pools. Transects were evenly spaced throughout the length of the habitat unit (10%, 25%, 50%, and 75% for pools; 25%, 50%, and 75% for flatwaters and most riffles; and at 33% and 66% for the short riffles with two measured transects).

At each transect, a calibrated measuring tape was stretched across the river and attached with clamps to rebar driven into the streambanks perpendicular to the flow. The wetted width of each transect was recorded, and depth and shelter rating (see below) were recorded at 3 foot intervals. Stream velocities were collected at the 50 percent transect (middle of the unit) within riffle and flatwater habitats, and from at the 10 percent transect (upstream end) in pools. Velocity measurements were recorded at three foot intervals at 60 percent of the total depth for each cell measured.

Permanent photo stations were established at each habitat unit. At each transect, photos were taken looking upstream, downstream, and across the transect. In addition, a photo was taken from mid-channel at the upstream end of each habitat unit measured. Photos were taken from river right for consistency. Photo monitoring stations were marked using GPS.

Instream shelter within each habitat unit was rated according to the Department of Fish and Game *California Salmonid Stream Habitat Restoration Manual (*Flosi et al. 1998). Instream shelter was rated based on the percentage cover provided by boulders, large woody debris, overhanging vegetation, etc. The upper Russian River provides habitat for approximately 15 native species. Since many of these species have different habitat requirements, it was impractical to establish a standardized rating system to assess cover. However, this qualitative rating system described changes to the percentage of overall cover within each habitat type. Habitat ratings were recoded at three foot increments.

JUVENILE DIVE SURVEYS

Survey methods implemented during 2009 were similar to techniques used during a 2002 study (Cook 2003). A total of 12 sites were surveyed between August 17 and 25, 2009 (Figure 1). Eight of the survey sites sampled in 2002 were re-sampled in 2009 to allow comparisons between years. Each survey reach was 500 m long. A dive survey started at the lower end of the study site and divers visually searched for fish in an upstream direction. To increase the accuracy of fish counts, each reach was partitioned into three dive lanes. All fish observed during surveys were identified to species when feasible. Several species of native minnows (family Cyprinidae) have similar characteristics and can be difficult to identify underwater. These fish were grouped as "cyprinids" and consisted of mostly juvenile fish. Fish were grouped into three size classes (<100 mm TL, 101-300 mm TL, and >300 mm TL). In general, steelhead <100 mm TL are young-of-the-year, fish 101-300 mm in length are age 1-2, and fish greater than 300 mm are age 3+. At the end of a survey, fish data from all divers was recorded on a data form for each site. In addition, water temperature, transparency (Secchi depth), and dissolved oxygen was recorded.

ADULT CHINOOK DIVE SURVEYS

Starting September 1, 2009, Chinook salmon presence in areas downstream and upstream of the Mirabel Dam was evaluated by divers. These dive surveys were to continue until 200 adult Chinook salmon passed Mirabel Dam or until the Fisheries Monitoring Plan expired on October 2, 2009. During the early migration season three lower River sites were sampled weekly, including Vacation Beach Dam, Johnson's Beach Dam, and Mirabel Dam. To assess potential habitat conditions at lower flow, a site at Geyserville (pool above Highway 128 Bridge) was sampled every two weeks during the early season. After 200 salmon passed Mirabel Dam, effort would shift to upstream sites at Mirabel Dam, Healdsburg Dam, Digger's Bend, and Geyserville. However, this sampling scheme was not implemented because 200 adult salmon did not pass Mirabel Dam prior to October 2, 2009. Dive surveys were conducted similar to the summer 2009 Juvenile Steelhead Monitoring. Fish were identified to species and grouped into size categories. Water temperature, visibility, and dissolved oxygen were measured at each site.

VIDEO MONITORING

Two video monitoring stations have been operated at the upstream ends of the fish ladders at the Mirabel Inflatable Dam since 2000. The video monitoring stations are operated from approximately August 15 of each year until the dam is deflated with the onset of heavy rains (typically mid-November to mid-January). The video monitoring stations provide information on anadromous fish passage during this time frame. The data collected to date indicates that the Russian River supports a self-sustaining run of Chinook salmon. Steelhead typically migrate after the dam is deflated, therefore no estimates of their abundance are available.

RESULTS

HABITAT SURVEYS

Physical measurements were collected in seven reaches along the Russian River between the City of Ukiah and the Wohler Pool (Figure 1). At these seven reaches, a total of 63 habitat units were measured, including 204 transects (82 pools, 59 riffles, and 63 flatwaters). Although each transect was marked with flagging and GPS coordinates were recorded for each transect, in some cases individual transects could not be relocated exactly (or the channel configuration had changed substantially between surveys). As a conservative approach, we excluded transects where the Pre and Post flow reduction contour data did not follow the same general pattern. In all, we excluded 25 transects. The analysis used for this report includes data for 179 individual transects (73 pools, 49 riffles, and 57 flatwaters habitats). Graphs of cross sectional areas for each transect analyzed are presented in Appendices A-G. Measured widths, depths, and cross sectional areas for each transect are presented in Appendix H. Appendix I lists transects excluded from the analysis (however, graphs of all transects are included in the appropriate appendices). Photographs were taken at all transect stations during Pre- and Post flow reduction surveys and are available on CD.

Actual flow releases in the upper Russian River were maintained above the minimum levels set by the TUCP. Flows were essentially unchanged in the upper (Ukiah) Reach, and were reduced by about 13 to 20 cfs at the three middle reaches (Comminsky Station, Cloverdale, and Geyserville reaches). At the three lower reaches (Digger's Bend, Healdsburg, and Below Dry Creek), flow reductions were on the order of 69 to 74 cfs (Table 1).

Table 1. Daily average stream flows recorded at USGS stations near each of the seven habitat monitoring reaches.

Reach	Pre-flows	Post flows
Ukiah	106 – 118	115
Comminsky Station	123	103
Cloverdale	110	93
Geyserville	106	93
Digger's Bend	138	64
Healdsburg	132	63
Below Dry Creek	187 – 213	146 - 182

Data were collected over approximately 70 miles of river at 179 separate transects. Changes to the river channel between the sampling events, or a slight adjustment in the location of transects between surveys could introduce error into the measurements. A reduction in stream flow would be expected to result in a narrower, shallower river with lower water velocities. While this was often the case, in some instances, a reduction in flow resulted in an increase in the calculated average stream depth. Some habitat types, riffles and flatwaters in particular, had extensive areas of very shallow water. A reduction in stream flow and the corresponding reduction in the water surface elevation dewatered extensive shallow areas. The removal of these shallow areas resulted in an overall increase in the average depth across transects. Similarly, a reduction in flow may appear to increase the overall stream velocity by reducing the amounts of low velocity habitat across an individual transect. Width measurements were based on the "wetted width" which could also result in small differences in measures between the Pre- and Post surveys. Channel geomorphology also influences how changing stream flow affects available habitat, with wide shallow channels being more susceptible to changes in flow compared to narrow, deep channels. The following is a description of habitat changes in each reach.

Ukiah Reach

Pools: Stream flow increased by 4.0 to 9.0 cfs at the three Pool sites between the Pre- and Post surveys. Overall, average pool widths decreased from 58.3 to 57.0 ft (1.3 ft) and average depths decreased from 3.5 to 3.4 ft (0.1 ft). Cross sectional areas decreased from 164.2 to 158.5 ft^2 (2.0 percent reduction in potential living space) (Table 2).

Riffles: Stream flow decreased by 3.0 cfs at Riffles habitats 1 and 2, and increased by 4.0 cfs at Riffle 3 between the Pre- and Post flow reduction surveys. Overall, average widths decreased from 57.1 to 56.6 ft (0.5 ft) and average depths were unchanged (1.0 ft Pre- and Post surveys. Cross sectional areas increase, on average, from 50.9 to 52.0 ft^2 (2.0 percent increase in potential living space) (Table 2). Average cross sectional velocities decreased from 1.41 to 1.06 feet per second (fps) between the Pre- and Post surveys (Table 3).

Flatwaters: Stream flow decreased by 3.0 cfs at Flatwater 1 (only one transect included in the analysis), and increased by 4.0 cfs at Flatwaters 2 and 3 between the Pre- and Post flow reduction surveys. Overall, average widths increased between the two surveys from 48.7 to 49.6 ft (0.9 ft) and average depths decreased from 2.0 to 1.9 ft (0.1 ft). Cross sectional areas in Flatwaters 2 and 3 were measured to increase from 86.8 to 90.6 ft^2 (2.8 percent increase in potential living space) (Table 2).

Comminsky Station Reach

Pools: Stream flow decreased from 123 to 103 cfs (20 cfs) at Pool habitats between the Pre- and Post flow reduction surveys. Overall, average widths were measured to increase from 89.0 to 90.1 ft (1.1 ft) and depths decreased from 3.8 to 3.6 ft (0.2 ft). Cross sectional areas were measured to decrease from 308.1 to 297.8 ft^2 (3.3 percent decrease in potential living space) (Table 2). Average cross sectional velocities decreased from

0.51 to 0.33 fps between the Pre- and Post surveys (Table 3).

Riffles: Stream flow decreased from 123 to 103 cfs (20 cfs) at Riffle habitats between the Pre- and Post flow reduction surveys. Overall, widths decreased from 65.1 to 64.9 ft (0.2 ft) and depths decreased from 1.2 to 1.1 ft (0.1 ft). Cross sectional areas in riffles were measured to decrease from 65.2 to 58.3 ft^2 (10.6 percent decrease in potential living space) (Table 2). Average cross sectional velocities decreased from 1.62 to 1.40 fps between the Pre- and Post surveys (Table 3).

Flatwaters: Stream flows decreased from 123 to 103 cfs (20 cfs) at Flatwater habitats between the Pre- and Post flow reduction surveys. Although flow releases decreased by 20 cfs between the Pre- and Post surveys, average stream widths were measured to increase slightly, from 68.1 to 69.3 ft (0.8 ft). Average depths were measured to decrease from 2.0 to 1.9 ft (0.1 ft). Cross sectional area decreased from 144.5 to 133.5 ft^2 (7.6 percent reduction in potential living space) (Table 2). Average cross sectional velocities increased from 0.23 to 0.34 fps between the Pre- and Post surveys.

Cloverdale Reach

Pool: Stream flow decreased from 110 to 93 cfs (17 cfs) at Pool habitats between the Pre- and Post flow reduction surveys. Overall, average widths decreased from 77.3 to 74.0 ft (3.3 ft), and average depths were unchanged at 2.4 ft Pre- and Post surveys. Cross sectional areas in Pools were measured to decrease from 169.7 to 161.5 ft^2 (3.8 percent decrease in potential living space) (Table 2). Average cross section velocities were unchanged between the Pre- and Post surveys at 0.55 fps, respectively (Table 3).

Riffles: Stream flow decreased from 110 to 93 cfs (17 cfs) riffle habitats. Overall, widths were essentially unchanged (92.9 ft) and depths decreased from 1.1 to 0.9 ft (0.2) between the Pre- and Post flow reduction surveys. Cross sectional areas in riffles decrease from 67.2 to 55.1 ft^2 (18.0 percent decrease in potential living space) (Table 2). Average cross section velocities decreased from 1.42 and 0.46 fps, between the Pre- and Post flow reduction surveys (Table 3).

Flatwaters: Stream flow decreased from 110 to 93 cfs (17 cfs) at Flatwater habitats between the Pre- and Post flow reduction surveys. Overall, widths decreased from 91.3 to 90.4 ft (0.9 ft), and depths decreased from 1.4 to 1.3 ft (0.1 ft). Cross sectional areas in flatwaters were measured to decrease from 120.9 to 110.1 ft (8.9 percent decrease in potential living space) (Table 2). Average cross section velocities decreased from 0.71 and 0.54 fps between the Pre- and Post flow reduction surveys (Table 3).

Table 2. Overall cross sectional areas measured in pool, riffle and flatwater habitats at each of the seven study reaches, Pre- and Post Flow reductions.

Pools					
		Cross Sectional Area			
Reach	**Average Change in flow (cfs)**	**Pre- (ft^2) (June)**	**Post (ft^2) (August)**	**Difference (ft^2)**	**% Change**
Ukiah	+6	164.2	158.5	-5.7	-2.0%
Comminsky	-20	308.1	297.8	-10.3	-3.3%
Cloverdale	-17	167.9	161.5	-11.0	-3.8%
Geyserville	-13	165.4	150.7	-14.7	-8.9%
Digger's Bend	-74	357.4	344.2	-13.2	-6.1%
Healdsburg	-69	278.1	246.8	31.3	-13.2%
Below Dry Creek	-48	234.6	231.3	-3.4	-0.2%
Riffles					
		Cross Sectional Area			
Reach	**Average Change in flow (cfs)**	**Pre- (ft^2) (June)**	**Post (ft^2) (August)**	**Difference (ft^2)**	**% Change**
Ukiah	-1	50.9	52.0	+1.1	+2.0%
Comminsky	-20	65.2	58.3	-6.9	-10.6%
Cloverdale	-17	67.2	55.1	-12.1	-18.0%
Geyserville	-13	50.9	36.0	-14.9	-29.2%
Digger's Bend	-74	75.9	45.8	-30.1	-39.6%
Healdsburg	-69	55.1	35.3	-19.9	-36.0%
Below Dry Creek	-72	85.1	67.5	-17.6	-20.7%
Flatwaters					
		Cross Sectional Area			
Reach	**Average Change in flow (cfs)**	**Pre- (ft^2) (June)**	**Post (ft^2) (August)**	**Difference (ft^2)**	**% Change**
Ukiah	-2	86.8	90.6	+3.8	+2.8%
Comminsky	-20	144.5	133.5	-11.0	-7.6%
Cloverdale	-17	120.9	110.1	-15.3	-8.9%
Geyserville	-13	109.1	91.0	-18.1	-16.6%
Digger's Bend	-74	161.1	133.4	-27.7	-17.2%
Healdsburg	-69	94.4	70.5	-23.9	-24.6%
Below Dry Creek	-72	144.3	128.5	-15.8	-11.0%

Table 3. Stream flows and average transect velocities measured in Pool, Riffle, and Flatwater habitats Pre- and Post flow reduction.

Transect	Stream Flow (cfs)			Average Transect Velocity (fps)		
	Pre-	Post	Change	Pre-	Post	Change
Ukiah Reach						
Pool 1, T-1	111	115	+4	N/A		
Riffle 1, T-2	118	115	-3	1.41	1.06	0.35
Flatwater 1, T-2	111	115	+4	N/A		
Comminsky Station Reach						
Pool 1, T-1	123	103	-20	0.51	0.33	-0.18
Riffle 1, T-2	123	103	-20	1.62	1.40	-0.22
Flatwater 1, T-2	123	103	-20	0.23	0.34	+0.11
Cloverdale Reach						
Pool 1, T-1	110	93	-17	0.55	0.55	0.00
Riffle 1, T-2	110	93	-17	1.42	0.46	-0.96
Flatwater 1, T-2	110	93	-17	0.71	0.54	-0.17
Geyserville Reach						
Pool 1, T-1	106	93	-13	0.63	0.26	-0.37
Riffle 1, T-2	106	93	-13	1.99	1.30	-0.69
Flatwater 1, T-2	106	93	-13	0.84	0.56	-0.28
Digger's Bend Reach						
Pool 1, T-1	138	64	-74	1.30	0.7	-0.60
Riffle 1, T-2	138	64	-74	1.66	1.3	-0.36
Flatwater 1, T-2	138	64	-74	0.94	0.86	-0.08
Healdsburg Reach						
Pool 1, T-1	132	63	-69	0.72	0.5	-0.22
Riffle 1, T-2	132	63	-69	1.99	1.47	-0.52
Flatwater 1, T-2	132	63	-69	1.32	0.93	-0.39
Below Dry Creek Reach						
Pool 1, T-1	187	146	41	0.84	0.81	-0.03
Riffle 1, T-2	218	146	72	2.13	2.15	+0.02
Flatwater 1, T-2	218	146	72	1.18	0.98	-0.20

Geyserville Reach

Pool: Stream flow decreased from 106 to 93 cfs (13 cfs) at Pool habitats between the Pre- and Post flow reduction surveys. Overall, widths decreased from 70.8 to 68.1 ft (2.7 ft), and depths decreased from 2.5 to 2.4 ft (0.1 ft). Cross sectional areas in Pools were measured to decrease from 165.4 to 150.7 ft^2 (8.9 percent decrease in potential living area) (Table 2). Average cross sectional velocities decreased from 0.63 to 0.26 fps (Table 3).

Riffles: Stream flow decreased from 106 to 93 cfs (13 cfs) at Riffle habitats between the Pre- and Post flow reduction surveys. Average widths decreased from 54.0 to 48.4 ft (5.6 ft) and depths decreased from 1.0 to 0.8 ft (0.2 ft). Cross sectional areas in riffles decrease from 50.9 to 36.0 ft^2 (29.2 percent decrease in potential living space) (Table 2). Average cross sectional velocities decreased from 1.99 to 1.30 fps (Table 3).

Flatwaters: Stream flow decreased from 106 to 93 cfs (13 cfs) at Flatwater habitats between the Pre- and Post flow reduction surveys. Overall, widths decreased from 61.6 to 57.6 ft (4.0 ft) and depths decreased from 1.8 to 1.6 ft (0.2 ft). Cross sectional areas in flatwaters decrease from 109.1 to 91.0 ft^2 (16.6 percent decrease in potential living space) (Table 2). Average cross sectional velocities decreased from 0.84 to 0.56 fps (Table 3).

Digger's Bend Reach

Pools: Stream flow decreased from 138 to 64 (74 cfs) at Pool habitats between the Pre- and Post flow reduction surveys. Overall, widths decreased from 88.2 to 86.3 ft (1.9 ft), and depths decreased from 4.1 to 4.0 ft (0.1 ft). Cross sectional areas in Pools were measured to decrease from 357.4 to 344.2 ft^2 (6.1 percent reduction in potential living space) (Table 2). Average cross sectional velocities decreased from 1.30 to 0.70 fps (Table 3).

Riffles: Stream flow decreased from 138 to 64 (74 cfs) at riffle habitats between the Pre- and Post flow reduction surveys. Transect widths decreased from 91.3 to 83.6 ft (7.7 ft), and depths decreased from 0.9 to 0.6 ft (0.3 ft). Cross sectional areas in riffles were measured to decrease from 75.9 to 45.8 ft^2 (39.6 percent reduction in potential living space) (Table 2). Average cross sectional velocities decreased from 170 to 1.30 fps (Table 3).

Flatwaters: Stream flow decreased from 138 to 64 (74 cfs) at Flatwater habitats between the Pre- and Post flow reduction surveys. Transect widths decreased from 81.2 to 76.5 ft (4.7 ft) and transect depths decreased from 2.0 to 1.8 ft (0.2 ft). Cross sectional areas were measured to decrease from 161.1 to 133.4 ft^2 (18.1 percent reduction in potential living space) (Table 2). Average cross sectional velocities decreased from 0.94 to 0.86 fps (Table 3).

Healdsburg Reach.

Pools: Stream flow decreased from 132 to 63 cfs (69 cfs) at Pool habitats between the Pre- and Post flow reduction surveys. Overall, widths decreased from 102.9 to 98.2 ft (4.8 ft) and average transect depths decreased from 2.9 to 2.6 ft (0.3 ft). Cross sectional areas in Pool transects were measured to decrease from 278.1 to 246.8 ft^2 (13.2 percent reduction in potential living space) (Table 2). Average velocities decreased from 0.72 to 0.50 fps (Table 3).

Riffles: Stream flow decreased from 132 to 63 cfs (69 cfs) at riffle habitats between the Pre- and Post flow reduction surveys. Widths decreased from 47.2 to 43.0 ft (4.2 ft) and average transect depths decreased from 1.2 to 0.9 ft (0.3 ft). Cross sectional areas in riffles were measured to decrease from 55.1 to 35.3 ft^2 (36.0 percent reduction in potential living space) (Table 2). Average cross sectional velocities decreased from 1.99 to 1.47 fps (Table 3).

Flatwaters: Stream flow decreased by 69 cfs at Flatwater habitats between the Pre- and Post flow reduction surveys. Overall, transect widths decreased from 73.9 to 71.0 ft (2.9 ft), and average depths decreased from 1.2 to 0.9 ft (0.3 ft). Cross sectional areas in Flatwater habitats were measured to decrease from 94.4 to 70.5 ft^2 (24.6 percent decrease in potential living space) (Table 2). Average cross sectional velocities decreased from 1.32 to 0.93 fps (Table 3).

Below Dry Creek Reach

Pools: Stream flow decreased by 41 to 52 cfs at Pool habitats between the Pre- and Post flow reduction surveys. Overall, widths decreased from 71.9 to 69.6 ft (2.3 ft) and depths decreased from 3.6 to 3.5 ft (0.1 ft). Cross sectional areas in Pools were measured to decrease from 234.6 to 231.3 ft^2 (0.2 percent decrease in potential living space) (Table 2). Average cross sectional velocities decreased from 0.84 to 0.81 fps (Table 3).

Riffles: Stream flow decreased 72 cfs between the Pre- and Post flow reduction surveys at Riffle 1. Transect widths and depths in Riffle 1 decreased from 74.7 to 70.3 ft (4.3 ft) and average depth decreased from 1.2 to 1.0 ft (0.2 ft) between the two surveys. Cross sectional area at the three transects measured in Riffle 1 decreased from 85.1 to 67.5 (20.7 percent reduction in potential living space) (Table 2). Average cross sectional velocities increased from 2.13 to 2.15 fps (Table 3).

Stream flow decreased 36 cfs between the Pre- and Post surveys at Riffle 2. Measured width at Transect 2 decreased from 86 to 80 ft, and the average depth did not change (0.9 ft) between the two surveys. Cross sectional area decreased from 76.0 to 70.0 ft^2 (5.3 percent reduction in potential living space).

Stream flow decreased 5 cfs between the Pre- and Post surveys At Riffle 3. Width at the two transects decreased 19.0 and 3.0 feet respectively. Average depth was measured to increase by 0.2 cfs at one transect (a case of very shallow water habitat being lost) and remained unchanged at the other transect. Cross sectional area decreased by 7.6 and 9.5 percent at the two transects.

Flatwaters: Stream flow decreased 72 cfs at Flatwaters 1 and 2, and by five cfs at Flatwater 3. Overall, transect widths at Flatwaters 1 and 2 decreased from 84.2 to 79.8 ft (4.3 feet), and depths decreased from 1.2 to 1.0 ft (0.2 ft). Cross sectional areas decreased by an average of 144.3 to 128.5 ft^2 (11.0 percent decrease in potential living space). Widths, depths, and cross sectional area at Flatwater 3 reacted similarly to those measured in Flatwaters 1 and 2. Widths and depths decreased on average by 5.3 and 0.2 ft, respectively, and the cross sectional area decreased by 12.5 percent. Average cross sectional velocities decreased from 1.18 to 0.98 fps (Table 3).

SUMMARY

Flows were essentially unchanged in the Ukiah Reach, declined by approximately 15 percent in the middle reaches (13 to 20 cfs), and declined by approximately 47 to 65 percent in the lower reaches (69 to 74 cfs). Overall, a reduction in stream flow resulted in a slight decrease in stream widths and depths, and an overall reduction in stream velocities. Of the variables measured, cross sectional area appeared to be the most descriptive in terms of assessing the affects of reduced stream flow on physical habitat. Flow velocities were highly variable and were influenced by channel geomorphology. Cover changed little with a reduction in flow. Cover was found primarily in relatively deep areas that were not subject to large changes in stream width over the range of stream flow reductions observed during this study. Deeper pool habitats changed little despite the reduction in flow. Shallower habitats were susceptible to change and in some instances the amount of available living space in riffles and flatwaters was reduced by approximately 40 percent.

Stream flows in the Ukiah Reach were essentially unchanged between the Pre- and Post surveys (±9 cfs) and measured cross sectional areas in pools, riffles, and flatwaters changed by ±2.8 percent between the Pre- and Post surveys. Since flows were essentially unchanged in this reach of the river, the data collected likely reflect the inherent error associated with this sampling program. Overall, the change in the percent cross sectional areas between the two surveys suggest that this error was likely on the order of 3percent for all habitat types.

JUVENILE STEELHEAD DIVE SURVEYS

A total of 16,384 fish were observed during summer dive surveys consisting of 13 species (Tables 1 and 2). Most of these fish consisted of native and non-native warm water species. Only 18 juvenile steelhead were detected at our 12 survey sites. Steelhead were found at artificial cascade habitats (Norgard Dam in Ukiah Valley and Healdsburg Dam at in Healdsburg), a boulder riffle in the Canyon Reach above Comminsky Station, and at the confluence of Dry Creek. The largest concentration of steelhead, 10 fish, was observed at the Dry Creek confluence. In comparison to the eight sites previously sampled during 2002, eight steelhead were detected during 2009 and 788 steelhead were found during 2002 (Table 4).

Water visibility and temperature conditions for steelhead were poor to good during 2009

surveys (Table 1). Water visibility was poor (<1 m) in upper Ukiah Valley and was fair to good (> 2 m) at lower reaches. Water temperatures ranged from 16.0 C in upper Ukiah Valley and gradually increased to 23.3 C in Healdsburg. River water below Dry Creek was substantially cooler (15.6 C). All of the eight comparison study sites were 1-4 C cooler in 2009 than in 2002.

Rearing steelhead were found in relatively large numbers in the Canyon Reach in summer 2002, but few were present this year even though water temperatures were cooler in the Canyon Reach in 2009 than in 2002. The low abundance of rearing steelhead may be due to low adult spawning. The two hatcheries in the Russian River basin had the lowest steelhead returns on record this past winter.

ADULT CHINOOK SALMON DIVE SURVEYS

A total of five adult Chinook salmon (dive) surveys were conducted during September, 2009 (Table 6). No Chinook salmon were observed. The Russian River mouth was closed from September 6 to October 5, which would prevent adult salmon entering the river. The first salmon recorded at the underwater camera at Mirabel Dam was on October 7. A supplemental dive survey was conducted on October 22, 2009 upstream of the Healdsburg dam where approximately 10 adult Chinook salmon were observed.

ADULT CHINOOK SALMON VIDEO MONITORING

Adult Chinook salmon typically begin their spawning migration in the Russian River during September but immigration does not peak until mid-October to mid-November. Closure of the sand bar at the mouth of the Russian River prevented early arriving Chinook from migrating into the Russian River until flows were increased on October 2 and the mouth opened on October 5. Through November 22, a total of 1,643 adult Chinook salmon were counted at the Mirabel fish counting station (Table 7). Video monitoring is on going and will continue until the Mirabel Inflatable Dam is deflated later this winter. As of November 22, the 2009 adult Chinook run ranks 7th out of the 10 years of sampling. Although Chinook salmon were prevented from entering the river until early October, run timing is similar to other years (Figure 2.) Based on the number of Chinook salmon observed passing Mirabel Dam and recent observations of Chinook salmon spawning in the upper Russian River, it does not appear that low flow conditions during summer 2009 affected adult Chinook salmon.

Table 4. Steelhead observations during summer 2002 and 2009 in the upper Russian River. Each site consisted of a 0.5 km river section. Location of Site C04 was slightly different between survey years. Site numbers correspond to Steelhead Distribution Study Report (Cook 2003).

Location	Site	Vis. (m)	Temp (C)	Steelhead (mm)			TOT
				1-100	101-300	>300	
2002							
Ukiah Valley, below Forks	U01	1-2	20	21	33	1	55
Ukiah Valley, above Perkins Bridge	U02	1-2	20.5	6	1		7
Ukiah Valley, Norgard Dam	U04	1-2	20	51	109	1	161
Canyon, above Squaw Rock	C04	1-2	20	57	56		113
Canyon, above Comminsky Station	C05	1-2	18.9	411	24		435
Alexander Valley, below Crocker Bridge	A01	1-2	22				
Alexander Valley, above Geyserville Bridge (Hwy 128)	A07	1-2	23	1			1
Healdsburg, Healdsburg Dam	H10	>2	24	4	12		16
TOTAL				**551**	**235**	**2**	**788**
2009							
Ukiah Valley, below Forks	U01	0-1	16				
Ukiah Valley, above Perkins Bridge	U02	0-1	18				
Ukiah Valley, Norgard Dam	U04	0-1	16.7	3	2		5
Canyon, below Squaw Rock	(C04)	1-2	17.7				
Canyon, above Comminsky Station	C05	1-2	17.7	1	1		2
Alexander Valley, below Crocker Bridge	A01	1-2	21.1				
Alexander Valley, above Geyserville Bridge (Hwy 128)	A07	>2	22.2				
Healdsburg, Healdsburg Dam	H10	>2	23.3		1		1
TOTAL				**4**	**4**	**0**	**8**
2009 New							
Ukiah Valley, Feliz Creek confluence		1-2	17.2				
Healdsburg, Digger's Bend		>2	21.7				
Lower Healdsburg, Dry Creek confluence		>2	26.7		10		10
Lower Healdsburg, above Riverfront Park		>2	16.7				
TOTAL				**0**	**10**	**0**	**10**

Table 5. Observations of non-salmonids during dive surveys from 2002 and 2009. Each site consisted of a 0.5 km section of river. Location of Site C04 was slightly different in 2002 and 2009.

Location	**Site**	Small Mouth Bass	Large Mouth Bass	Sac Sucker	Tule Perch	Hard-head	Sac Pike-minnow	Cyp-rinids	TS Stickle-back	Carp	Green Sunfish	Bluegill	Sculpin
2002													
Ukiah Valley, below Forks	U01	0		83	0	0	0	66	10	0	0		0
Ukiah Valley, above Perkins Bridge	U02	2		85	0	4	13	600	0	0	0		1
Ukiah Valley, Norgard Dam	U04	1		511	61	1	0	578	300	0	0		2
Canyon, above Squaw Rock	C04	0		298	119	10	9	1760	0	0	0		0
Canyon, above Comminsky Station	C05	2		1819	608	23	1	1737	0	0	0		0
Alexander Valley, below Crocker Bridge	A01	37		1764	1212	40	6	6304	0	0	0		0
Alexander Valley, above Geyserville Bridge (Hwy 128)	A07	5		239	353	18	14	1200	0	0	0		1
Healdsburg, Healdsburg Dam	H10	370		196	79	91	6	605	0	1	27		1
TOTAL		**417**	**0**	**4995**	**2432**	**187**	**49**	**12,850**	**310**	**1**	**27**	**0**	**5**
2009													
Ukiah Valley, below Forks	U01												
Ukiah Valley, above Perkins Bridge	U02												
Ukiah Valley, Norgard Dam	U04	0	0	0	0	0	0	0	0	0	0	0	0
Canyon, below Squaw Rock	(C04)	4	0	115	19	36	23	2060	10	1	0	0	1
Canyon, above Comminsky Station	C05	5	0	449	281	201	29	2589	0	0	0	0	0
Alexander Valley, below Crocker Bridge	A01	3	1	196	116	90	53	1775	0	0	0	0	0
Alexander Valley, above Geyserville Bridge (Hwy 128)	A07	14	0	222	40	102	33	1575	0	0	0	0	0
Healdsburg, Healdsburg Dam	H10	309	0	160	53	1438	43	83	0	0	1	9	0
TOTAL		**335**	**1**	**1142**	**509**	**1867**	**181**	**8082**	**10**	**1**	**1**	**9**	**1**

Table 5. Observations of non-salmonids during dive surveys from 2002 and 2009. Each site consisted of a 0.5 km section of river. Location of Site C04 was slightly different in 2002 and 2009.

Location	**Site**	Small Mouth Bass	Large Mouth Bass	Sac Sucker	Tule Perch	Hard-head	Sac Pike-minnow	Cyp-rinids	TS Stickle-back	Carp	Green Sunfish	Bluegill	Sculpin
2009 New													
Ukiah Valley, Feliz Creek confluence		5	0	47	85	17	1	0	5	0	0	0	0
Healdsburg, Digger's Bend		470	2	450	2	219	45	86	0	0	4	1	0
Lower Healdsburg, Dry Creek confluence		1	0	377	13	245	4	415	101	0	0	0	0
Lower Healdsburg, above Riverfront Park		4	0	241	124	26	27	1185	0	0	0	0	0
TOTAL		**480**	**2**	**1115**	**224**	**507**	**77**	**1686**	**106**	**0**	**4**	**1**	**0**

Table 6. Fish observations during early-fall Chinook salmon migration season 2009 in the lower Russian River.

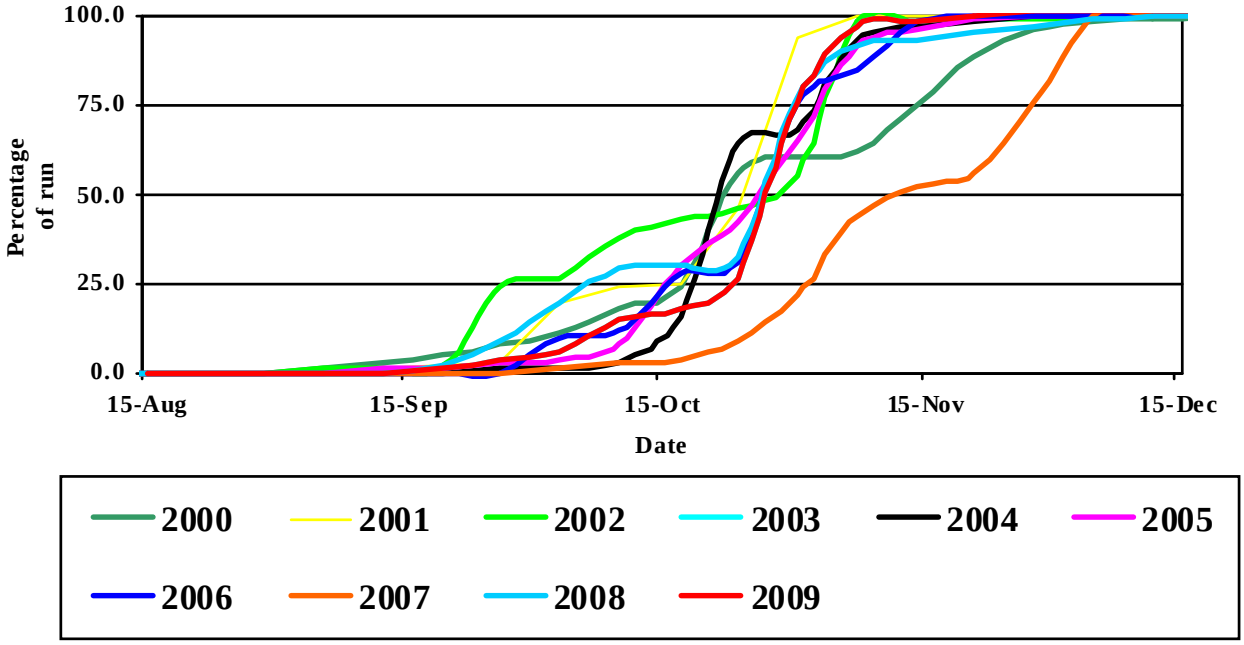
Location and Date	Water Temp (C)	Water Visib. (m)	Dissolve Oxygen (mg/l)	Chin-ook	Steel-head	SM Bass	LM Bass	Sac Sucker	Hard-head	Tule Perch	Sac Pike-minnow	Carp	Hitch/G Shiner	Blue-gill	Black Crappie	Am Shad
Johnson Dam (below)																
9/1/2009	23.3	0-1				present				10		1				
9/8/2009	22.2	0-1	7.5			16		2		6						
9/15/2009	21.3	1-2	8.22			14				2		10				
9/22/2009	22.3	1-2	8.45			14				4		13				
9/29/2009	20.2	0-1	8.82			6		6				12				
Vacation Beach Dam (below)																
9/8/2009	22.2	0-1	7.5		1	12		52		27	14		30			
9/1/2009	23.3	1-2			2	present		present		present	present			present		
9/15/2009	21.6	1-2	8.34		4	12	2	200		12	13	5	15			
9/22/2009	22.5	1-2	8.33		1	4		193	12	3	17	5	40		1	
9/29/2009	19.5	1-2	8.25		2	21		400			25				25	2 (adult)
Geyserville Bridge Pool																
9/1/2009	22.2	1-2				present		present	present	present	present	present				
9/15/2009	23.4	1-2	10.22			8		200	2	23	17					
9/29/2009	20.4	>2	10.41			5		250	60	7		9				
Mirabel Dam (below)																
9/1/2009	17.2	1-2			12	present				present						
9/8/2009	19.9	1-2	8.49		10	1			1	18						
9/15/2009	19.3	1-2	9.17		8	1				22						
9/22/2009	20.4	>2	8.38		8	5		2		2						
9/29/2009	18.1	>2	9.41		13	1				25						

Table 7. Weekly Chinook salmon counts at the Mirabel Dam video fish counting station, Russian River, 2000 – 2009.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1-Aug	0	0	0	0	0	0	0		0	
8-Aug	0	0	0	0	0	0	0		0	
15-Aug	0	0	1	0	0	0	0	0	1	0
22-Aug	1	0	8	0	0	1	0	0	0	0
29-Aug	0	3	7	2	1	4	0	0	2	0
5-Sep	9	1	18	7	1	4	0	0	18	0
12-Sep	38	7	19	20	3	14	3	0	83	0
19-Sep	23	12	65	23	8	14	4	1	124	0
26-Sep	50	17	1,223	181	16	31	8	2	98	0
3-Oct	31	240	113	146	42	27	318	10	13	78
10-Oct	115	51	628	515	52	112	88	39	21	562
17-Oct	81	10	272	232	651	556	529	26	502	177
24-Oct	466	300	153	532	2,287	307	114	103	173	283
31-Oct	63	661	505	2,969	185	611	1,535	249	13	135
7-Nov	24	81	2,337	1,289	1,189	668	299	429	24	335
14-Nov	182		20	47	221	127	458	152	19	41
21-Nov	200		37	95	57	63	54	96	9	128
28-Nov	111		14	45	60	33		375		24
5-Dec	19		54		16			477		6[1]
Total	**1,445**	**1,383**	**5,474**	**6,103**	**4,788**	**2,572**	**3,410**	**1,963**	**1,125**	**1,769**

[1]Note: this report was finalized on December 8, 2009, video monitoring was still in progress at this time.

Figure 2. Cumulative proportion of Chinook salmon that passed Mirabel Inflatable Dam from 2000 to 2009.



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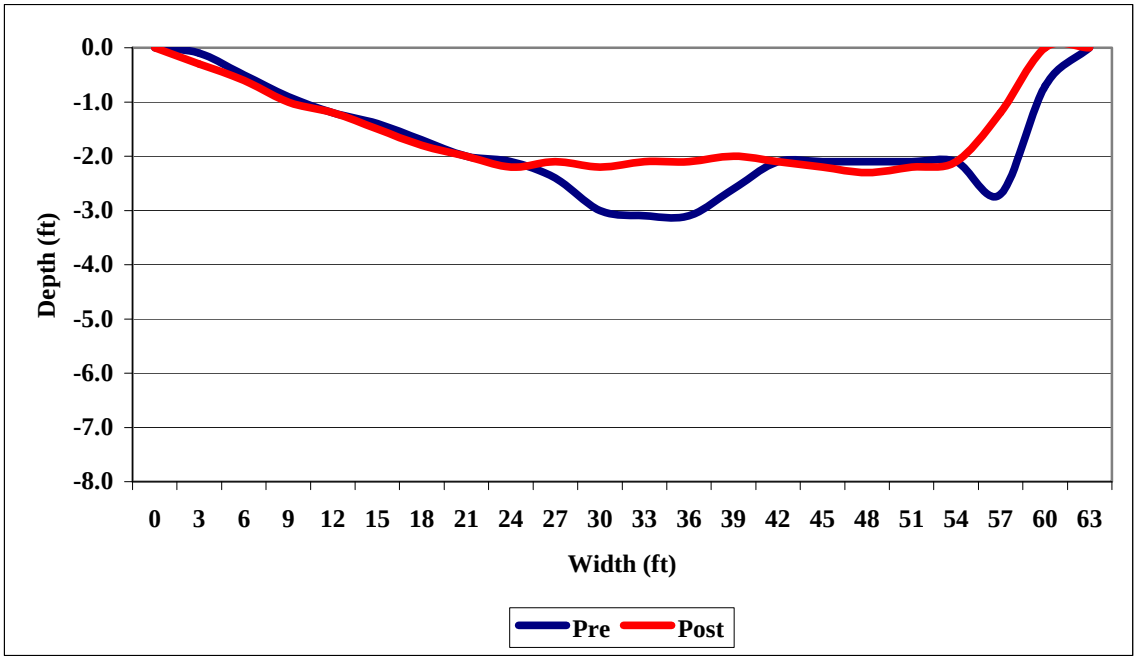
Flosi, G., and F.L. Reynolds, T. Curtis, M. Bird, S. Downie, and J. Hopelain. 1994. California Salmonid Stream Habitat Restoration Manual. Second Edition. California Department of Fish and Game.

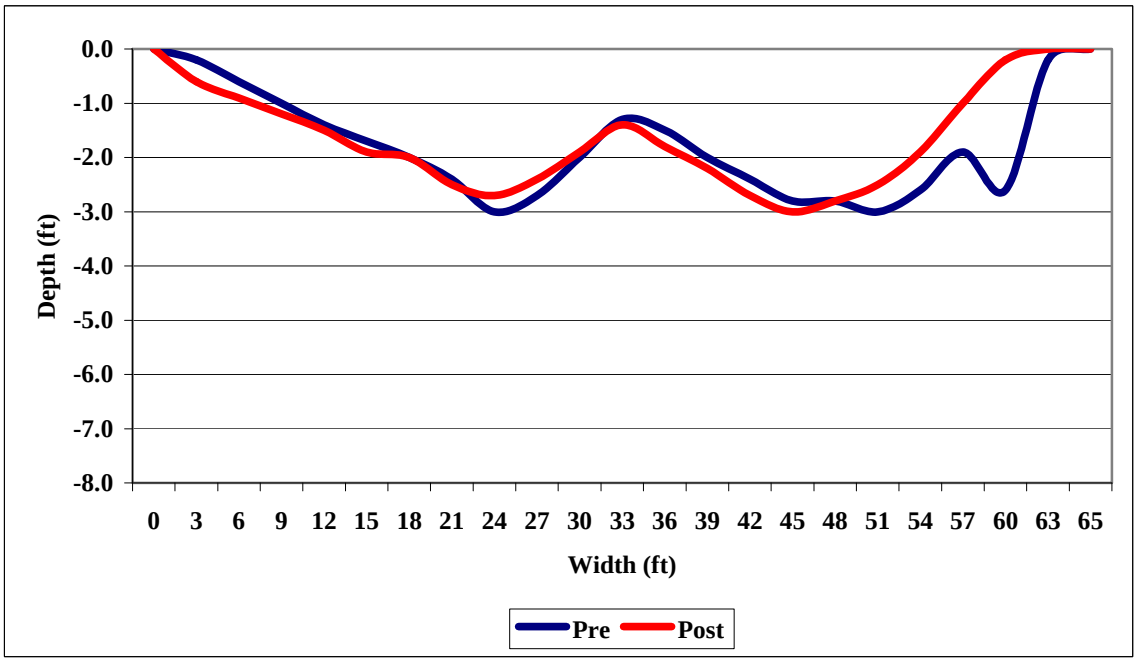
APPENDIX A

UKIAH REACH CROSS SECTIONS

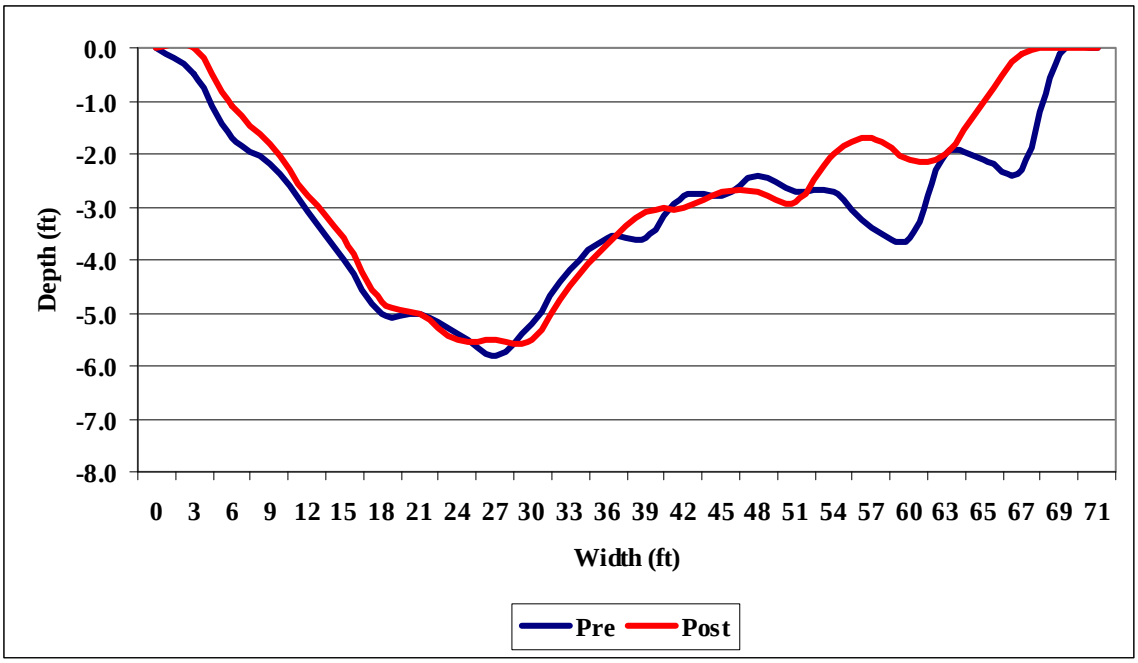
PRE AND POST FLOW REDUCTION SURVEYS



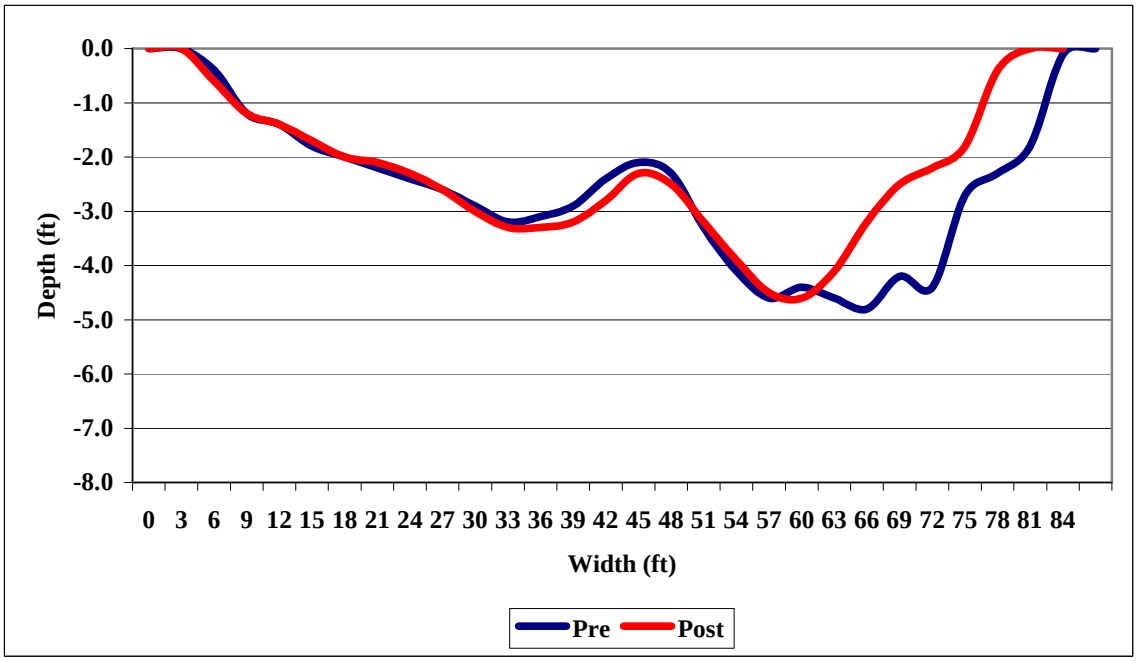
Appendix A-1. Pre and Post cross sections at Pool 1 Transect 1 – Ukiah Reach



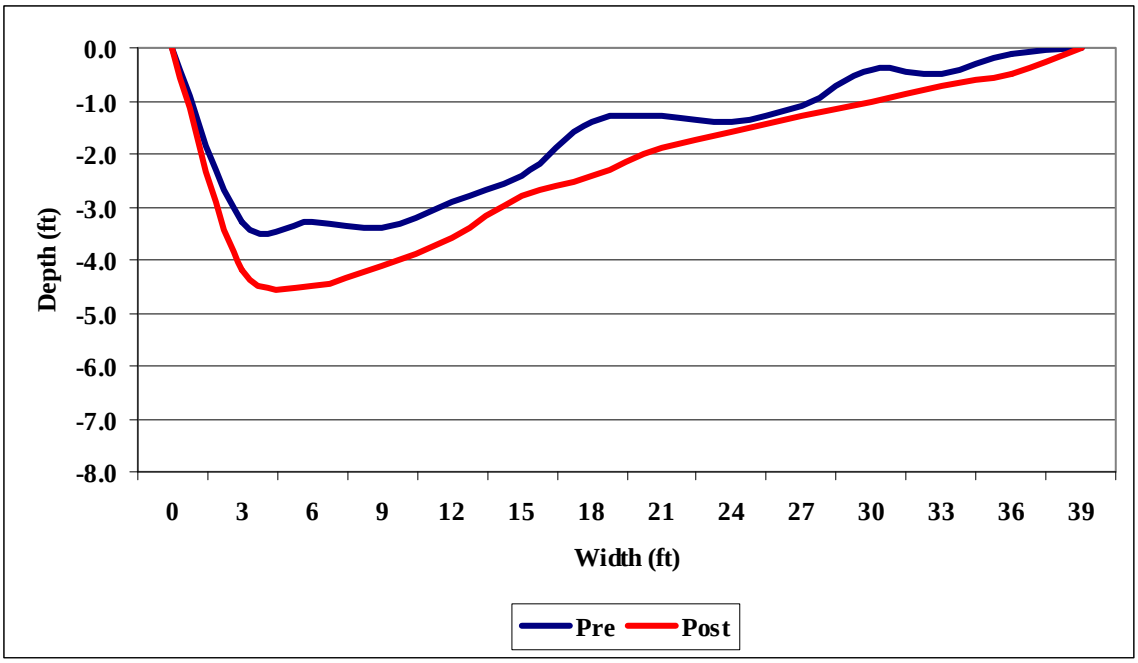
Appendix A-2. Pre and Post cross sections at Pool 1 Transect 2 – Ukiah Reach



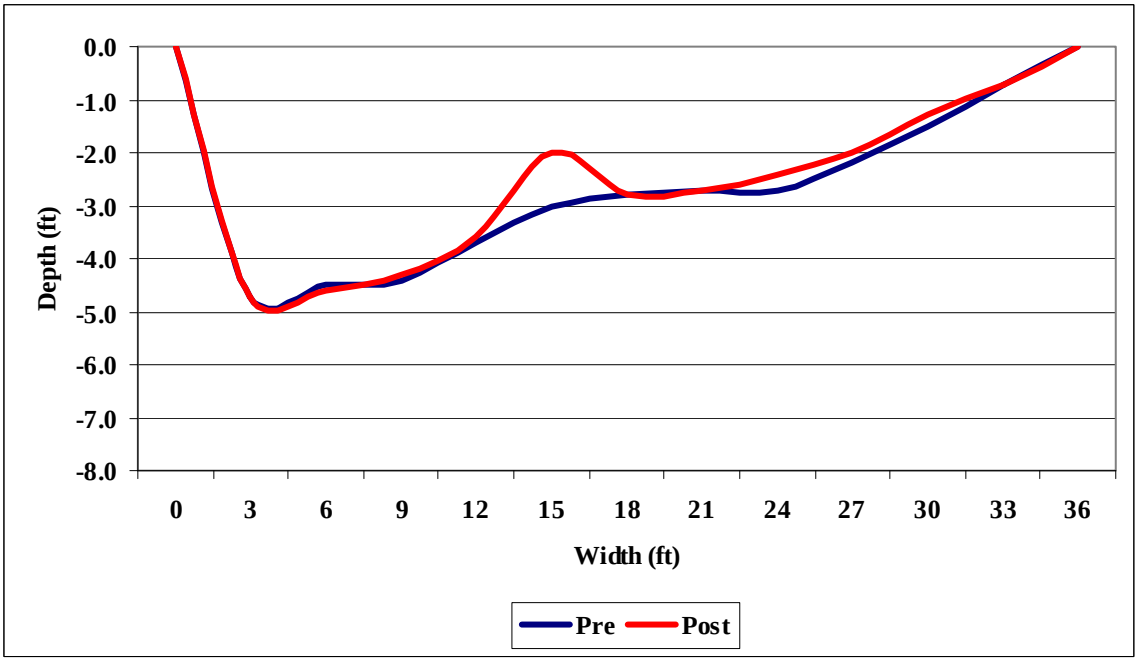
Appendix A-3. Pre and Post cross sections at Pool 1 Transect 3 – Ukiah Reach



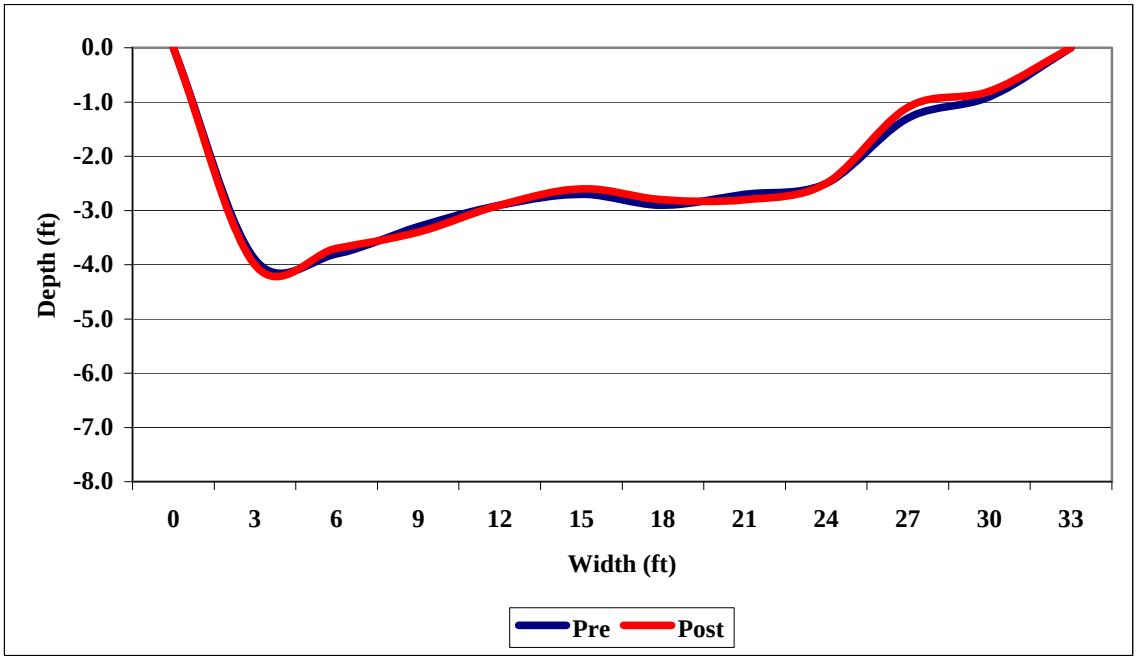
Appendix A-4. Pre and Post cross sections at Pool 1 Transect 4 – Ukiah Reach



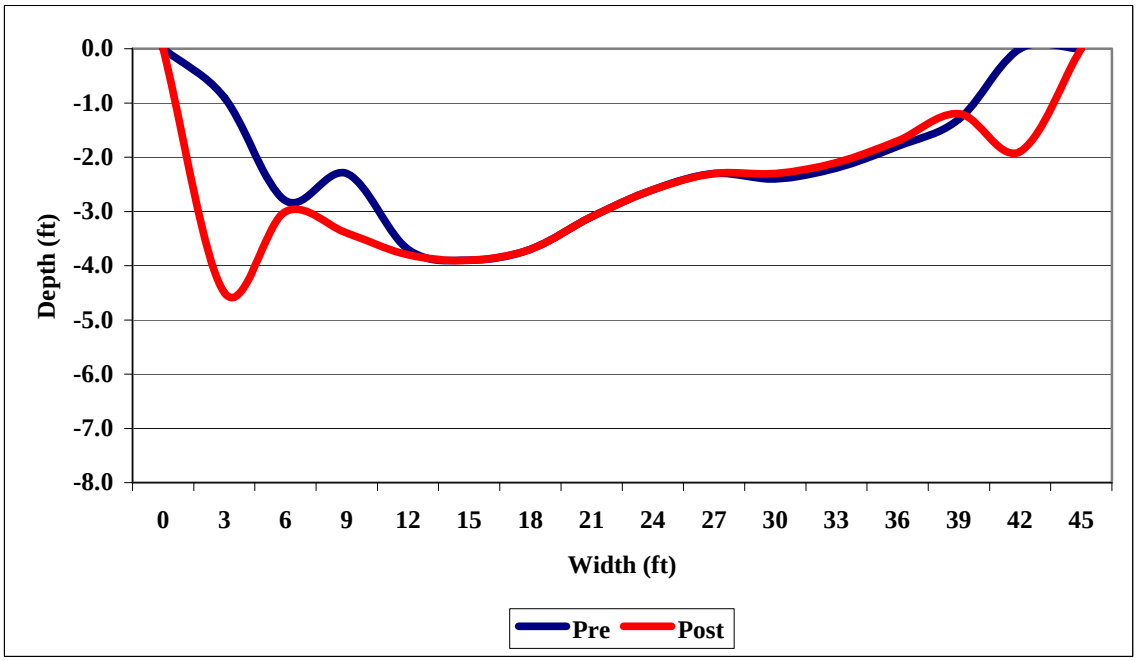
Appendix A-5. Pre and Post cross sections at Pool 2 Transect 1 – Ukiah Reach



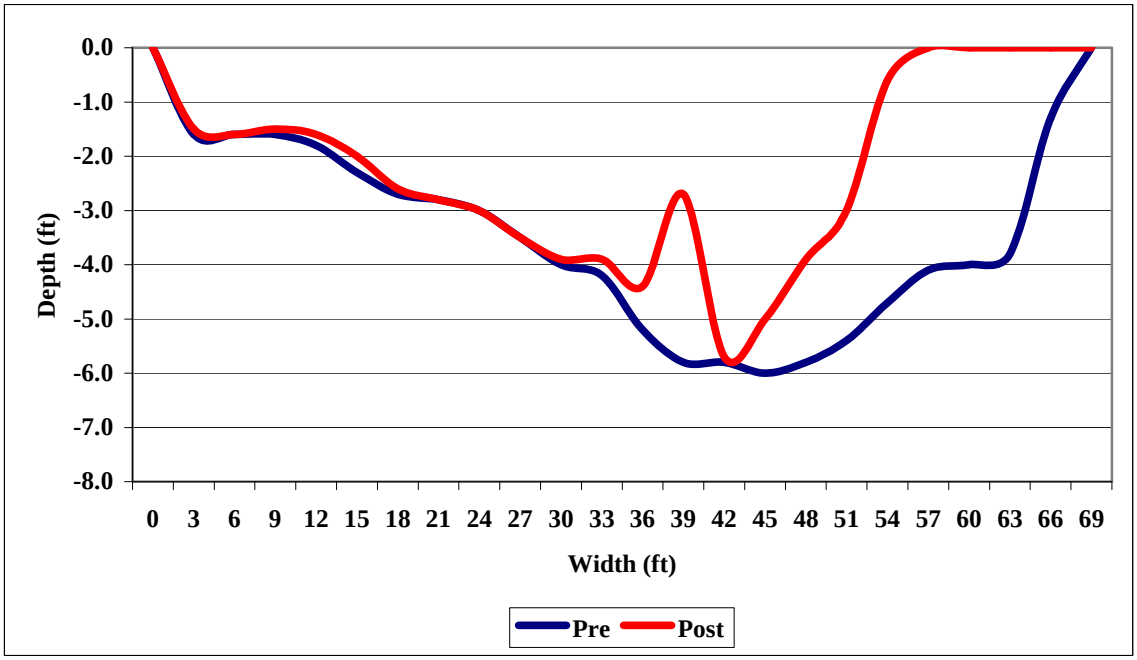
Appendix A-6. Pre and Post cross sections at Pool 2 Transect 2 – Ukiah Reach



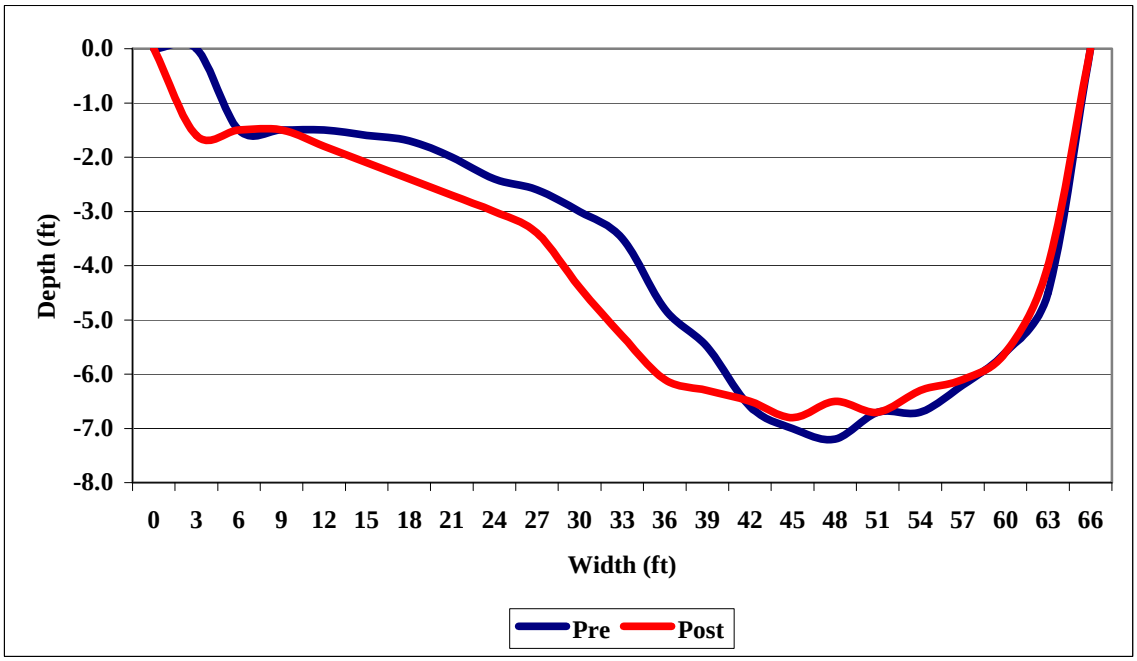
Appendix A-7. Pre and Post cross sections at Pool 2 Transect 3 – Ukiah Reach



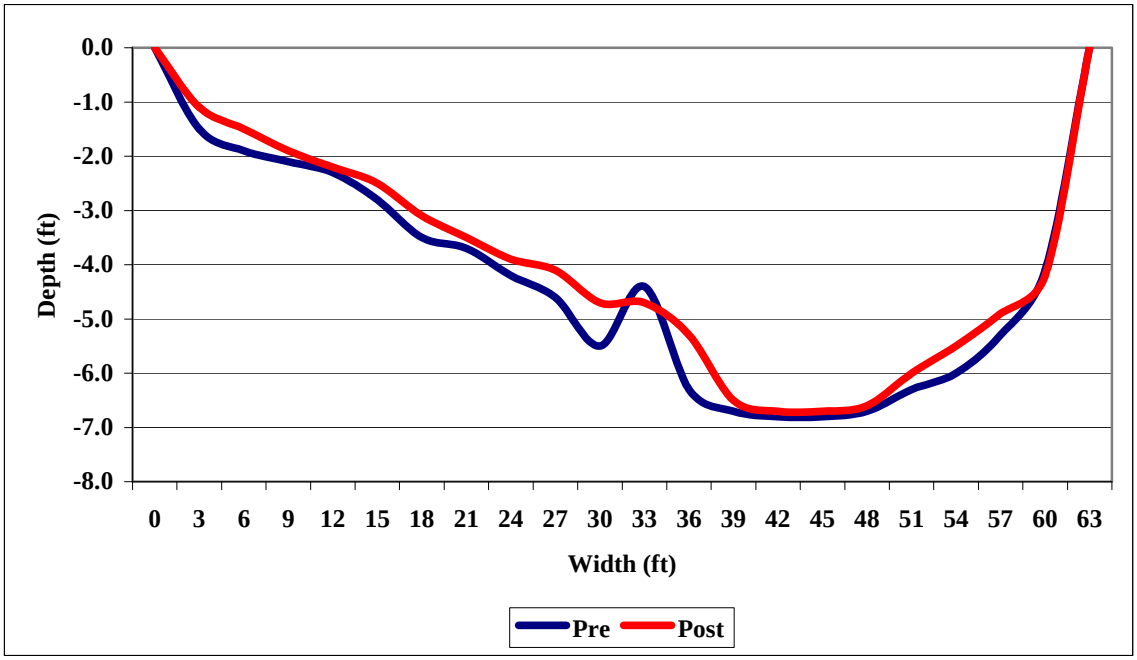
Appendix A-8. Pre and Post cross sections at Pool 2 Transect 4 – Ukiah Reach



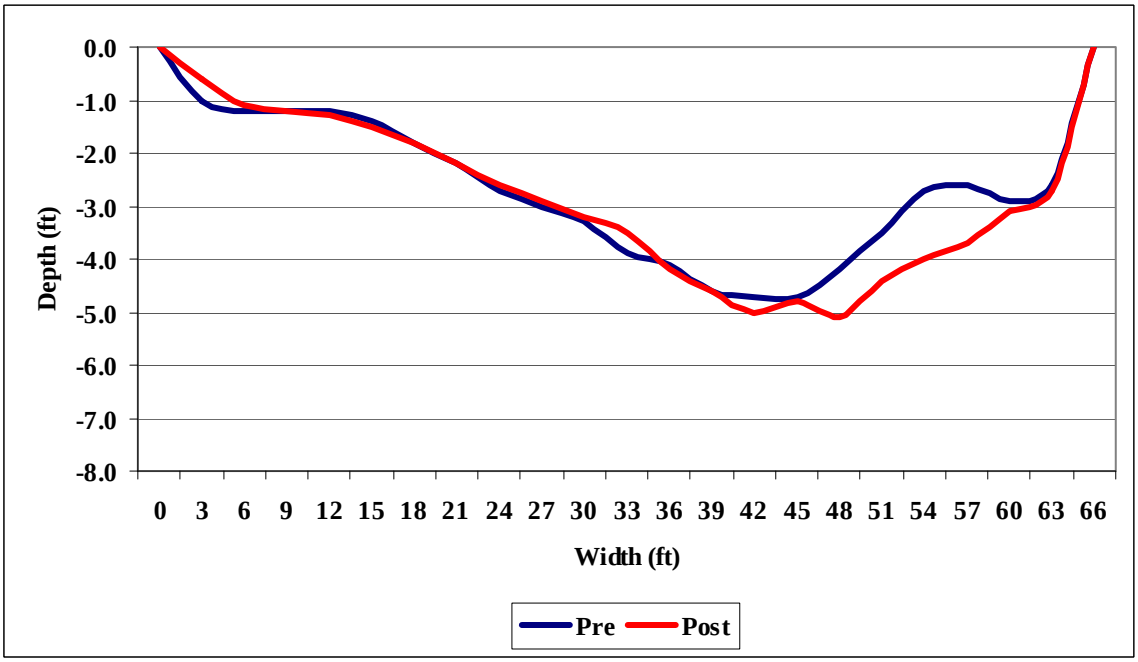
Appendix A-9. Pre and Post cross sections at Pool 3 Transect 1 – Ukiah Reach



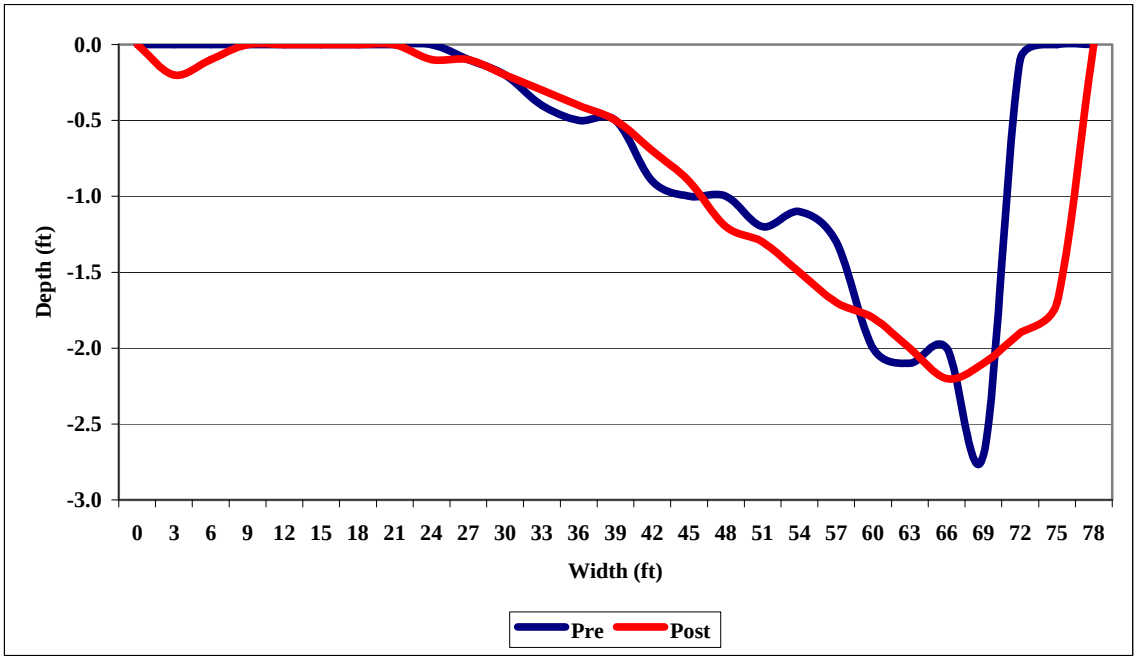
Appendix A-10. Pre and Post cross sections at Pool 3 Transect 2 – Ukiah Reach



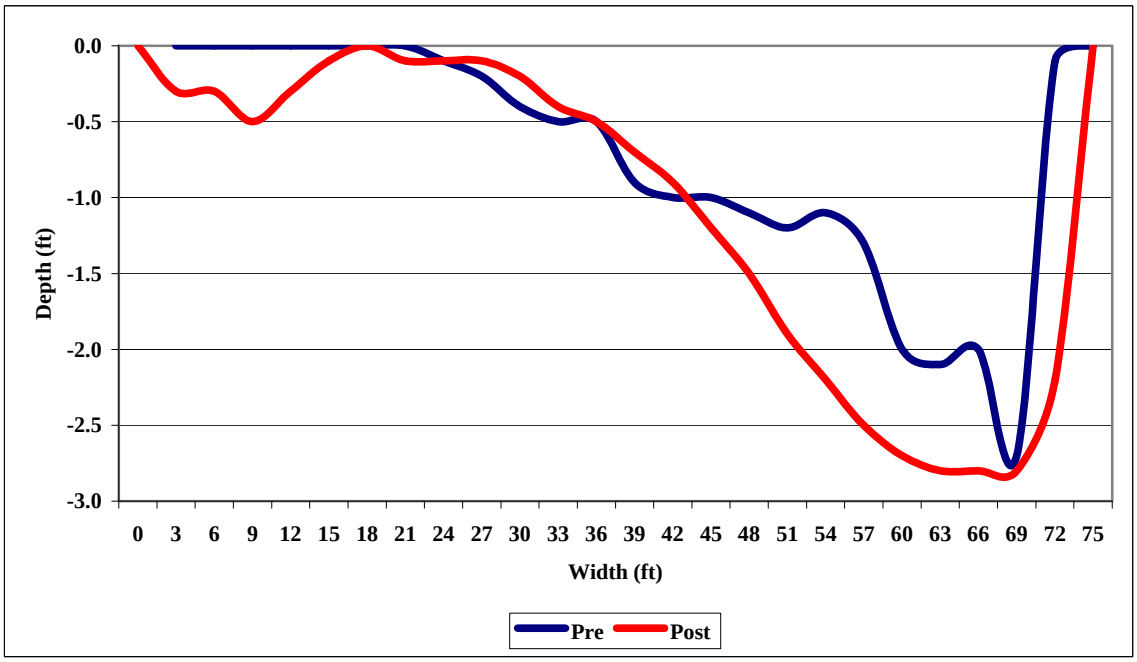
Appendix A-11. Pre and Post cross sections at Pool 3 Transect 3 – Ukiah Reach



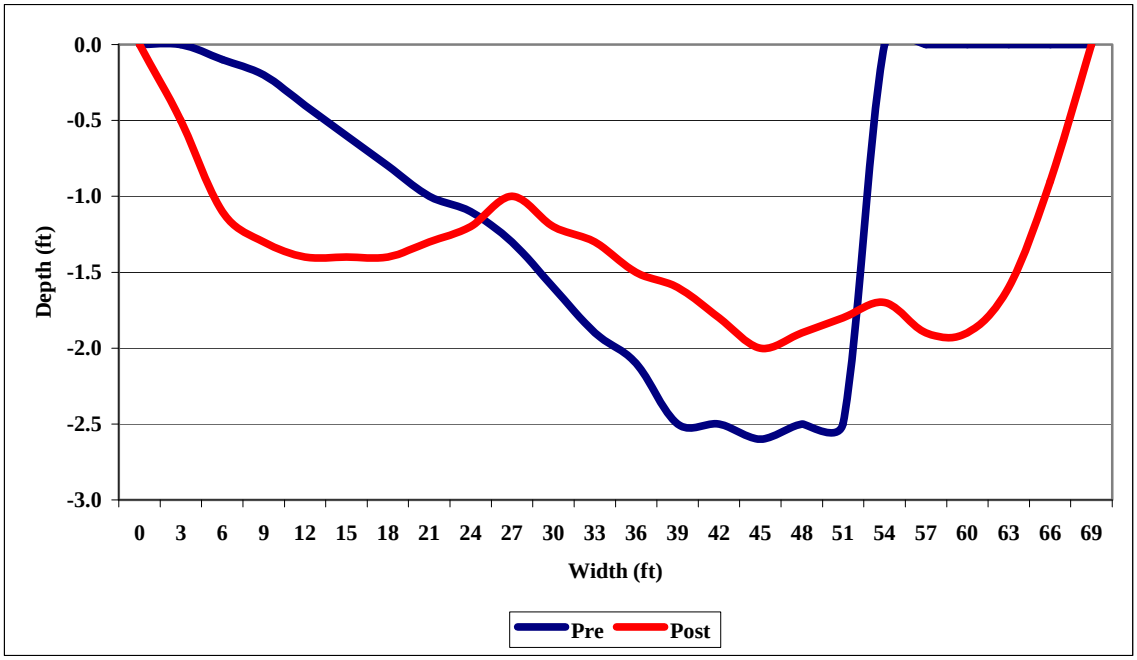
Appendix A-12. Pre and Post cross sections at Pool 3 Transect 4 – Ukiah Reach



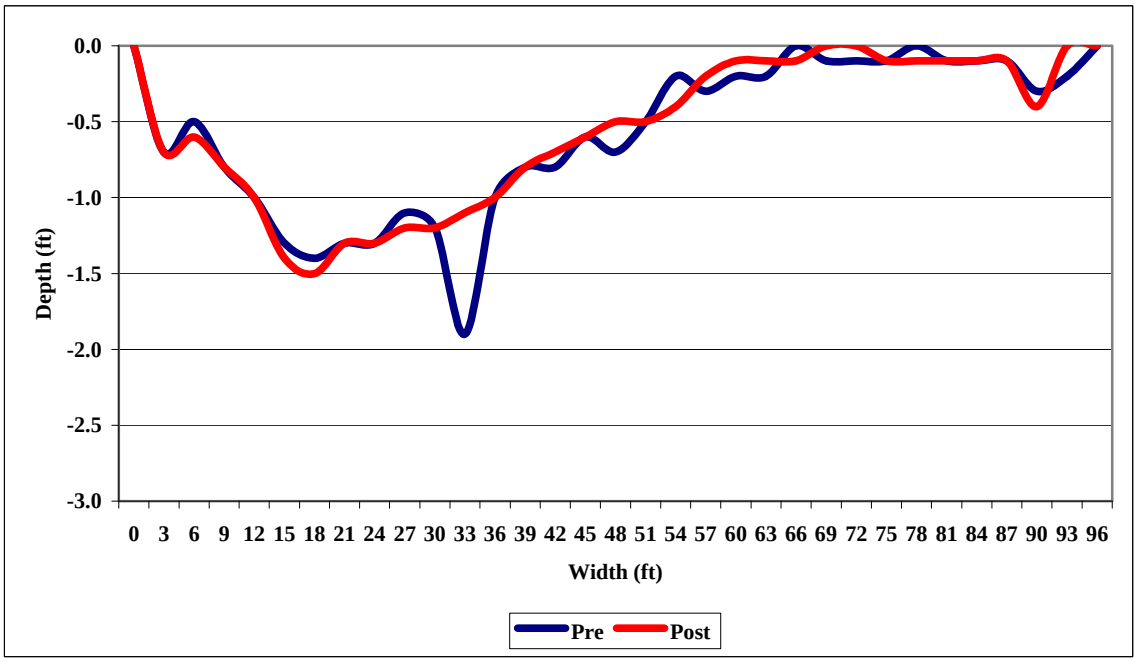
Appendix A-13. Pre and Post cross sections at Riffle 1 Transect 1 – Ukiah Reach



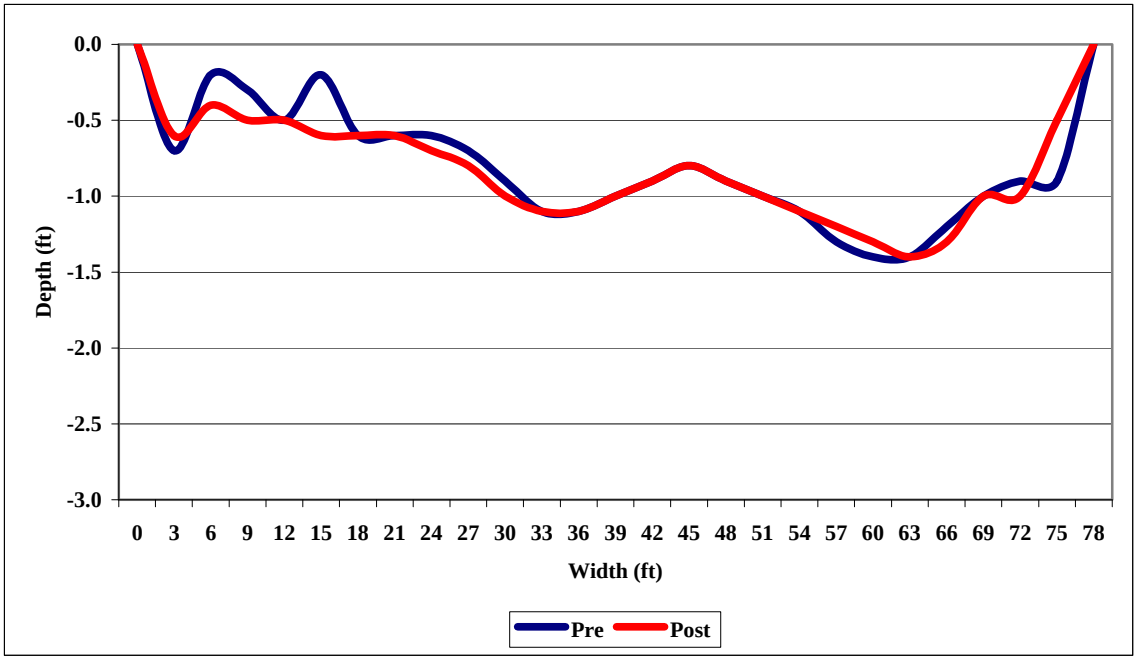
Appendix A-14. Pre and Post cross sections at Riffle 1 Transect 2 – Ukiah Reach



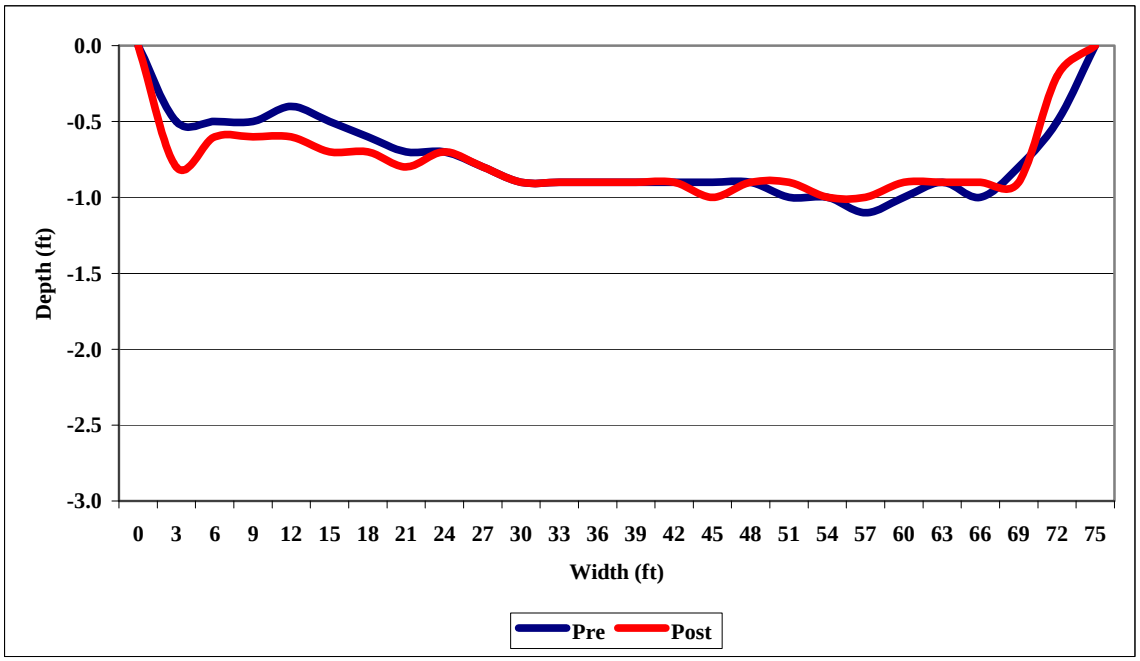
Appendix A-15. Pre and Post cross sections at Riffle 1 Transect 3 – Ukiah Reach



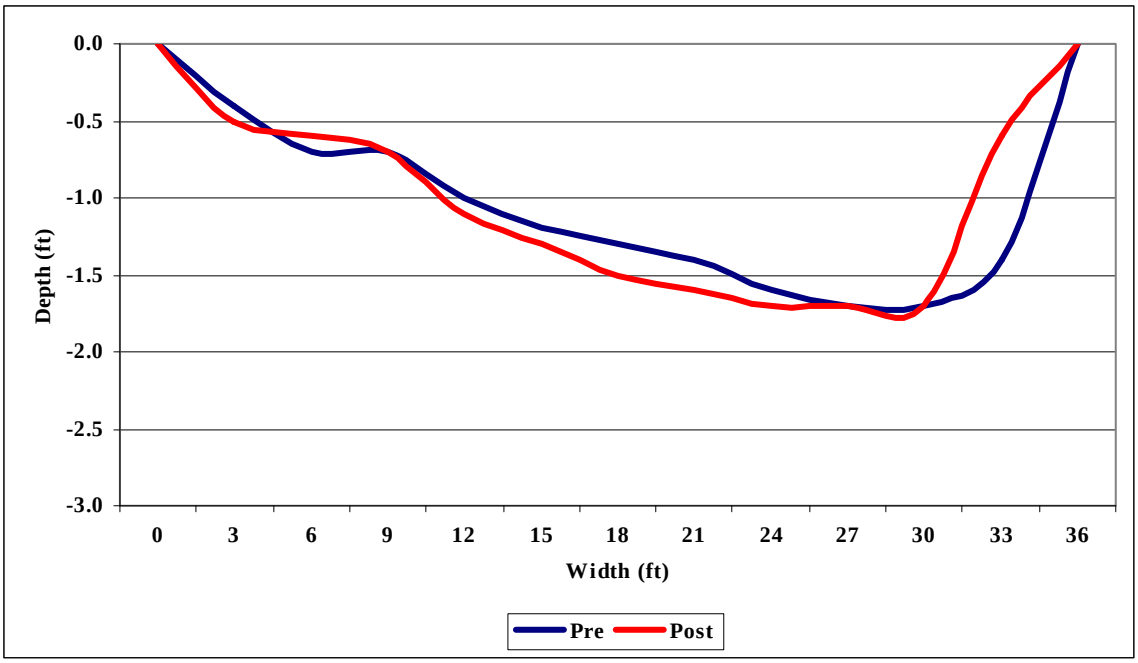
Appendix A-16. Pre and Post cross sections at Riffle 2 Transect 1 – Ukiah Reach



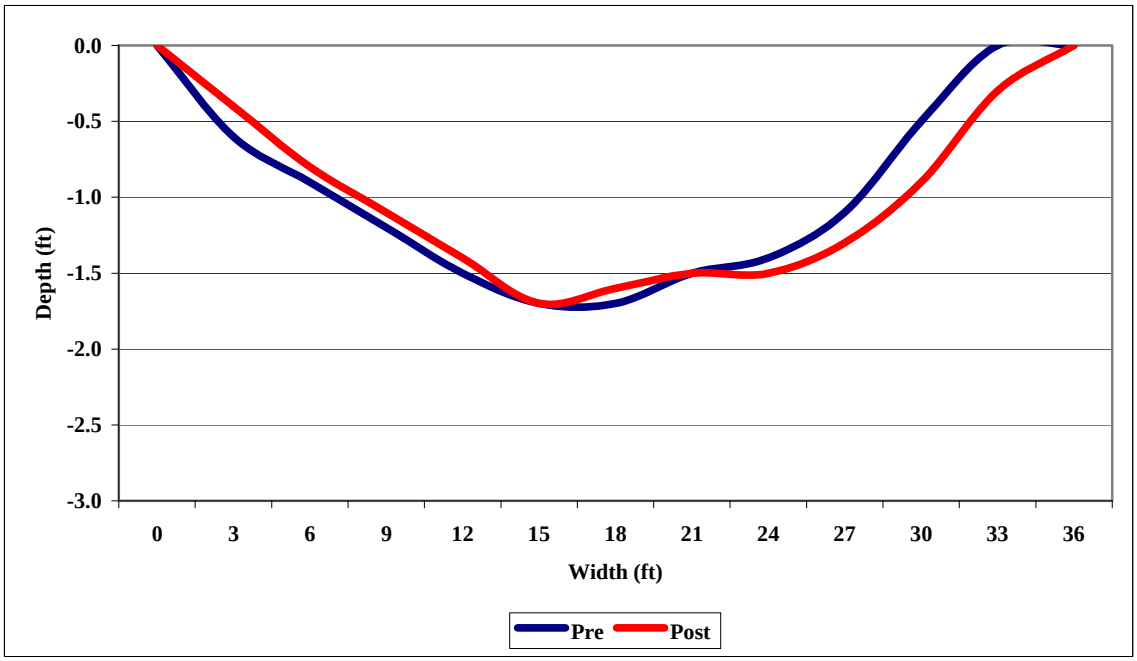
Appendix A-17. Pre and Post cross sections at Riffle 2 Transect 2 – Ukiah Reach



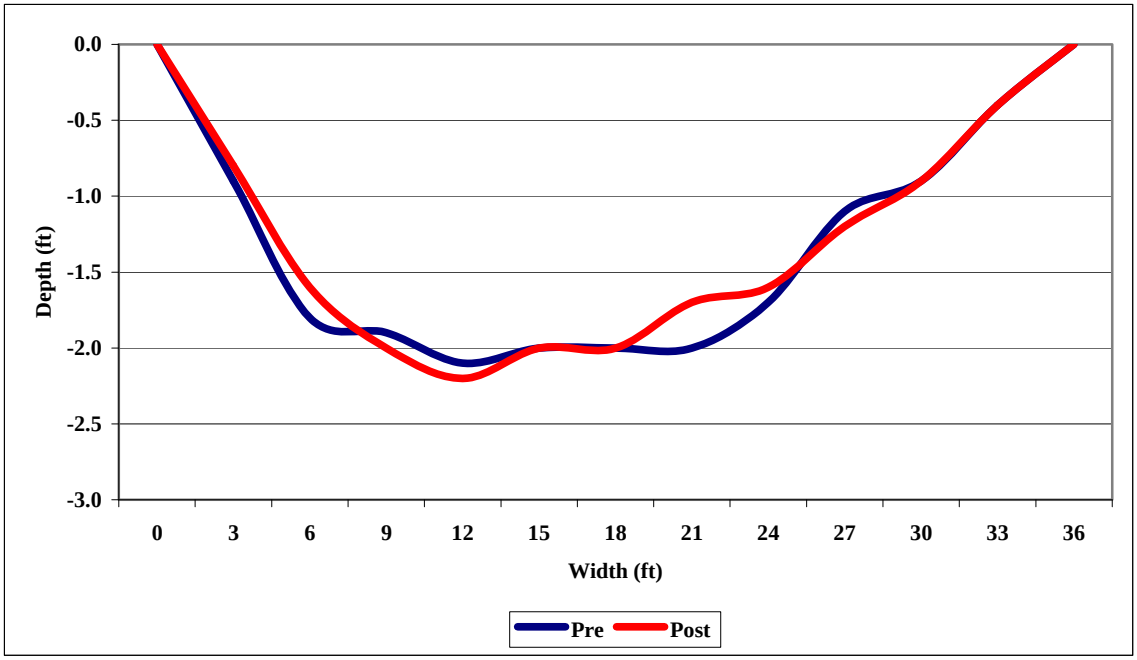
Appendix A-18. Pre and Post cross sections at Riffle 2 Transect 3 – Ukiah Reach



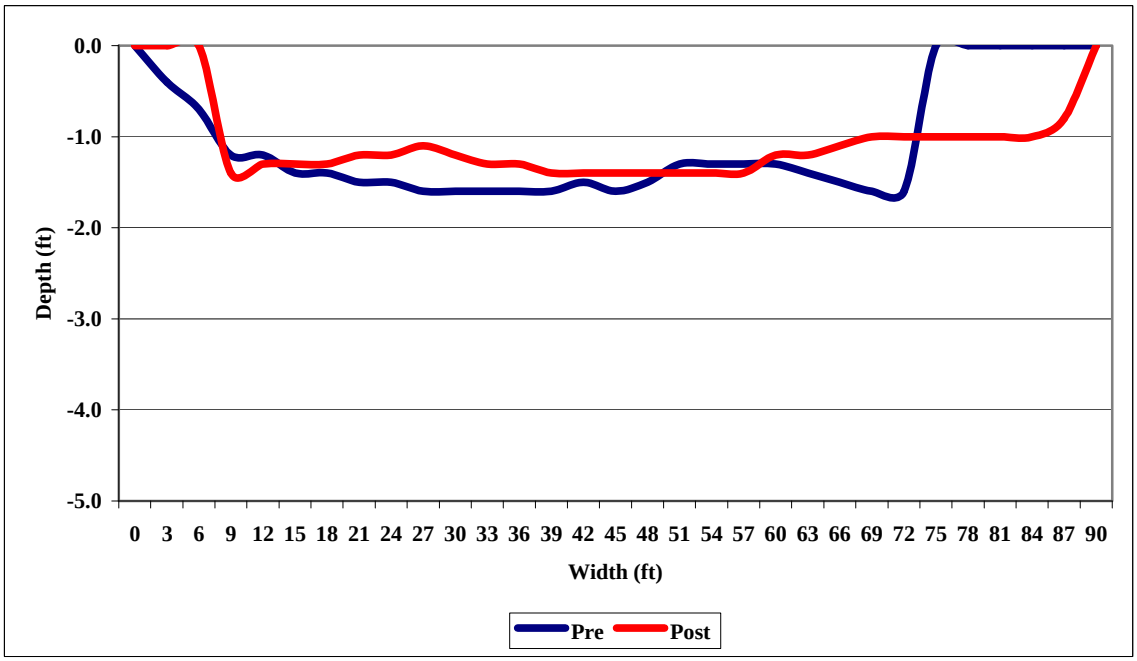
Appendix A-19. Pre and Post cross sections at Riffle 3 Transect 1 – Ukiah Reach



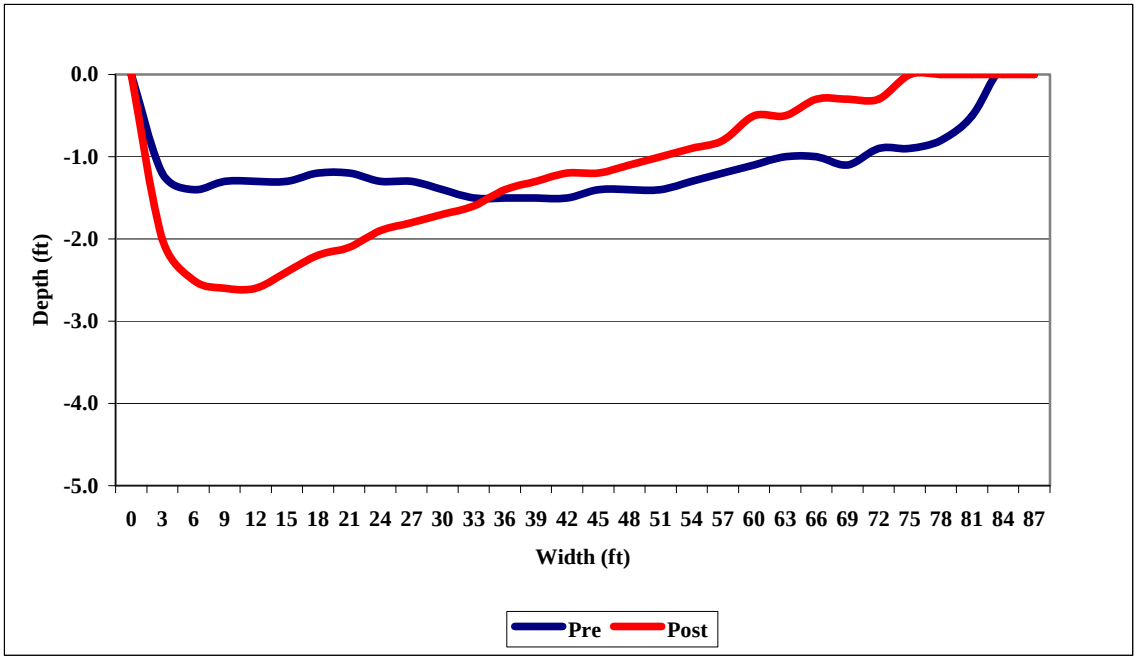
Appendix A-20. Pre and Post cross sections at Riffle 3 Transect 2 – Ukiah Reach



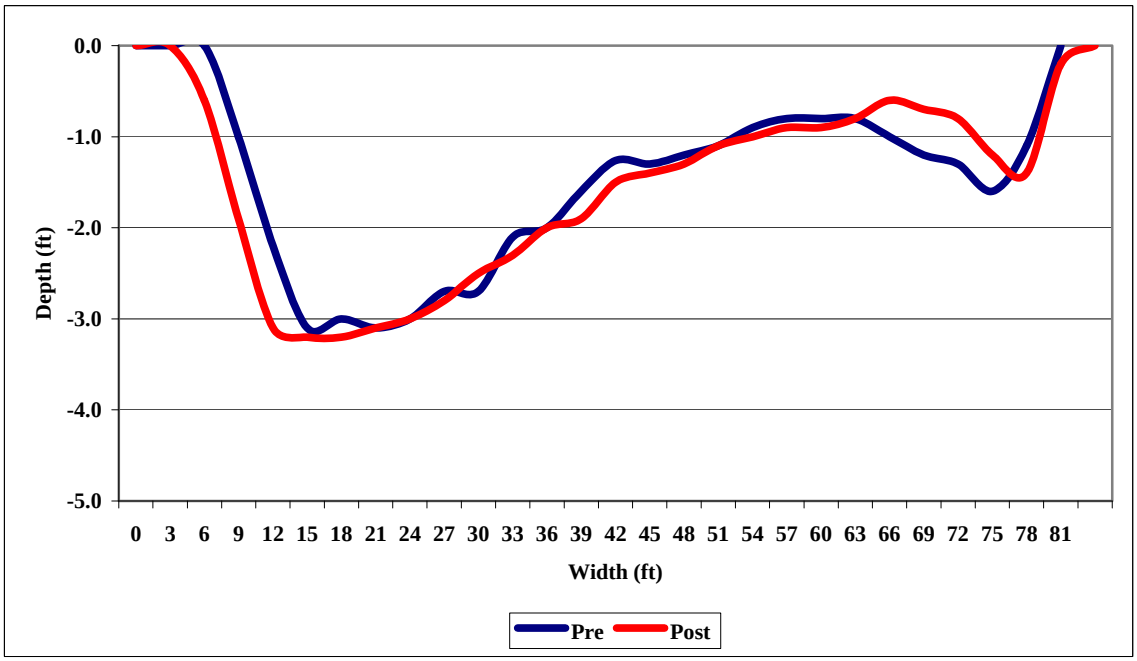
Appendix A-21. Pre and Post cross sections at Riffle 3 Transect 3 – Ukiah Reach



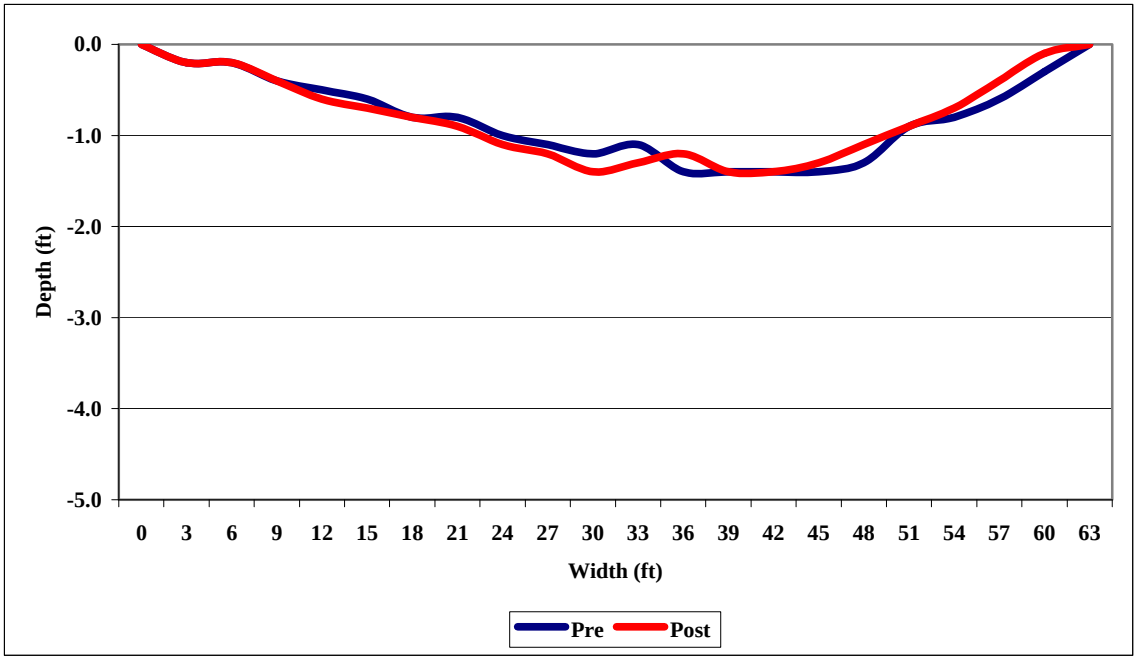
Appendix A-22. Pre and Post cross sections at Flatwater 1 Transect 1 – Ukiah Reach



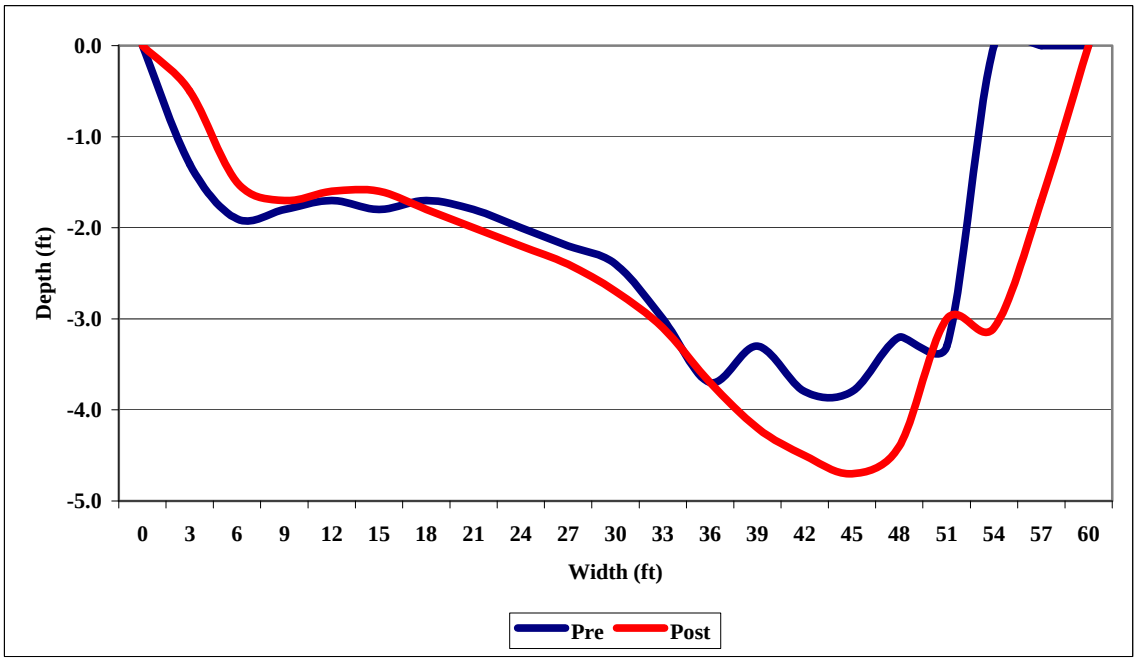
Appendix A-23. Pre and Post cross sections at Flatwater 1 Transect 2 – Ukiah Reach



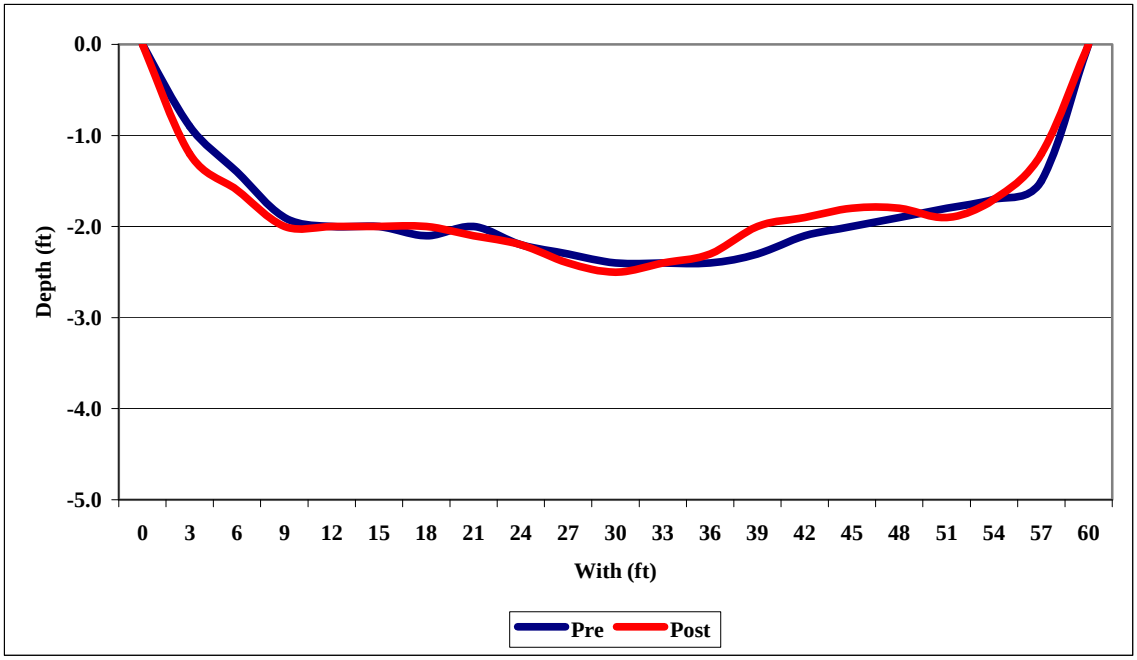
Appendix A-24. Pre and Post cross sections at Flatwater 1 Transect 3 – Ukiah Reach



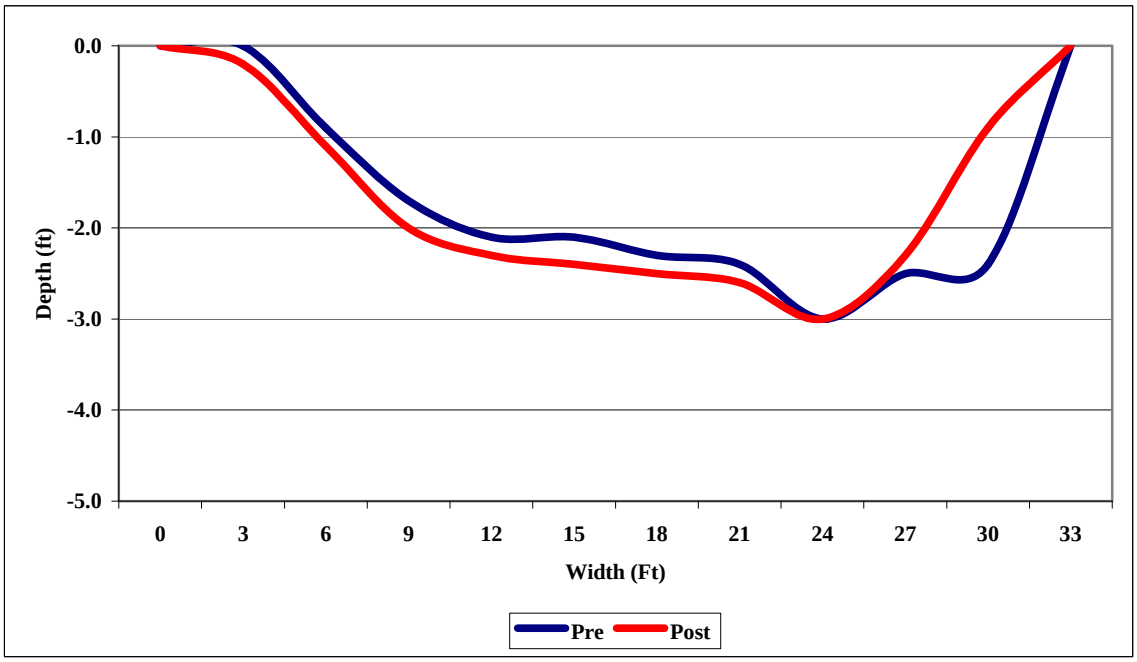
Appendix A-25. Pre and Post cross sections at Flatwater 2 Transect 1 – Ukiah Reach



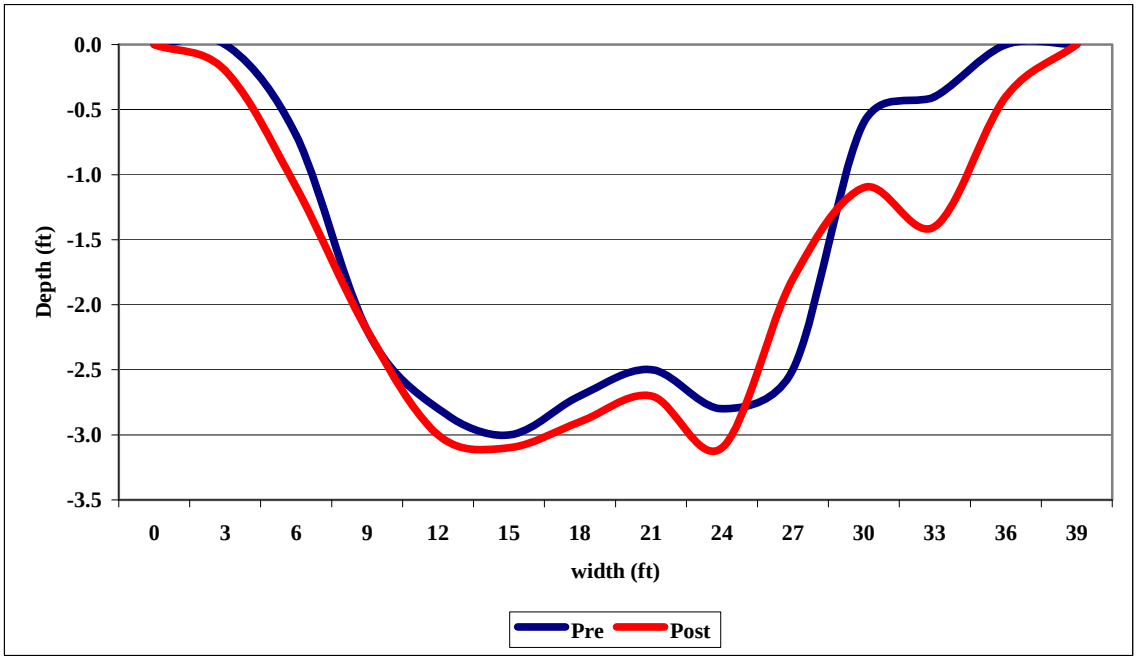
Appendix A-26. Pre and Post cross sections at Flatwater 2 Transect 2 – Ukiah Reach



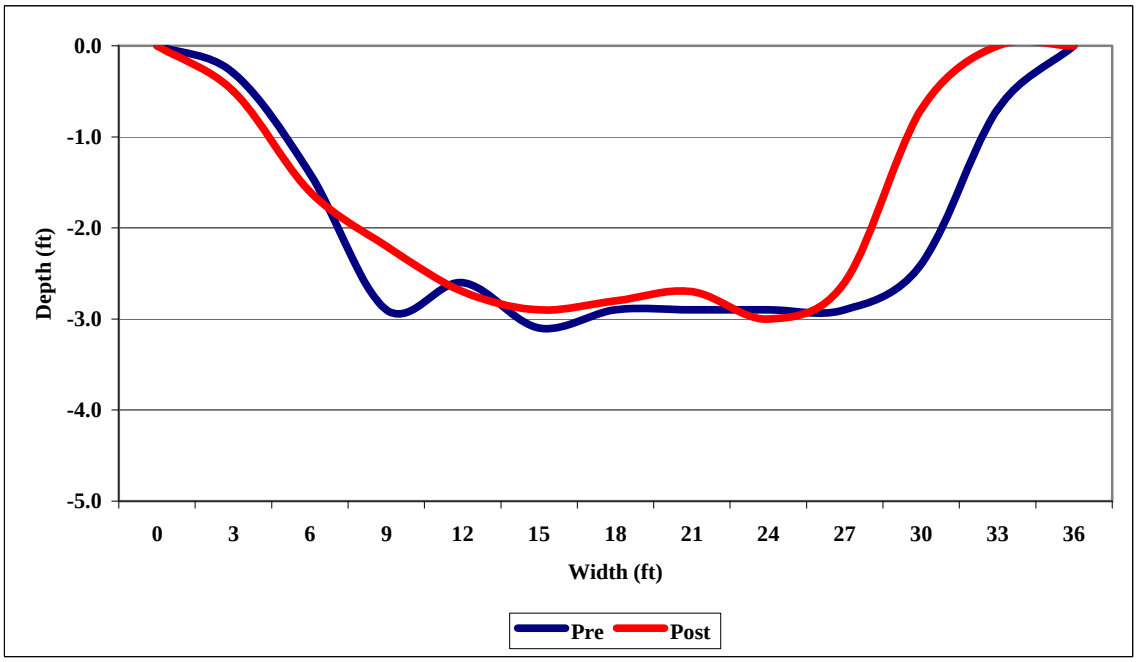
Appendix A-27. Pre and Post cross sections at Flatwater 2 Transect 3 – Ukiah Reach



Appendix A-28. Pre and Post cross sections at Flatwater 3 Transect 1 – Ukiah Reach



Appendix A-29. Pre and Post cross sections at Flatwater 3 Transect 2 – Ukiah Reach

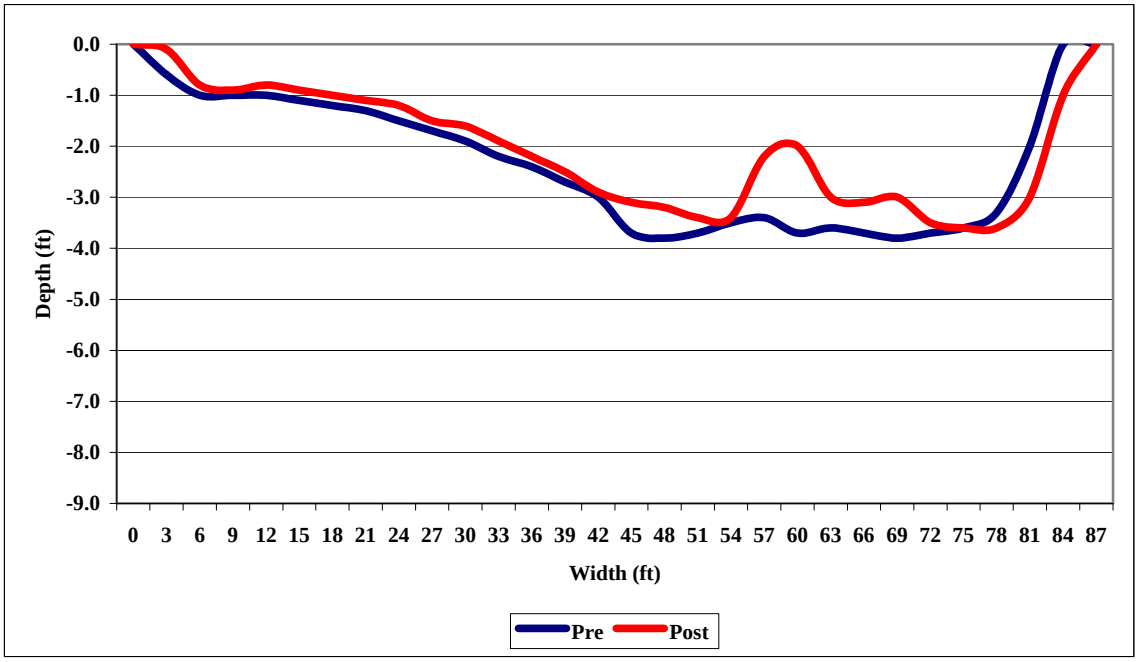


Appendix A-30. Pre and Post cross sections at Flatwater 3 Transect 3 – Ukiah Reach

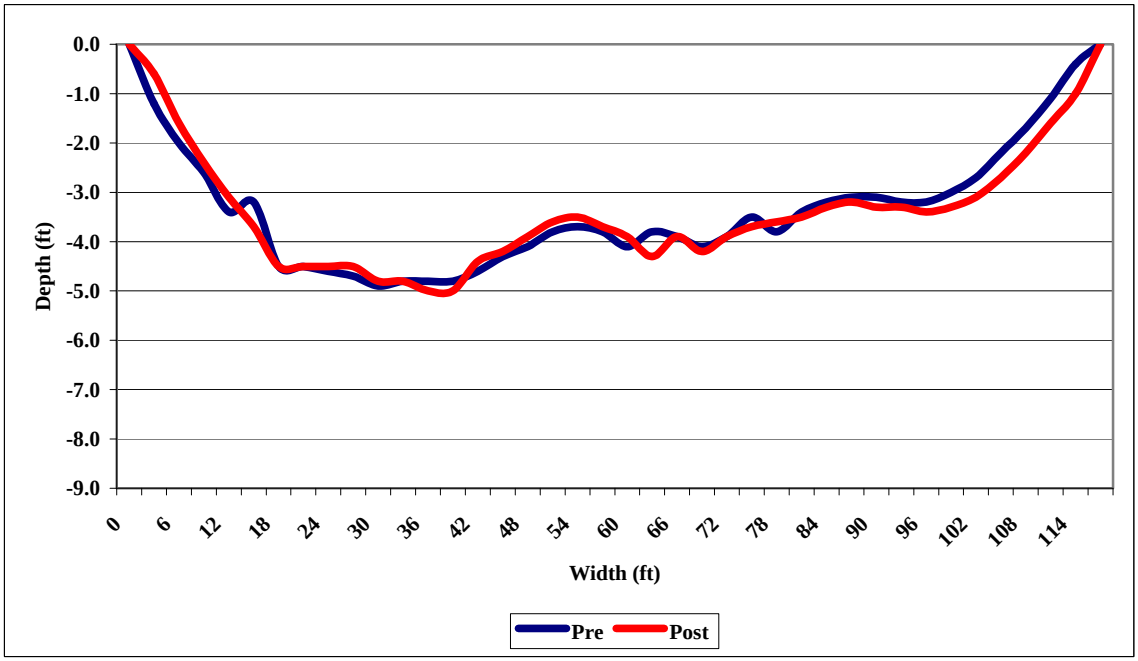
APPENDIX B

COMMINSKY STATION REACH CROSS SECTIONS

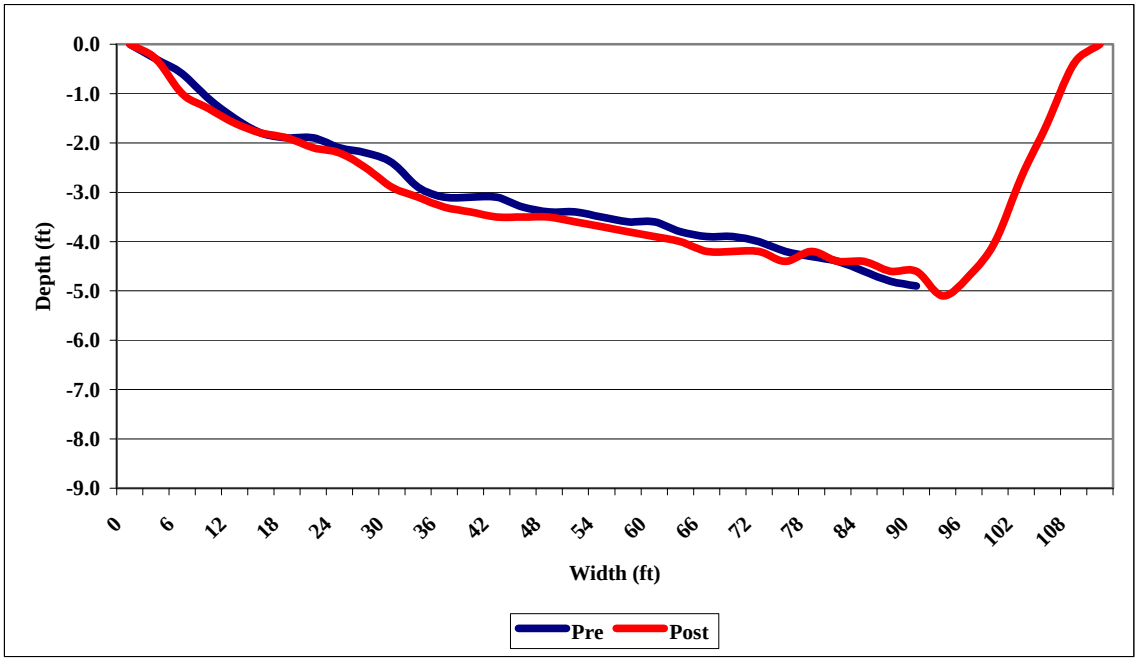
PRE AND POST FLOW REDUCTION SURVEYS



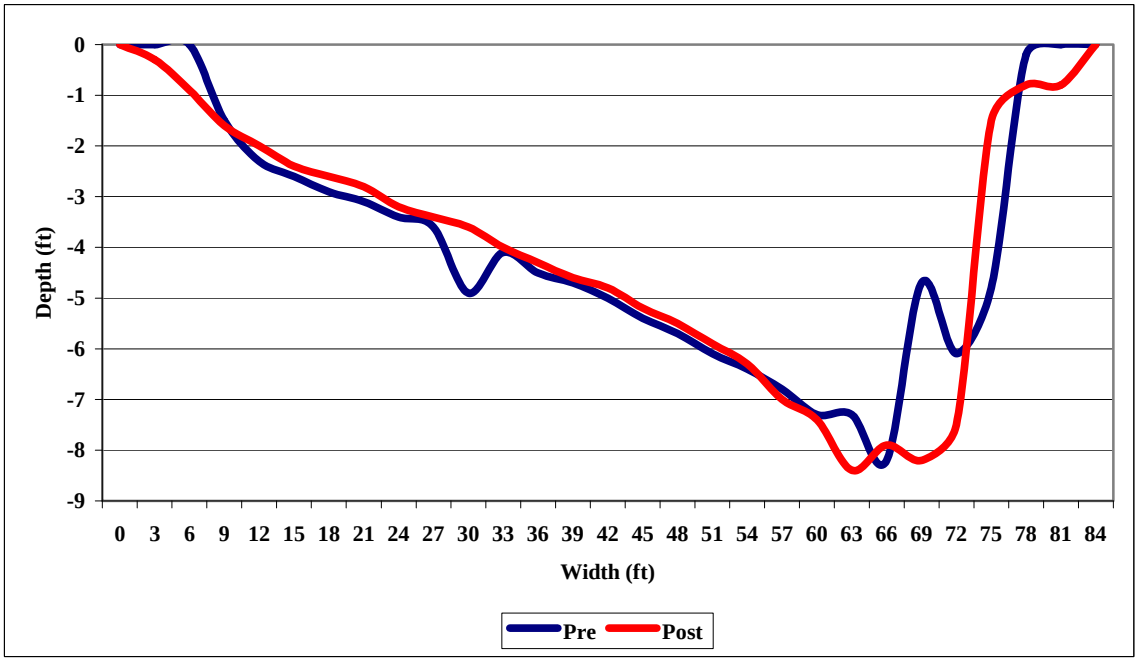
Appendix B-1. Pre and Post cross sections at Pool 1 Transect 1 – Comminsky Station Reach



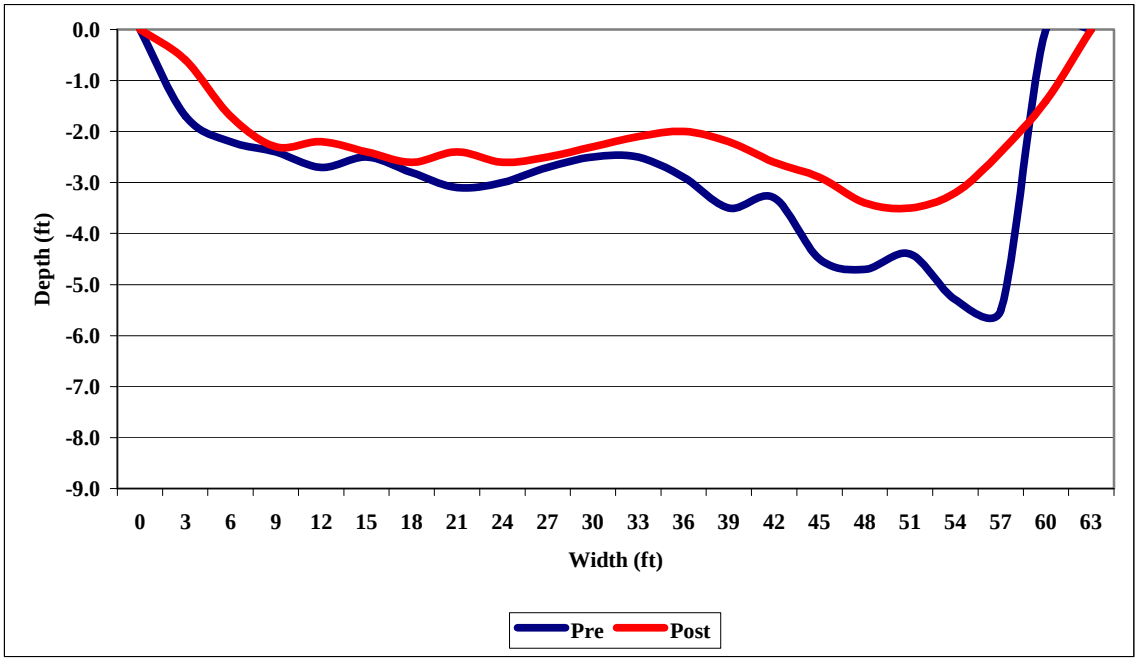
Appendix B2. Pre and Post cross sections at Pool 1 Transect 2 – Comminsky Station Reach



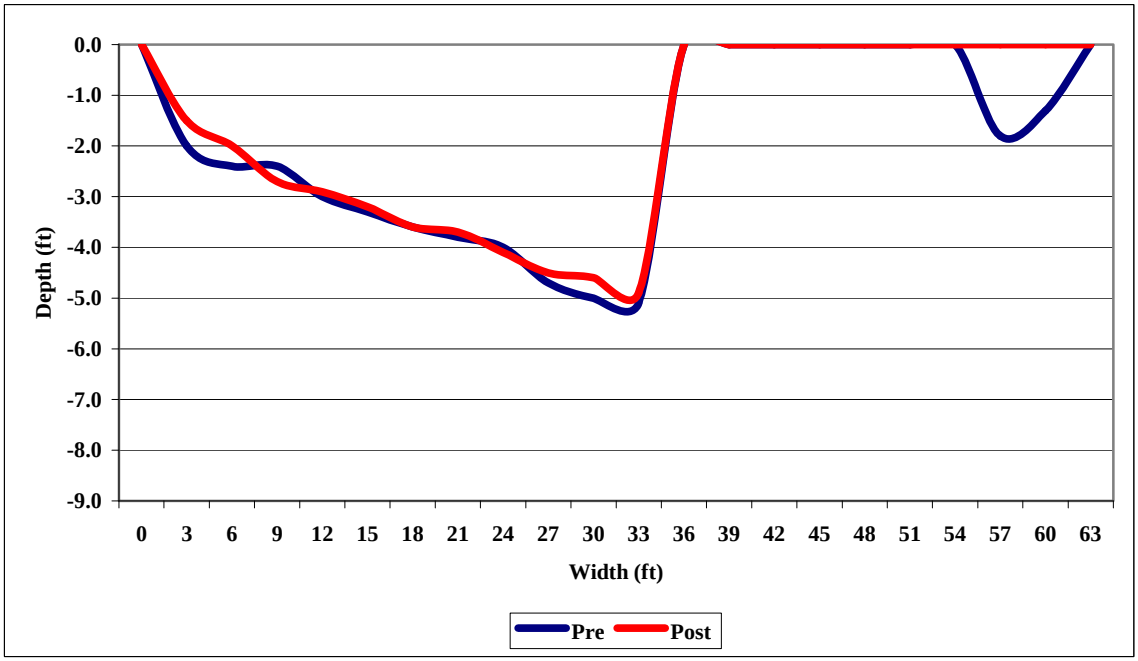
Appendix B-3. Pre and Post cross sections at Pool 1 Transect 3 – Comminsky Station Reach



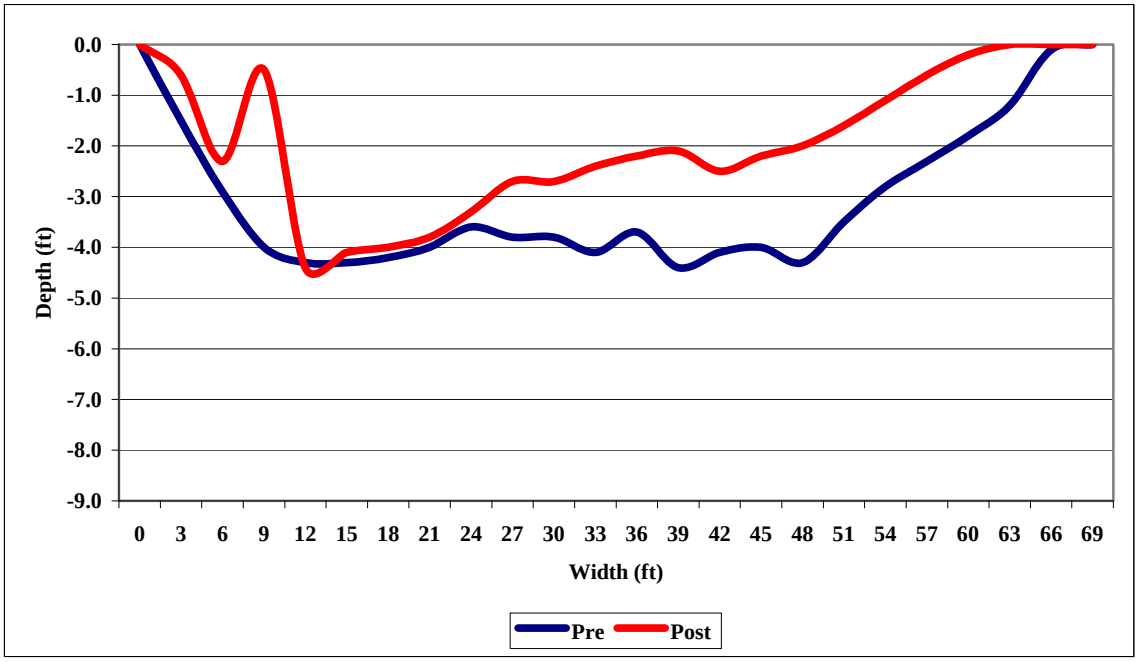
Appendix B4. Pre and Post cross sections at Pool 1 Transect 4 – Comminsky Station Reach



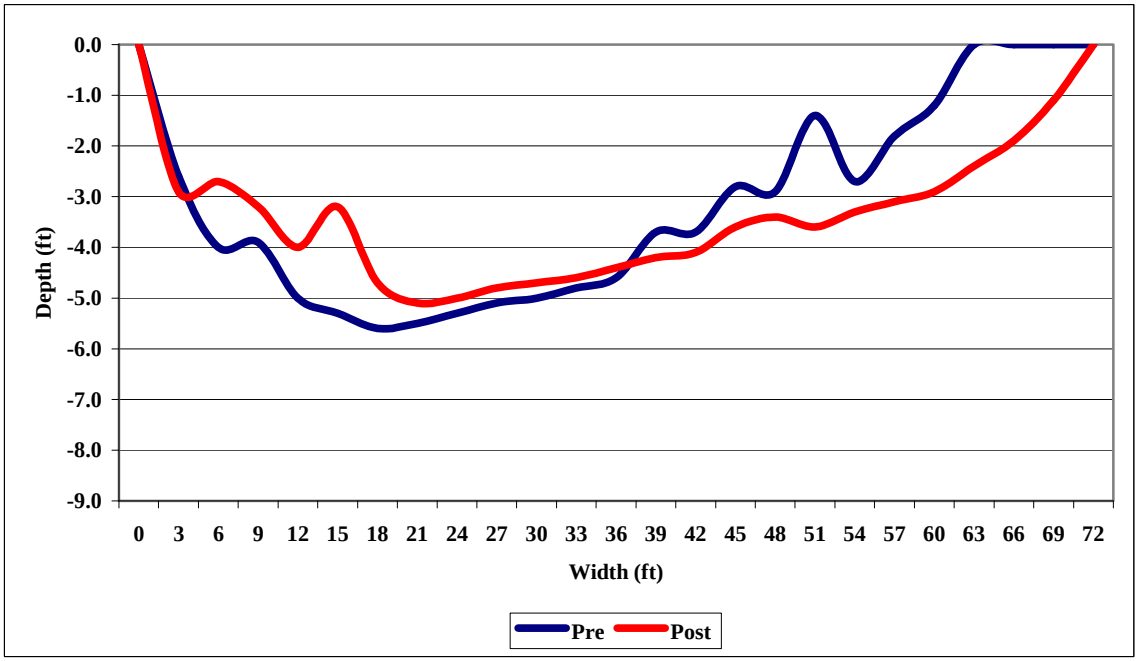
Appendix B-5. Pre and Post cross sections at Pool 2 Transect 1 – Comminsky Station Reach



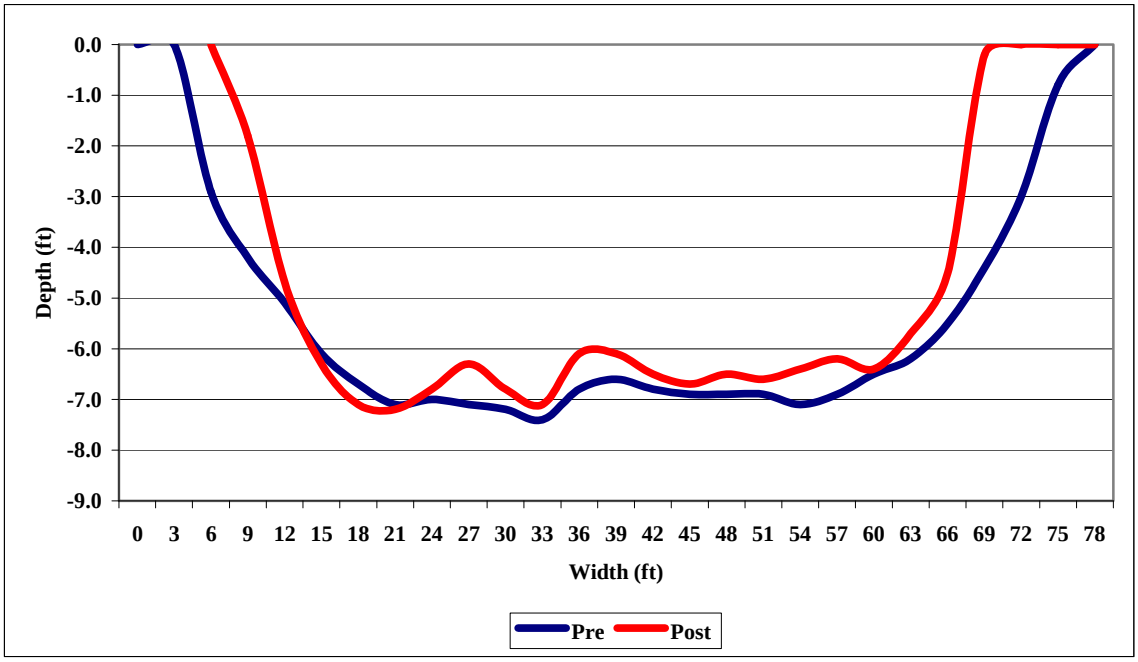
Appendix B6. Pre and Post cross sections at Pool 2 Transect 2 – Comminsky Station Reach



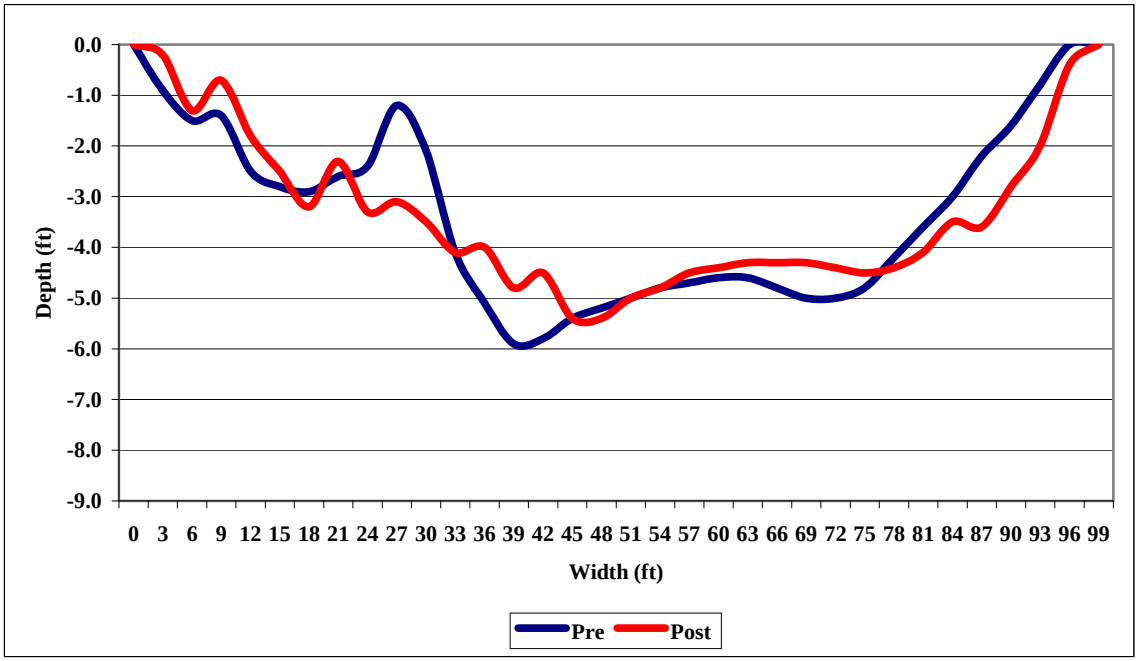
Appendix B-7. Pre and Post cross sections at Pool 2 Transect 3 – Comminsky Station Reach



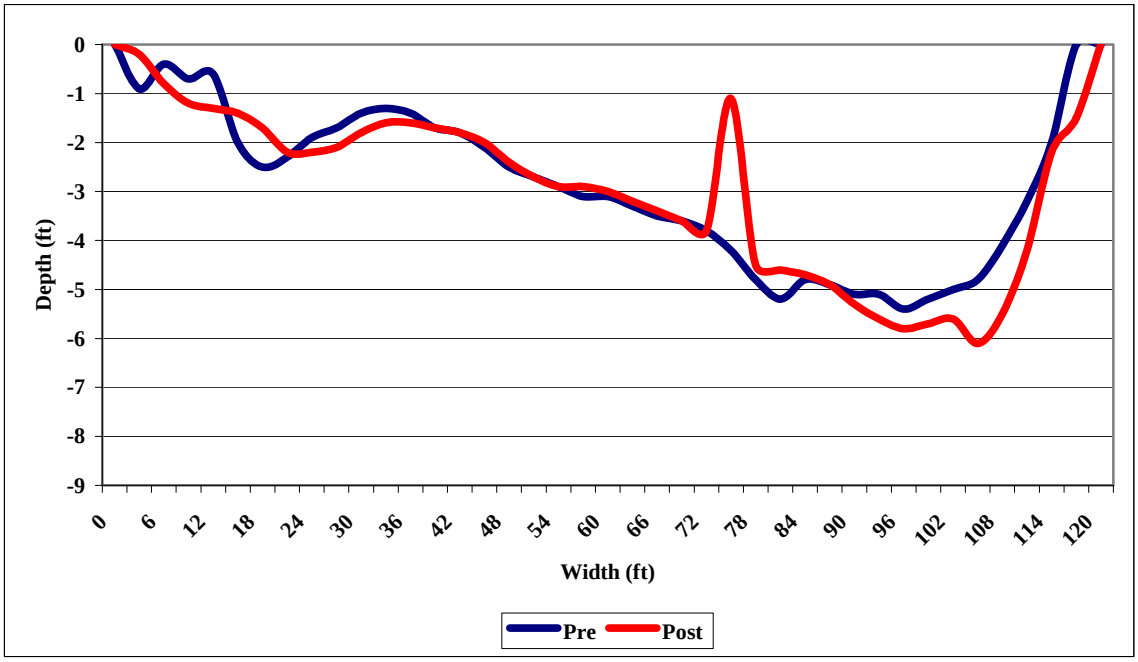
Appendix B-8. Pre and Post cross sections at Pool 3 Transect 1 – Comminsky Station Reach



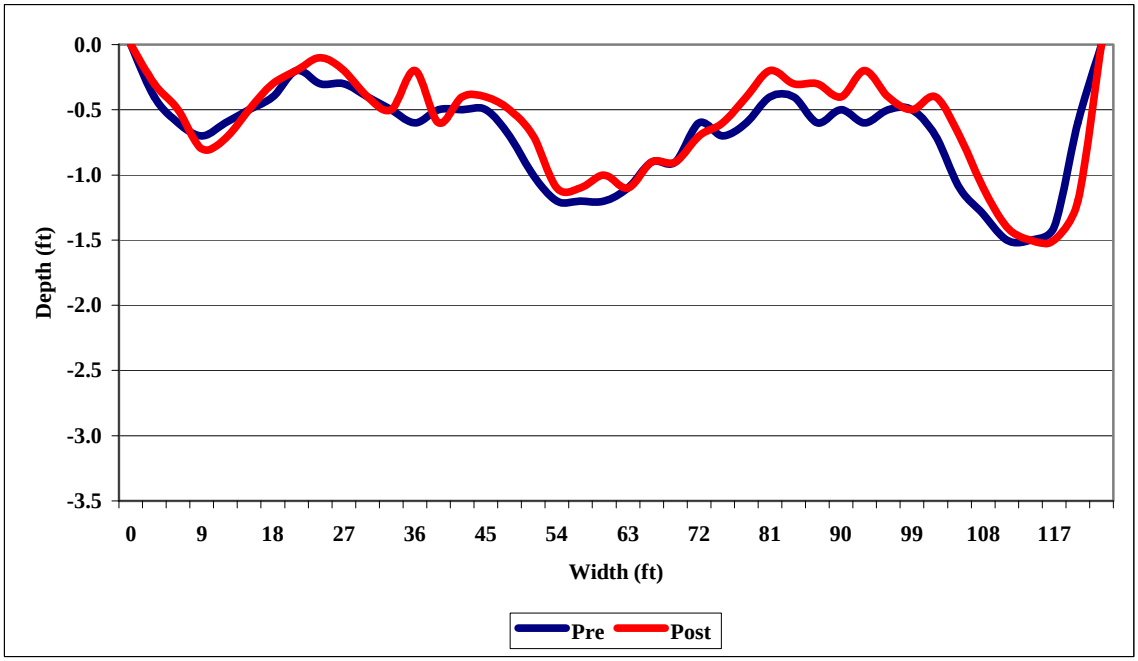
Appendix B-9. Pre and Post cross sections at Pool 3 Transect 2 – Comminsky Station Reach



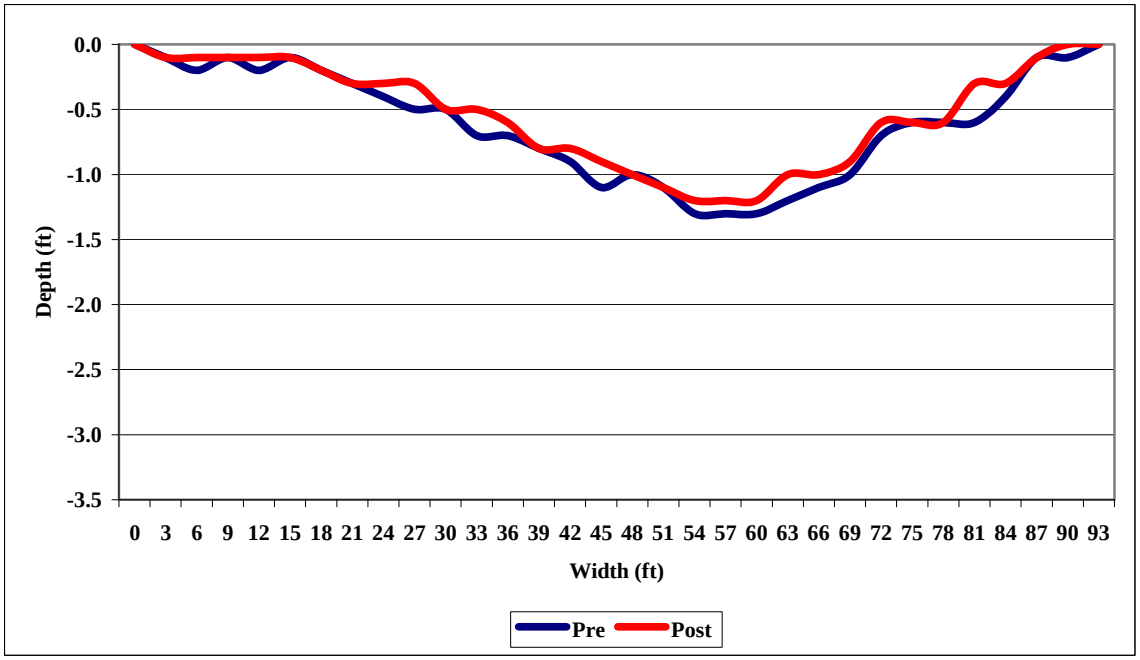
Appendix B-10. Pre and Post cross sections at Pool 3 Transect 3 – Comminsky Station Reach



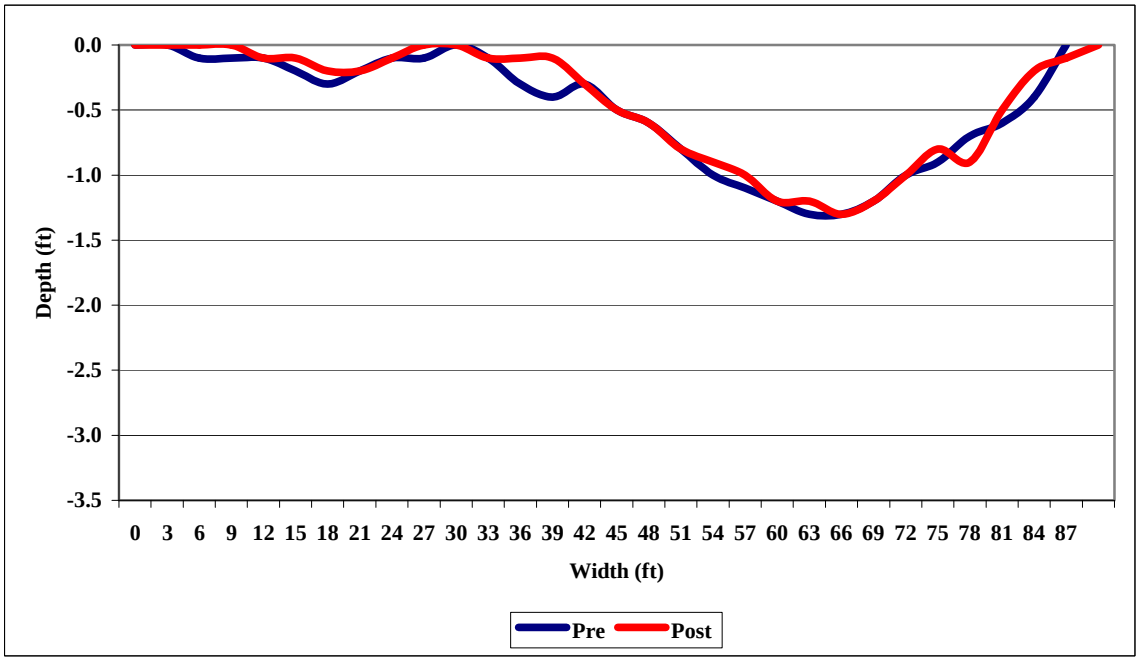
Appendix B-11. Pre and Post cross sections at Pool 3 Transect 4 – Comminsky Station Reach



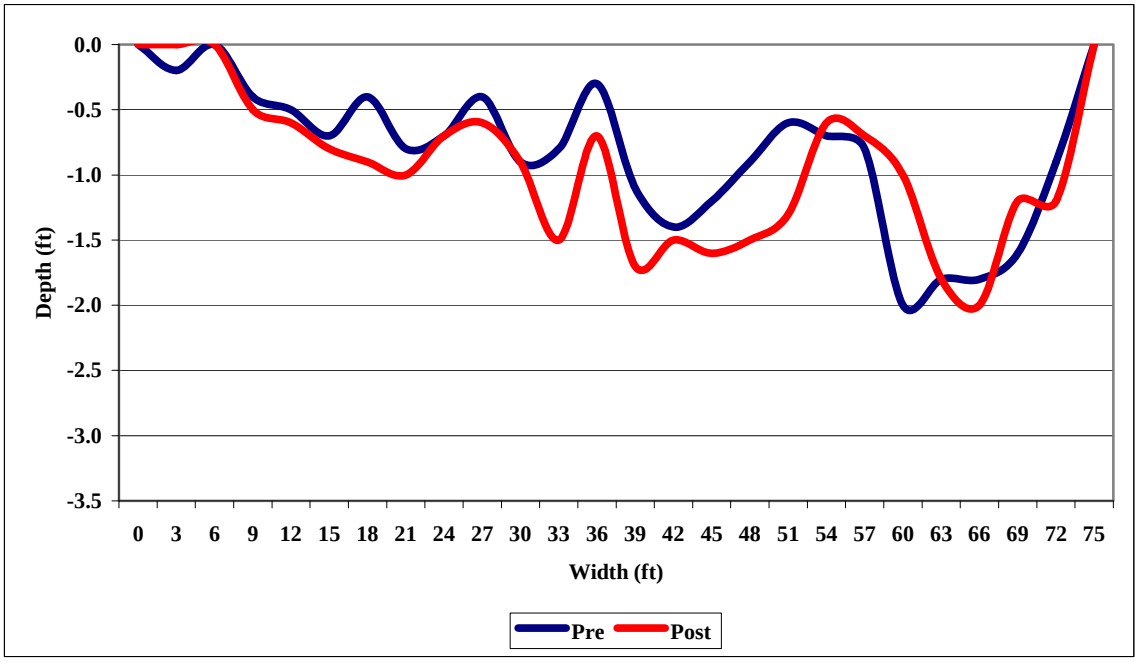
Appendix B-12. Pre and Post cross sections at Riffle 1 Transect 1 – Comminsky Station Reach



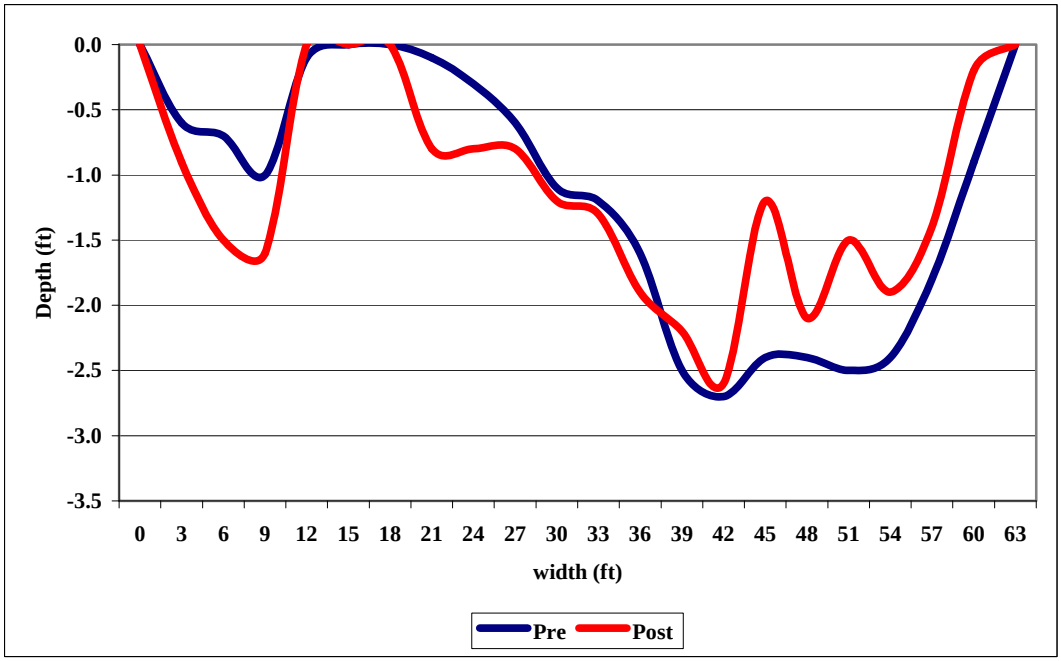
Appendix B-13. Pre and Post cross sections at Riffle 1 Transect 2 – Comminsky Station Reach



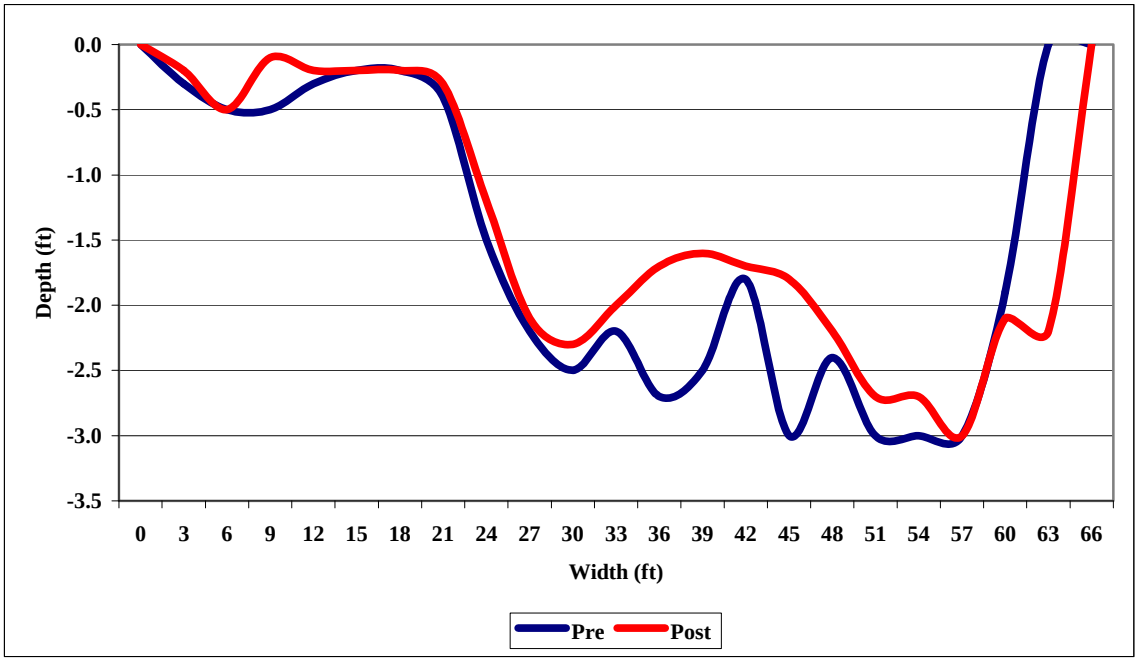
Appendix B-14. Pre and Post cross sections at Riffle 1 Transect 3 – Comminsky Station Reach



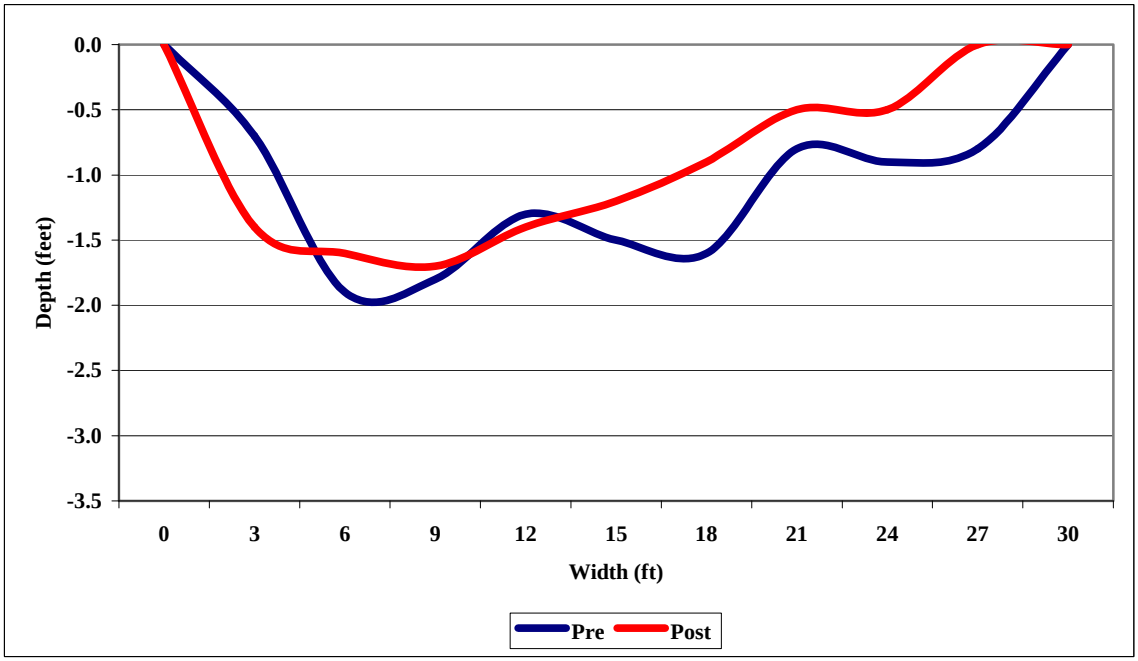
Appendix B-15. Pre and Post cross sections at Riffle 2 Transect 1 – Comminsky Station Reach



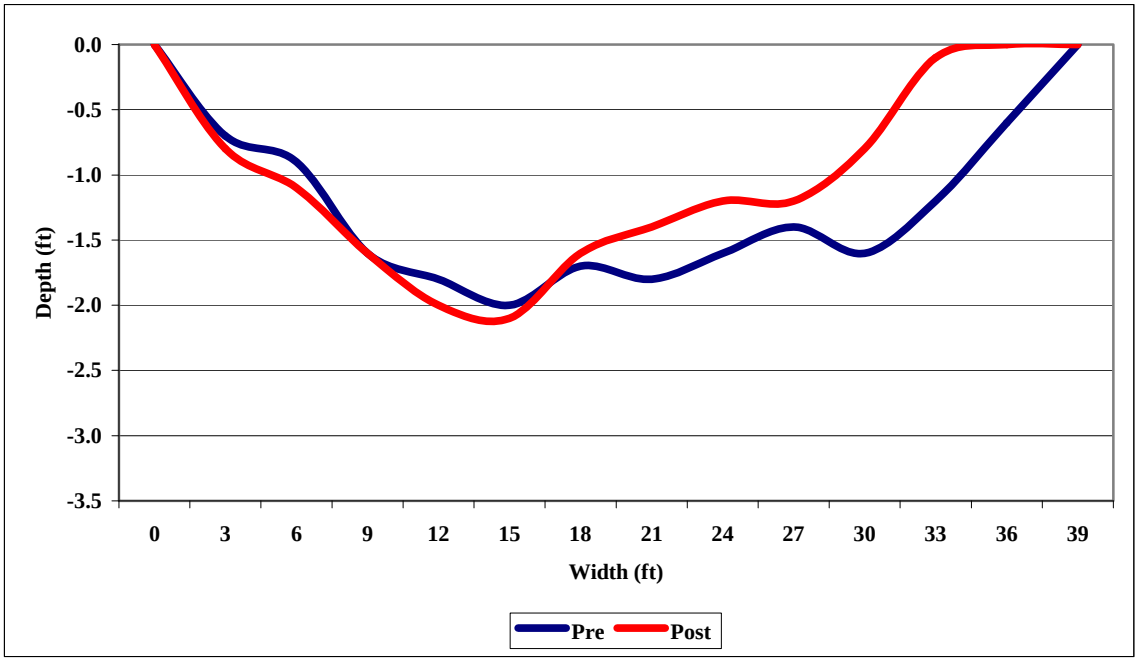
Appendix B-16. Pre and Post cross sections at Riffle 2 Transect 2 – Comminsky Station Reach



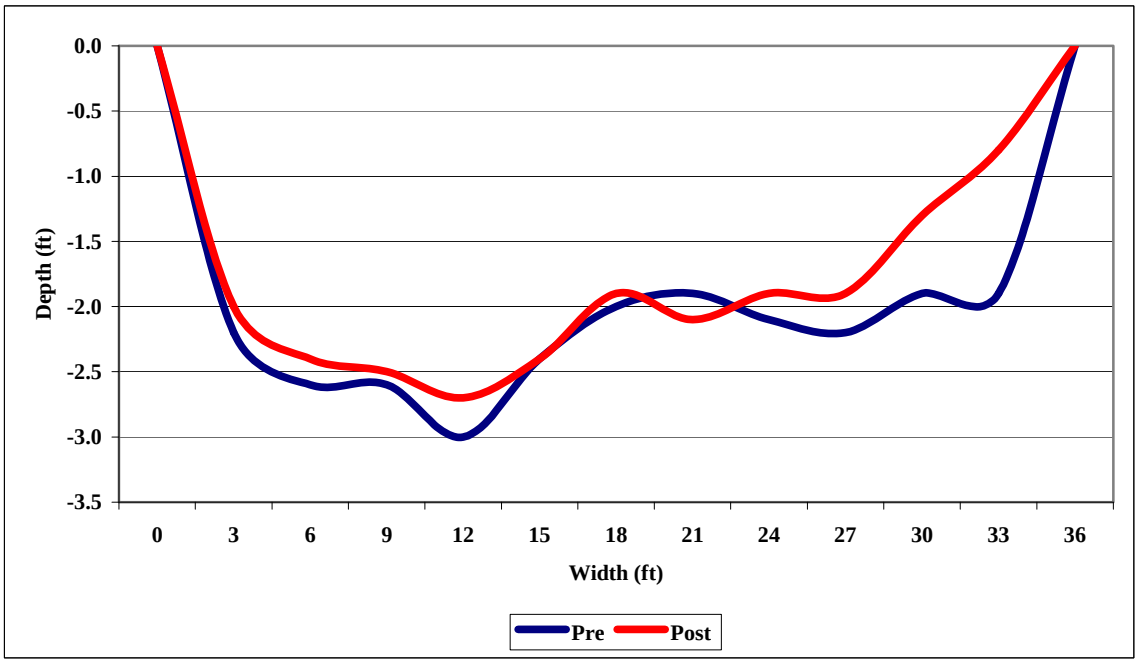
Appendix B-17. Pre and Post cross sections at Riffle 2 Transect 3 – Comminsky Station Reach



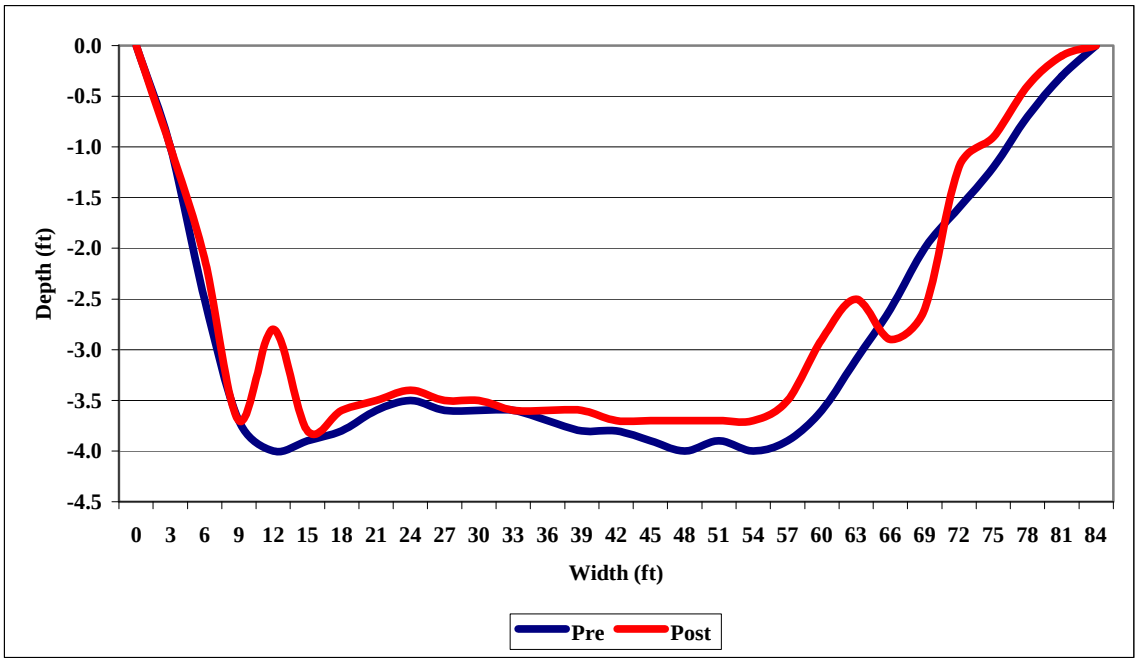
Appendix B-18. Pre and Post cross sections at Riffle 3 Transect 1 – Comminsky Station Reach



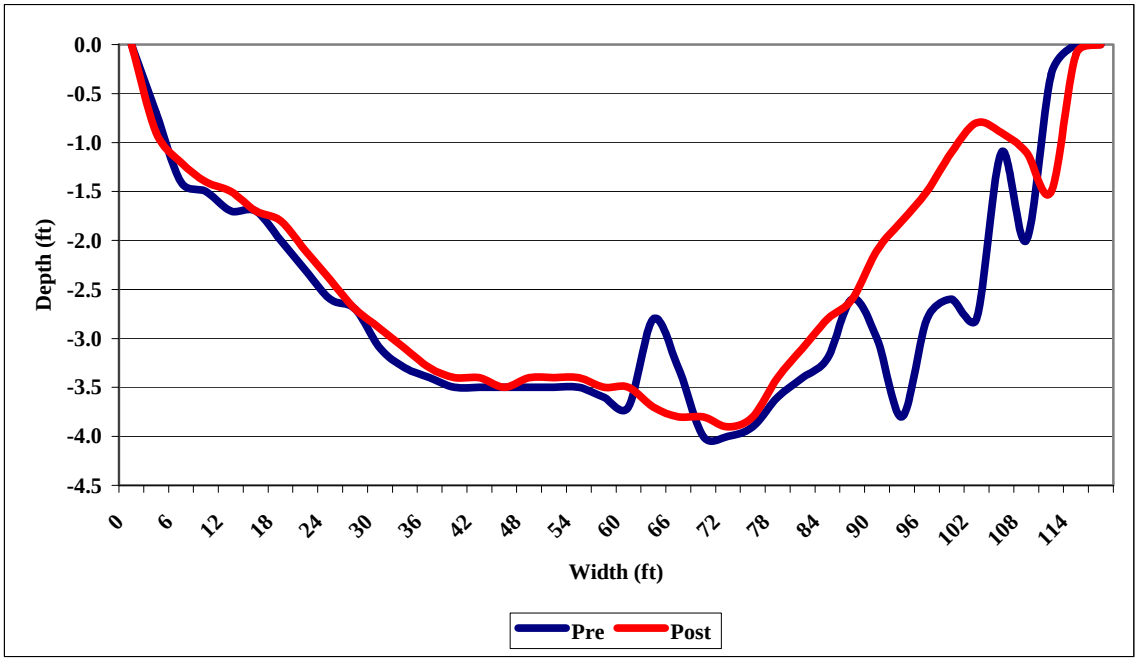
Appendix B-19. Pre and Post cross sections at Riffle 3 Transect 2 – Comminsky Station Reach



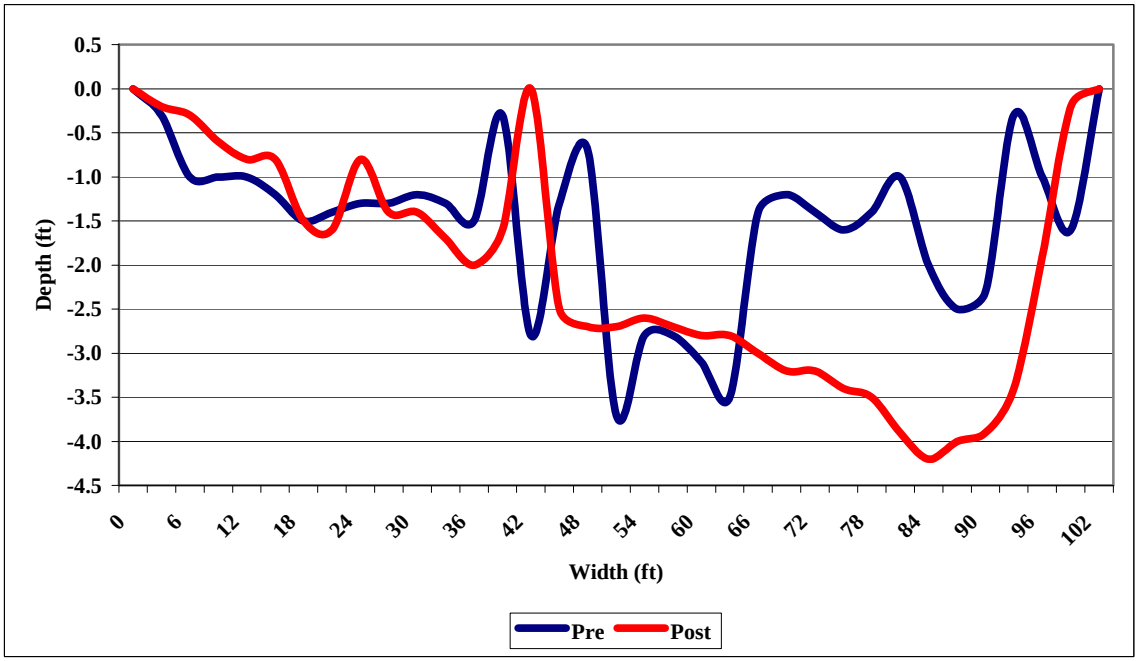
Appendix B-20. Pre and Post cross sections at Riffle 3 Transect 3 – Comminsky Station Reach



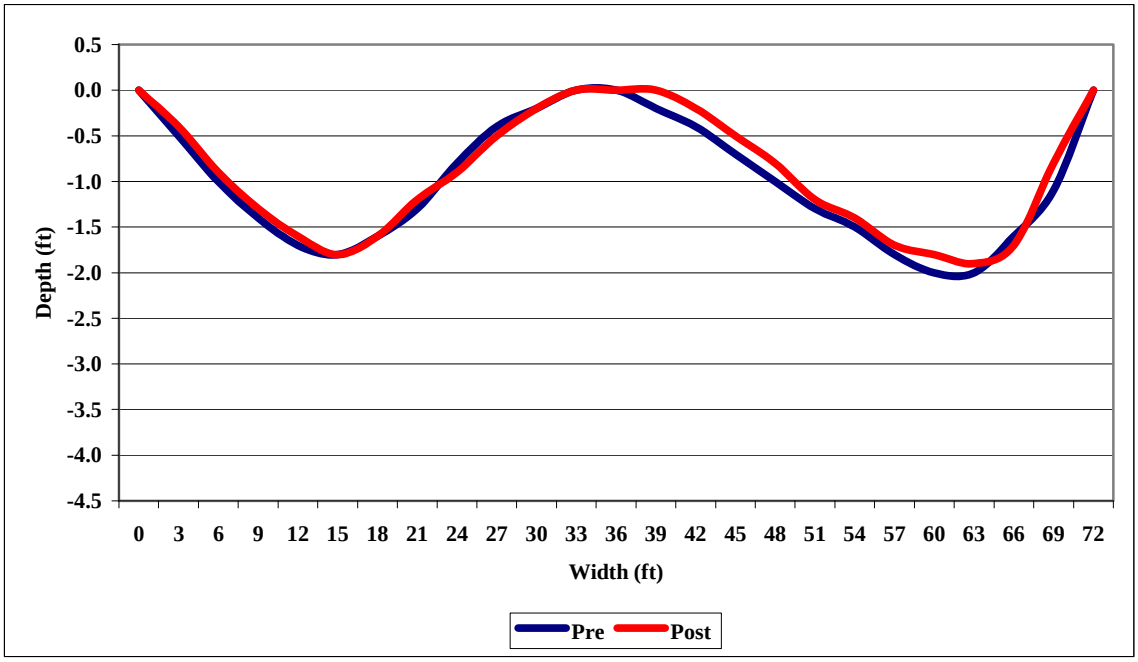
Appendix B-21. Pre and Post cross sections at Flatwater 1 Transect 1 – Comminsky Station Reach



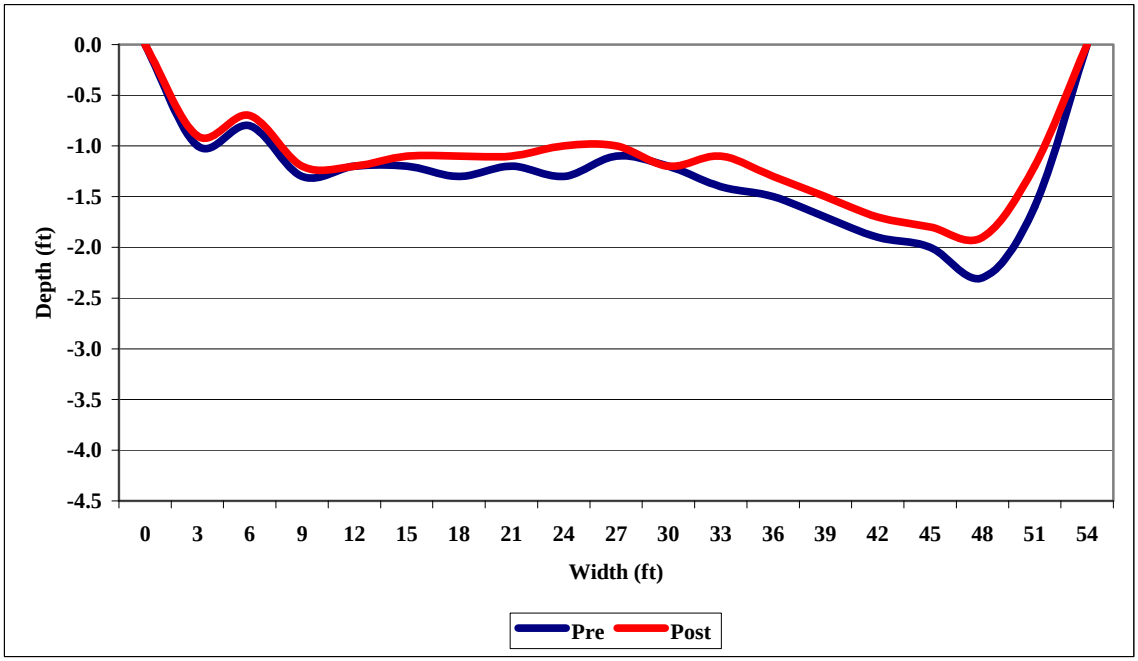
Appendix B-22. Pre and Post cross sections at Flatwater 1 Transect 2 – Comminsky Station Reach



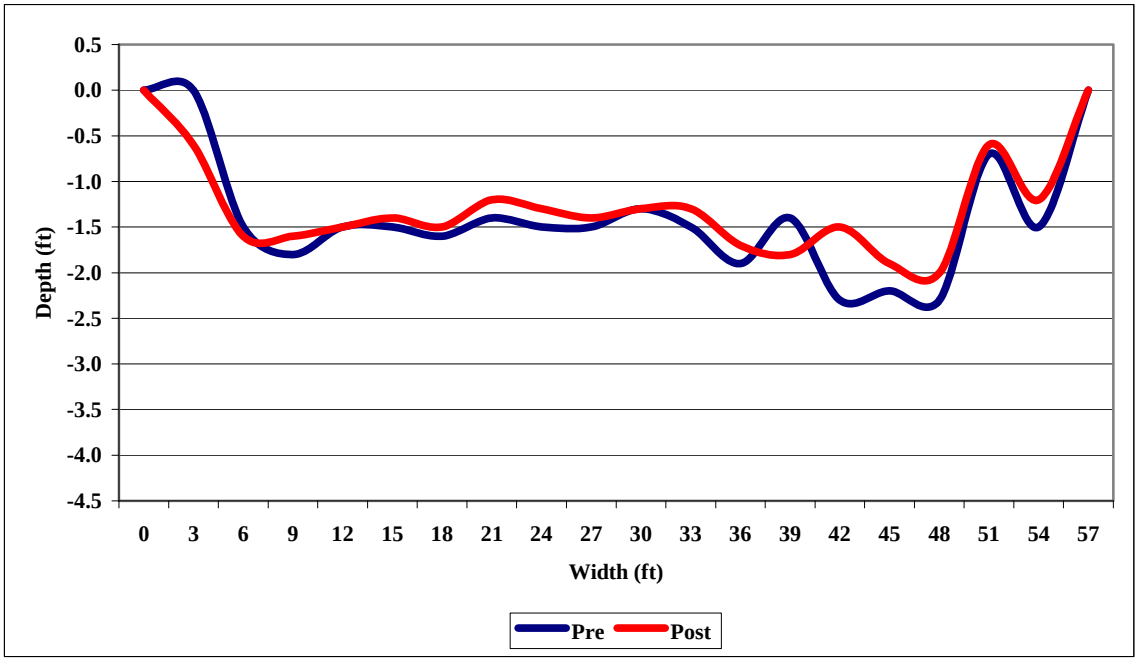
Appendix B-23. Pre and Post cross sections at Flatwater 1 Transect 3 – Comminsky Station Reach



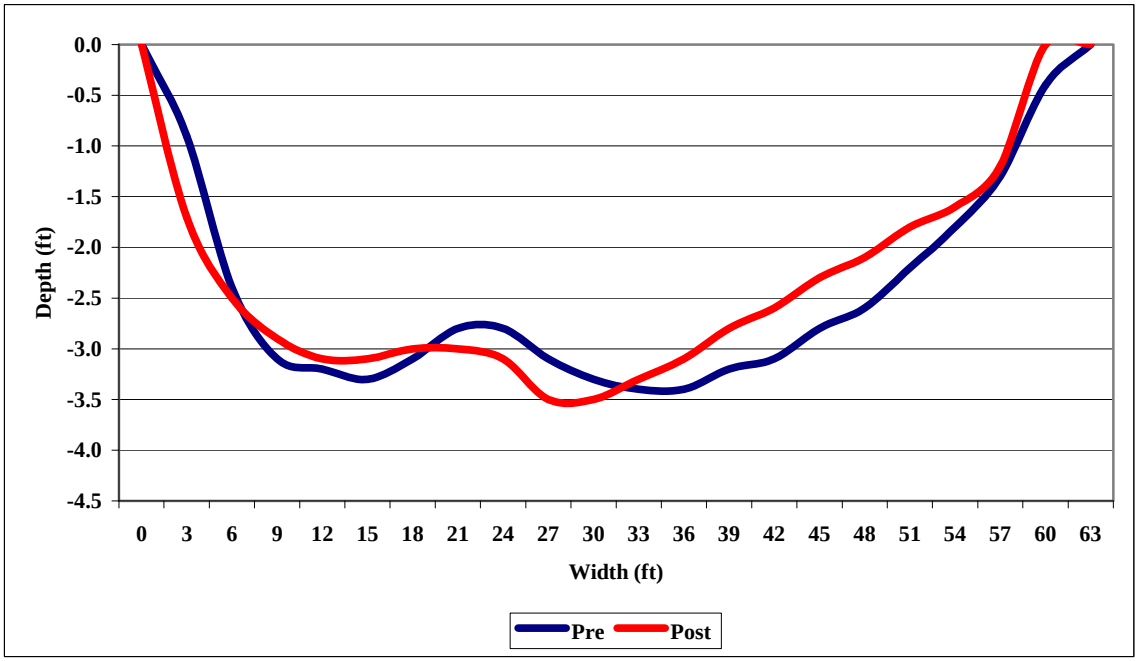
Appendix B-24. Pre and Post cross sections at Flatwater 2 Transect 1 – Comminsky Station Reach



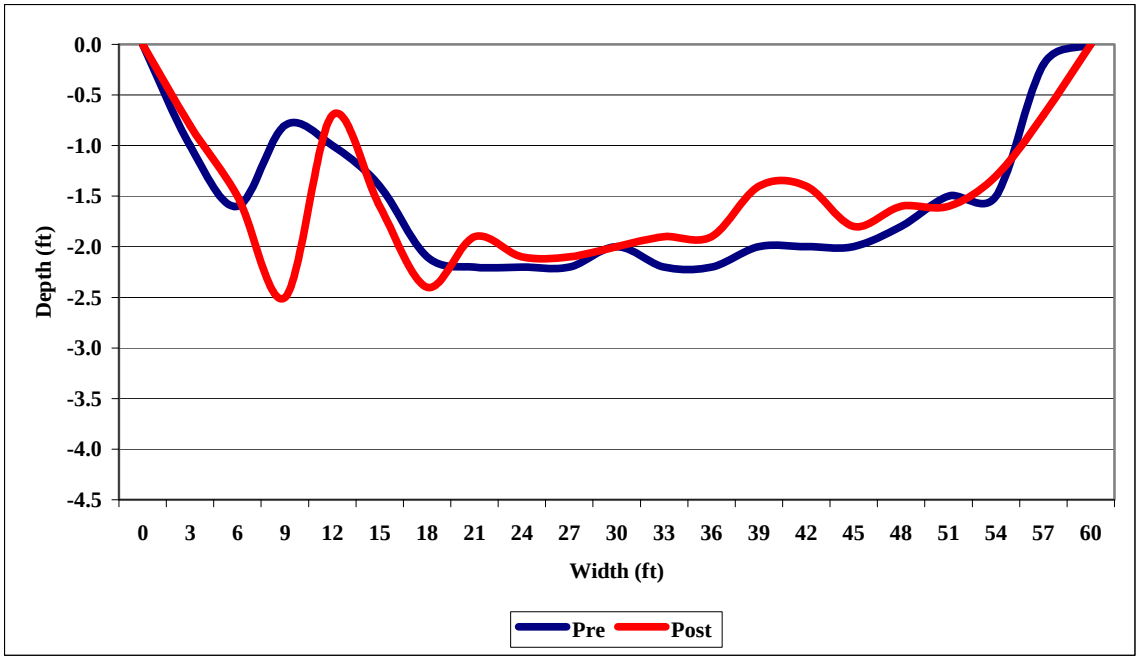
Appendix B-25. Pre and Post cross sections at Flatwater 2 Transect 2 – Comminsky Station Reach



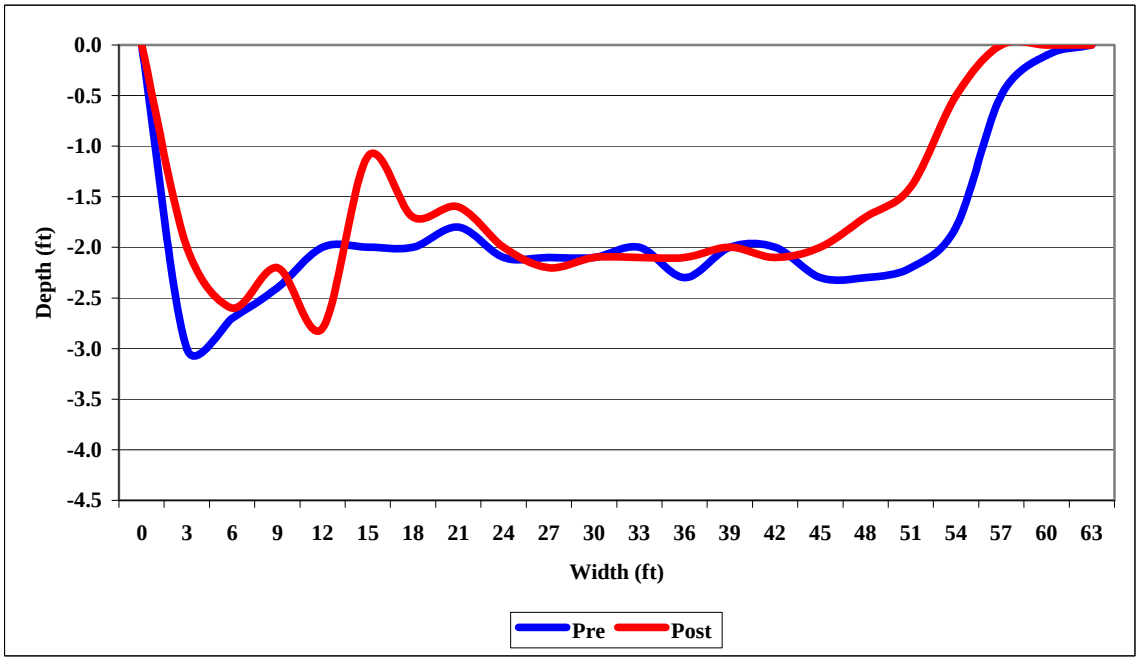
Appendix B-24. Pre and Post cross sections at Flatwater 2 Transect 3 – Comminsky Station Reach



Appendix B-25. Pre and Post cross sections at Flatwater 3 Transect 1 – Comminsky Station Reach



Appendix B-26. Pre and Post cross sections at Flatwater 3 Transect 2 – Comminsky Station Reach

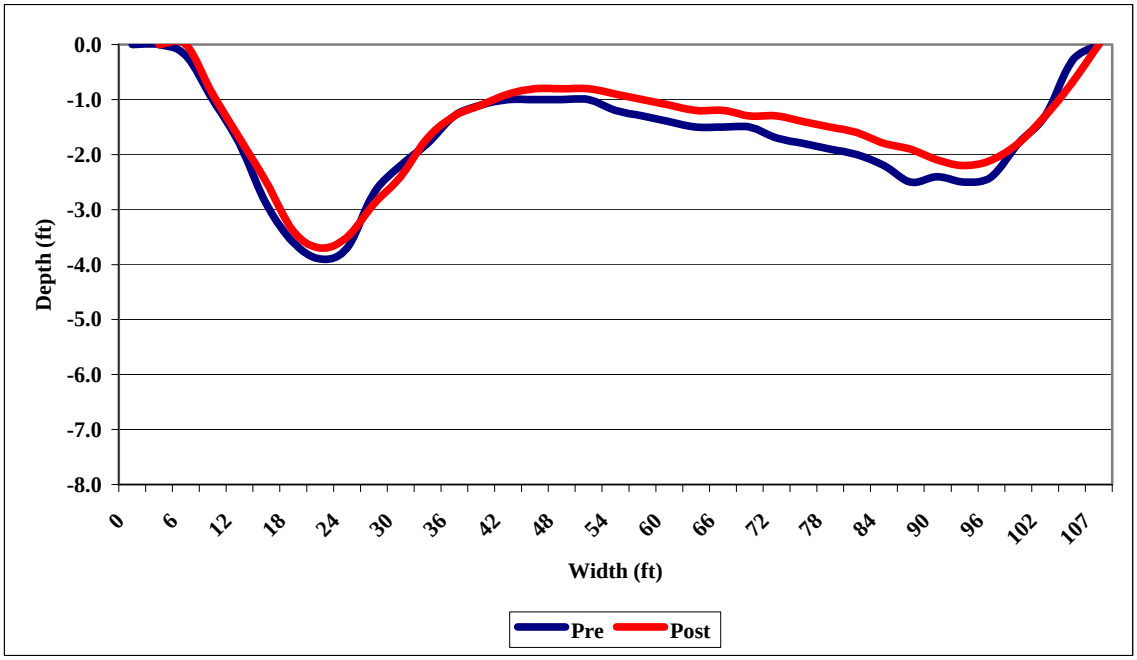


Appendix B-27. Pre and Post cross sections at Flatwater 3 Transect 3 – Comminsky Station Reach

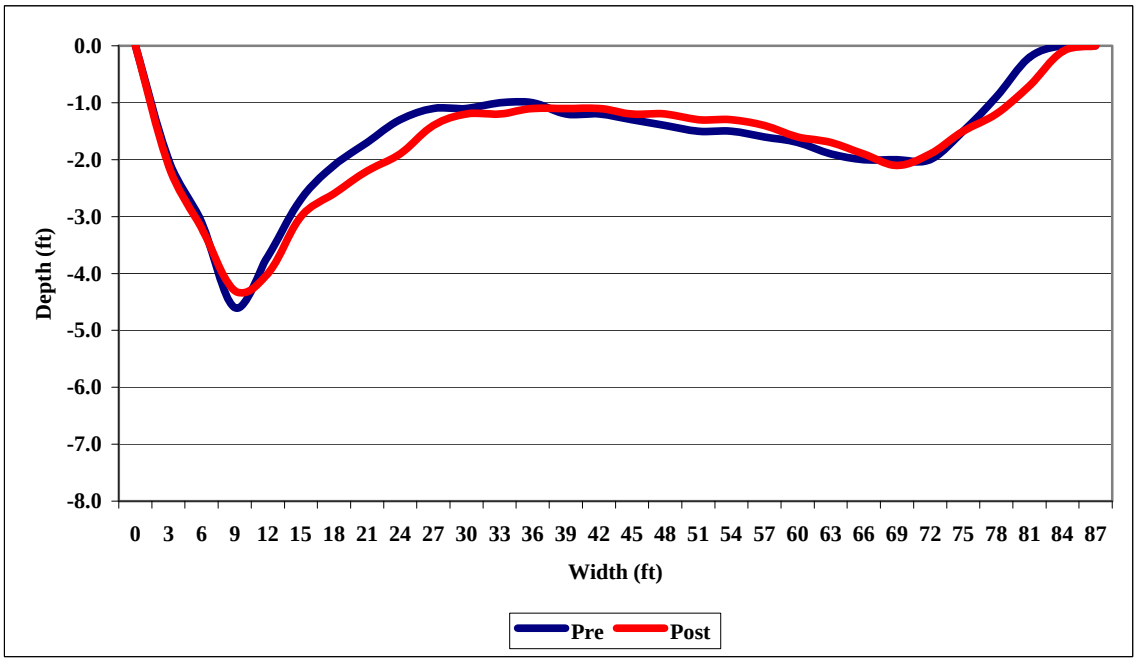
APPENDIX C

CLOVERDALE REACH CROSS SECTIONS

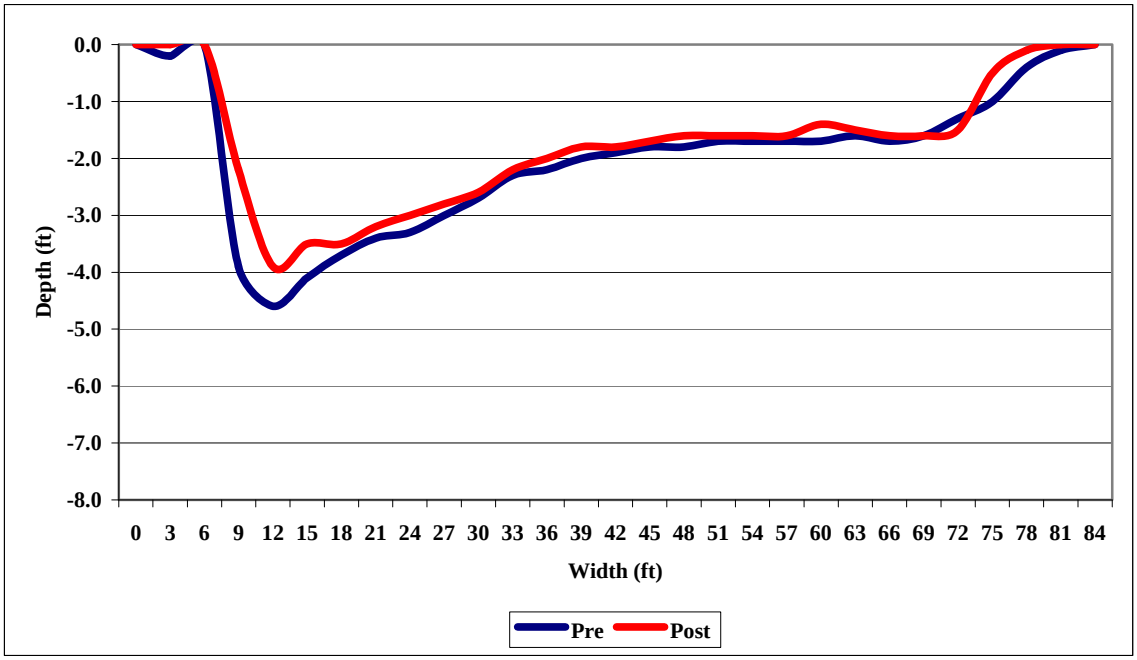
PRE AND POST FLOW REDUCTION SURVEYS



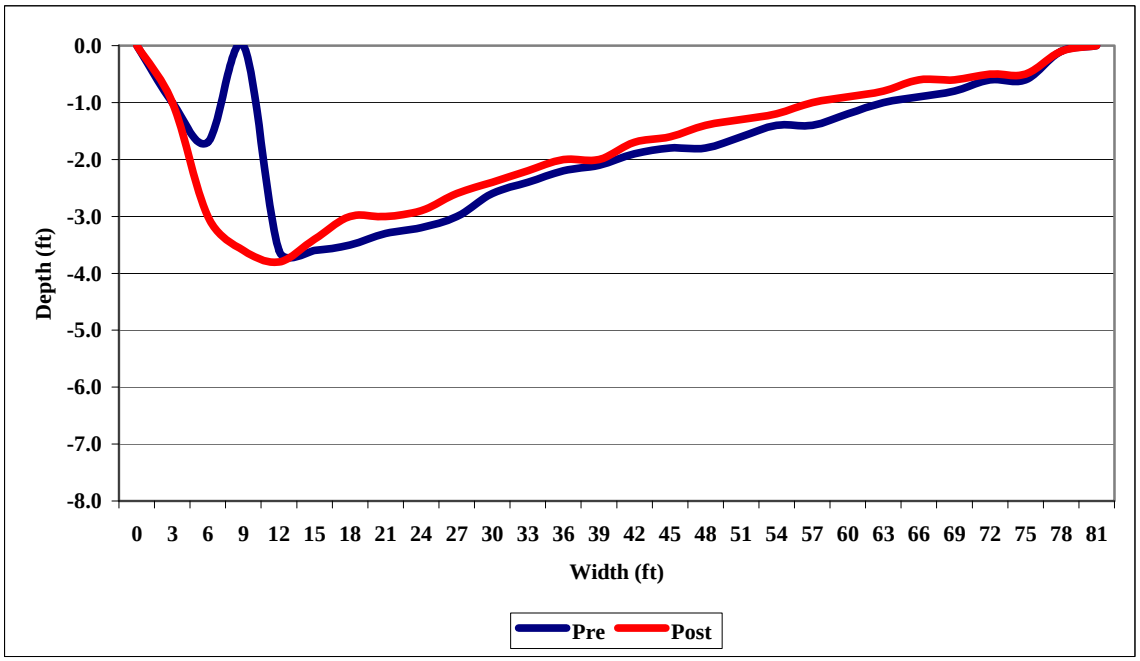
Appendix C-1. Pre- and Post cross sections at Pool 1 Transect 1 – Cloverdale Reach



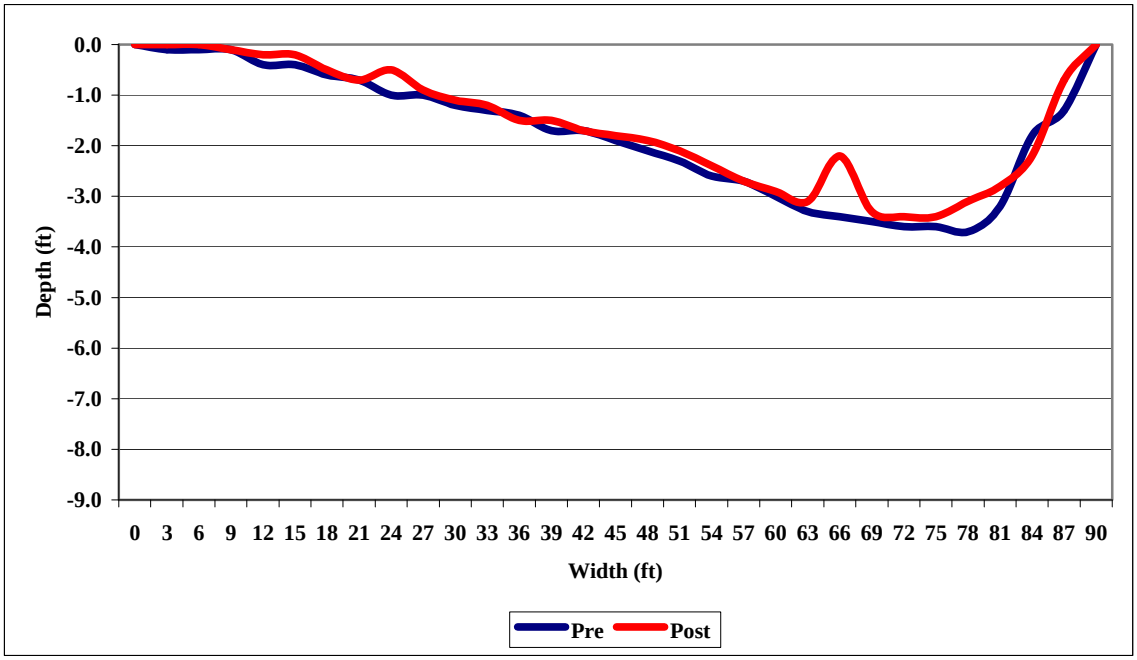
Appendix C-2. Pre- and Post cross sections at Pool 1 Transect 2 – Cloverdale Reach



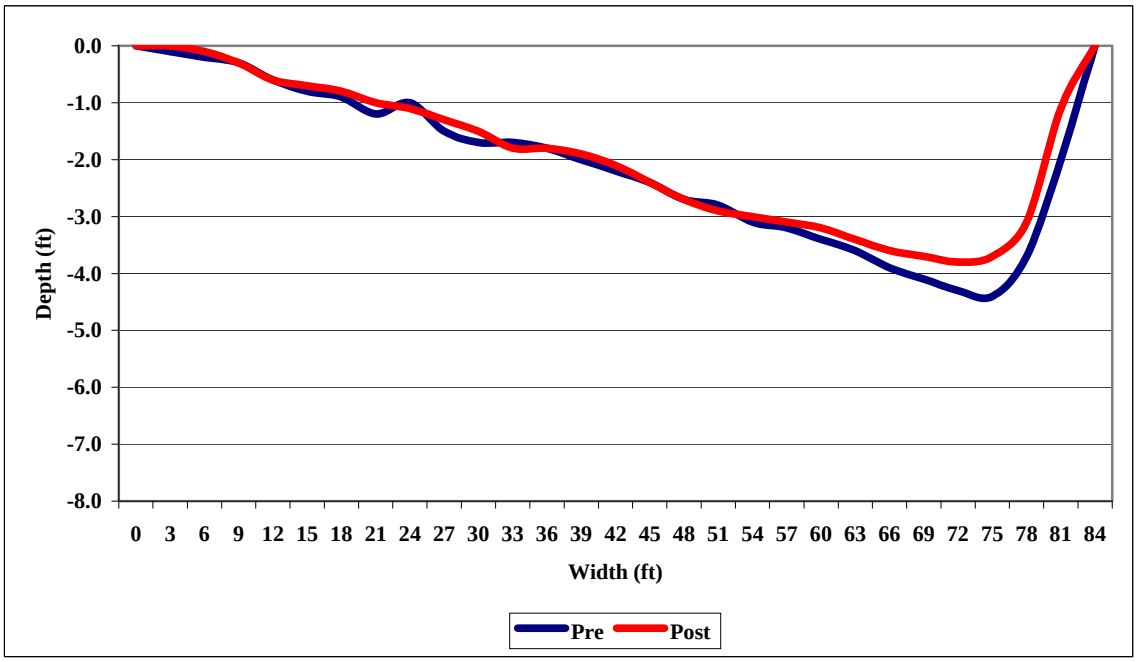
Appendix C-3. Pre- and Post cross sections at Pool 1 Transect 3 – Cloverdale Reach



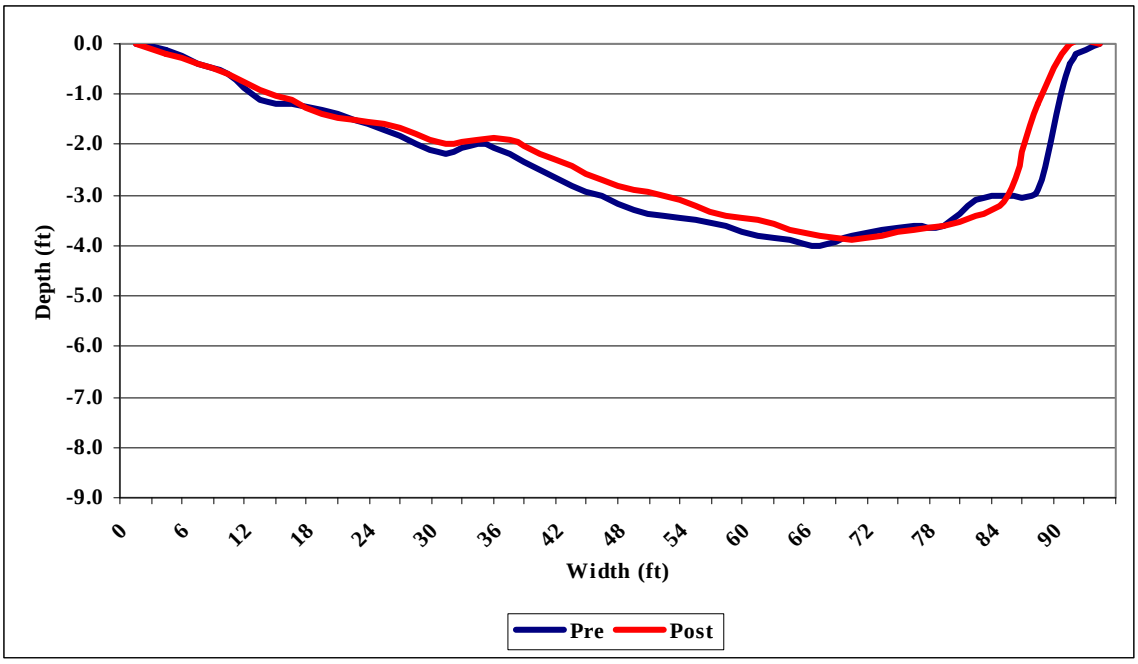
Appendix C-4. Pre- and Post cross sections at Pool 1 Transect 4 – Cloverdale Reach



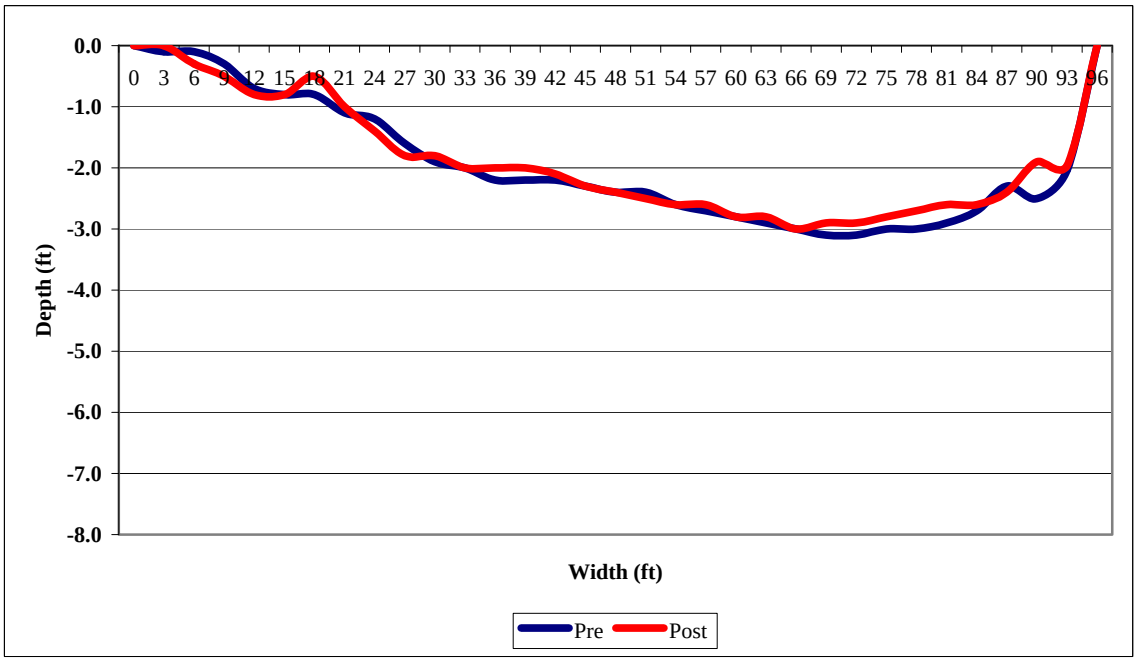
Appendix C-5. Pre- and Post cross sections at Pool 2 Transect 1 – Cloverdale Reach



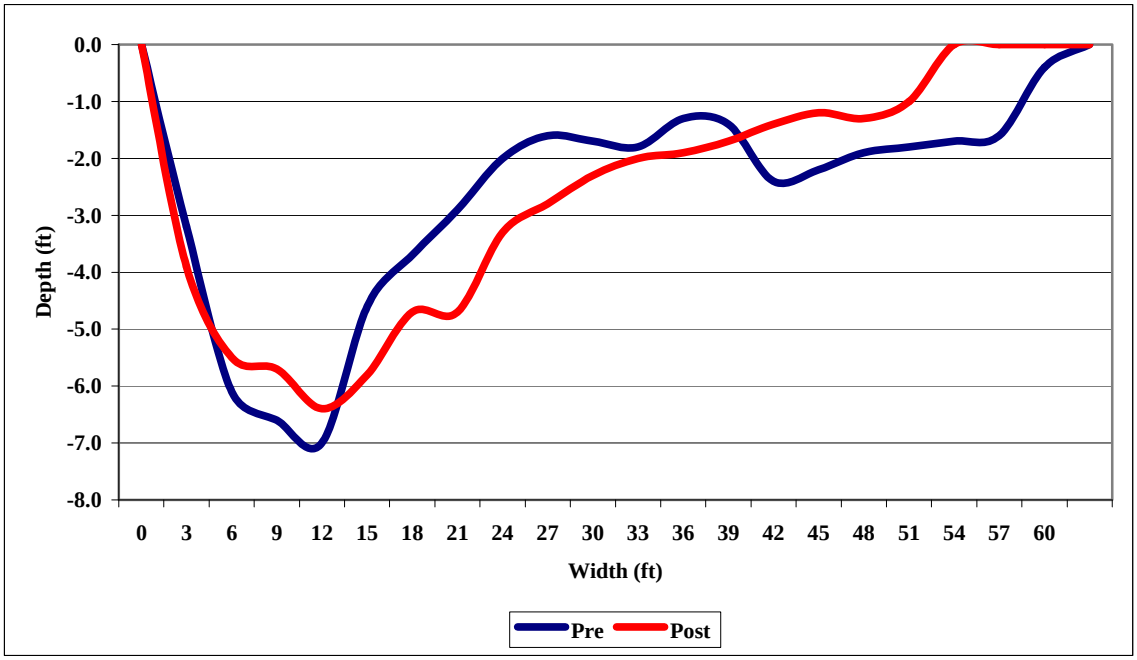
Appendix C-6. Pre- and Post cross sections at Pool 2 Transect 2 – Cloverdale Reach



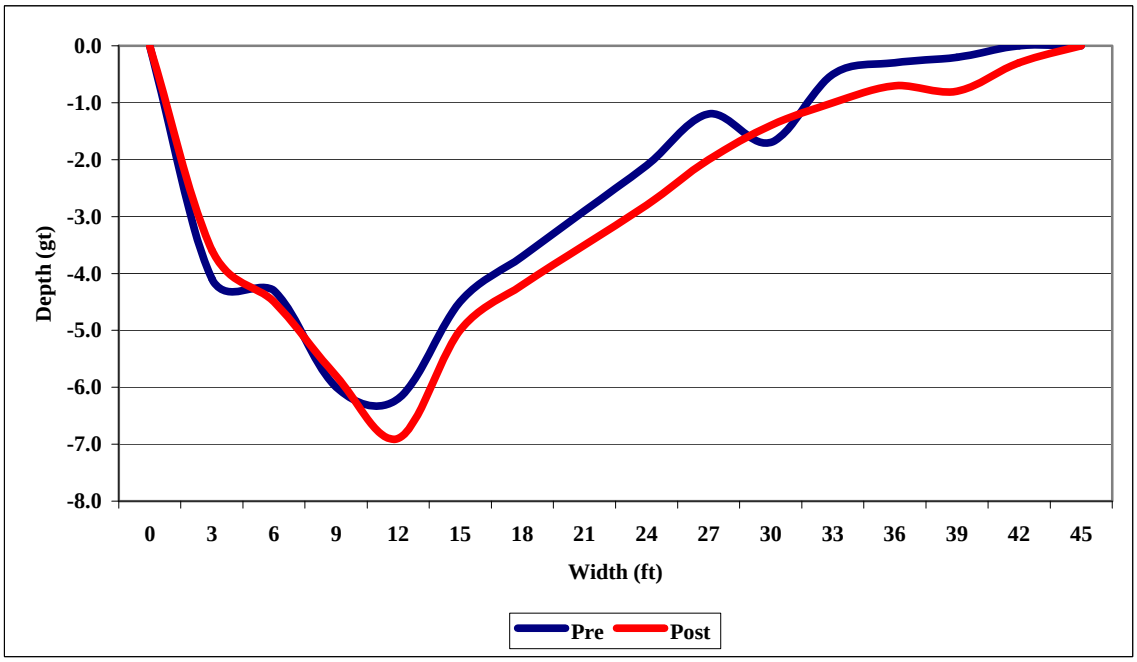
Appendix C-7. Pre- and Post cross sections at Pool 2 Transect 3 – Cloverdale Reach



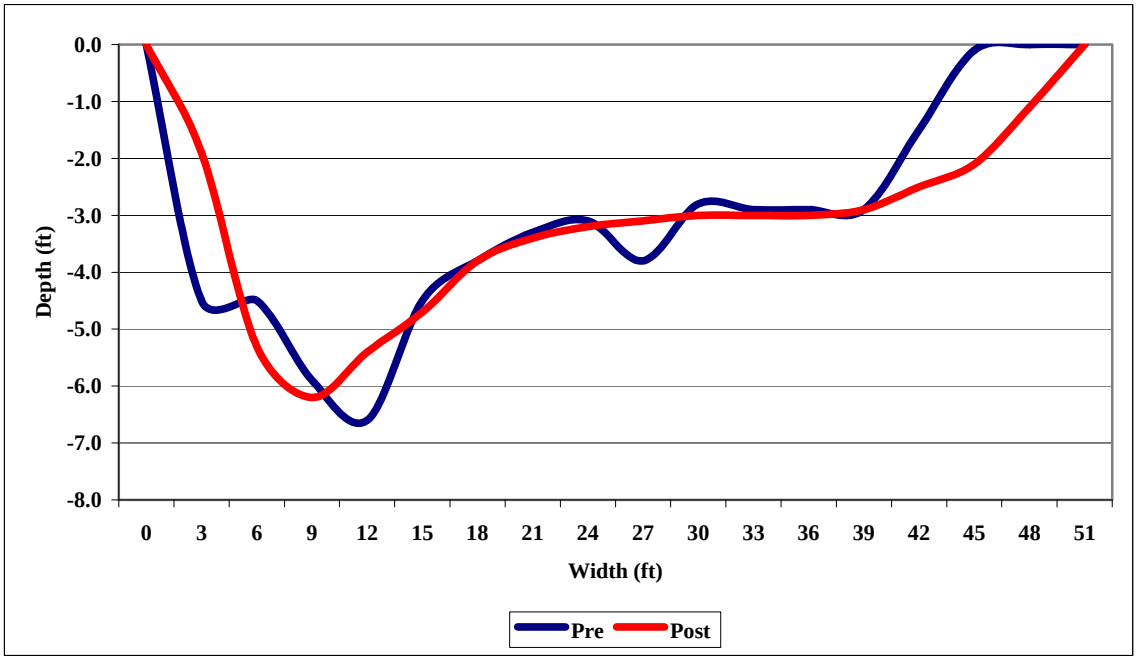
Appendix C-8. Pre- and Post cross sections at Pool 2 Transect 4 – Cloverdale Reach



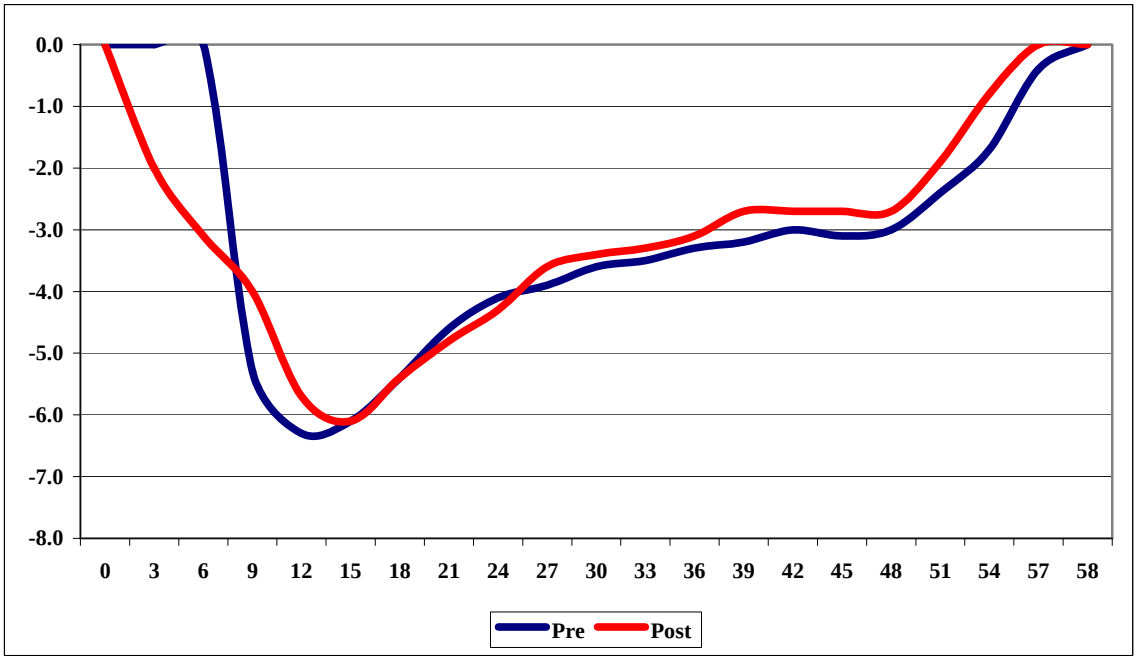
Appendix C-9. Pre- and Post cross sections at Pool 3 Transect 1 – Cloverdale Reach



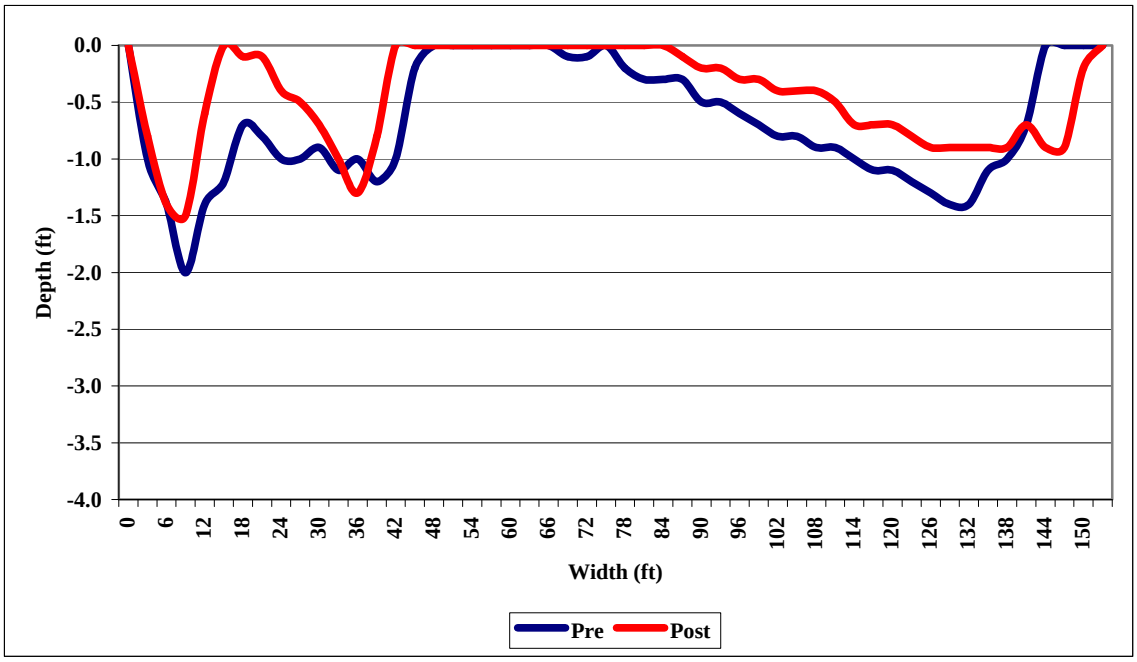
Appendix C-10. Pre- and Post cross sections at Pool 3 Transect 2 – Cloverdale Reach



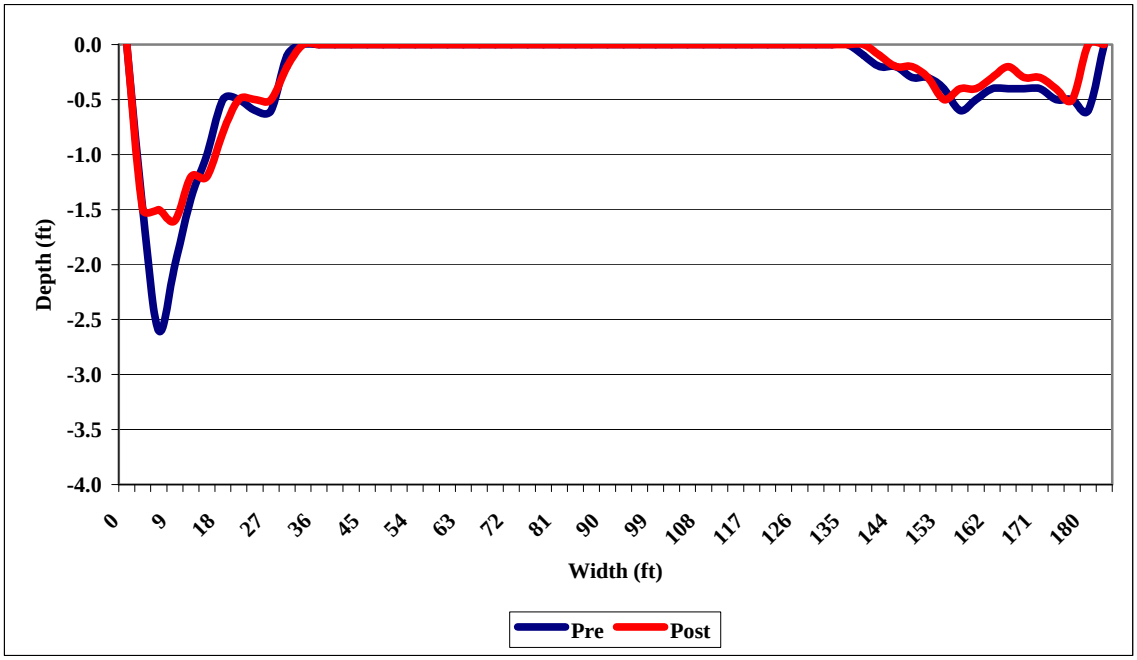
Appendix C-11. Pre- and Post cross sections at Pool 3 Transect 3 – Cloverdale Reach



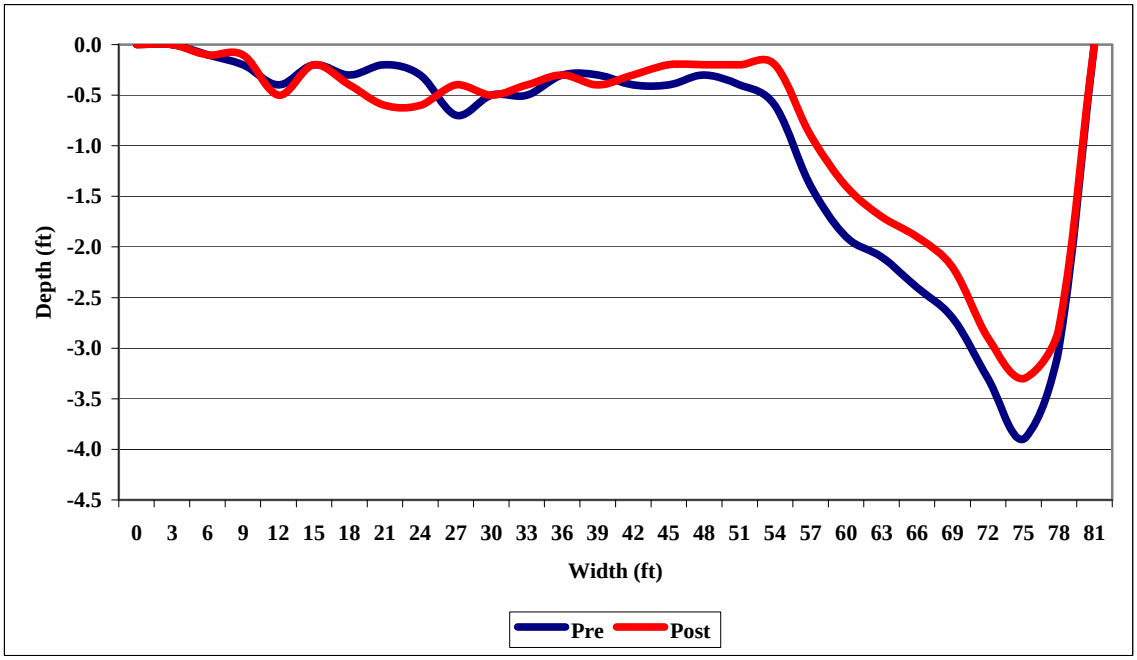
Appendix C-12. Pre- and Post cross sections at Pool 3 Transect 4 – Cloverdale Reach



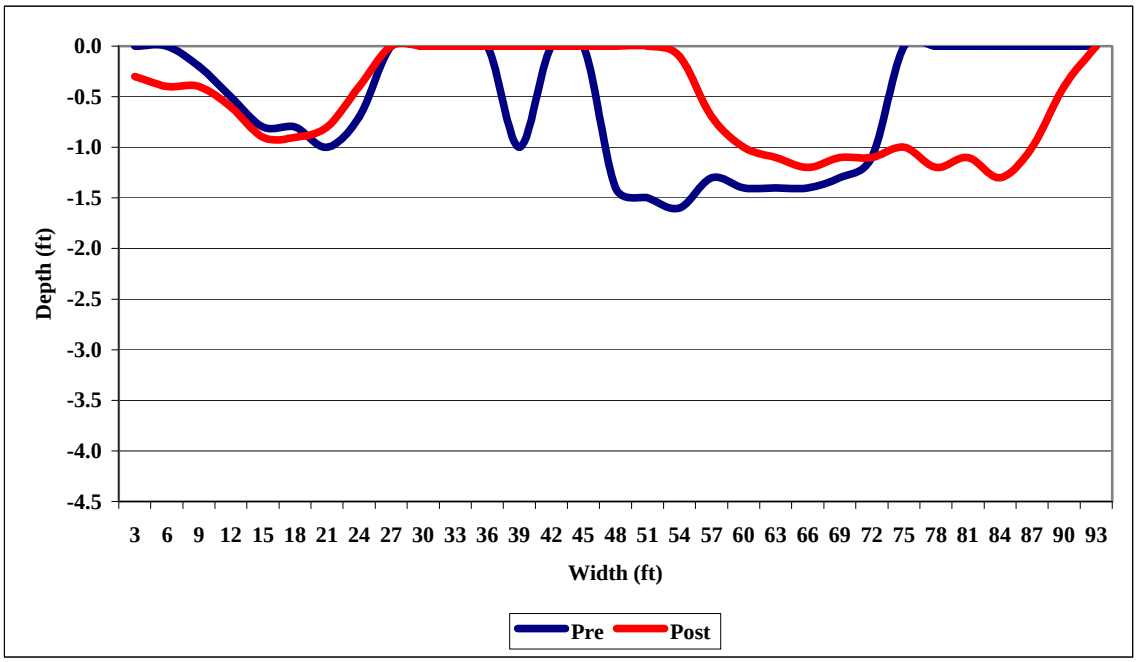
Appendix C-13. Pre- and Post cross sections at Riffle 1 Transect 1 – Cloverdale Reach



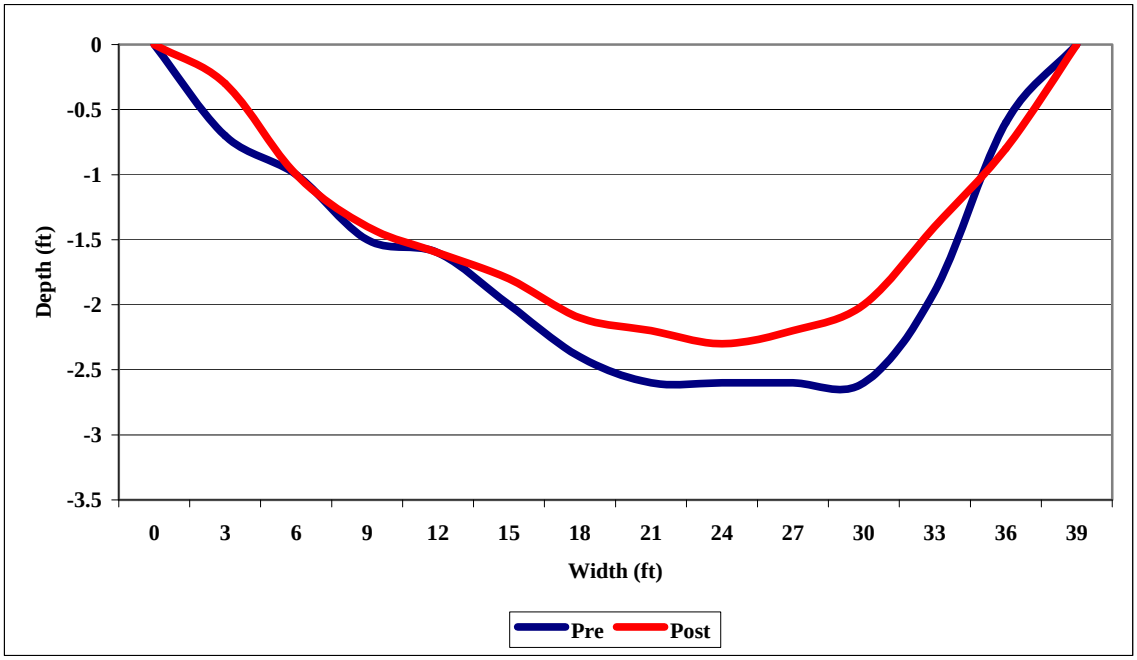
Appendix C-14. Pre- and Post cross sections at Riffle 1 Transect 2 – Cloverdale Reach



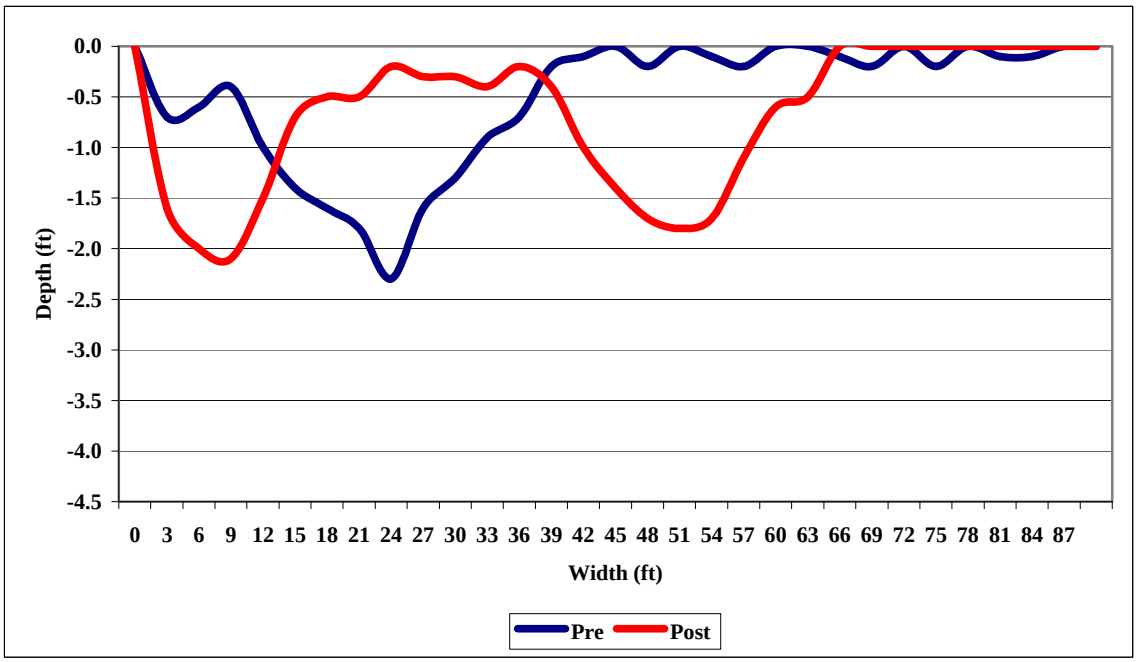
Appendix C-15. Pre- and Post cross sections at Riffle 2 Transect 1 – Cloverdale Reach



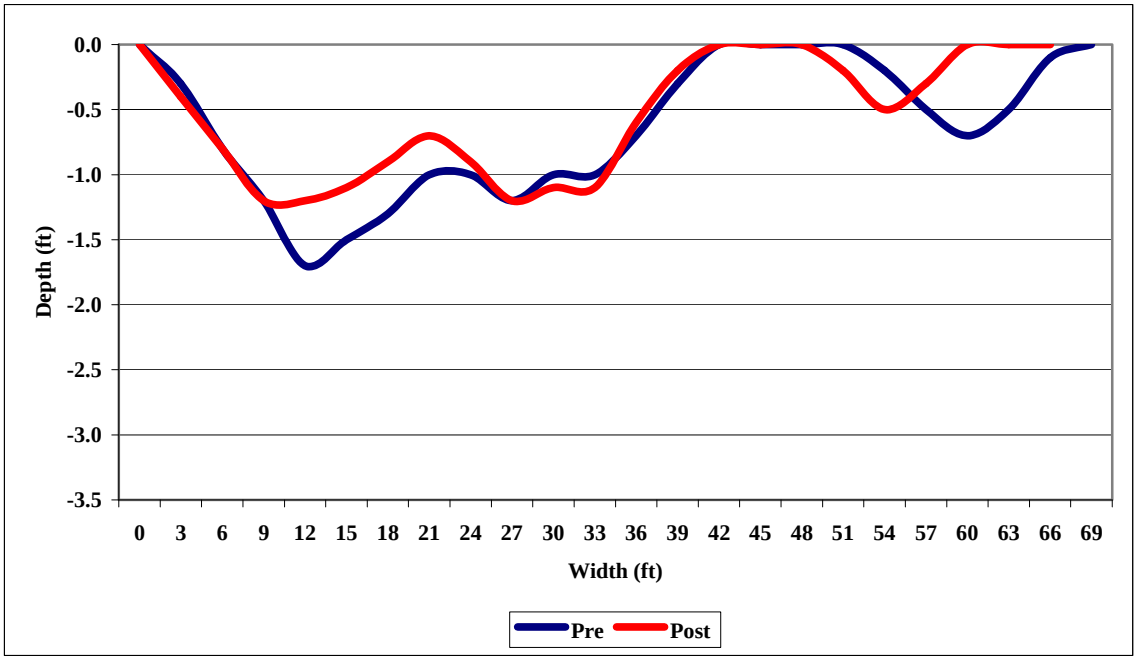
Appendix C-16. Pre- and Post cross sections at Riffle 2 Transect 2 – Cloverdale Reach



Appendix C-17. Pre- and Post cross sections at Riffle 2 Transect 3 – Cloverdale Reach



Appendix C-18. Pre- and Post cross sections at Riffle 3 Transect 1 – Cloverdale Reach



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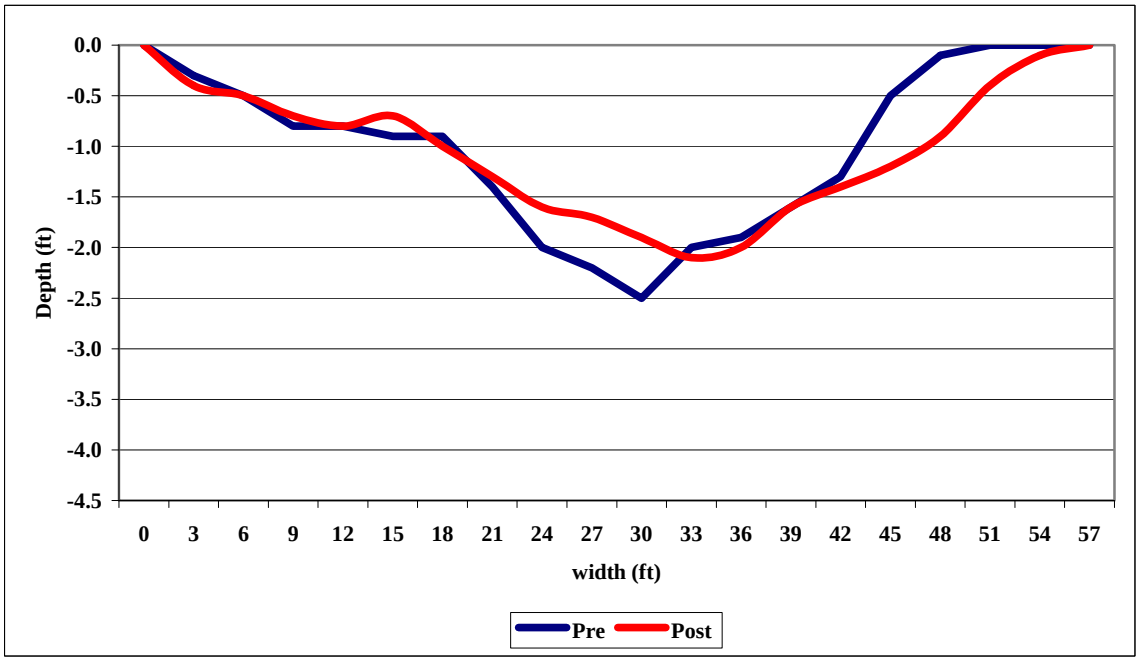
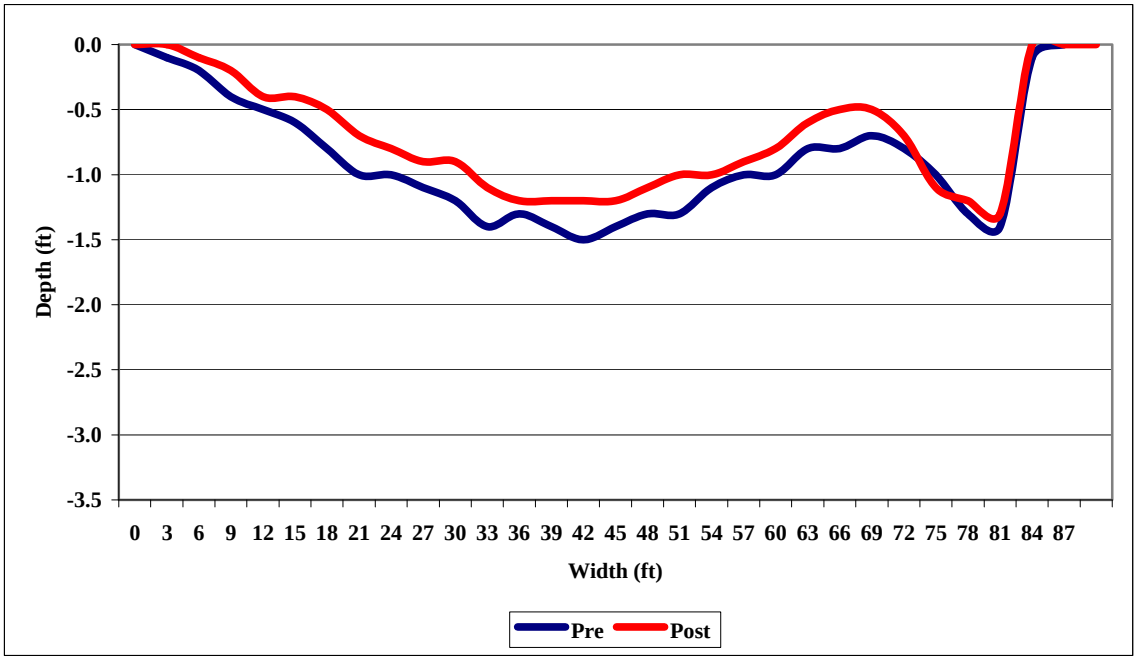
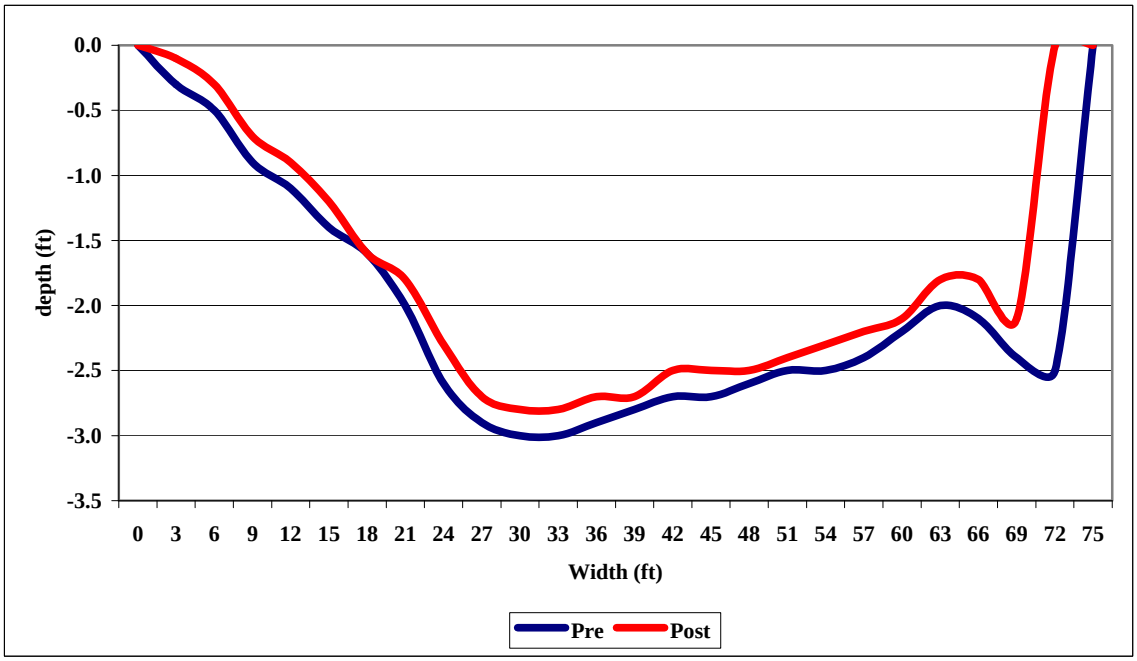


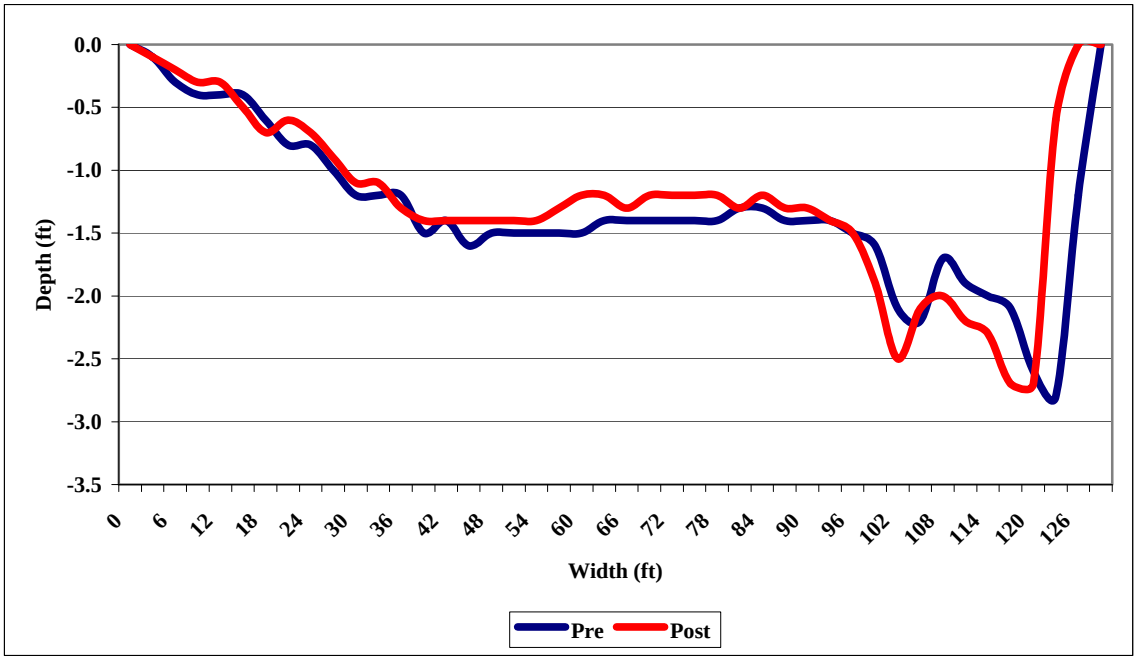
Appendix C-20. Pre- and Post cross sections at Riffle 3 Transect 3 – Cloverdale Reach



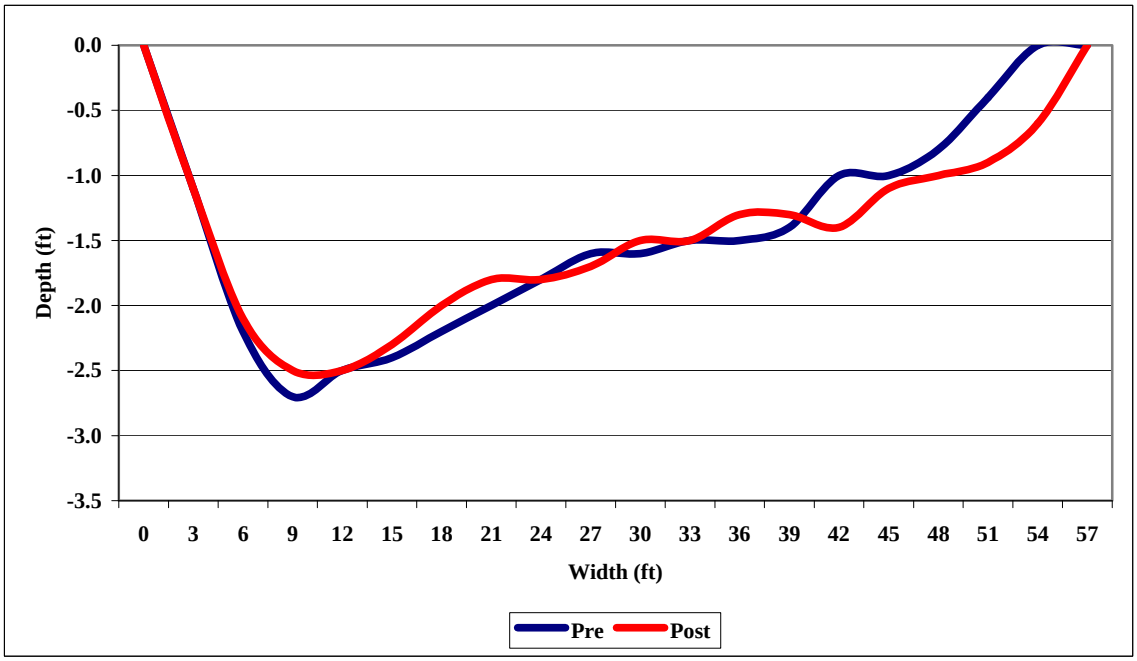
Appendix C-21. Pre- and Post cross sections at Flatwater 1 Transect 1 – Cloverdale Reach



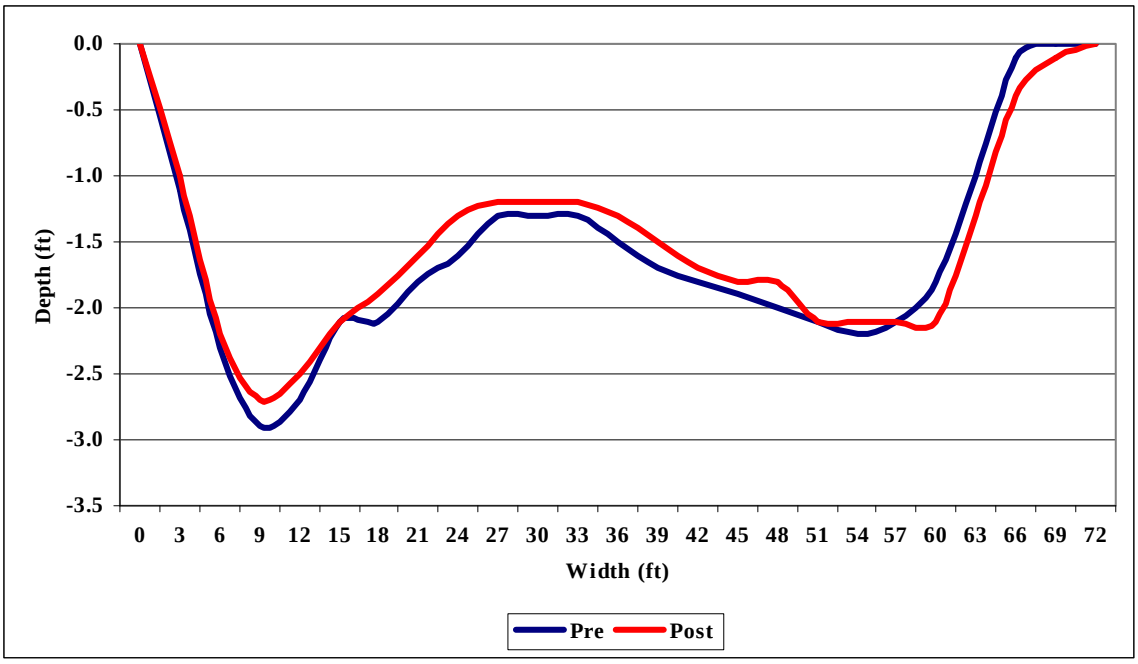
Appendix C-22. Pre- and Post cross sections at Flatwater 1 Transect 2 – Cloverdale Reach



Appendix C-23. Pre- and Post cross sections at Flatwater 1 Transect 3 – Cloverdale Reach



Appendix C-24. Pre- and Post cross sections at Flatwater 2 Transect 1 – Cloverdale Reach



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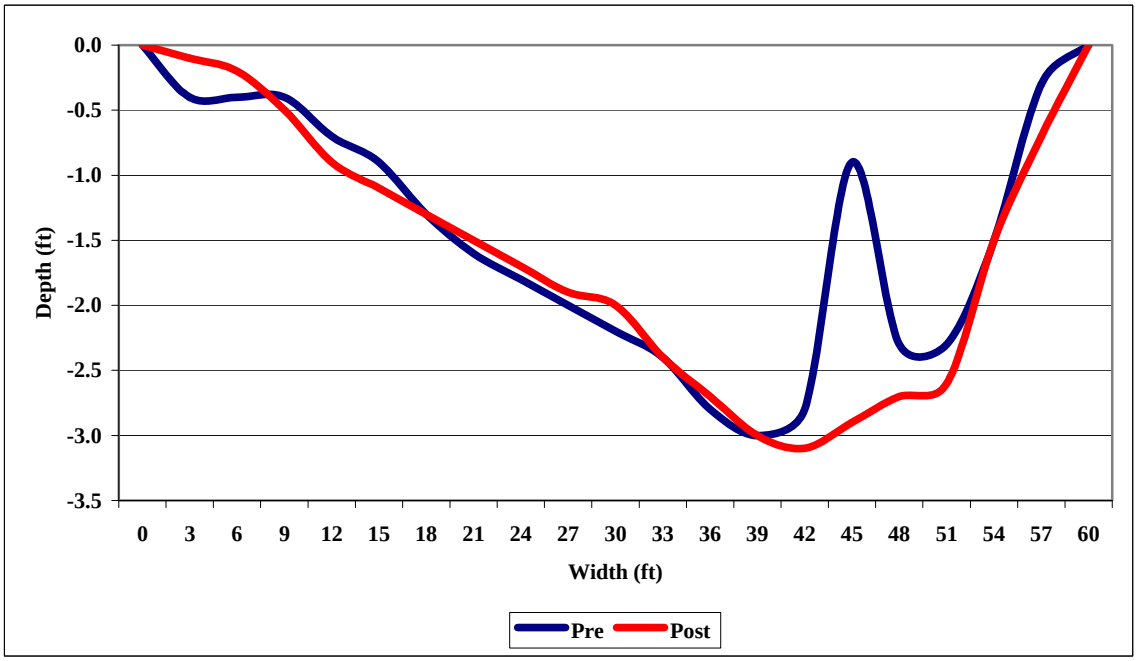

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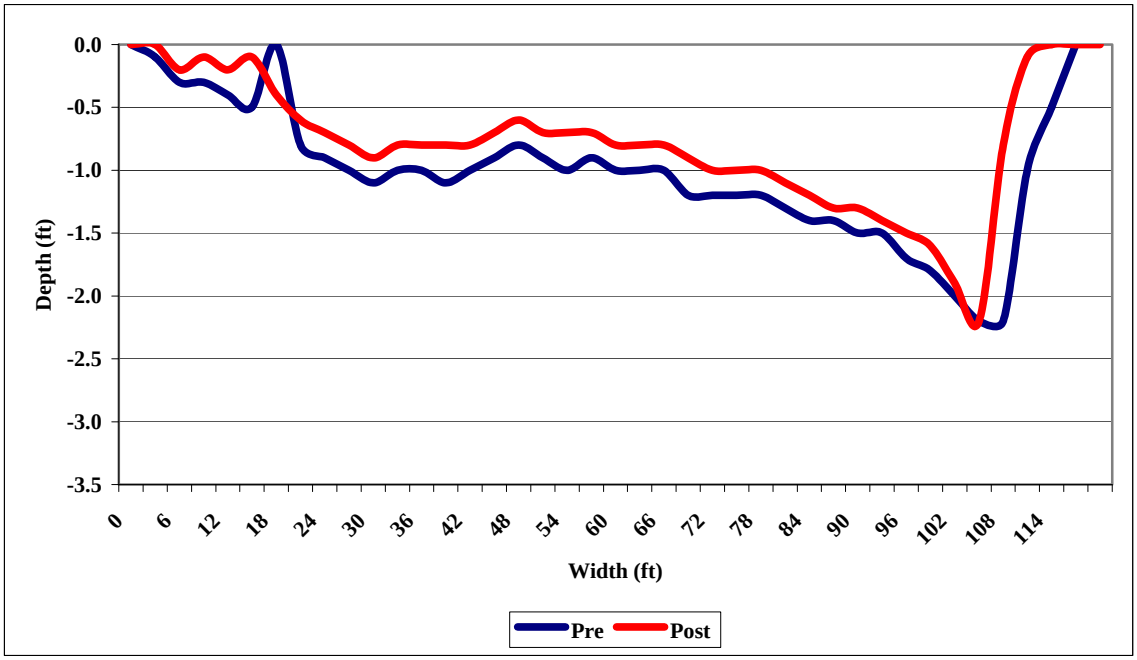
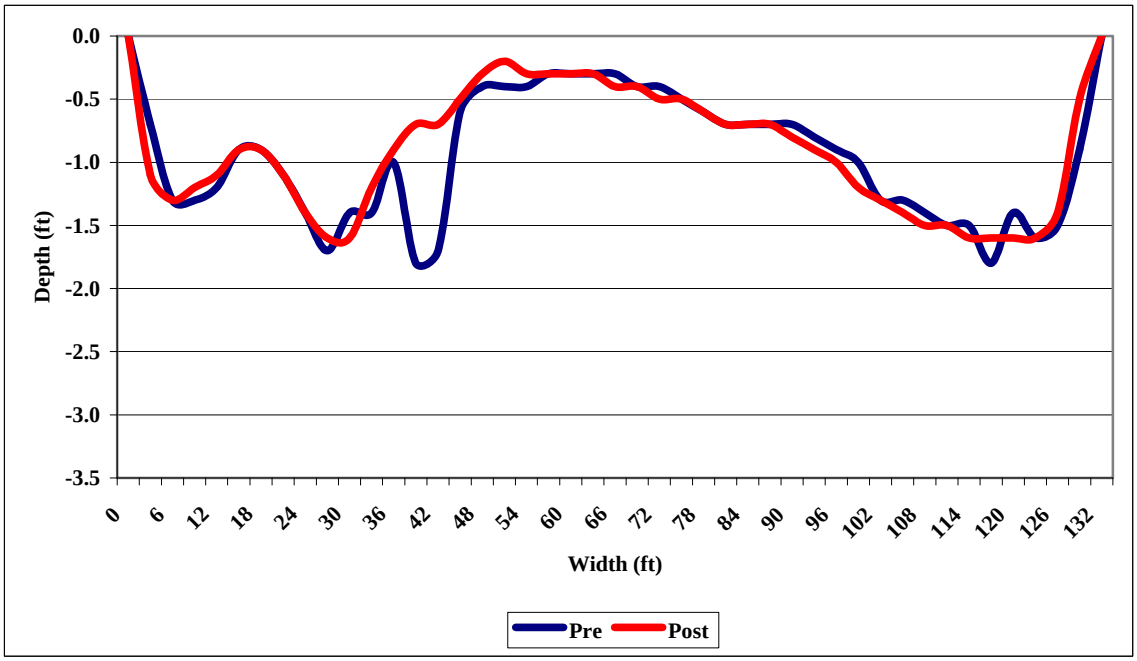
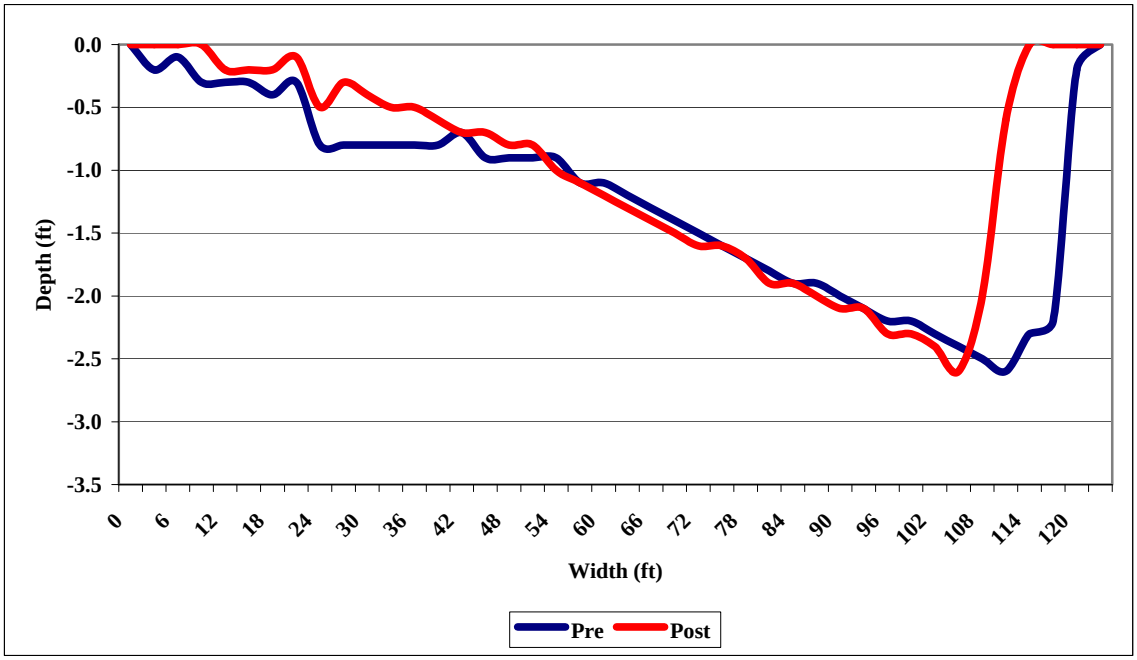


Appendix C-27. Pre- and Post cross sections at Flatwater 3 Transect 1 – Cloverdale Reach



Appendix C-28. Pre- and Post cross sections at Flatwater 3 Transect 2 – Cloverdale Reach

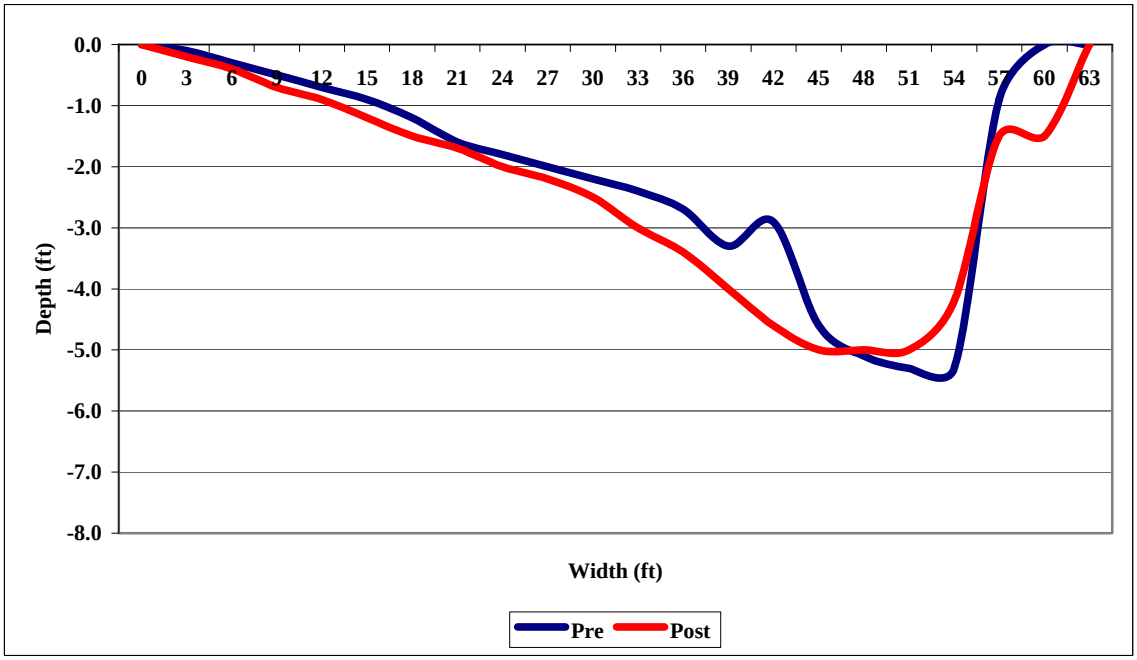


Appendix C-29. Pre- and Post cross sections at Flatwater 3 Transect 3 – Cloverdale Reach

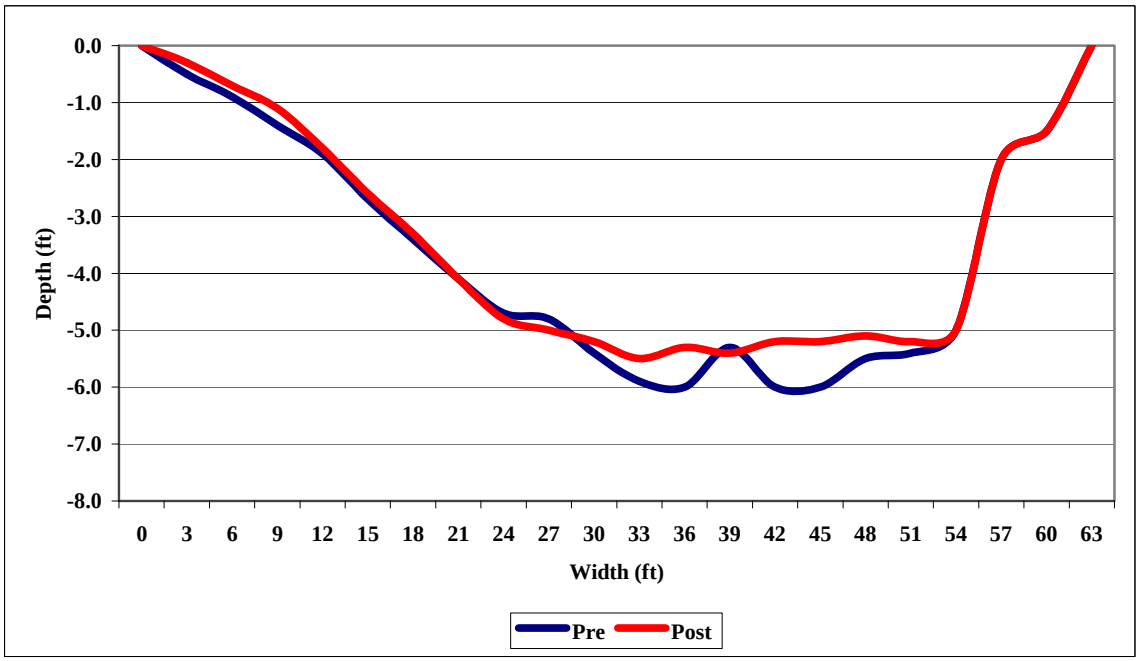
APPENDIX D

GEYSERVILLE REACH CROSS SECTIONS

PRE AND POST FLOW REDUCTION SURVEYS



Appendix D-1. Pre- and Post cross sections at Pool 1 Transect 1 – Geyserville Reach



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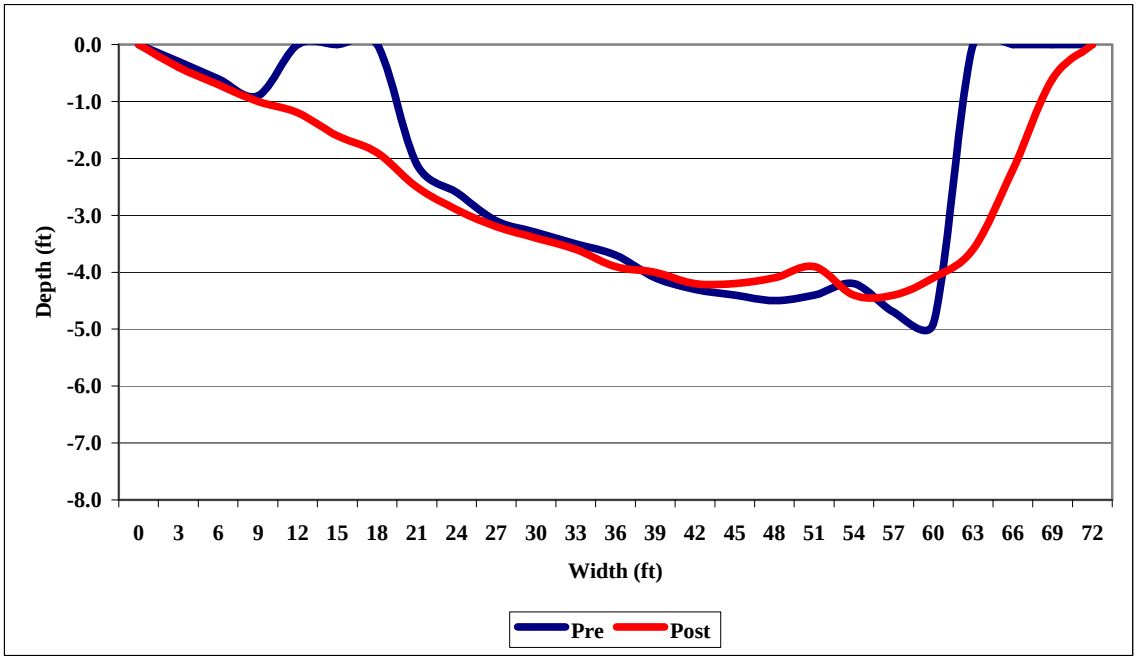

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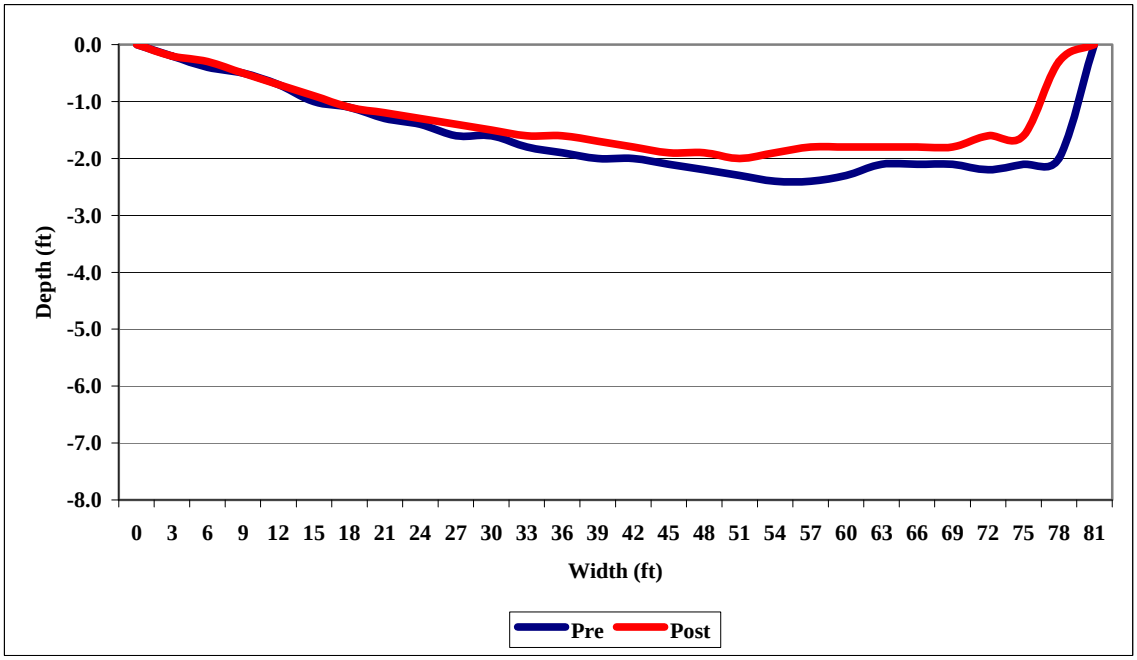
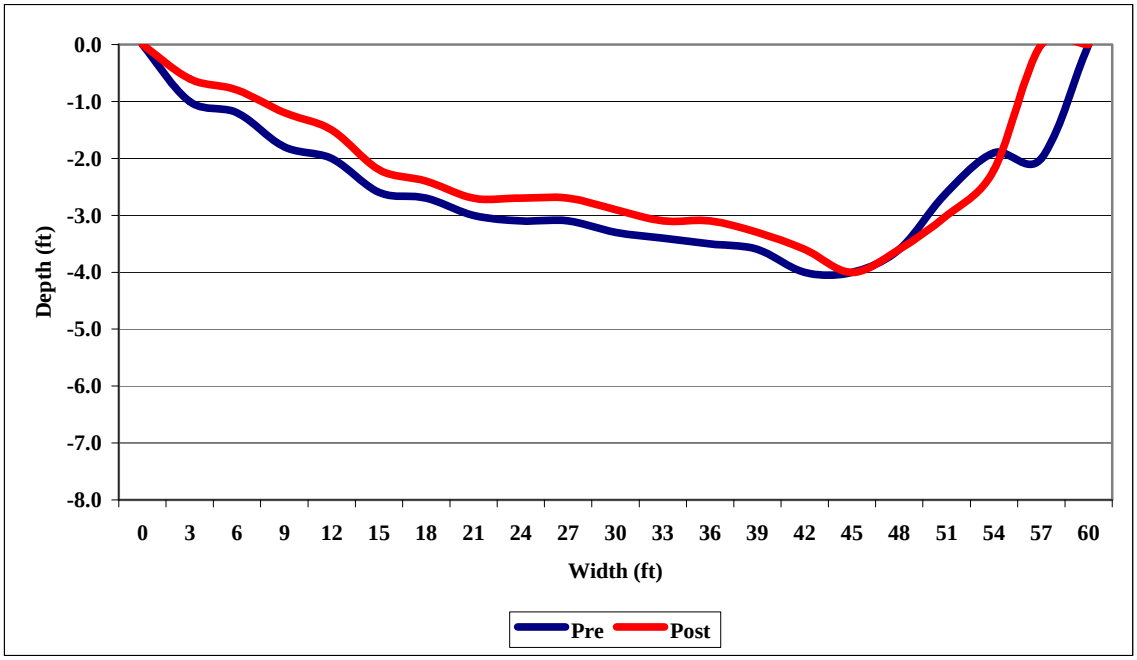
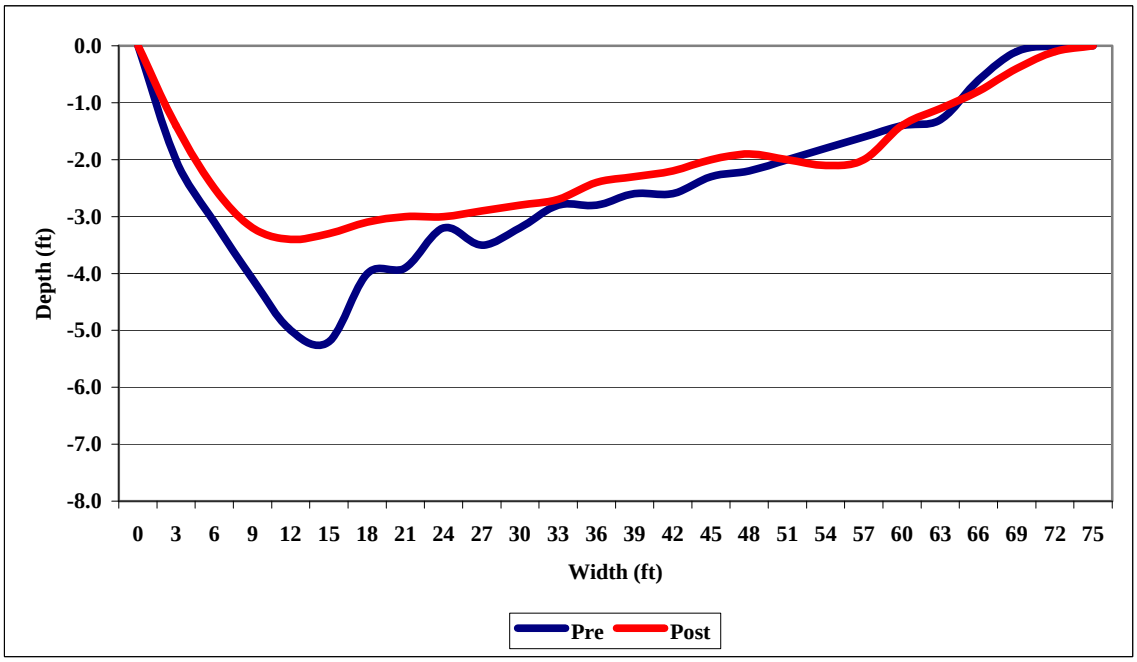


Appendix D-4. Pre- and Post cross sections at Pool 1 Transect 4 – Geyserville Reach



Appendix D-5. Pre- and Post cross sections at Pool 2 Transect 1 – Geyserville Reach



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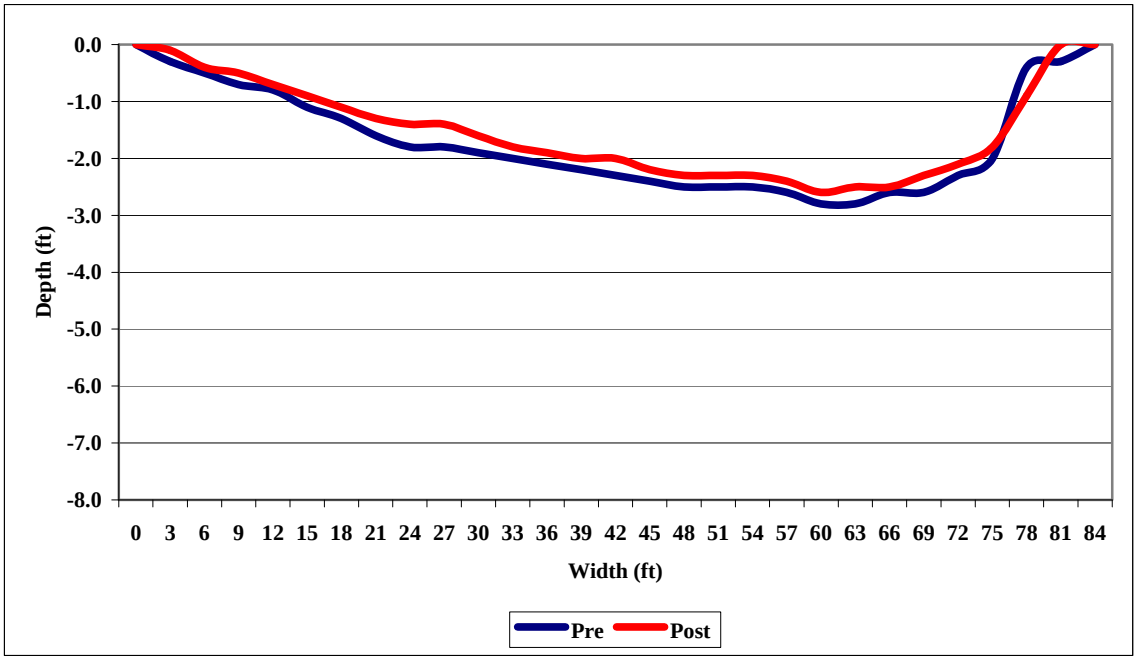
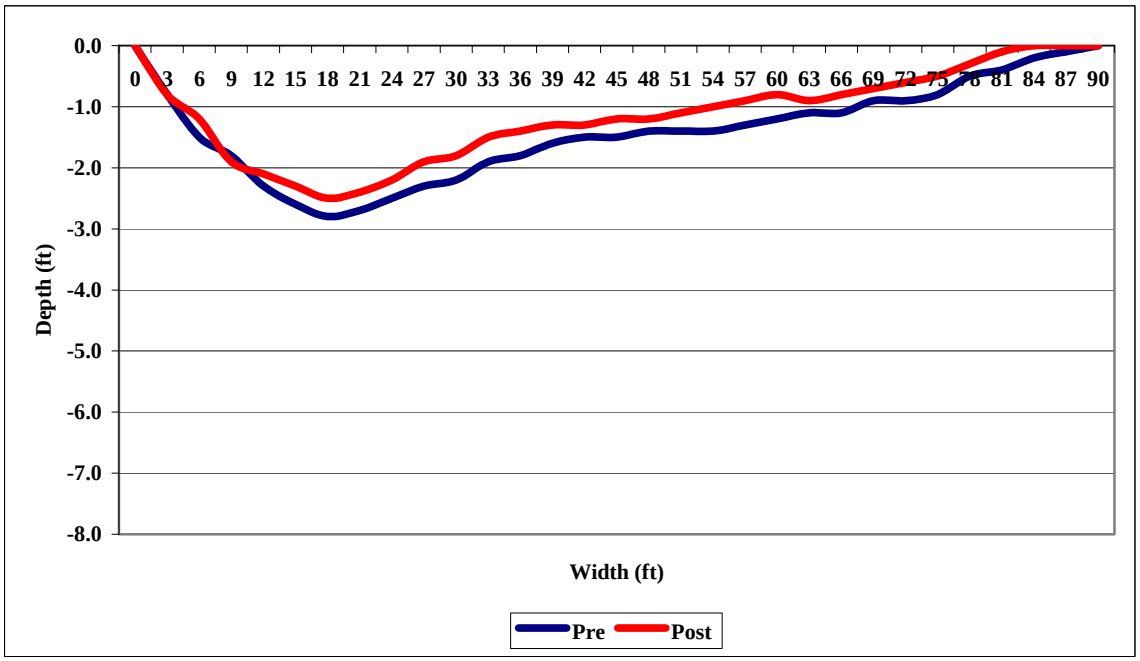
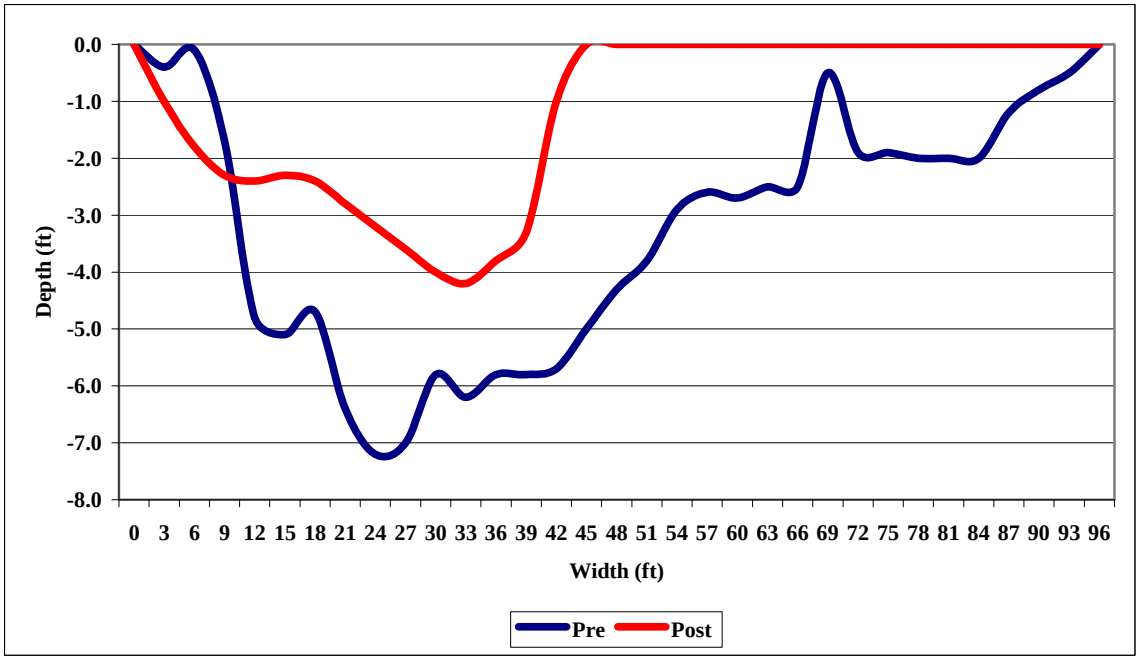


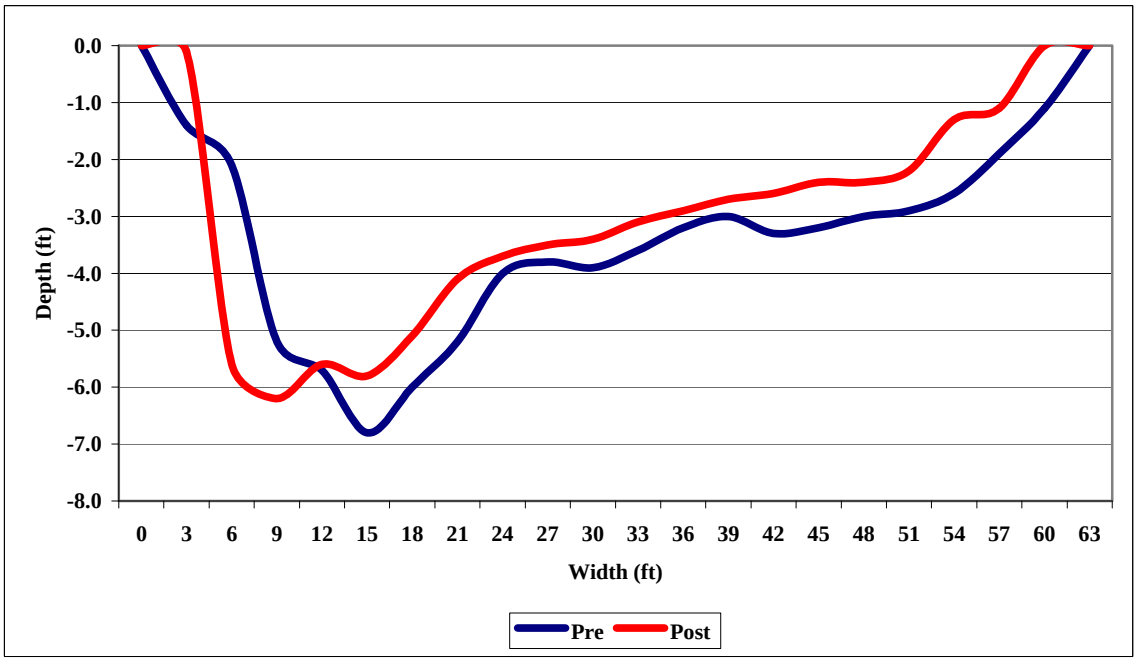
Appendix D-7. Pre- and Post cross sections at Pool 2 Transect 3 – Geyserville Reach



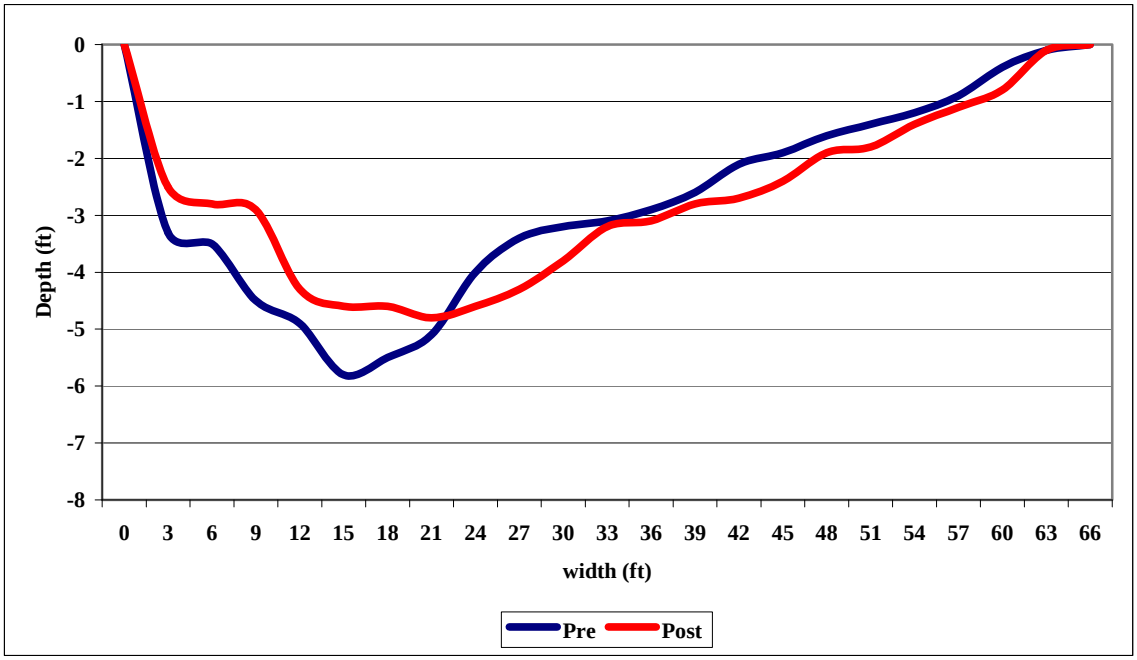
Appendix D-8. Pre- and Post cross sections at Pool 2 Transect 4 – Geyserville Reach



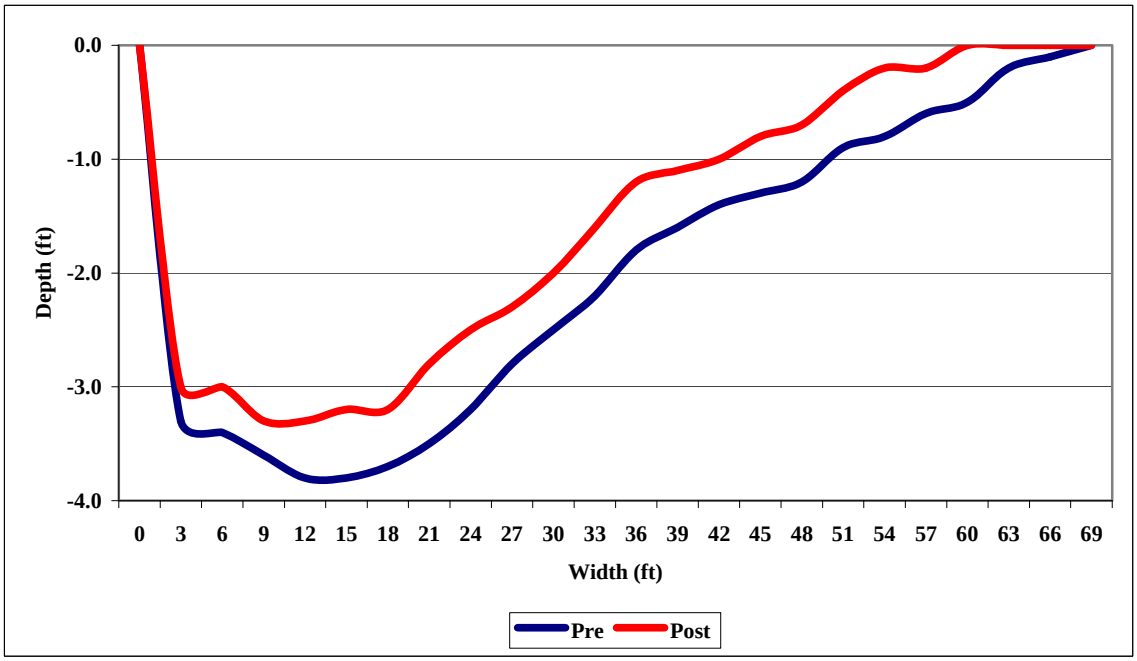
Appendix D-9. Pre- and Post cross sections at Pool 3 Transect 1 – Geyserville Reach



Appendix D-10. Pre- and Post cross sections at Pool 3 Transect 2 – Geyserville Reach



Appendix D-11. **Pre- and Post cross sections at Pool 3 Transect 3 – Geyserville Reach**



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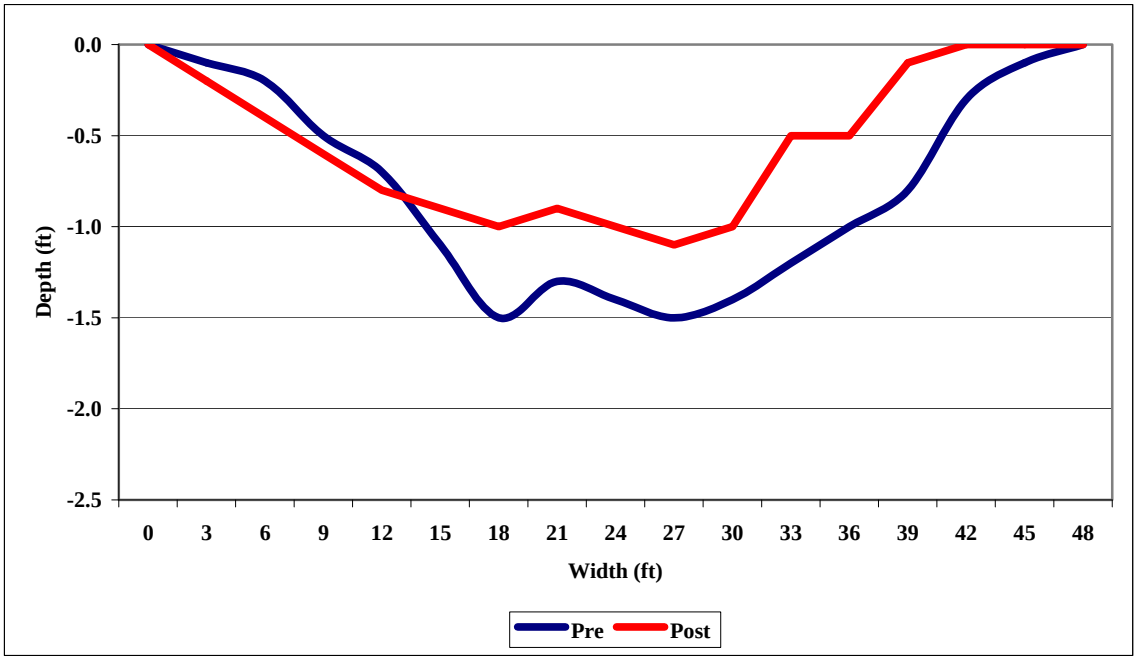
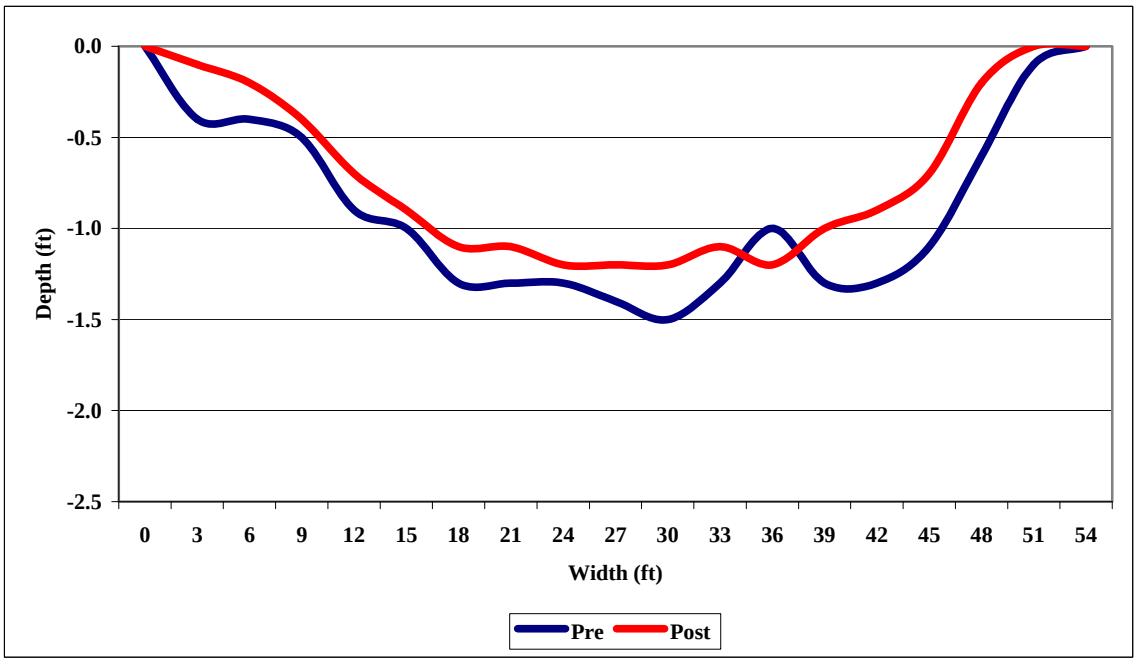
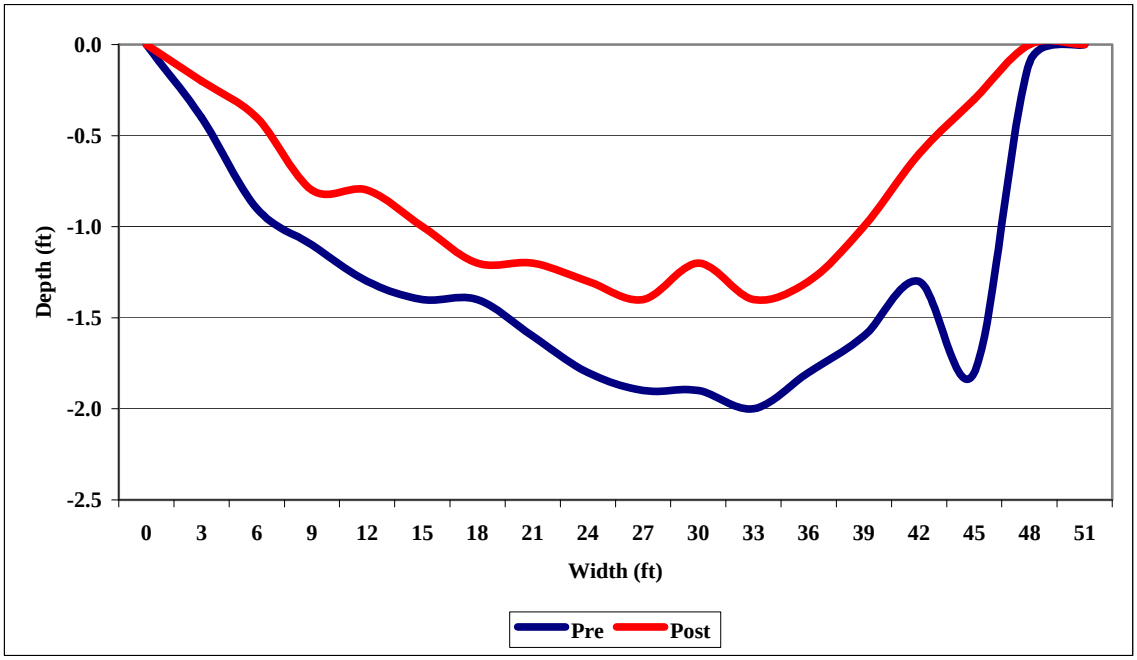


Appendix D-12. **Pre- and Post cross sections at Riffle 1 Transect 1 – Geyserville Reach**



Appendix D-13. **Pre- and Post cross sections at Riffle 1 Transect 2 – Geyserville Reach**



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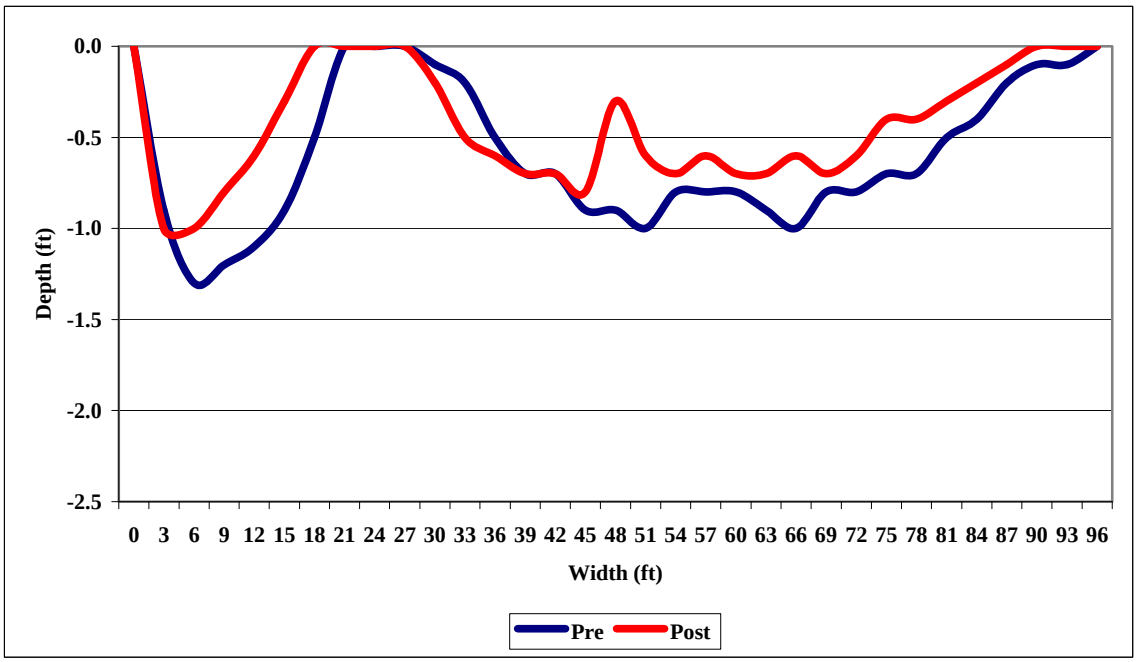

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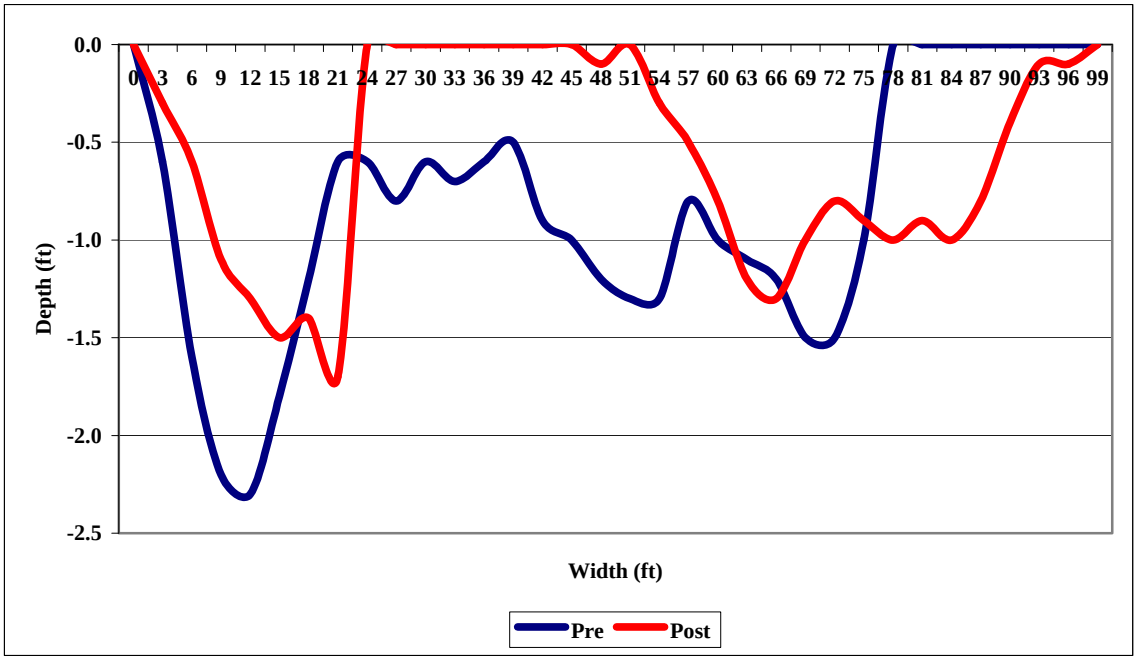
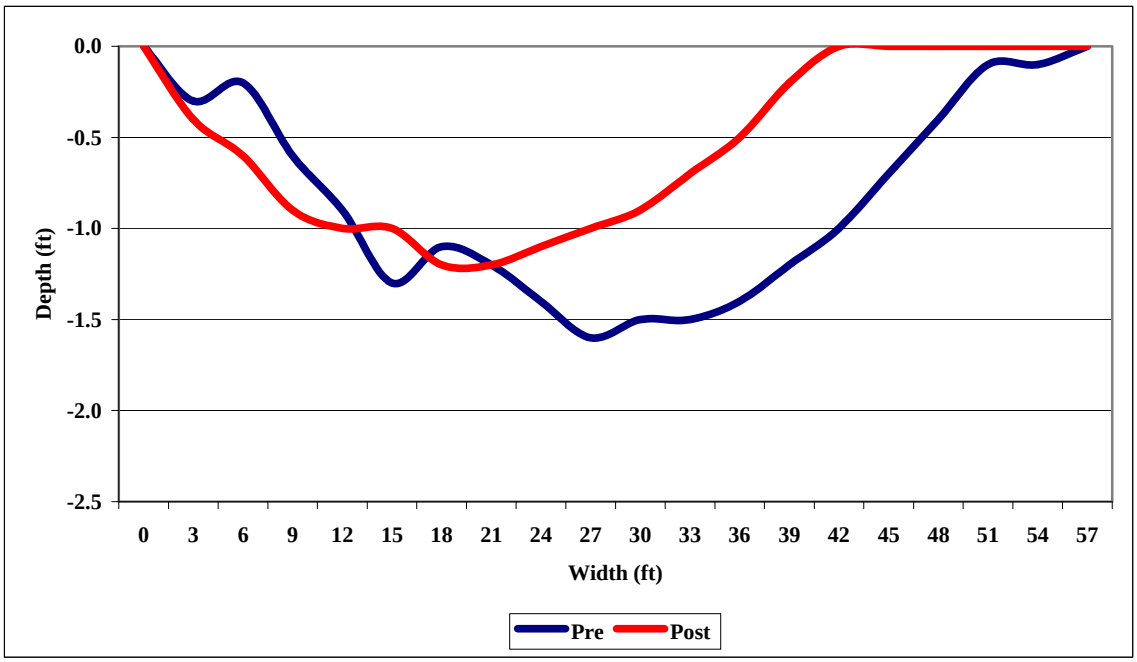
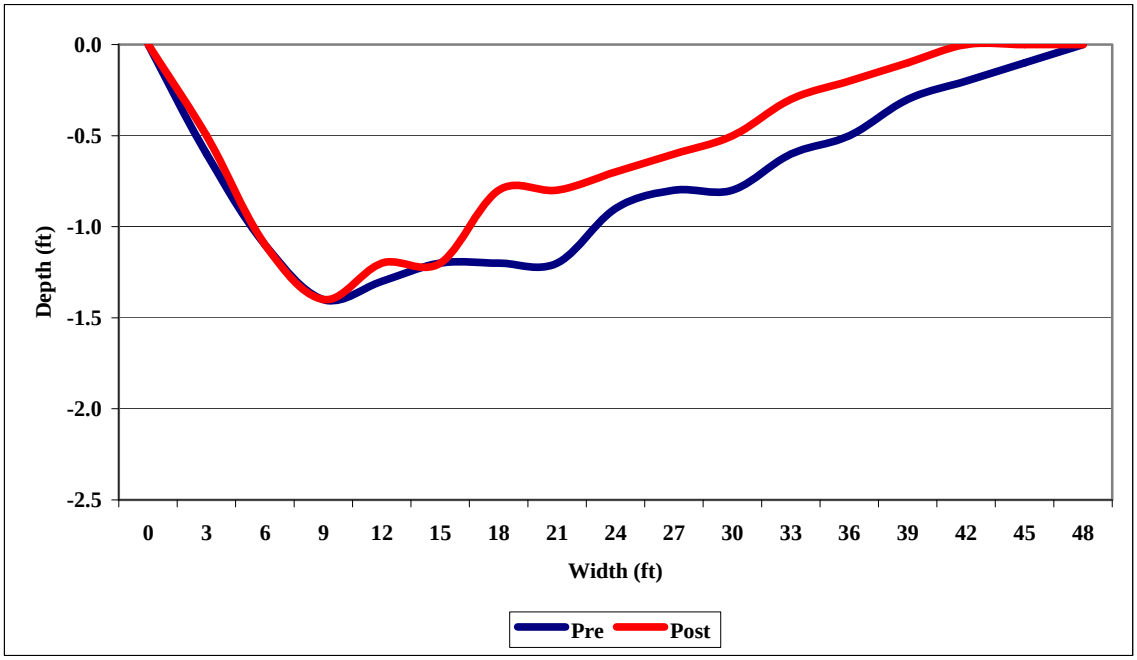


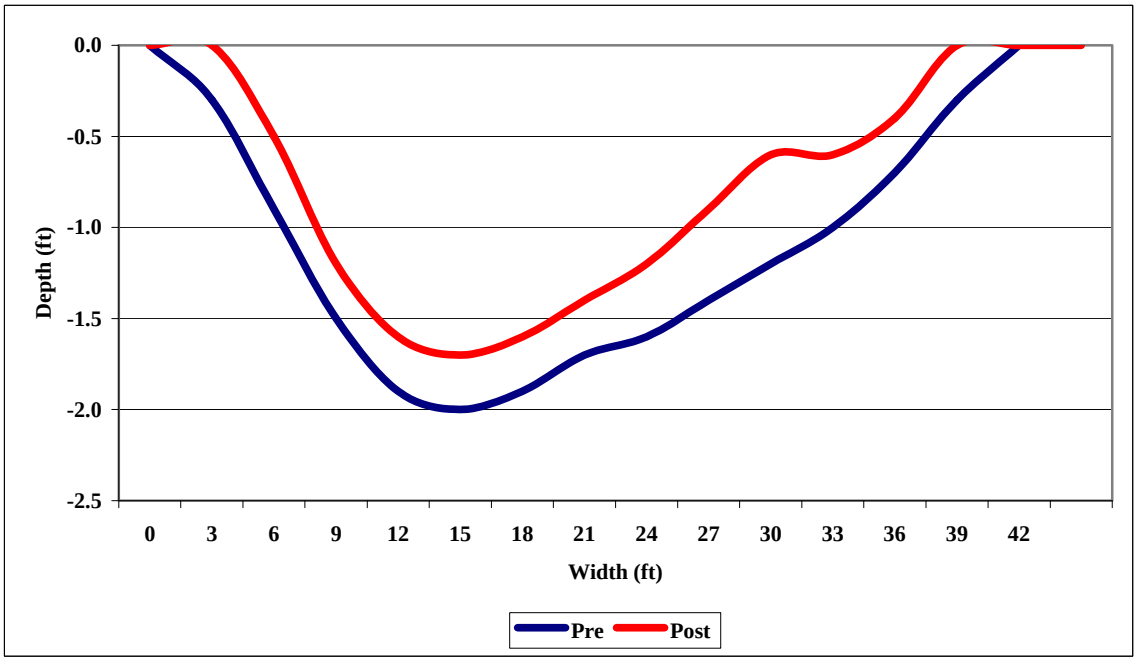
Appendix D-16. **Pre- and Post cross sections at Riffle 2 Transect 2 – Geyserville Reach**



Appendix D-17. **Pre- and Post cross sections at Riffle 2 Transect 3 – Geyserville Reach**



Appendix D-18. **Pre- and Post cross sections at Riffle 3 Transect 1 – Geyserville Reach**



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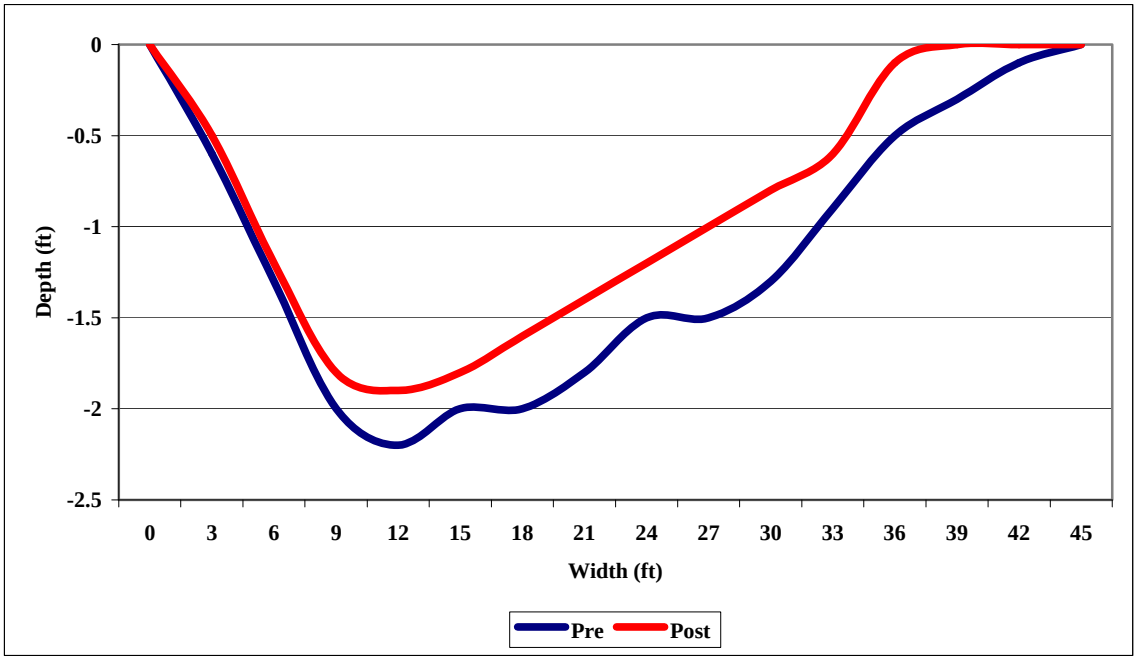
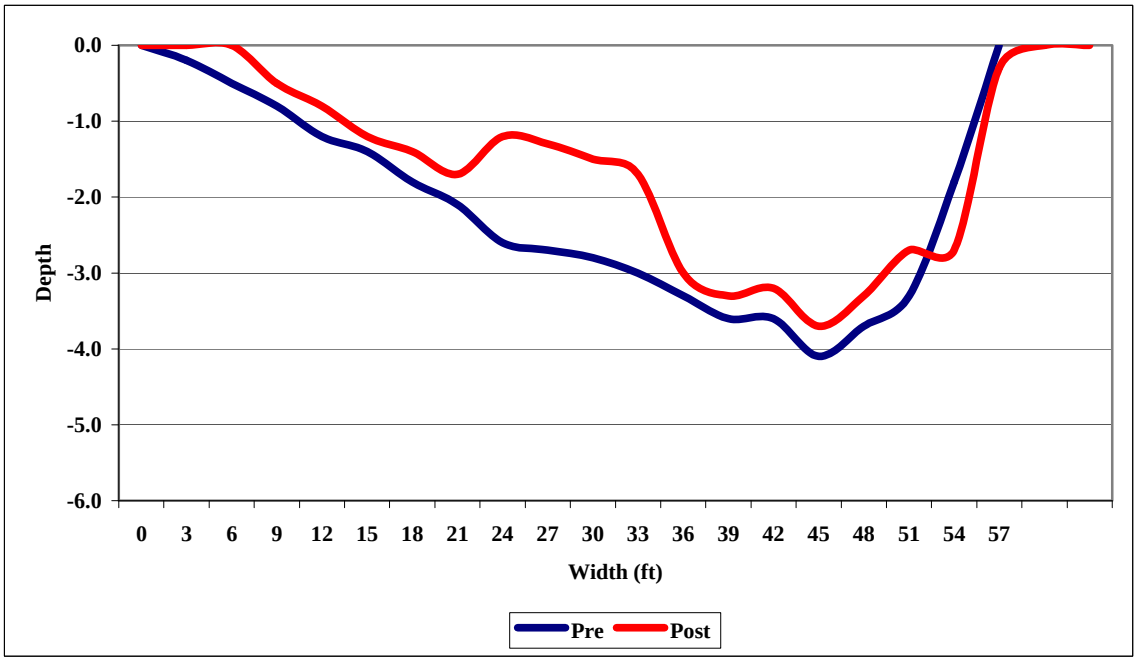
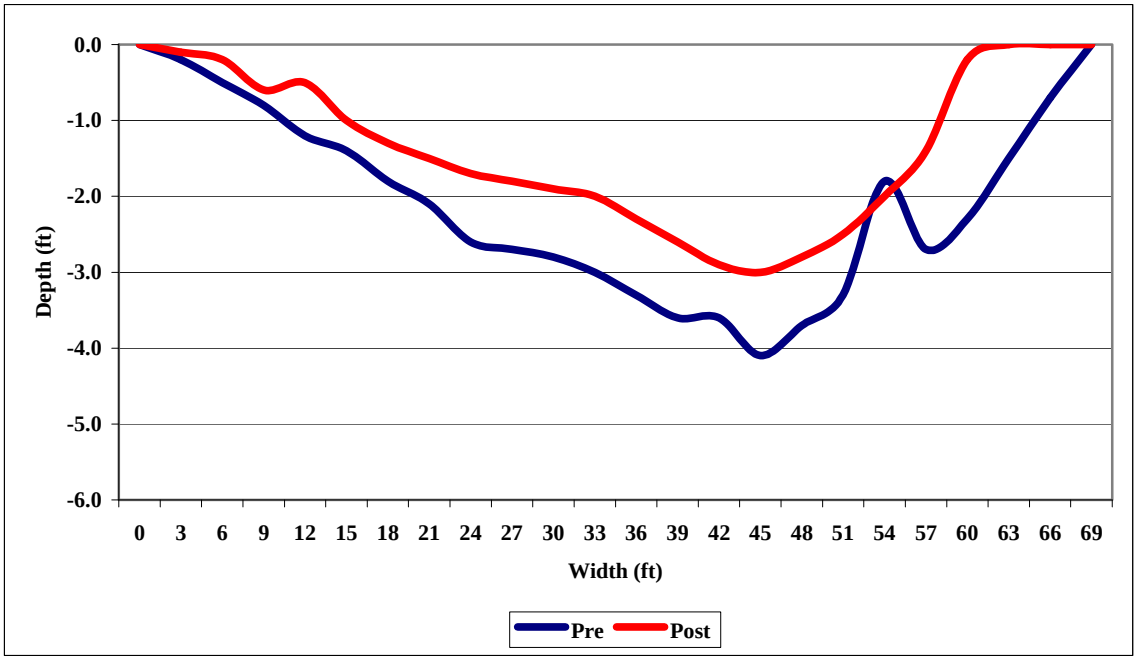


Appendix D-19. **Pre- and Post cross sections at Riffle 3 Transect 3 – Geyserville Reach**



Appendix D-20. **Pre- and Post cross sections at Flatwater 1 Transect 1 – Geyserville Reach**



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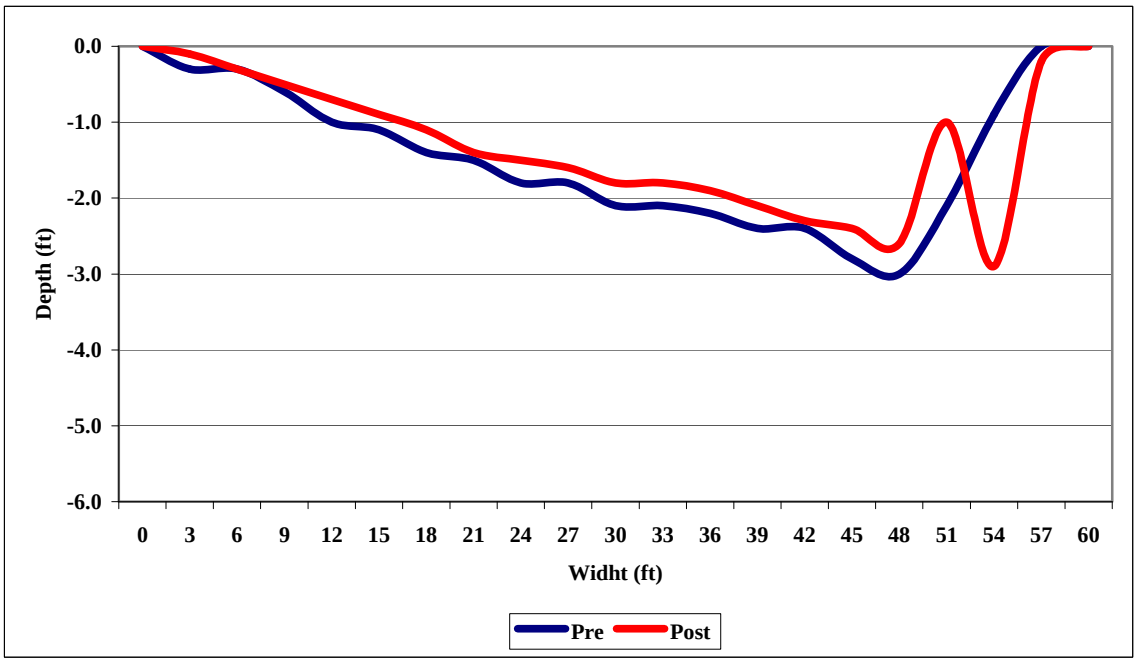

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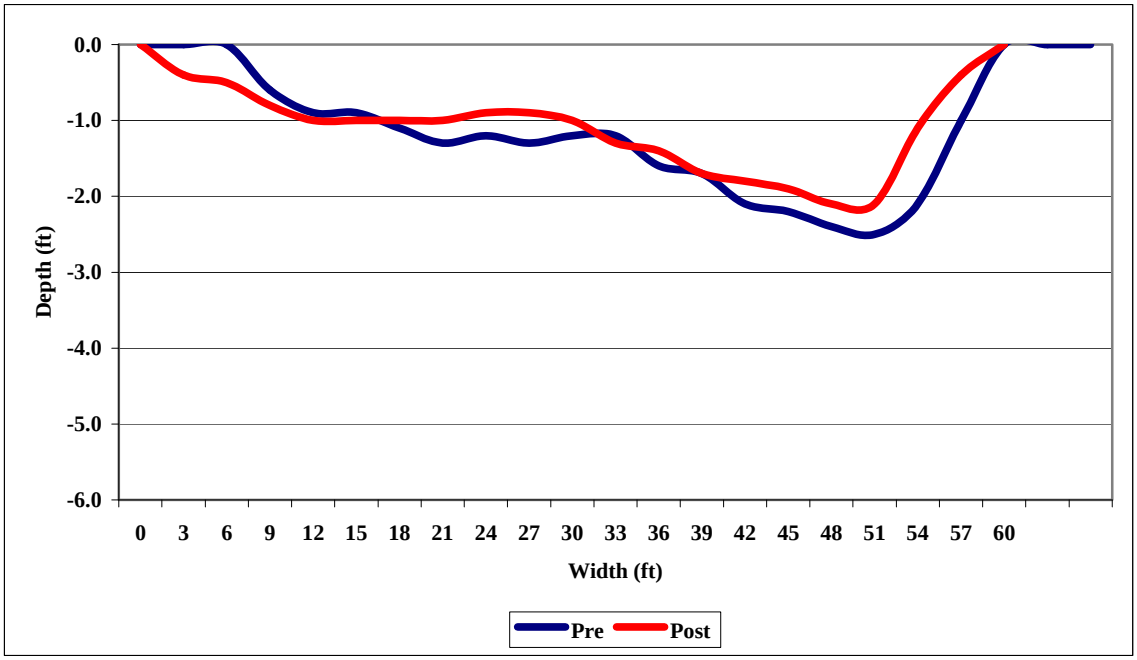
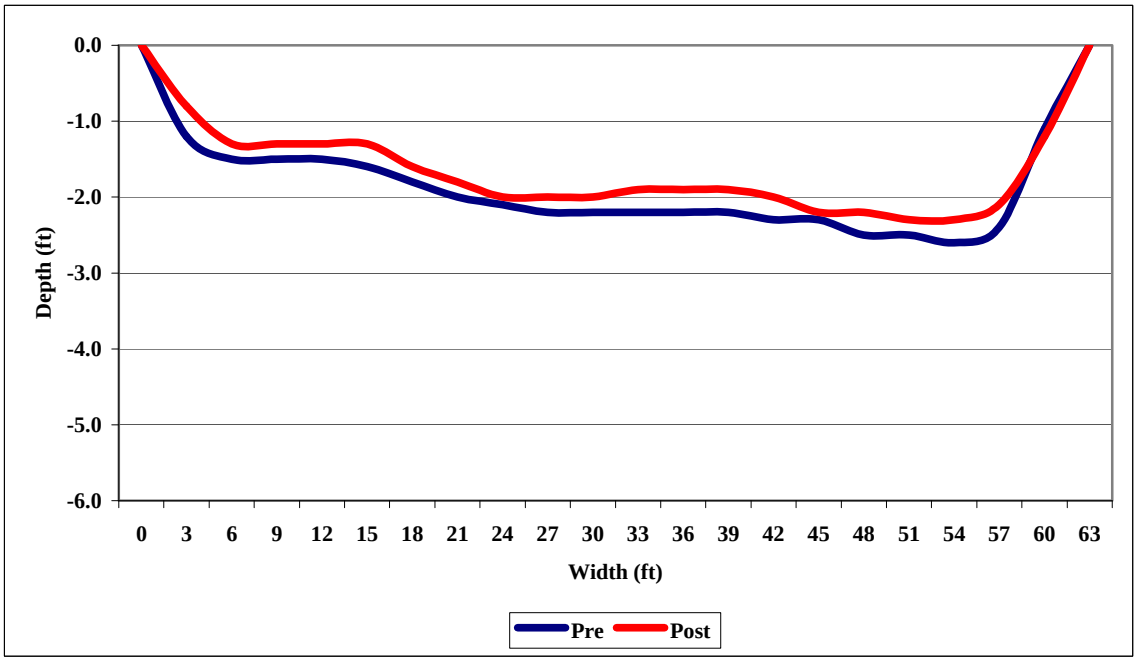


Appendix D-23. **Pre- and Post cross sections at Flatwater 2 Transect 1 – Geyserville Reach**



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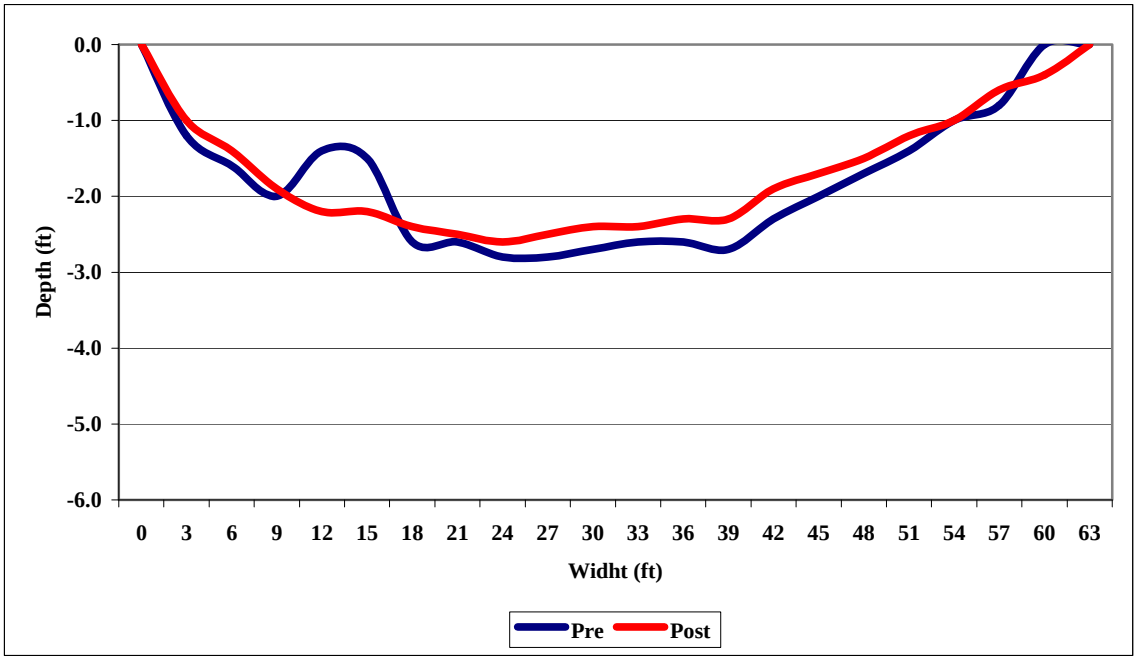
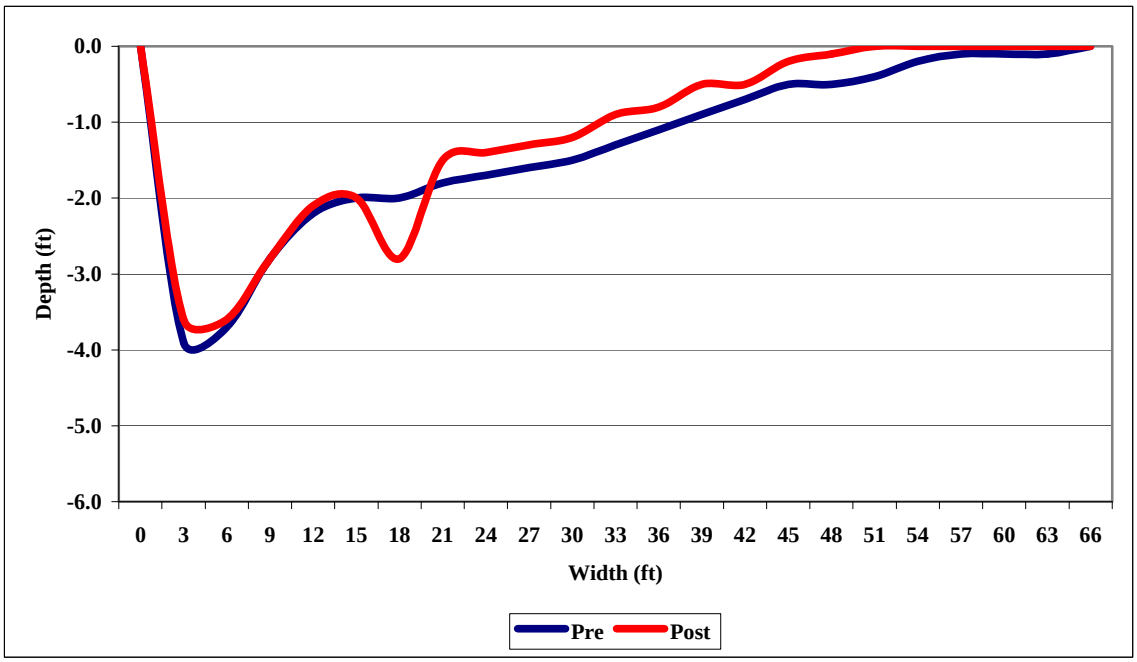
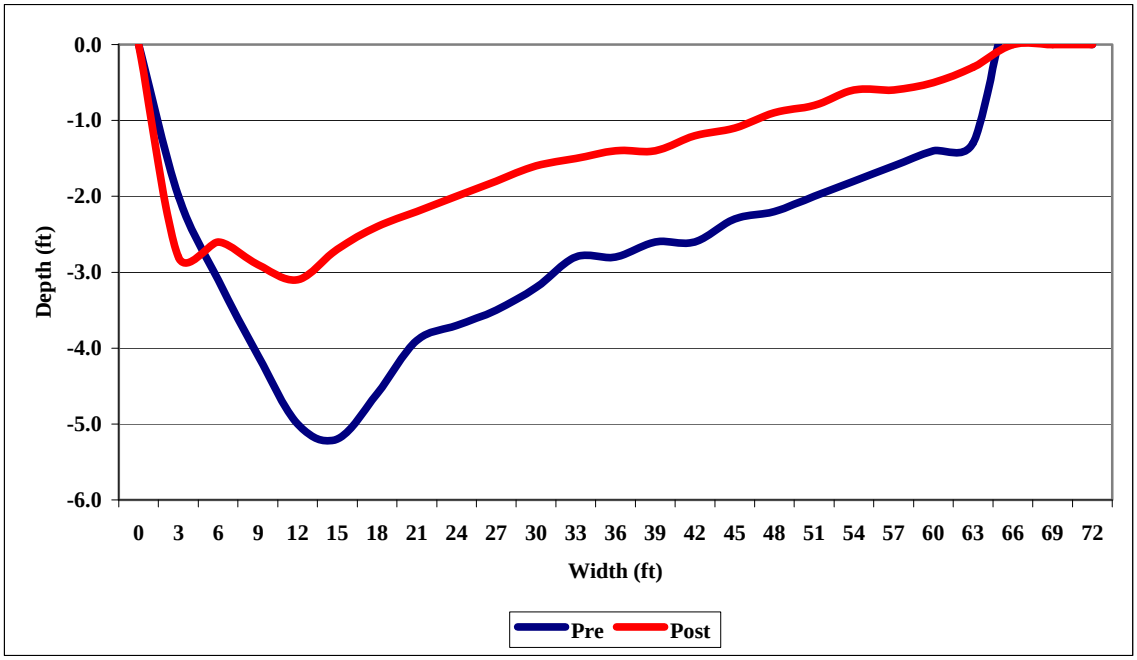


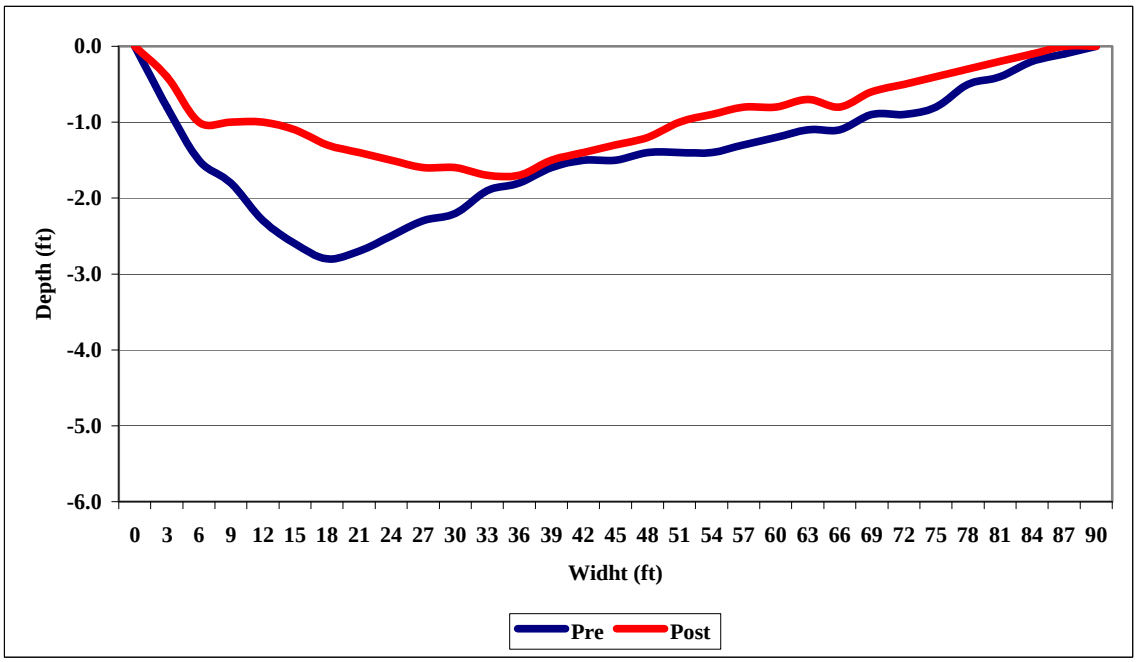
Appendix D-25. **Pre- and Post cross sections at Flatwater 2 Transect 3 – Geyserville Reach**



Appendix D-26. **Pre- and Post cross sections at Flatwater 3 Transect 1 – Geyserville Reach**



Appendix D-27. **Pre- and Post cross sections at Flatwater 3 Transect 2 – Geyserville Reach**

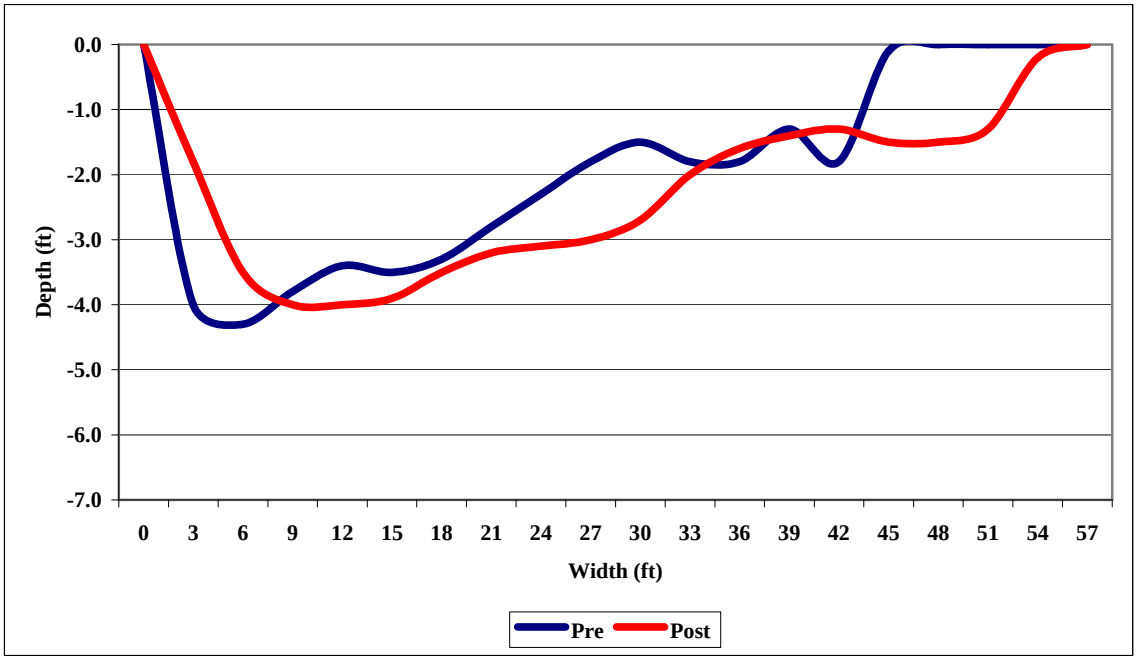


Appendix D-28. **Pre- and Post cross sections at Flatwater 3 Transect 3 – Geyserville Reach**

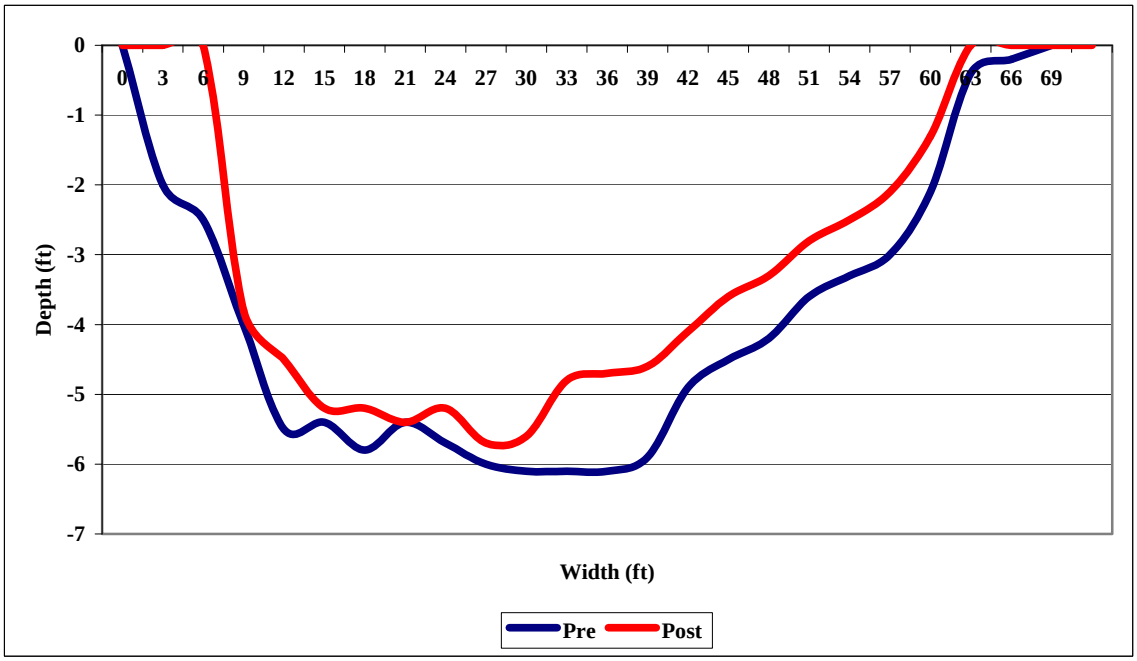
APPENDIX E

DIGGERS BEND REACH CROSS SECTIONS

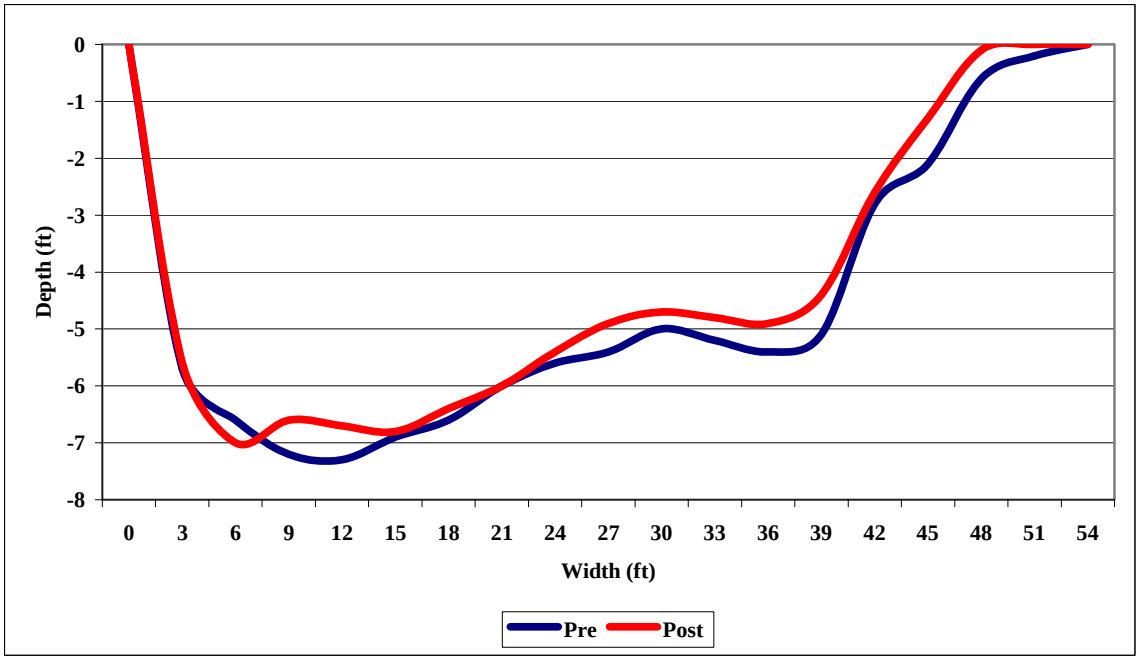
PRE AND POST FLOW REDUCTION SURVEYS



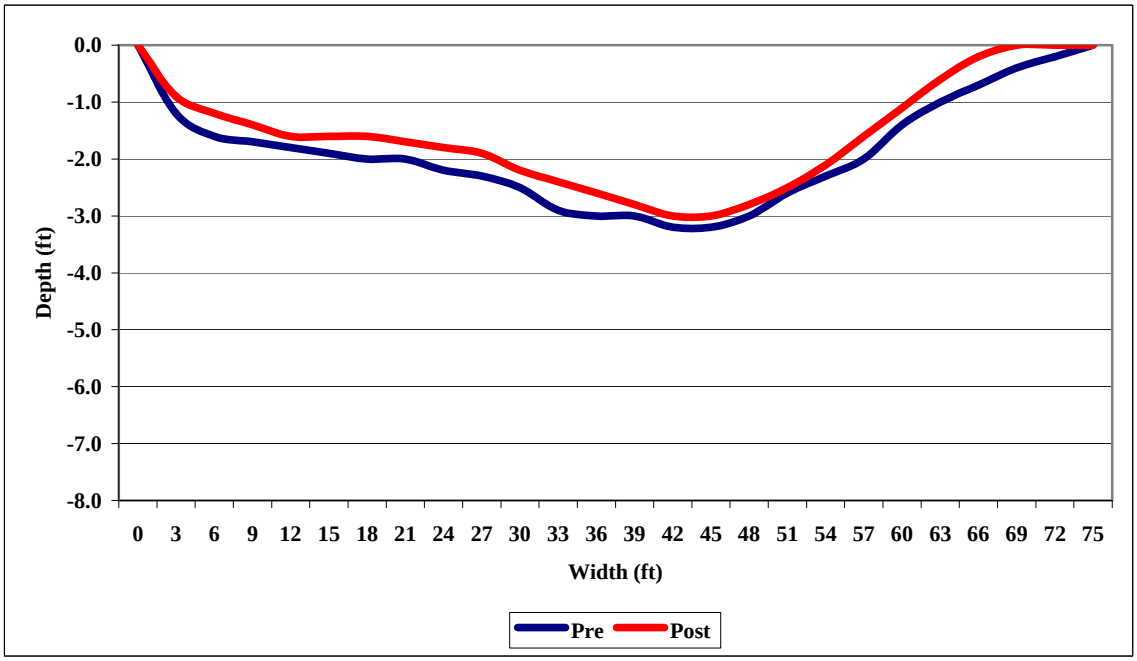
Appendix E-1. Pre and Post cross sections at Pool 1 Transect 1 – Diggers Bend Reach



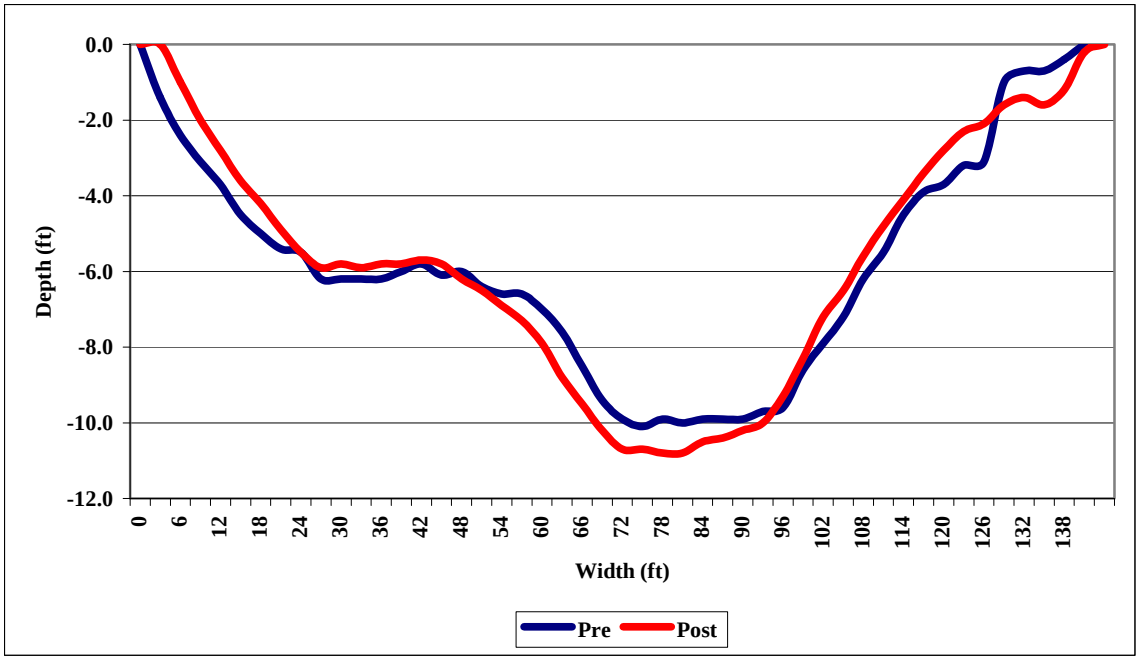
Appendix E-2. Pre and Post cross sections at Pool 1 Transect 2 – Diggers Bend Reach



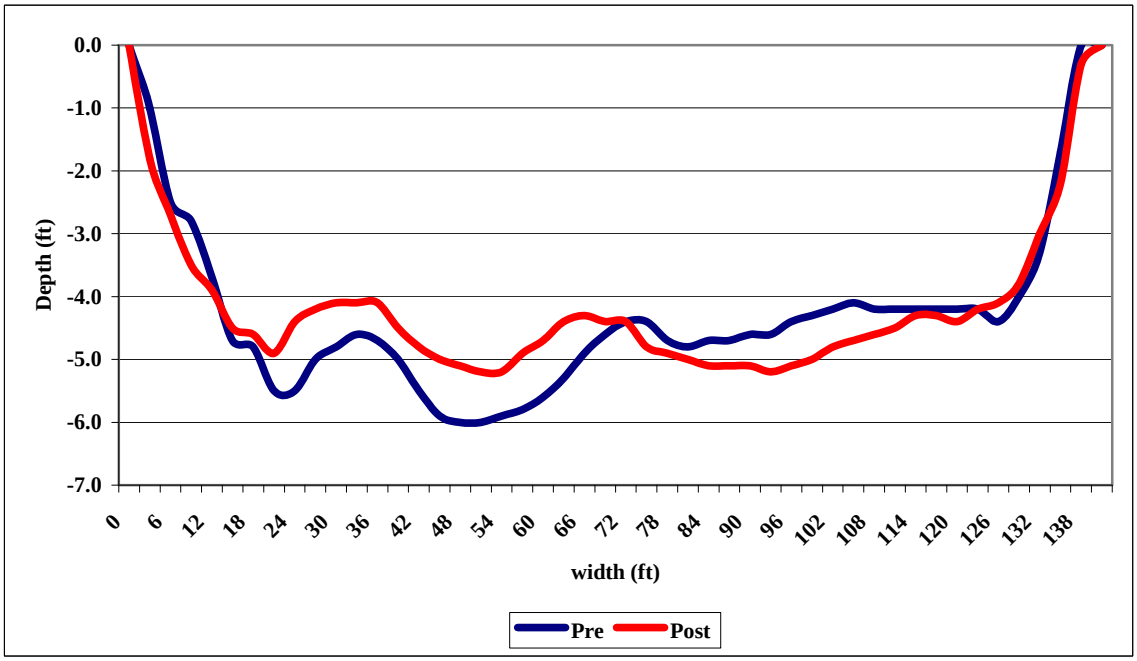
Appendix E-3. Pre and Post cross sections at Pool 1 Transect 3 – Diggers Bend Reach



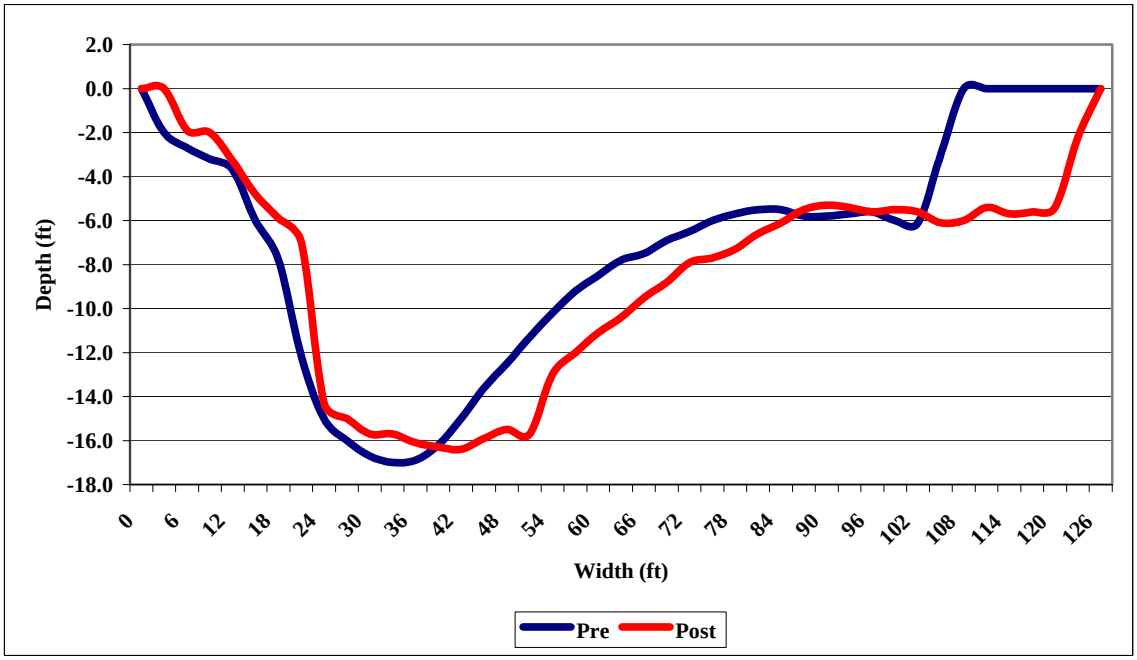
Appendix E-4. Pre and Post cross sections at Pool 1 Transect 4 – Diggers Bend Reach



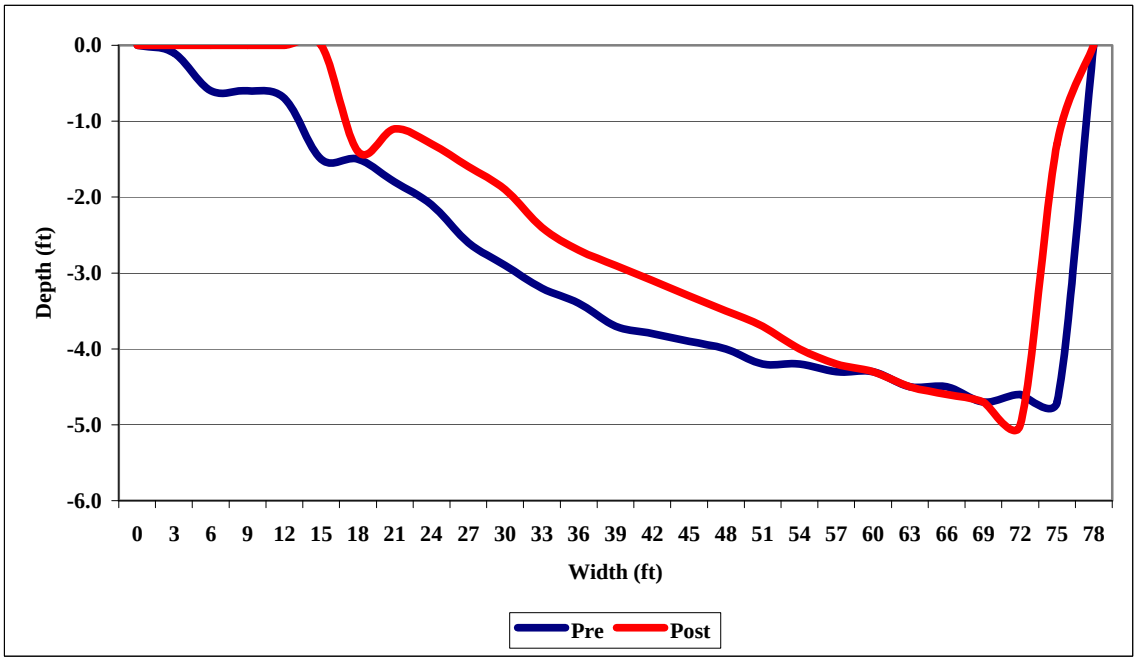
Appendix E-5. Pre and Post cross sections at Pool 2 Transect 1 – Diggers Bend Reach



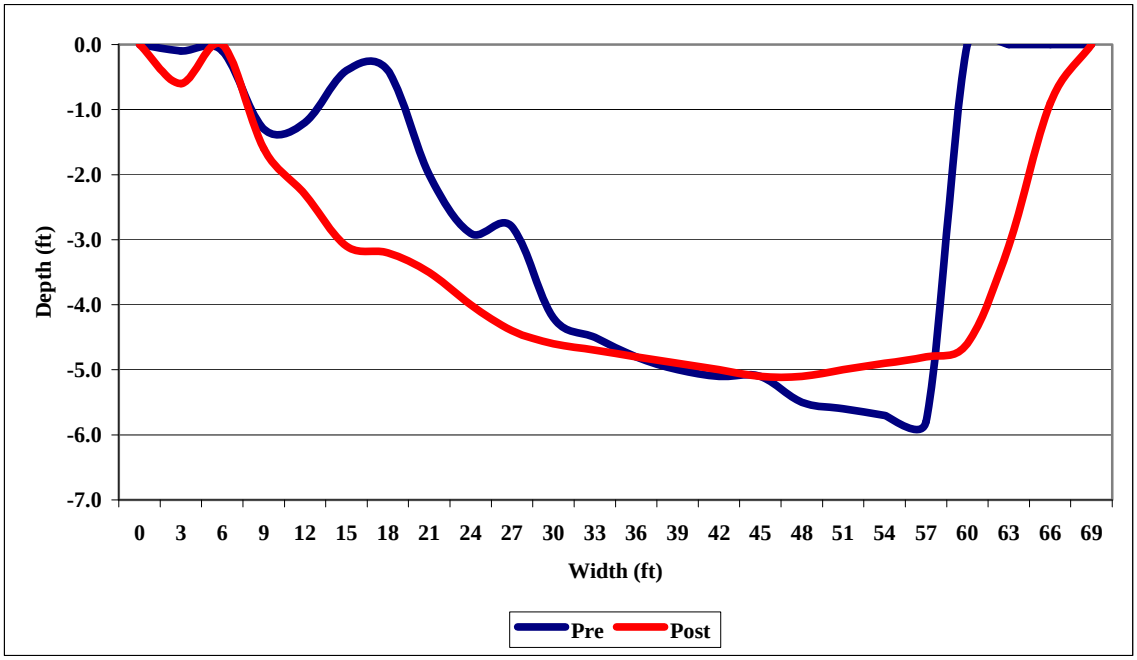
Appendix E-6. Pre and Post cross sections at Pool 2 Transect 2 – Diggers Bend Reach



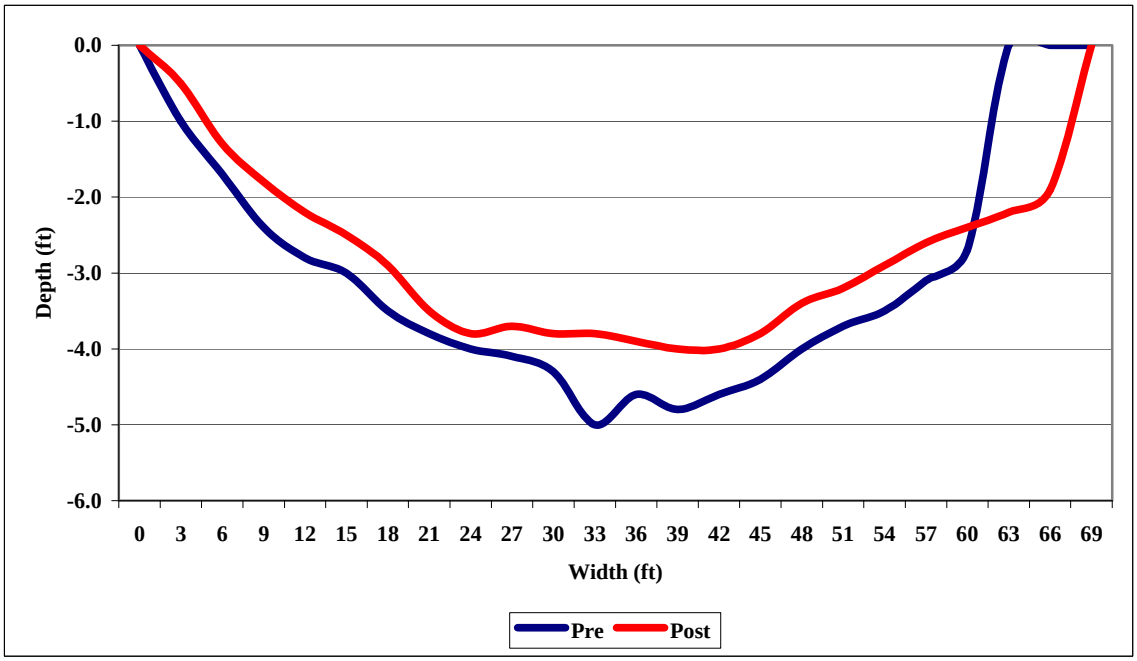
Appendix E-7. Pre and Post cross sections at Pool 2 Transect 3 – Diggers Bend Reach



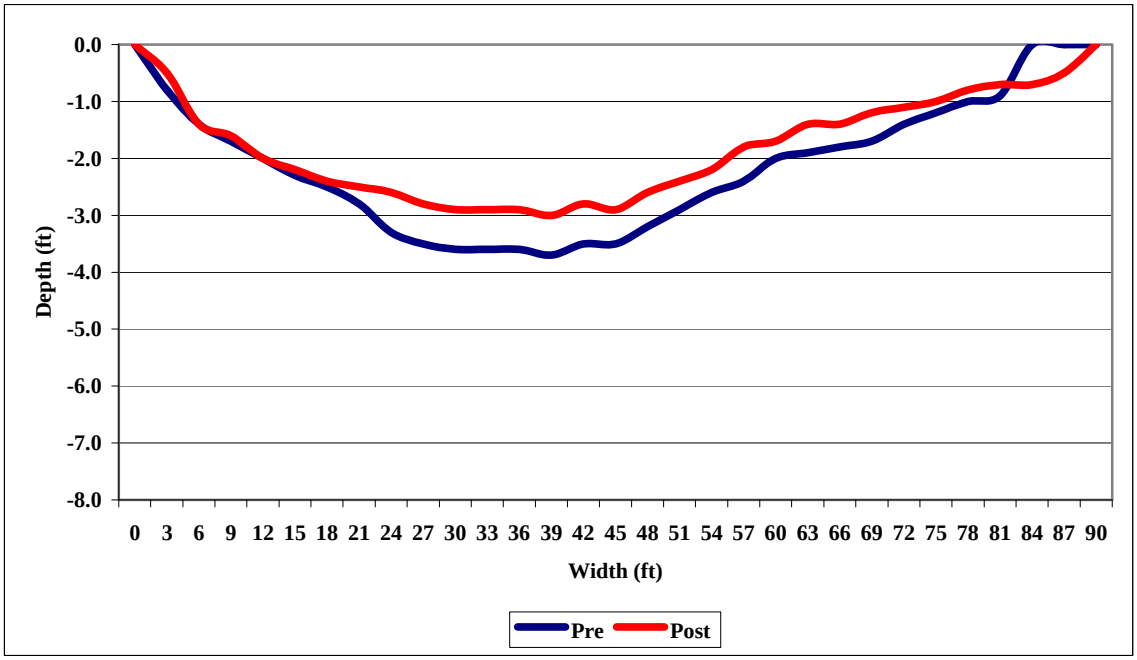
Appendix E-8. Pre and Post cross sections at Pool 3 Transect 1 – Diggers Bend Reach



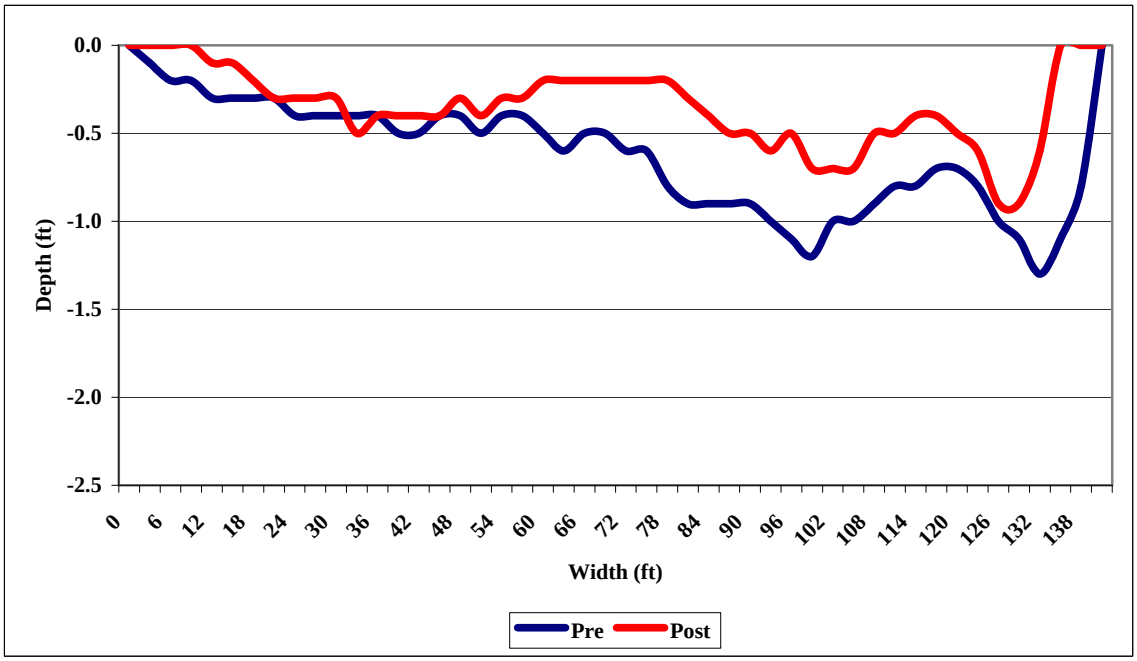
Appendix E-9. Pre and Post cross sections at Pool 3 Transect 2 – Diggers Bend Reach



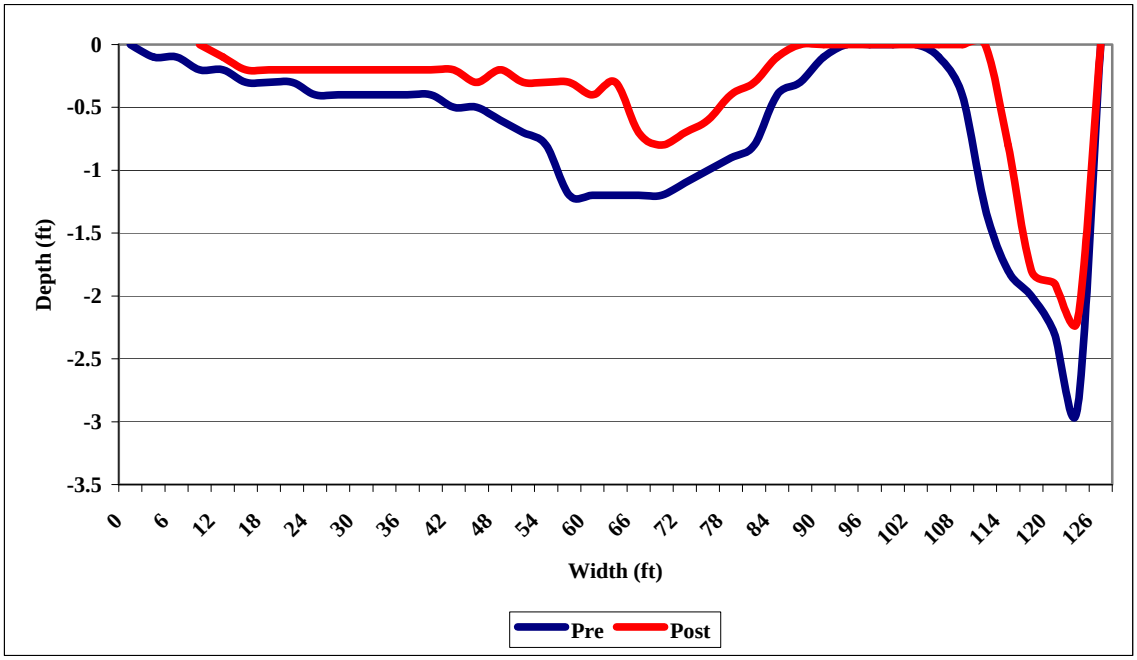
Appendix E-10. Pre and Post cross sections at Pool 3 Transect 3 – Diggers Bend Reach



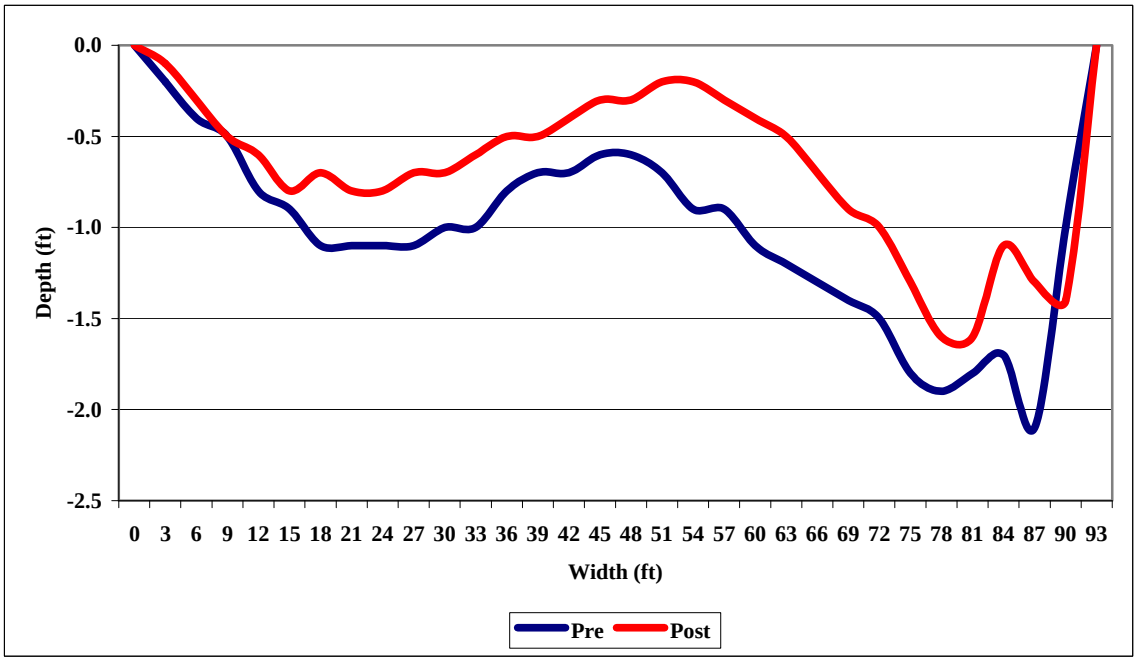
Appendix E-11. Pre and Post cross sections at Pool 3 Transect 4 – Diggers Bend Reach



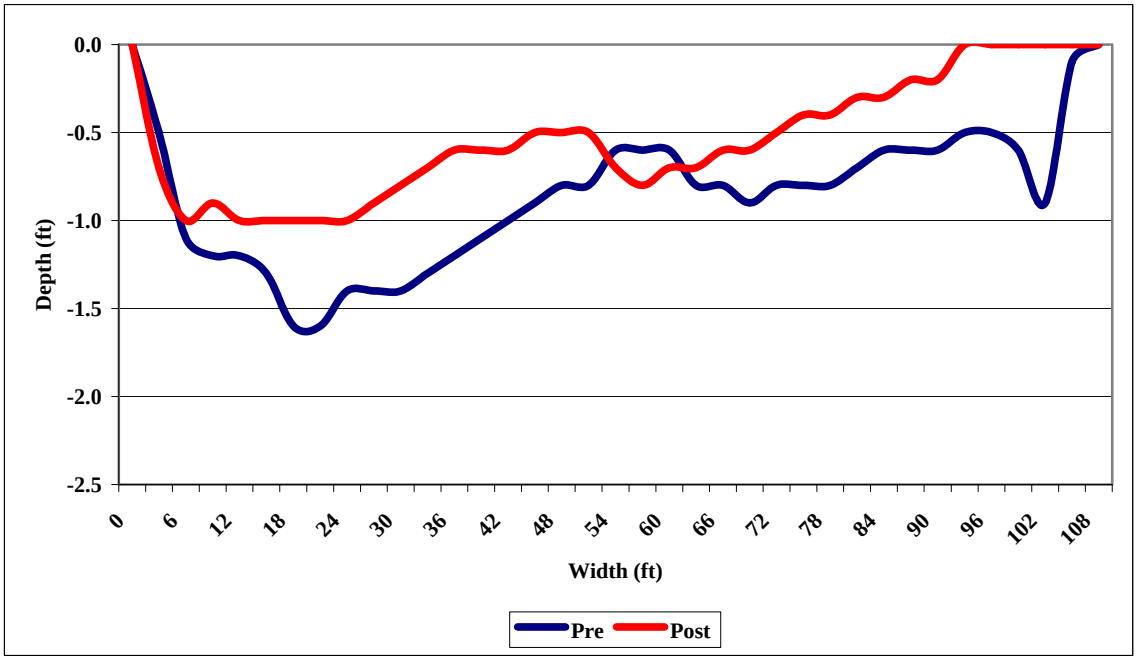
Appendix E-12. Pre and Post cross sections at Riffle 1 Transect 1 – Diggers Bend Reach



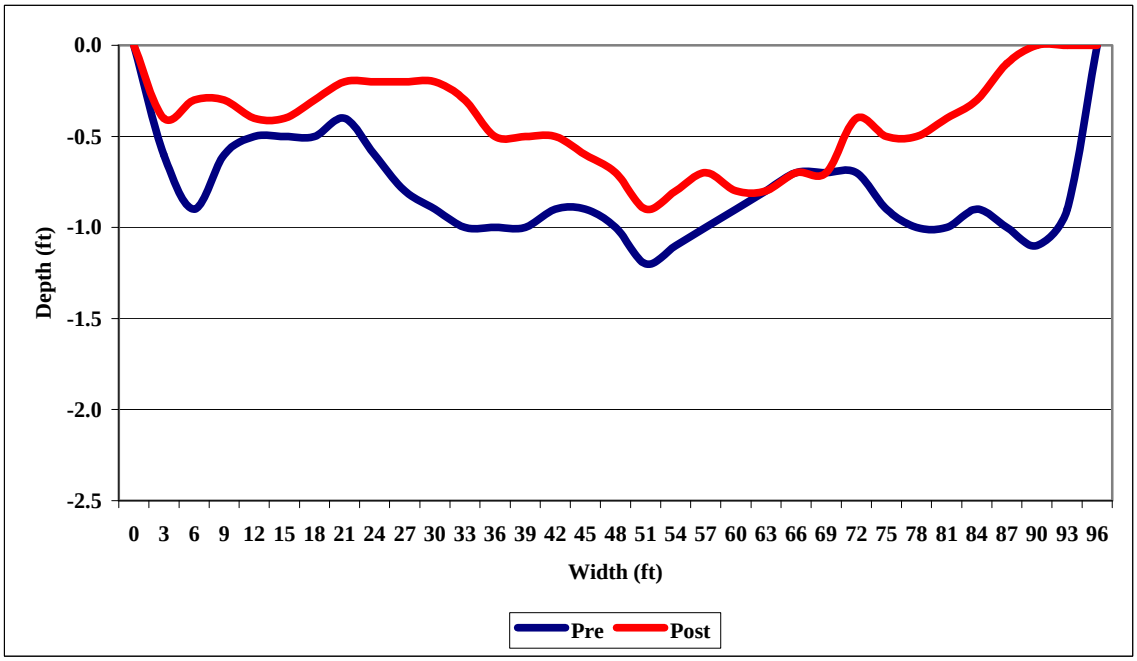
Appendix E-13. Pre and Post cross sections at Riffle 1 Transect 2 – Diggers Bend Reach



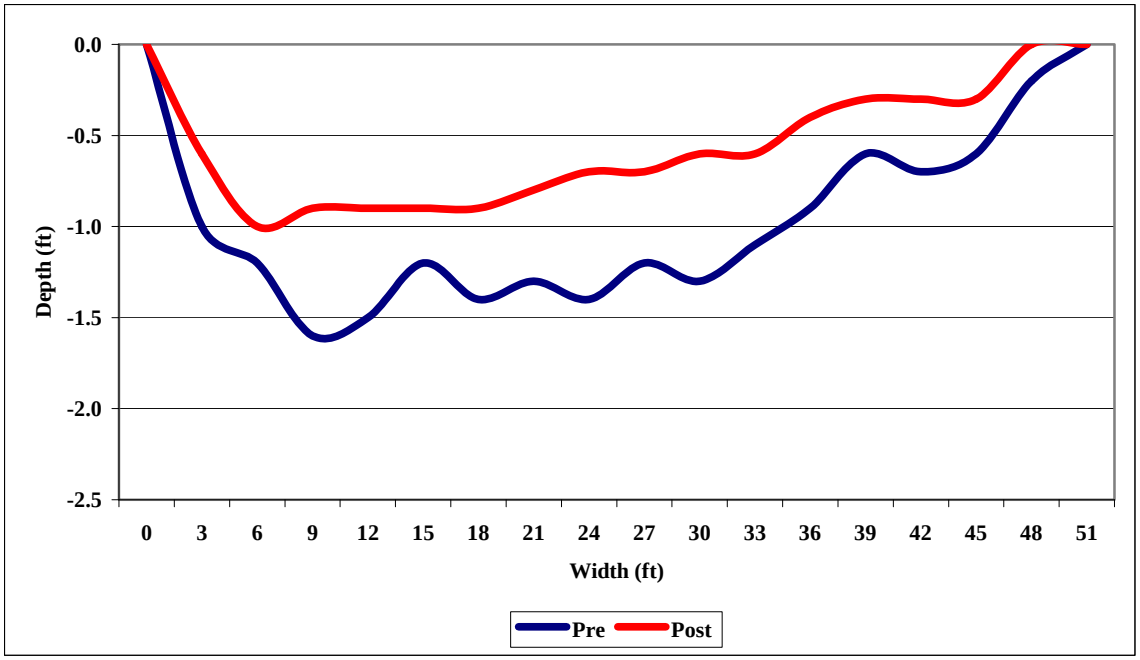
Appendix E-14. Pre and Post cross sections at Riffle 2 Transect 1 – Diggers Bend Reach



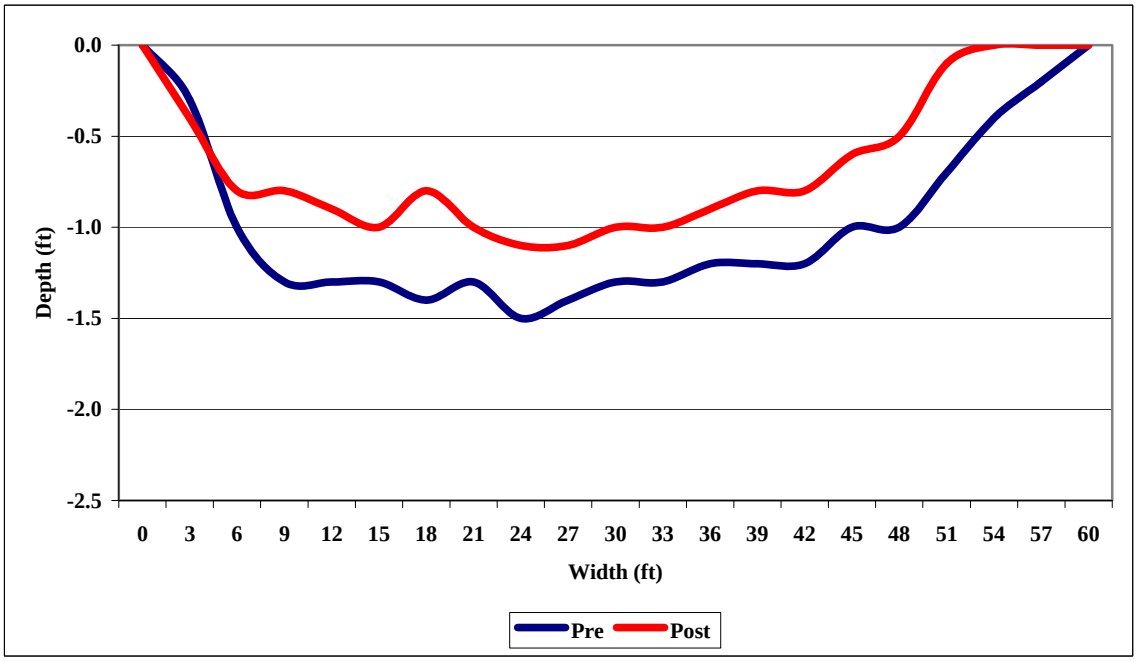
Appendix E-15. Pre and Post cross sections at Riffle 2 Transect 2 – Diggers Bend Reach



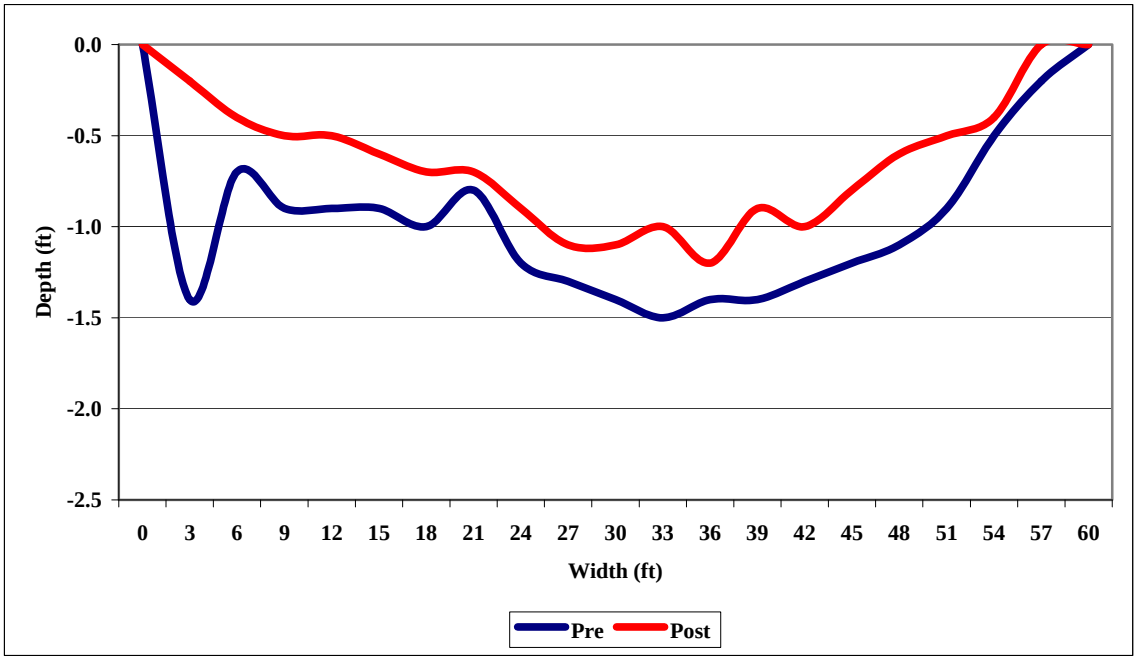
Appendix E-16. Pre and Post cross sections at Riffle 2 Transect 3 – Diggers Bend Reach



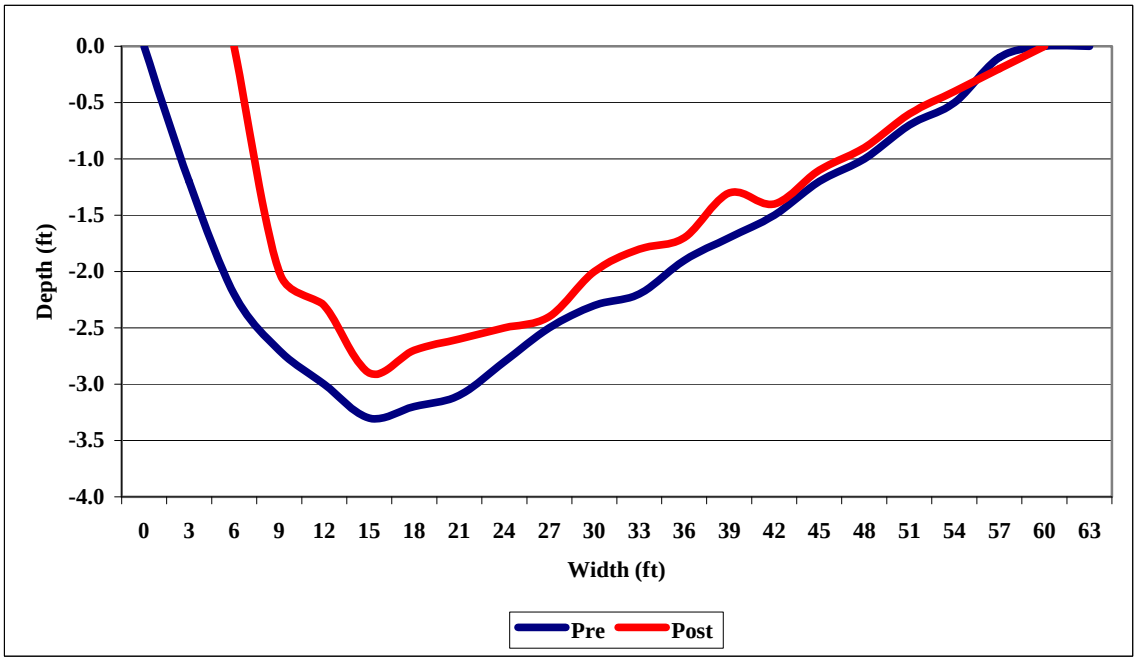
Appendix E-17. Pre and Post cross sections at Riffle 3 Transect 1 – Diggers Bend Reach



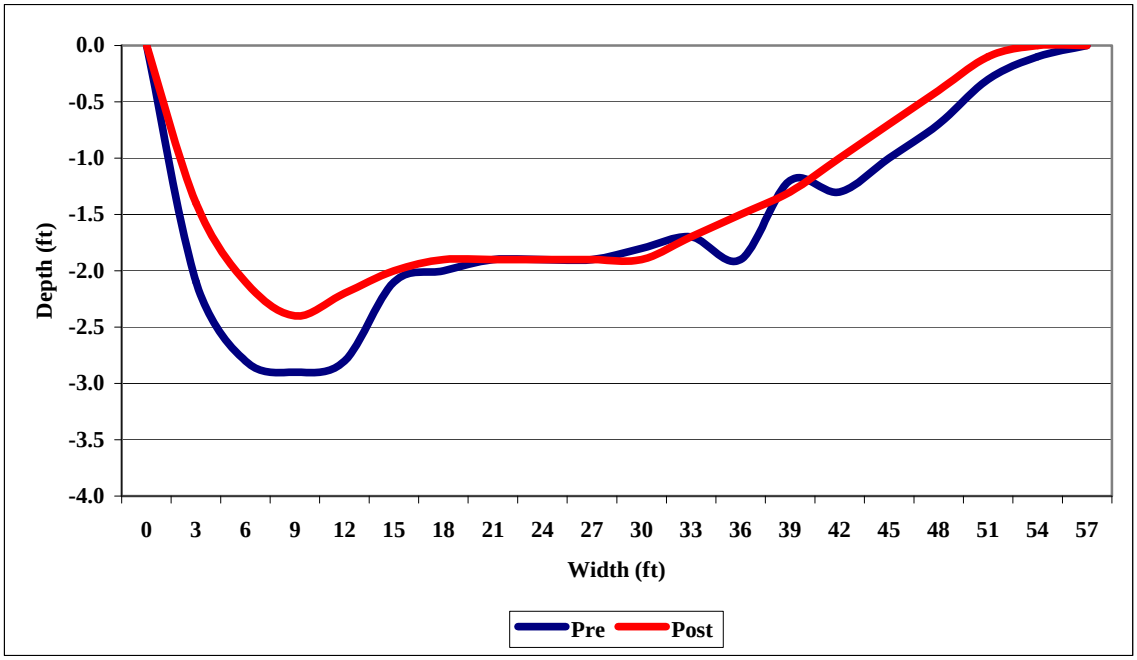
Appendix E-18. Pre and Post cross sections at Riffle 3 Transect 2 – Diggers Bend Reach



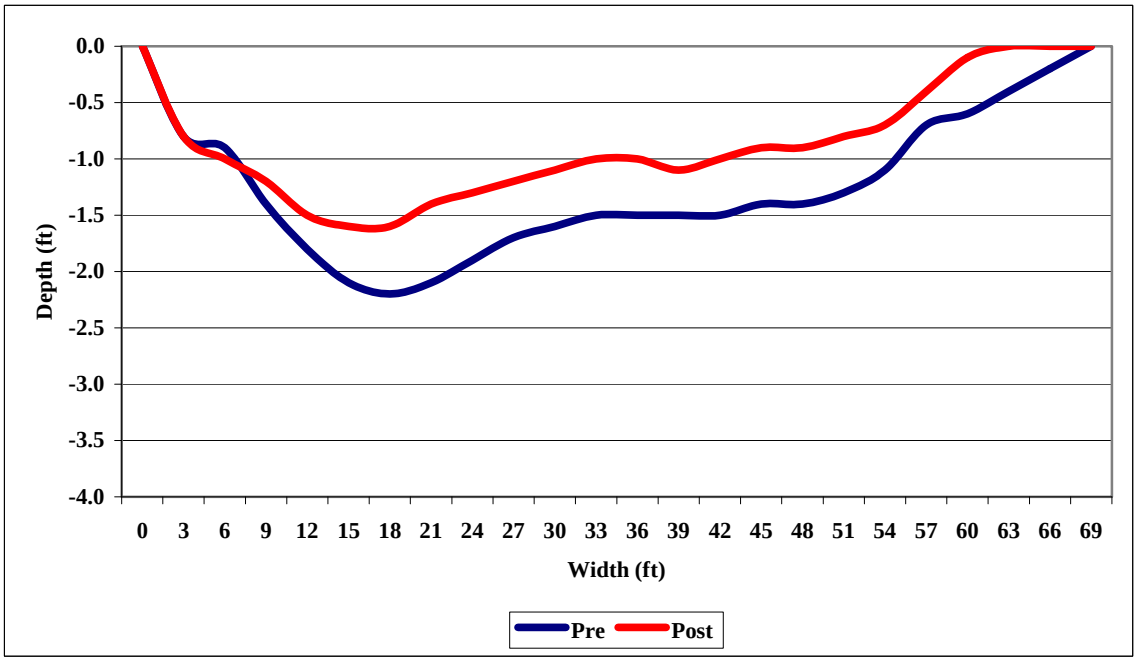
Appendix E-19. **Pre and Post cross sections at Riffle 3 Transect 3 – Diggers Bend Reach**



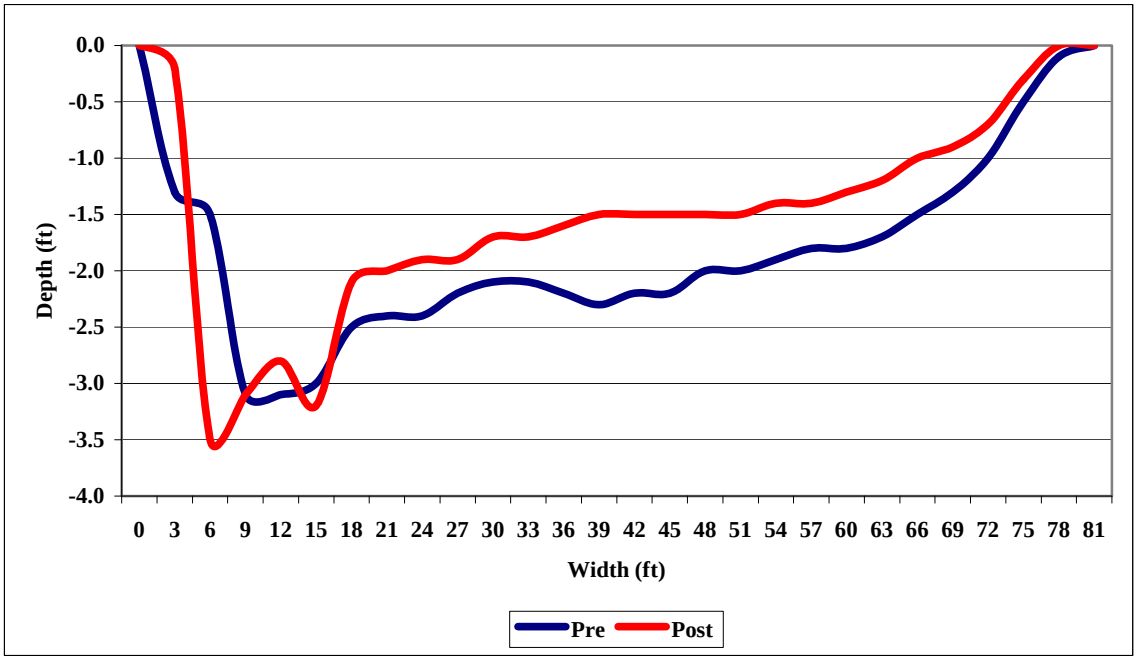
Appendix E-20. **Pre and Post cross sections at Flatwater 1 Transect 1 – Diggers Bend Reach**



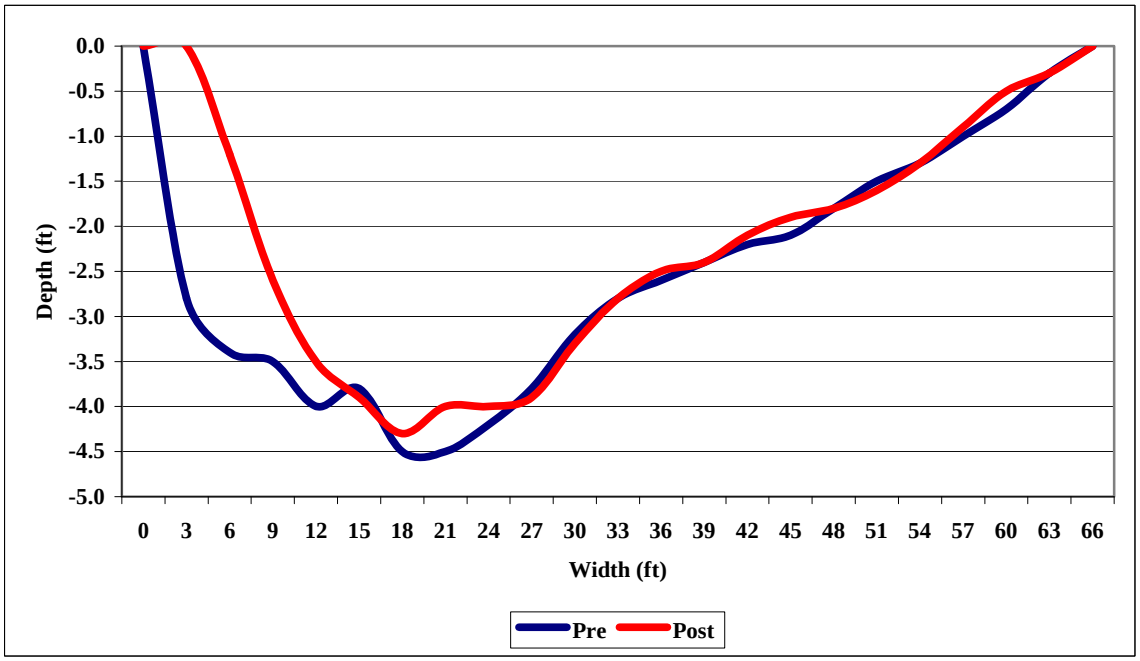
Appendix E-21. **Pre and Post cross sections at Flatwater 1 Transect 2 – Diggers Bend Reach**



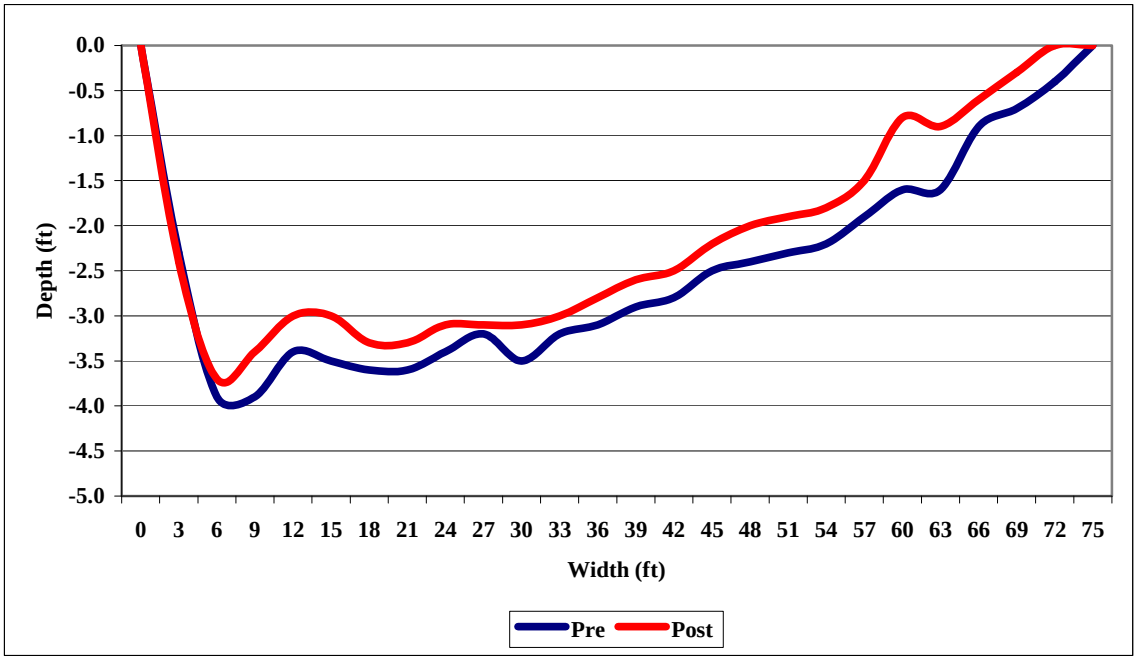
Appendix E-22. **Pre and Post cross sections at Flatwater 1 Transect 3 – Diggers Bend Reach**



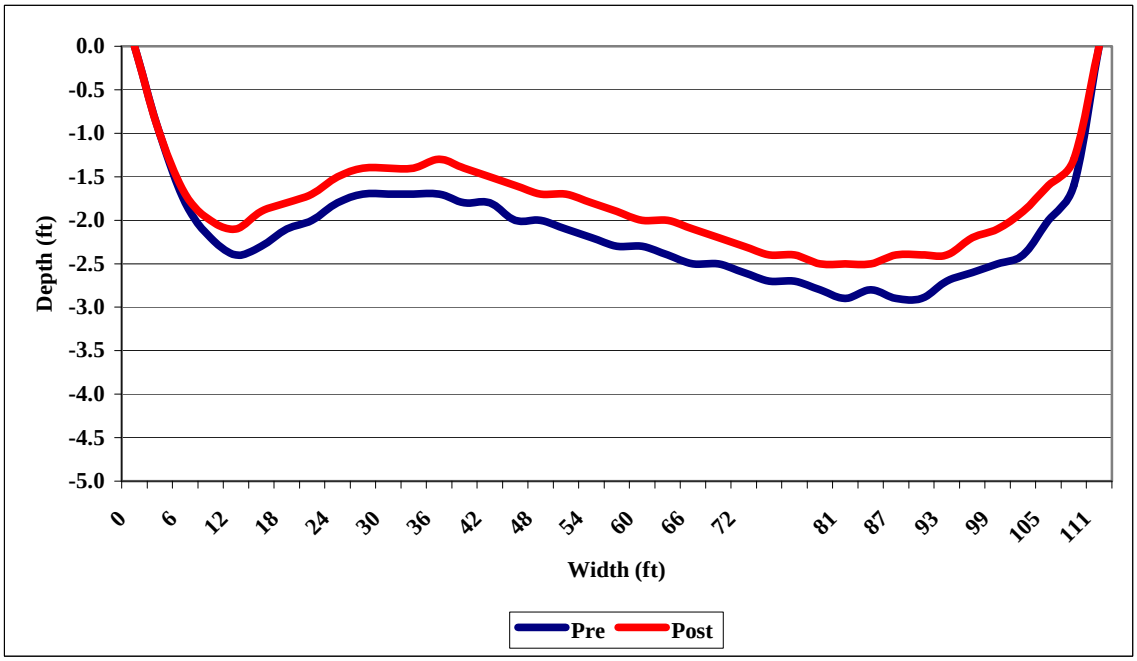
Appendix E-23. **Pre and Post cross sections at Flatwater 2 Transect 1 – Diggers Bend Reach**



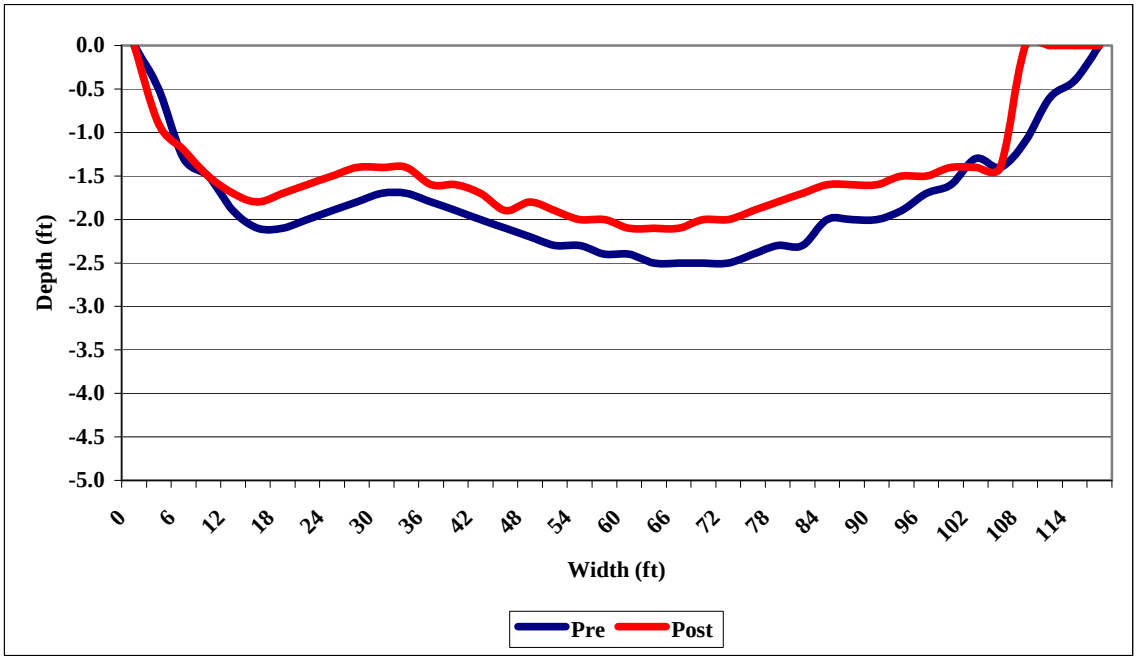
Appendix E-24. **Pre and Post cross sections at Flatwater 2 Transect 2 – Diggers Bend Reach**



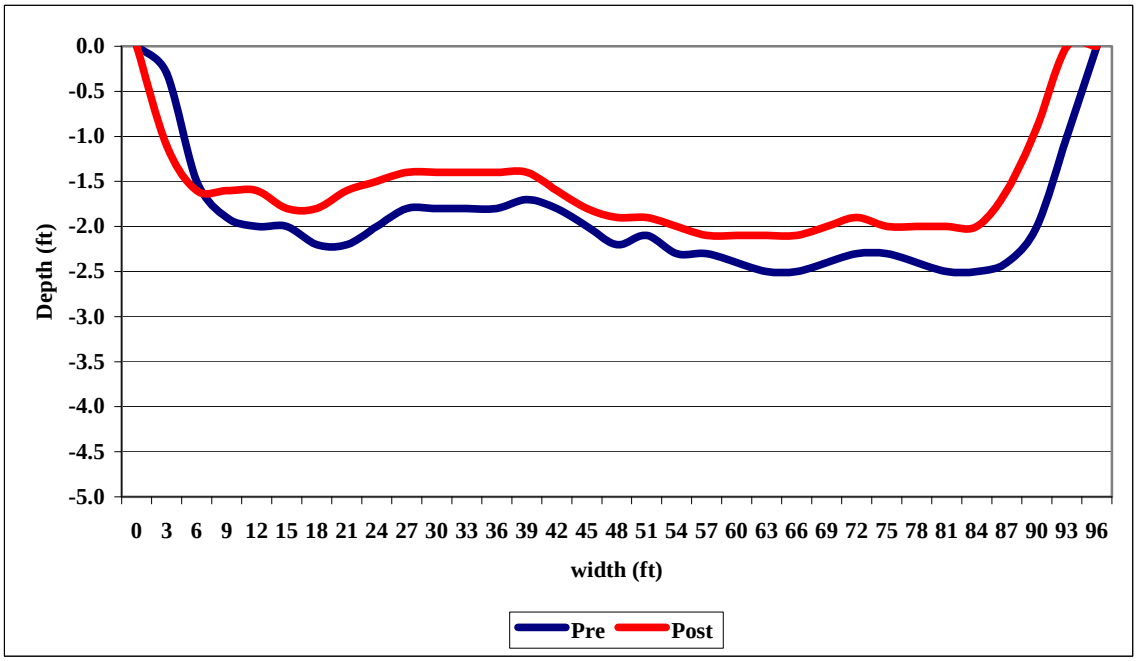
Appendix E-25. **Pre and Post cross sections at Flatwater 2 Transect 3 – Diggers Bend Reach**



Appendix E-26. **Pre and Post cross sections at Flatwater 3 Transect 1 – Diggers Bend Reach**



Appendix E-27. **Pre and Post cross sections at Flatwater 3 Transect 2 – Diggers Bend Reach**

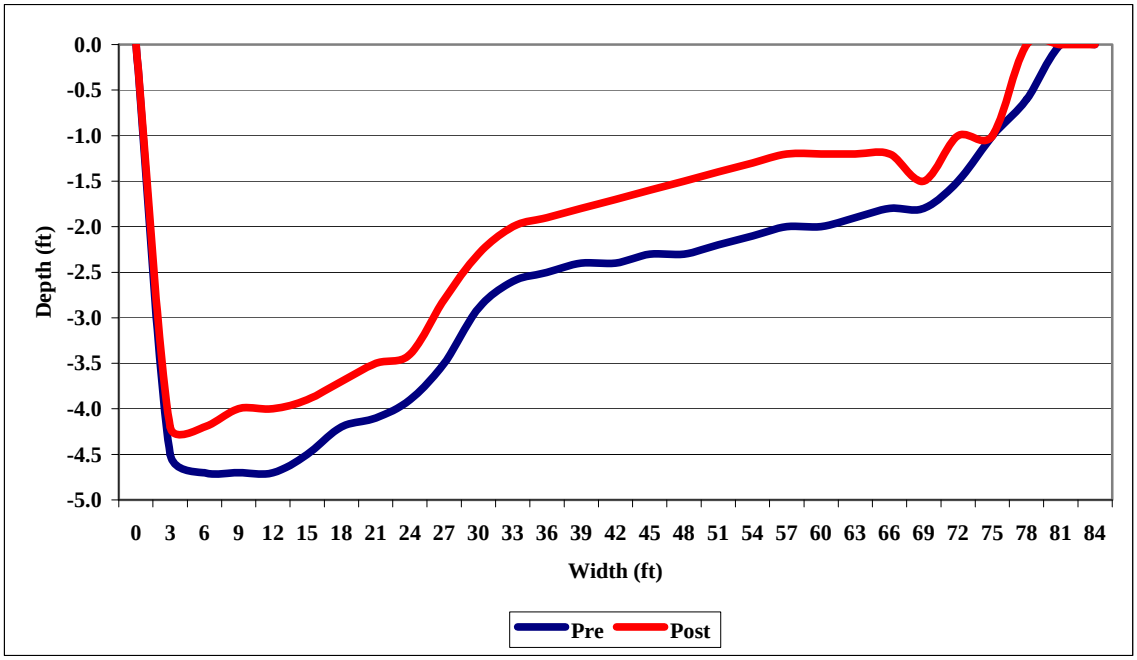


Appendix E-28. **Pre and Post cross sections at Flatwater 3 Transect 3 – Diggers Bend Reach**

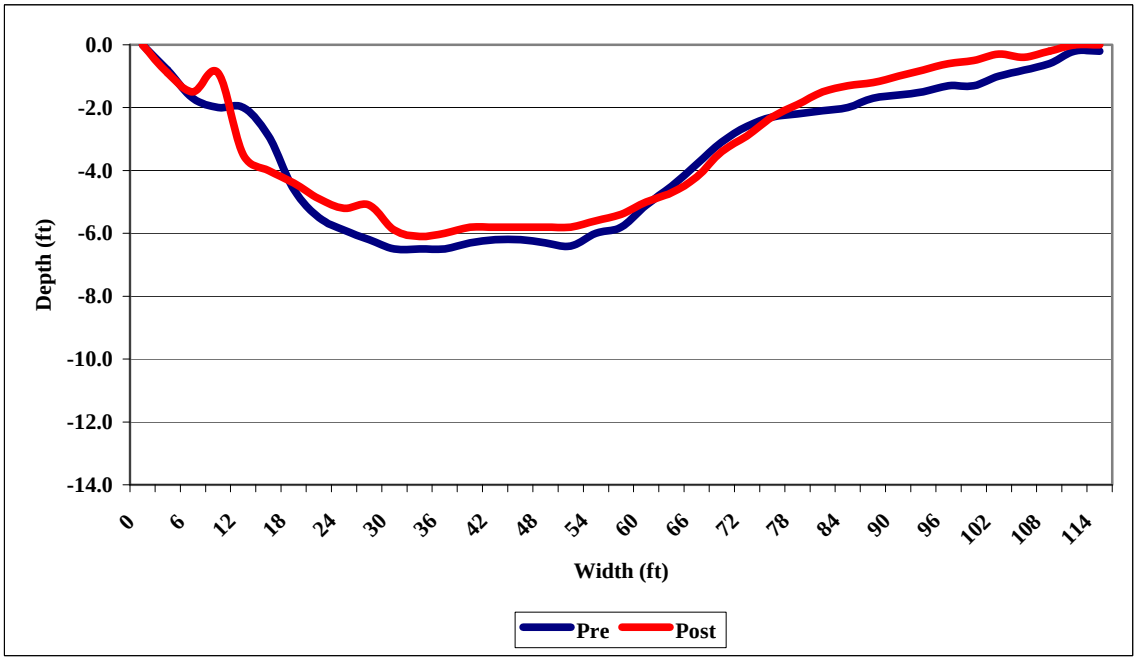
APPENDIX F

HEALDSBURG REACH CROSS SECTIONS

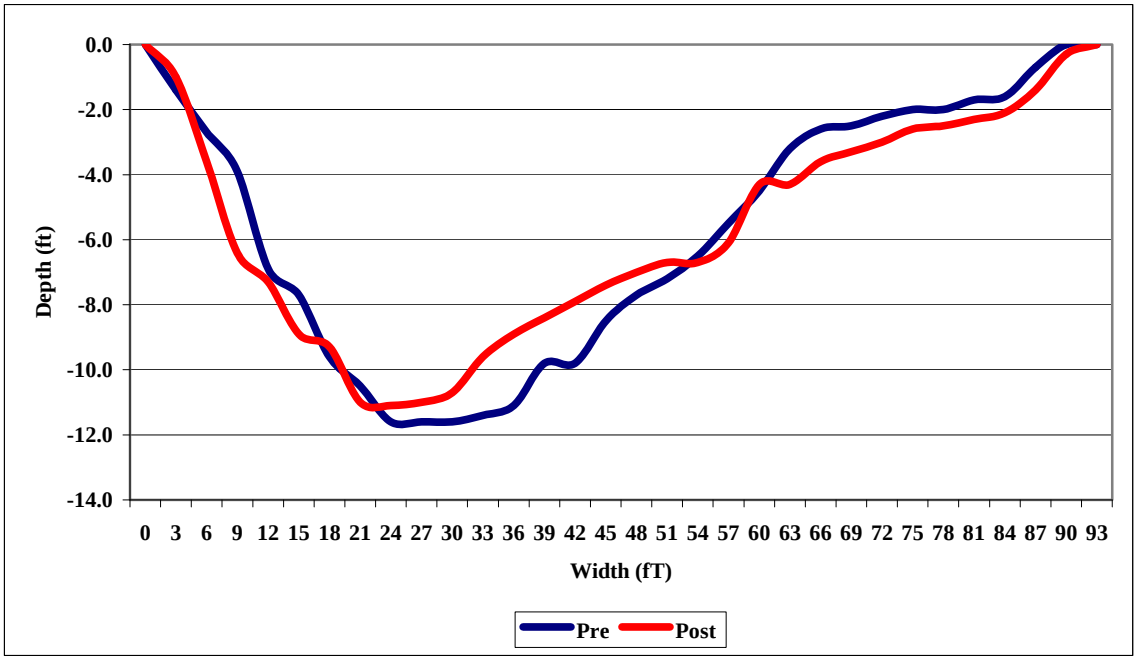
PRE AND POST FLOW REDUCTION SURVEYS



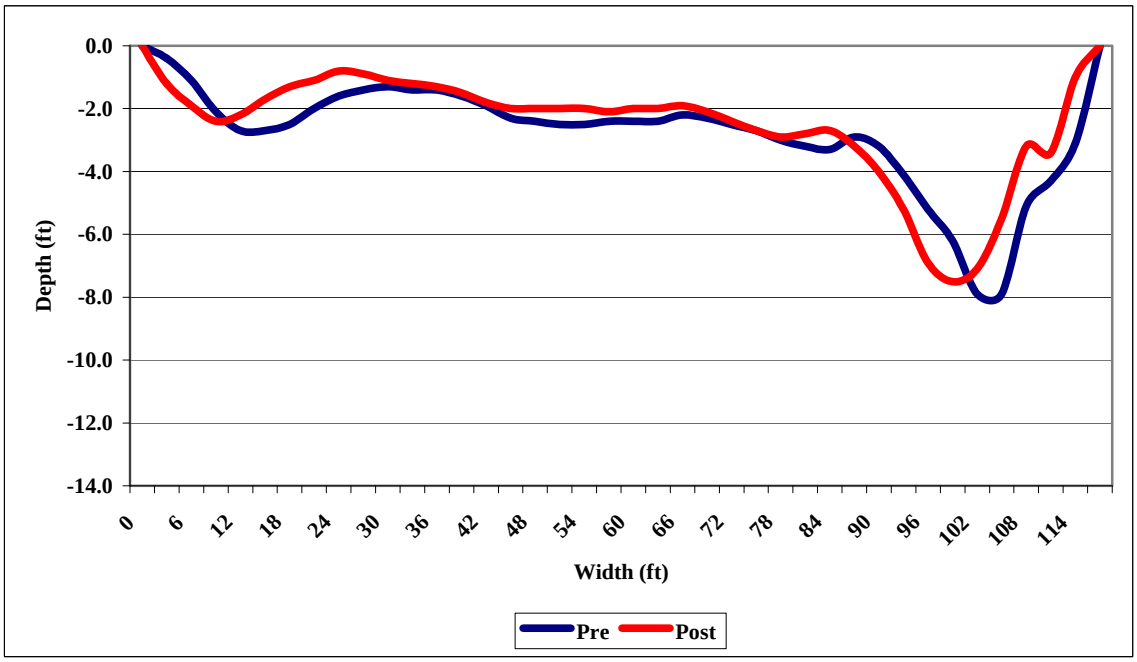
Appendix F-1. Pre and Post cross sections at Pool 1 Transect 1 – Healdsburg Reach



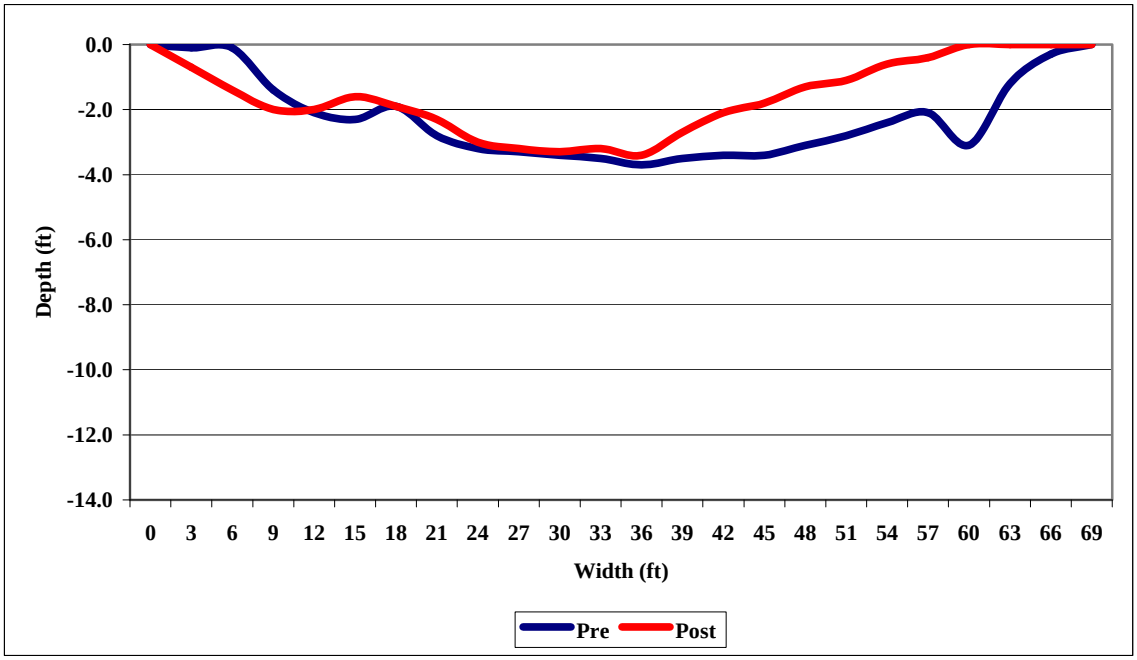
Appendix F-2. Pre and Post cross sections at Pool 1 Transect 2 – Healdsburg Reach



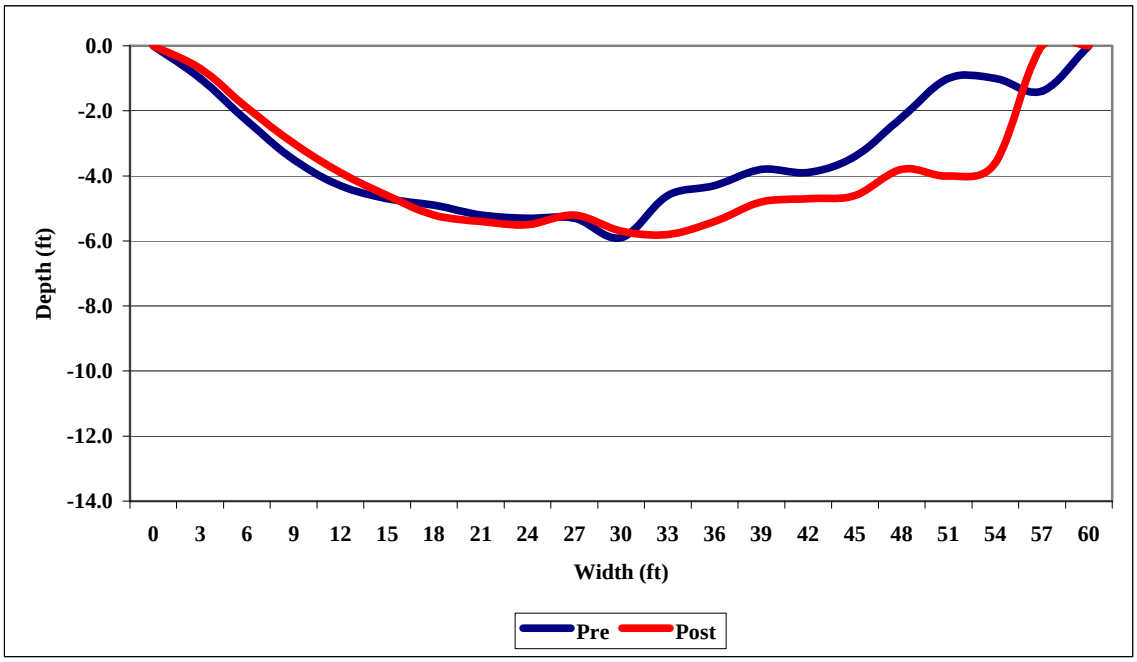
Appendix F-3. Pre and Post cross sections at Pool 1 Transect 3 – Healdsburg Reach



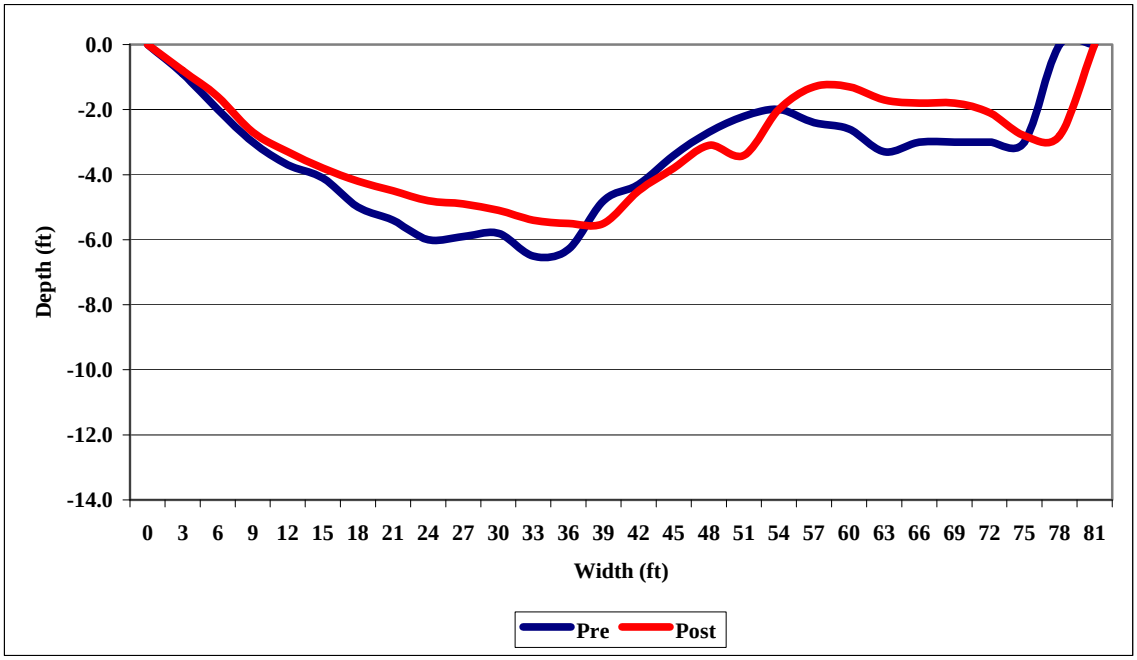
Appendix F-4. Pre and Post cross sections at Pool 1 Transect 4 – Healdsburg Reach



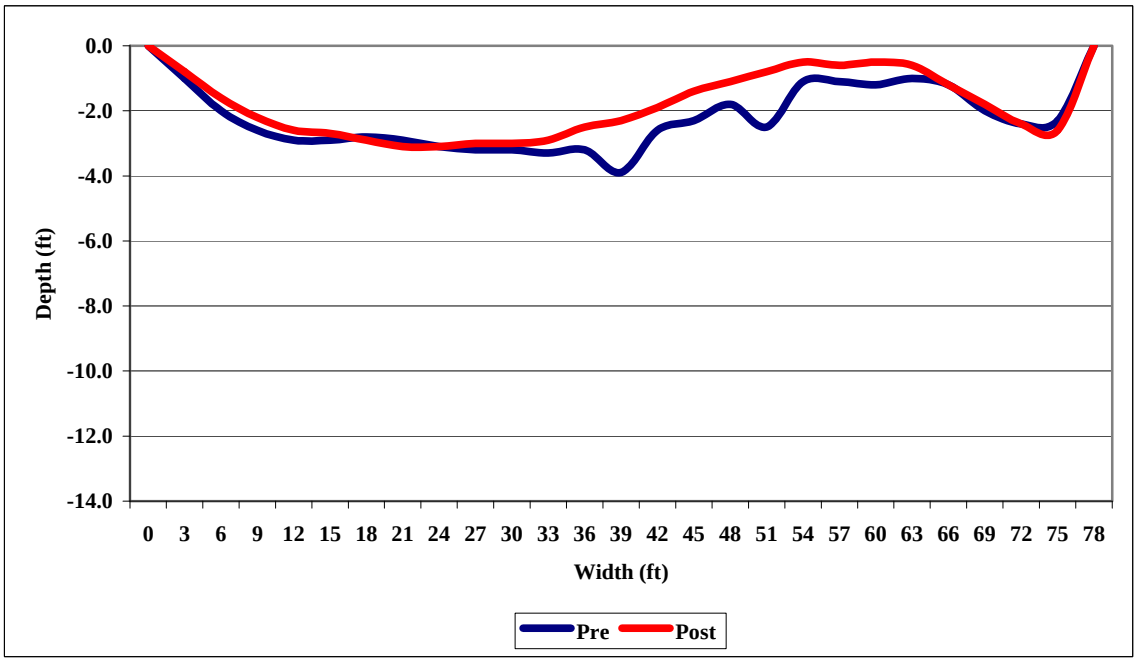
Appendix F-5. Pre and Post cross sections at Pool 2 Transect 1 – Healdsburg Reach



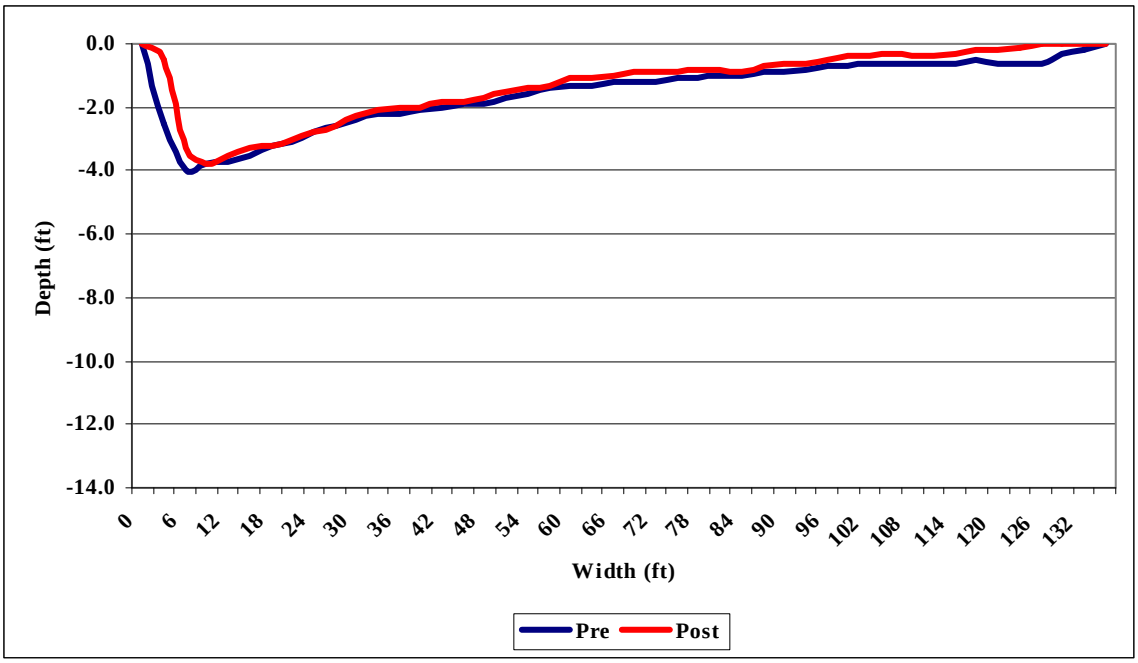
Appendix F-6. Pre and Post cross sections at Pool 2 Transect 2 – Healdsburg Reach



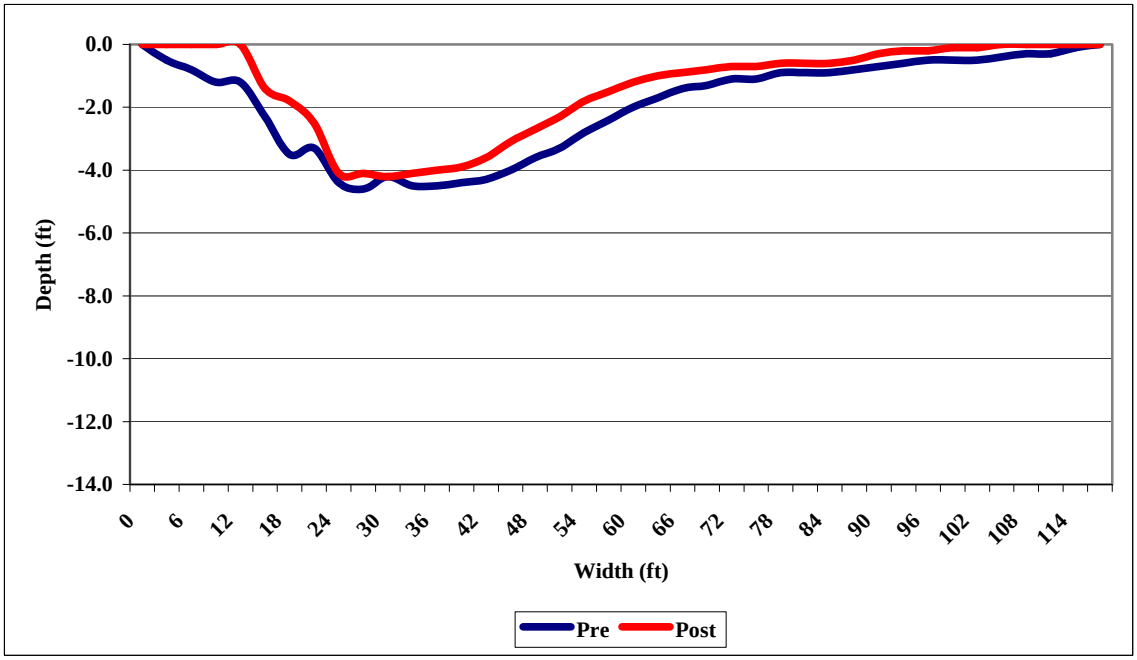
Appendix F-7. Pre and Post cross sections at Pool 2 Transect 3 – Healdsburg Reach



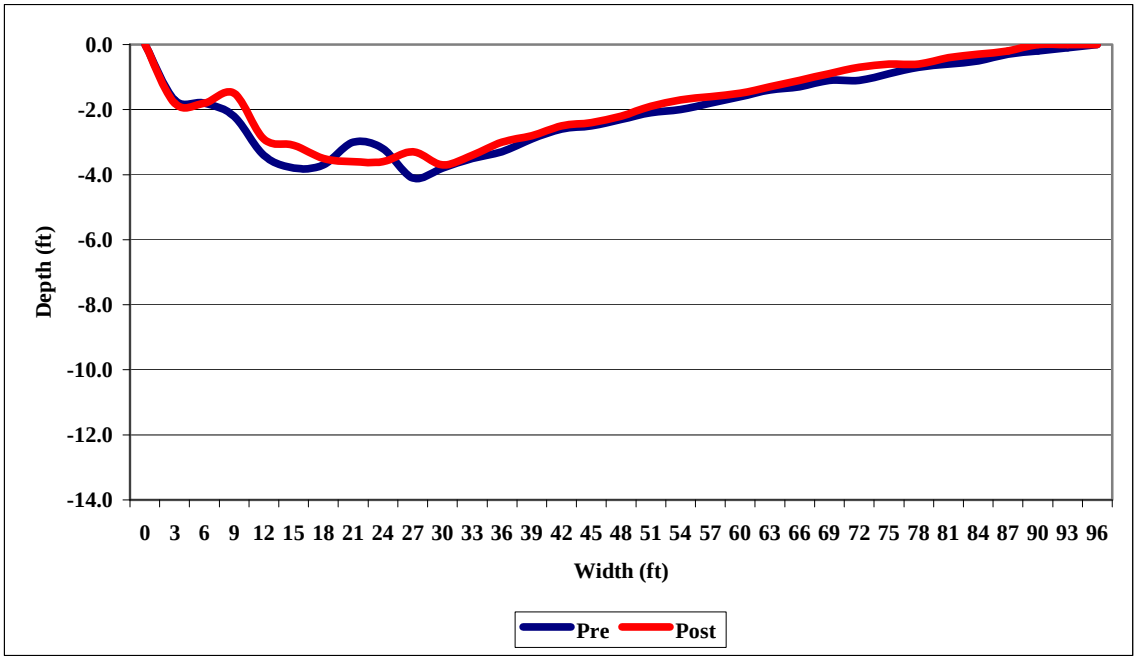
Appendix F-8. Pre and Post cross sections at Pool 2 Transect 4 – Healdsburg Reach



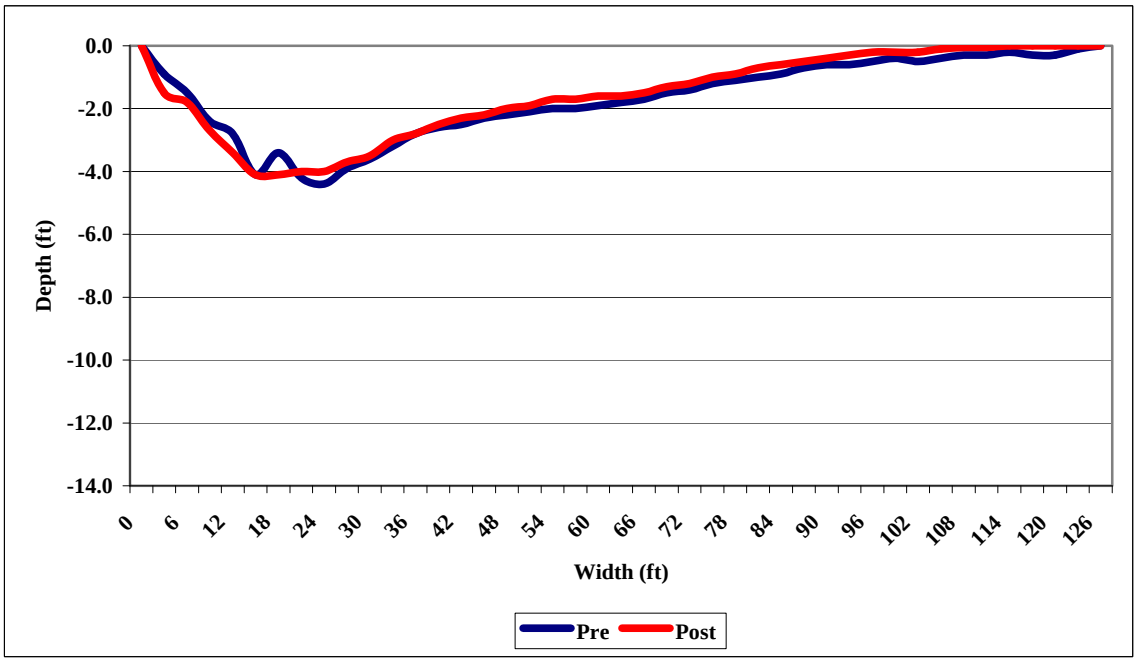
Appendix F-9. Pre and Post cross sections at Pool 3 Transect 1 – Healdsburg Reach



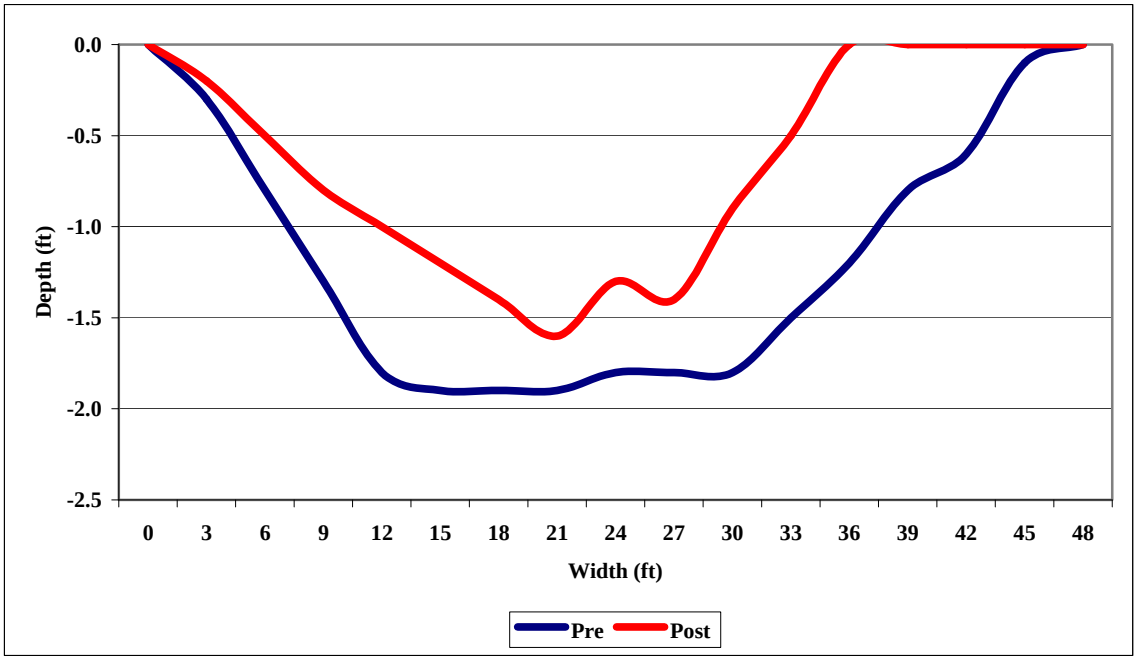
Appendix F-10. Pre and Post cross sections at Pool 3 Transect 2 – Healdsburg Reach



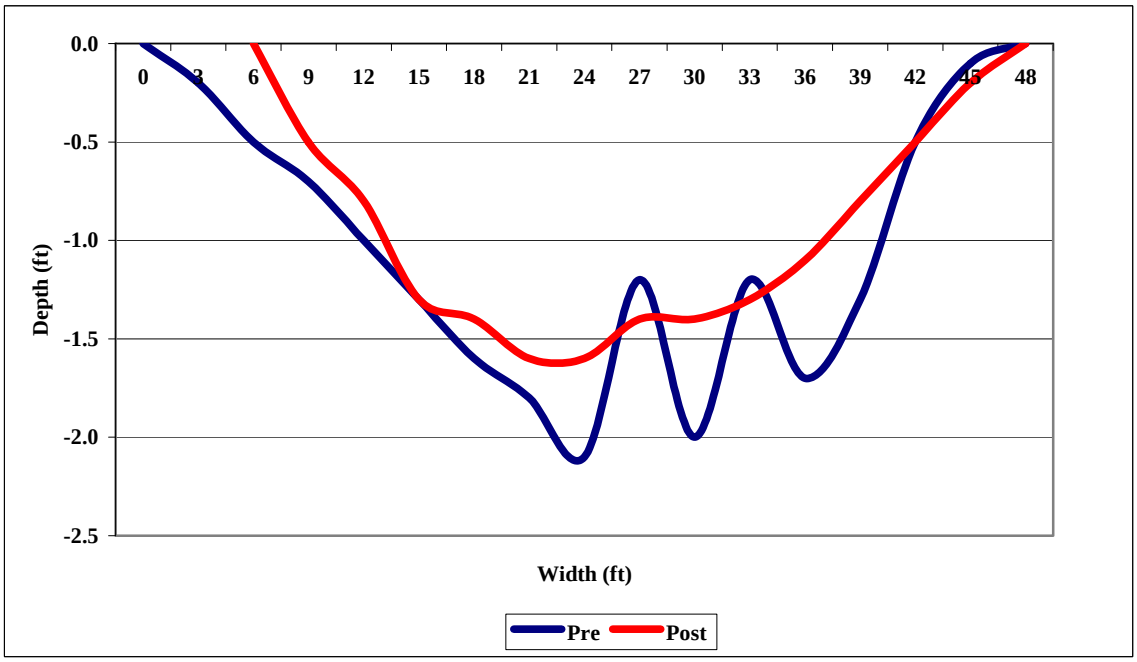
Appendix F-11. Pre and Post cross sections at Pool 3 Transect 3 – Healdsburg Reach



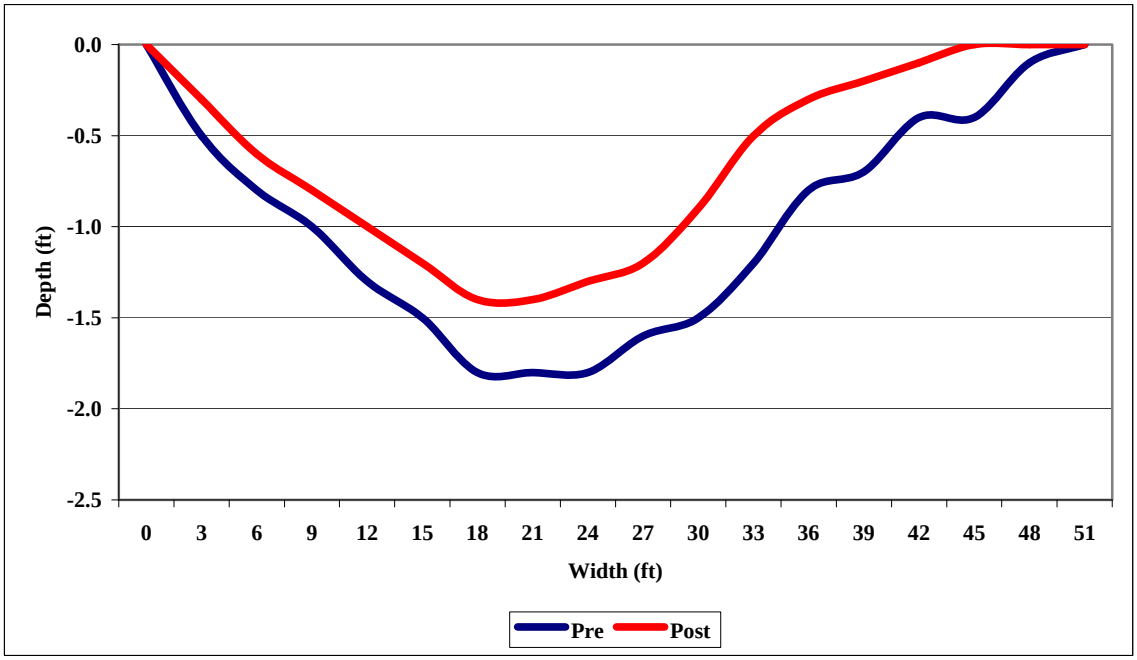
Appendix F-12. Pre and Post cross sections at Pool 3 Transect 4 – Healdsburg Reach



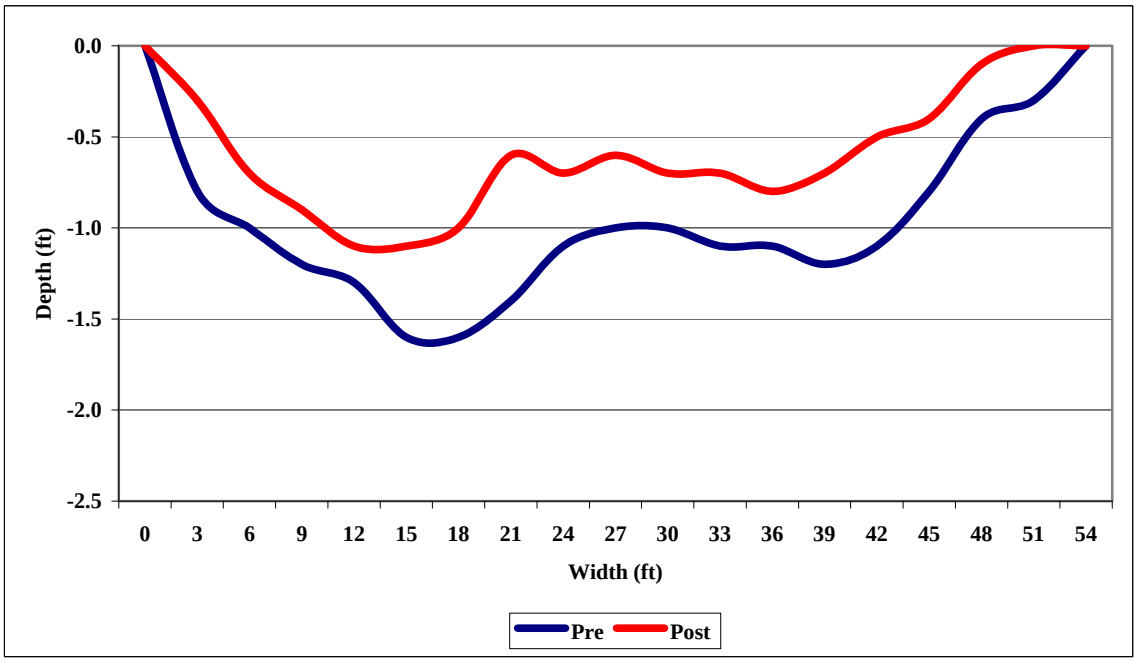
Appendix F-13. Pre and Post cross sections at Riffle 1 Transect 1 – Healdsburg Reach



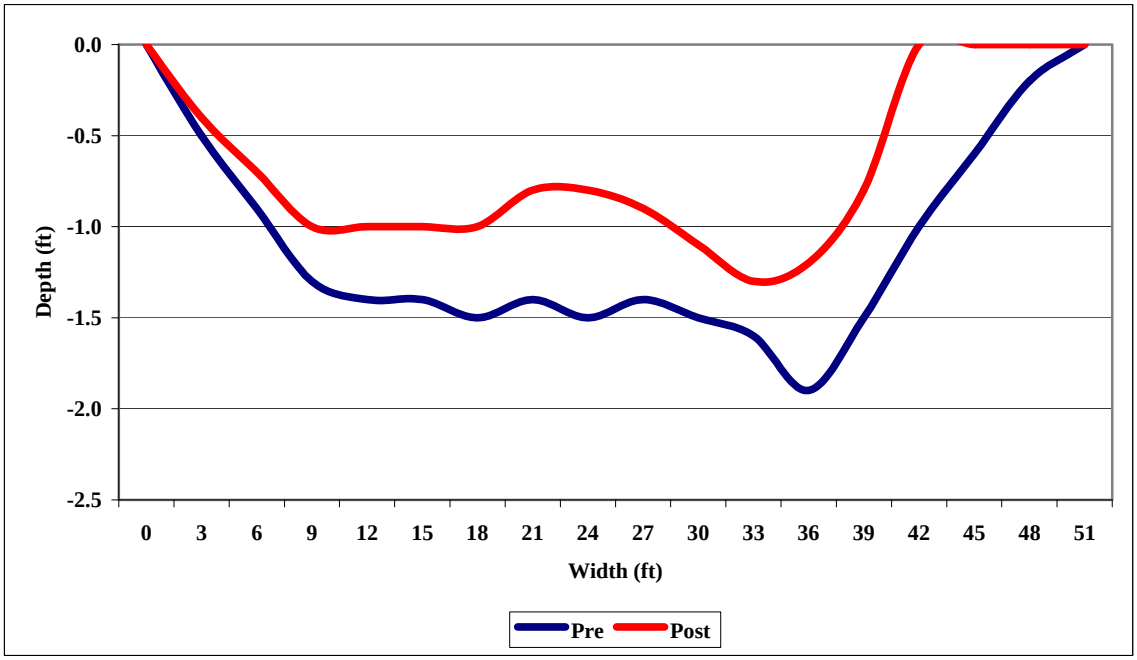
Appendix F-14. Pre and Post cross sections at Riffle 1 Transect 2 – Healdsburg Reach



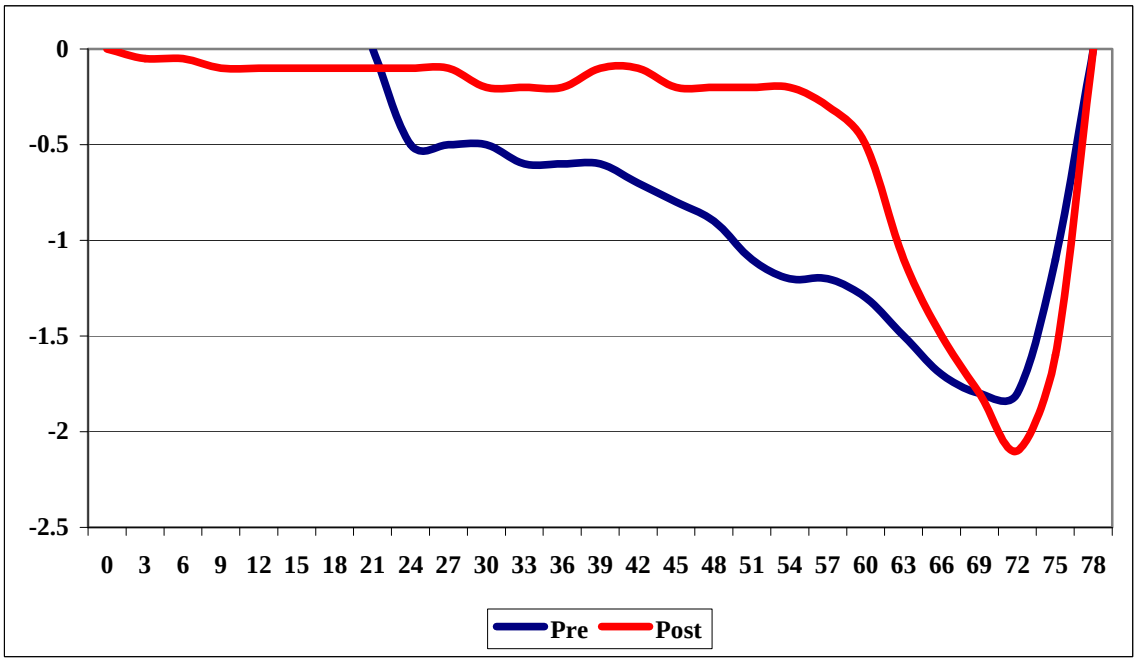
Appendix F-15. Pre and Post cross sections at Riffle 1 Transect 3 – Healdsburg Reach



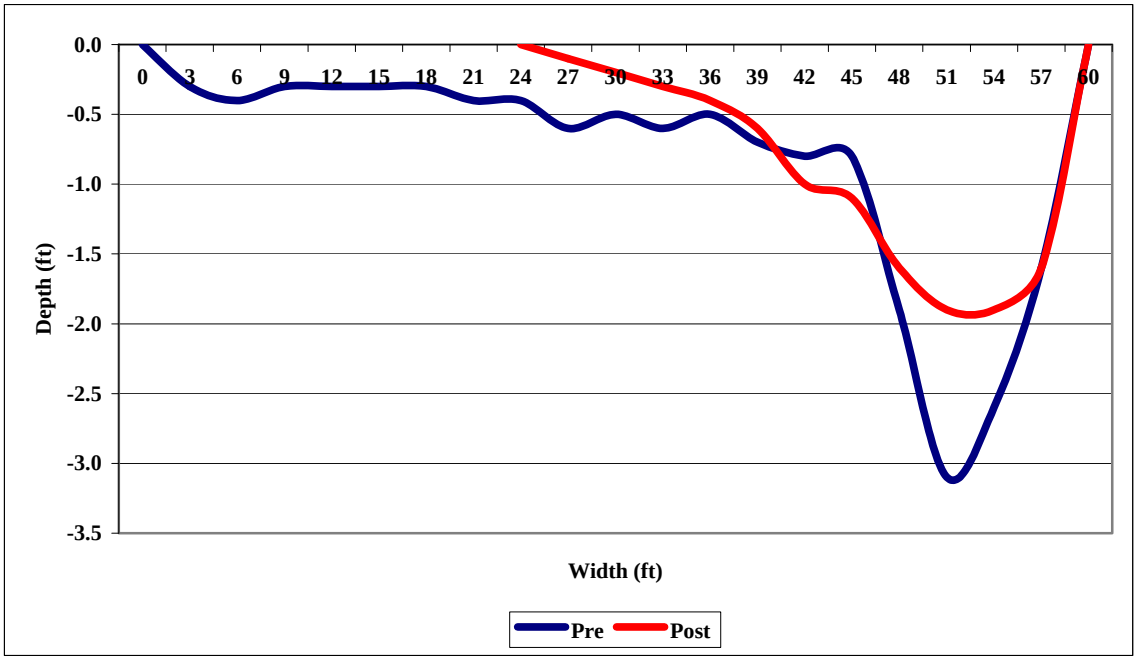
Appendix F-16. Pre and Post cross sections at Riffle 2 Transect 1 – Healdsburg Reach



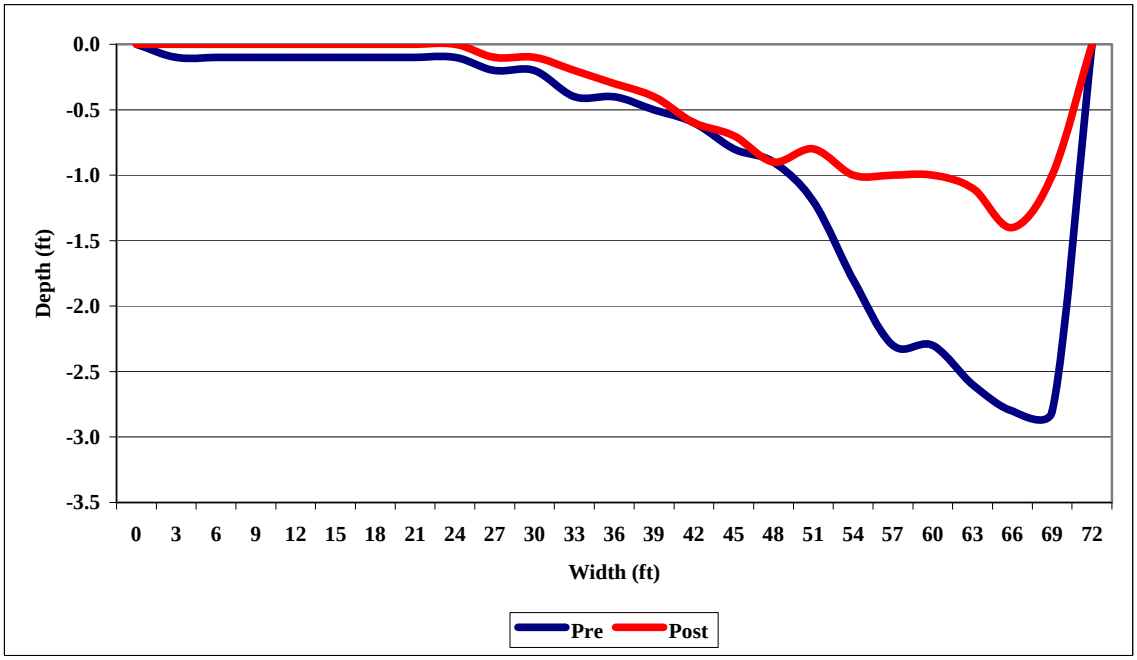
Appendix F-17. Pre and Post cross sections at Riffle 2 Transect 2 – Healdsburg Reach



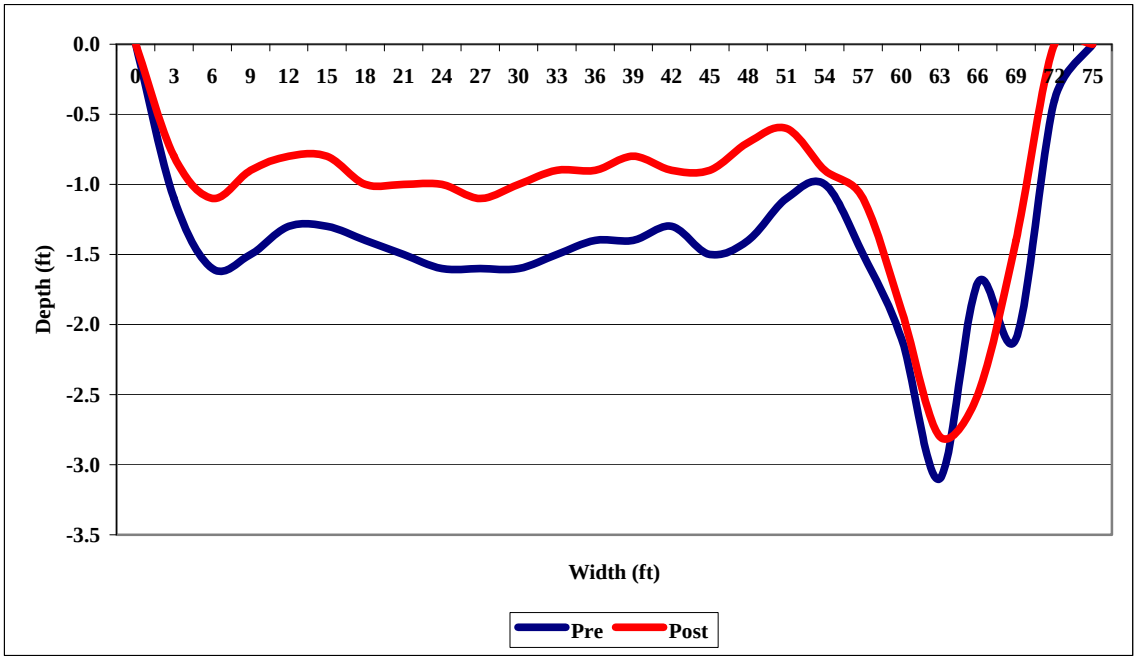
Appendix F-18. Pre and Post cross sections at Riffle 3 Transect 1 – Healdsburg Reach



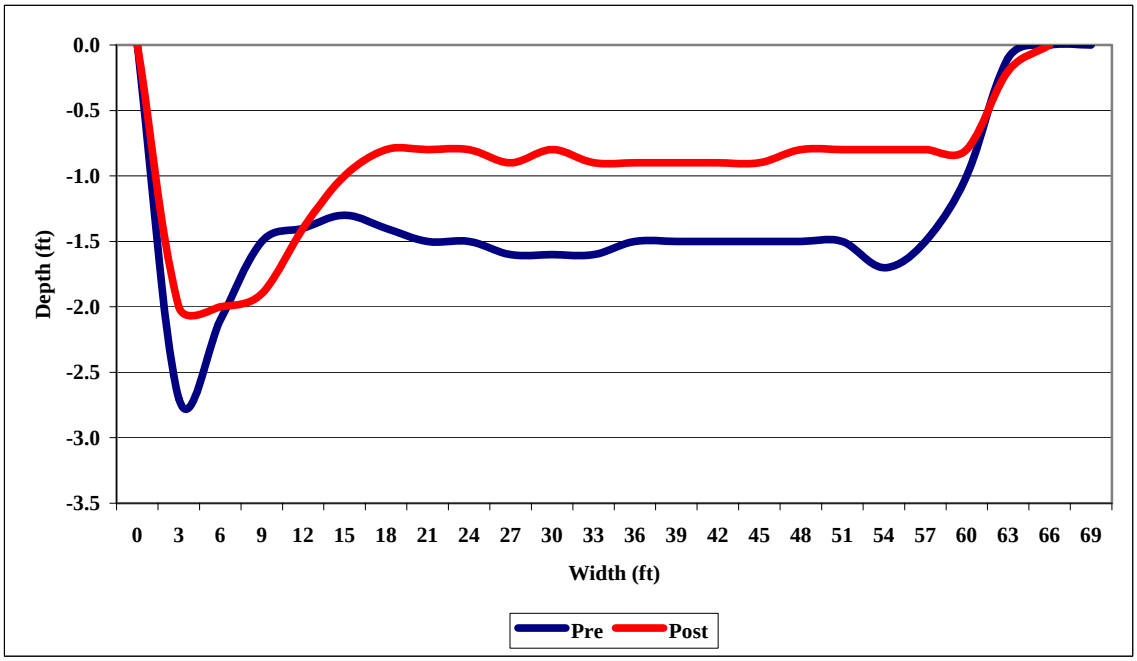
Appendix F-19. Pre and Post cross sections at Riffle 3 Transect 2 – Healdsburg Reach



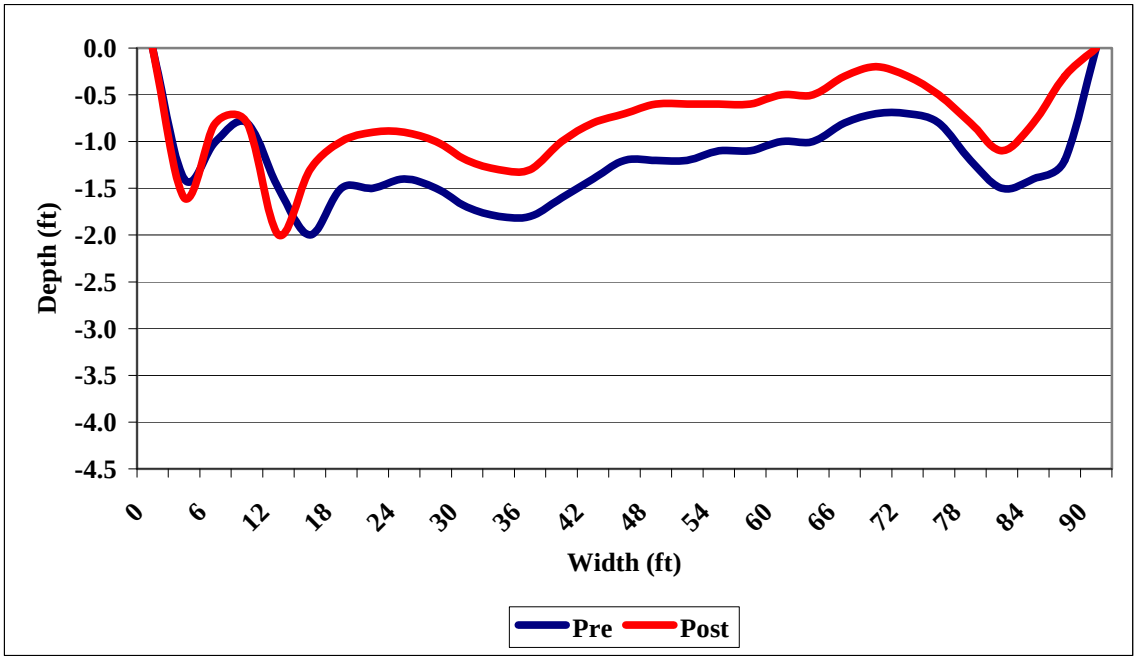
Appendix F-20. Pre and Post cross sections at Riffle 3 Transect 3 – Healdsburg Reach



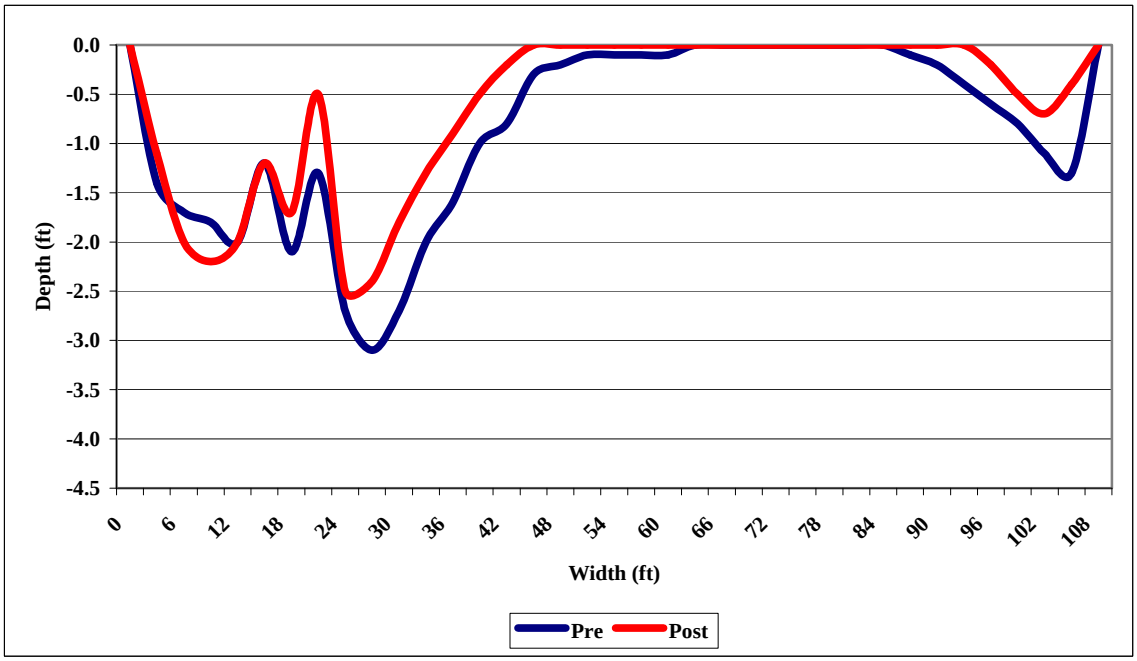
Appendix F-21. Pre and Post cross sections at Flatwater 1 Transect 1 – Healdsburg Reach



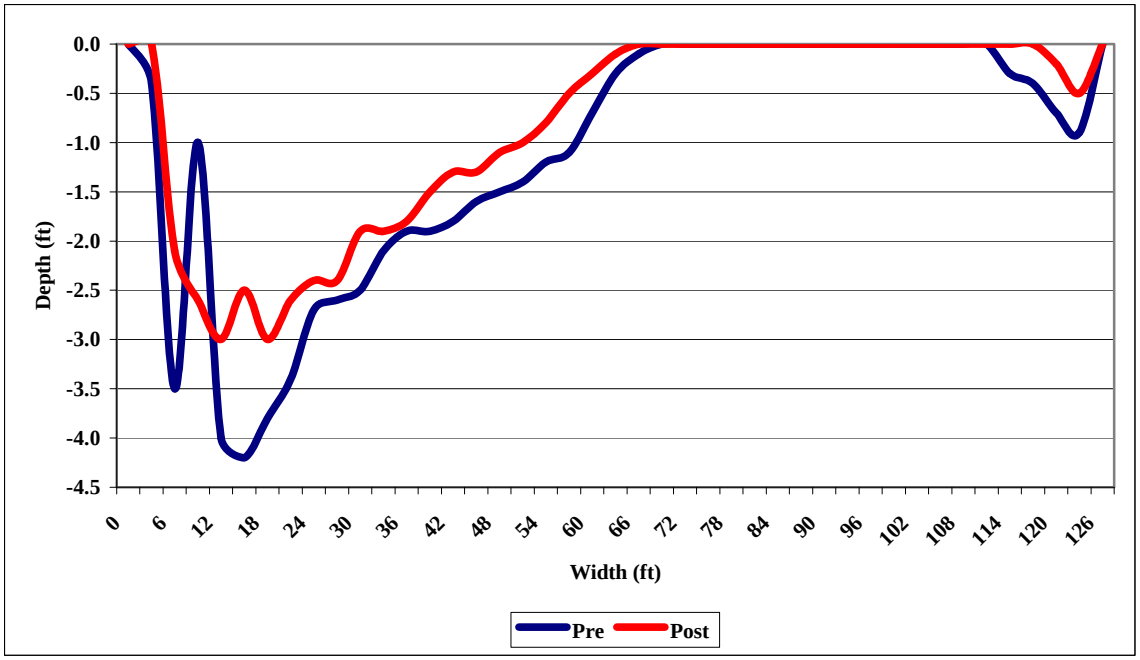
Appendix F-22. Pre and Post cross sections at Flatwater 1 Transect 2 – Healdsburg Reach



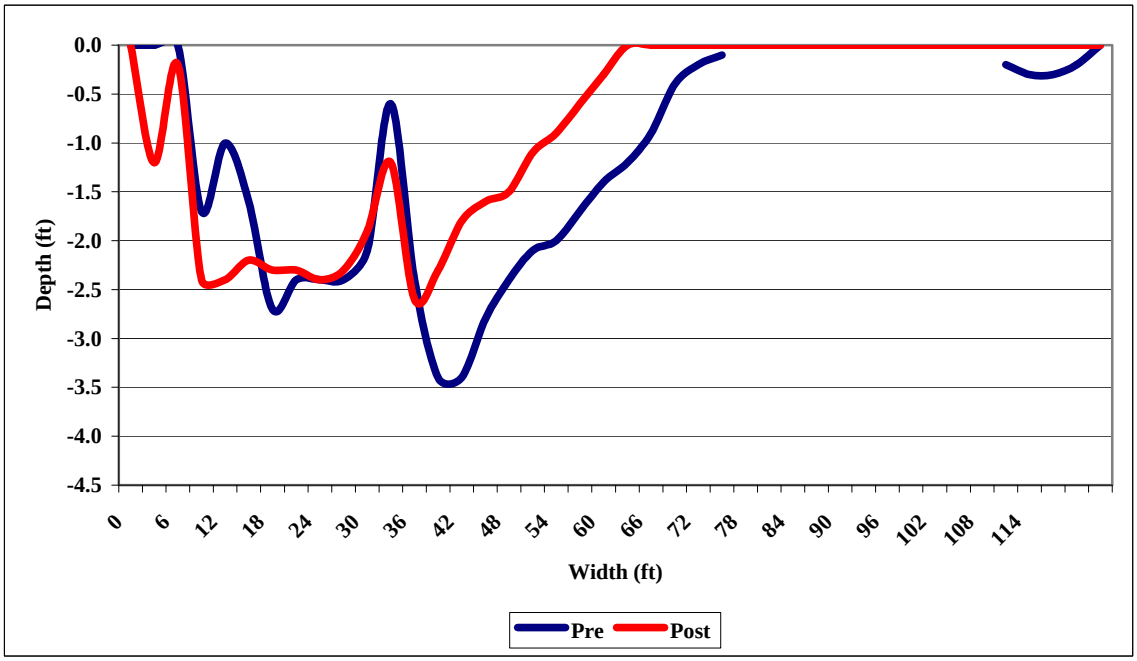
Appendix F-23. Pre and Post cross sections at Flatwater 1 Transect 3 – Healdsburg Reach



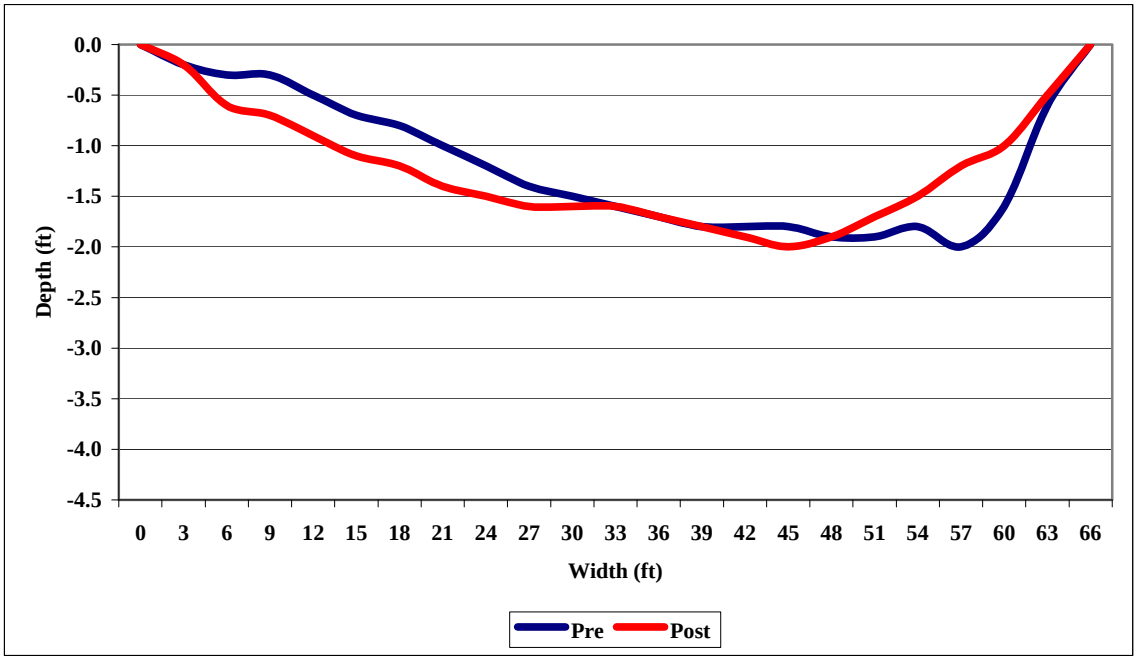
Appendix F-24. Pre and Post cross sections at Flatwater 2 Transect 1 – Healdsburg Reach



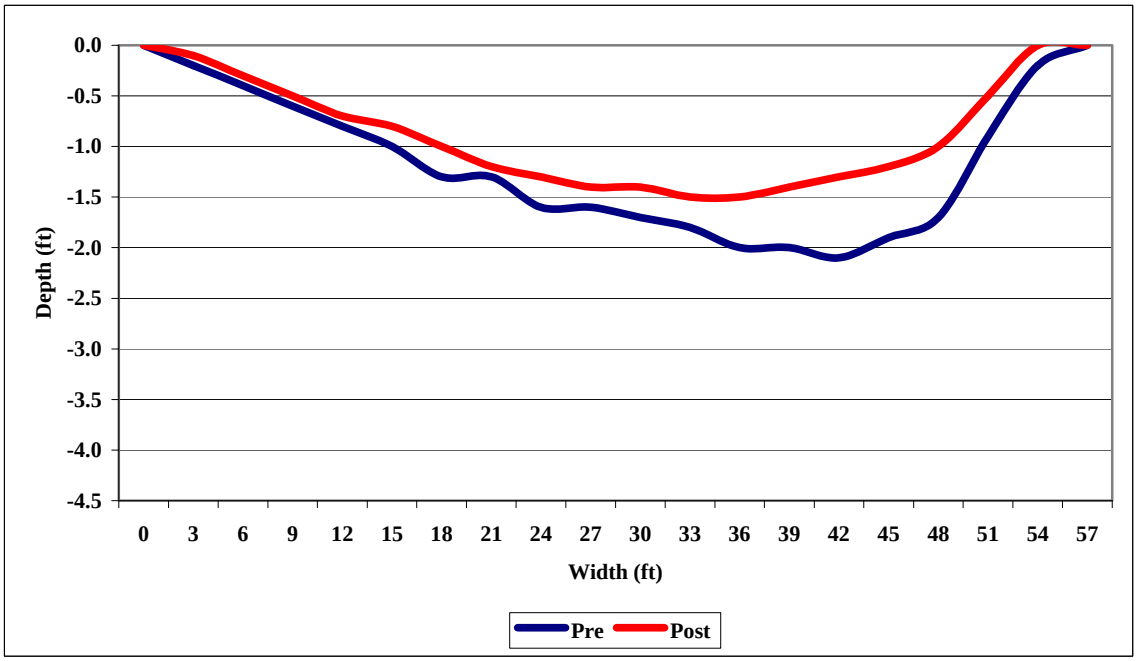
Appendix F-25. Pre and Post cross sections at Flatwater 2 Transect 2 – Healdsburg Reach



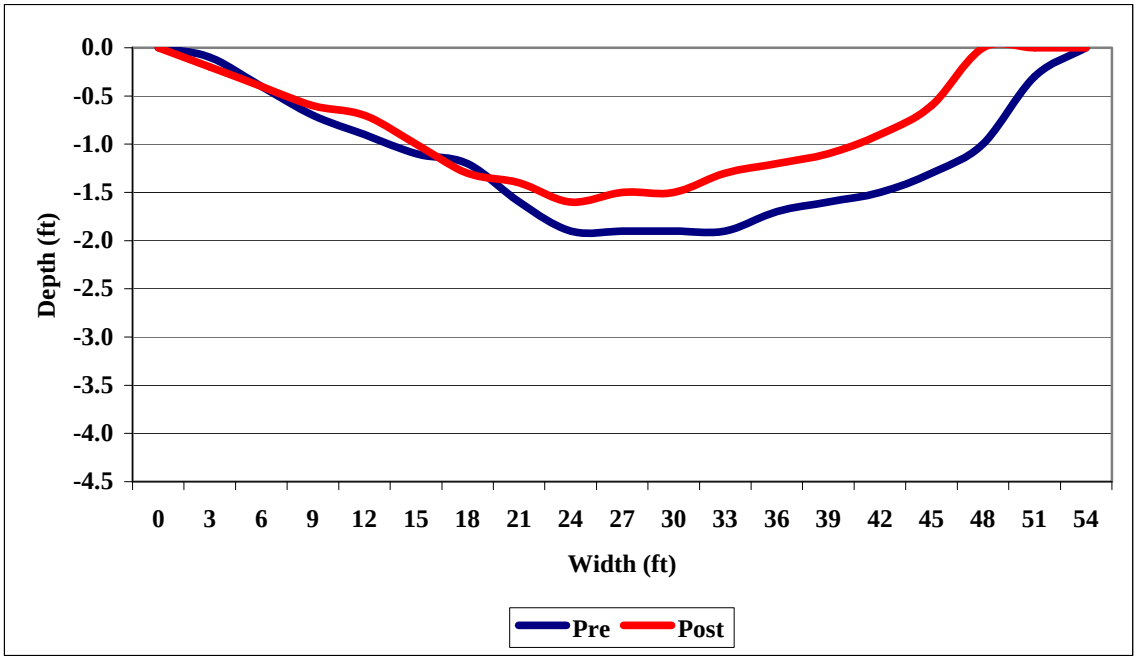
Appendix F-26. Pre and Post cross sections at Flatwater 2 Transect 3 – Healdsburg Reach



Appendix F-27. Pre and Post cross sections at Flatwater 3 Transect 1 – Healdsburg Reach



Appendix F-28. Pre and Post cross sections at Flatwater 3 Transect 2 – Healdsburg Reach

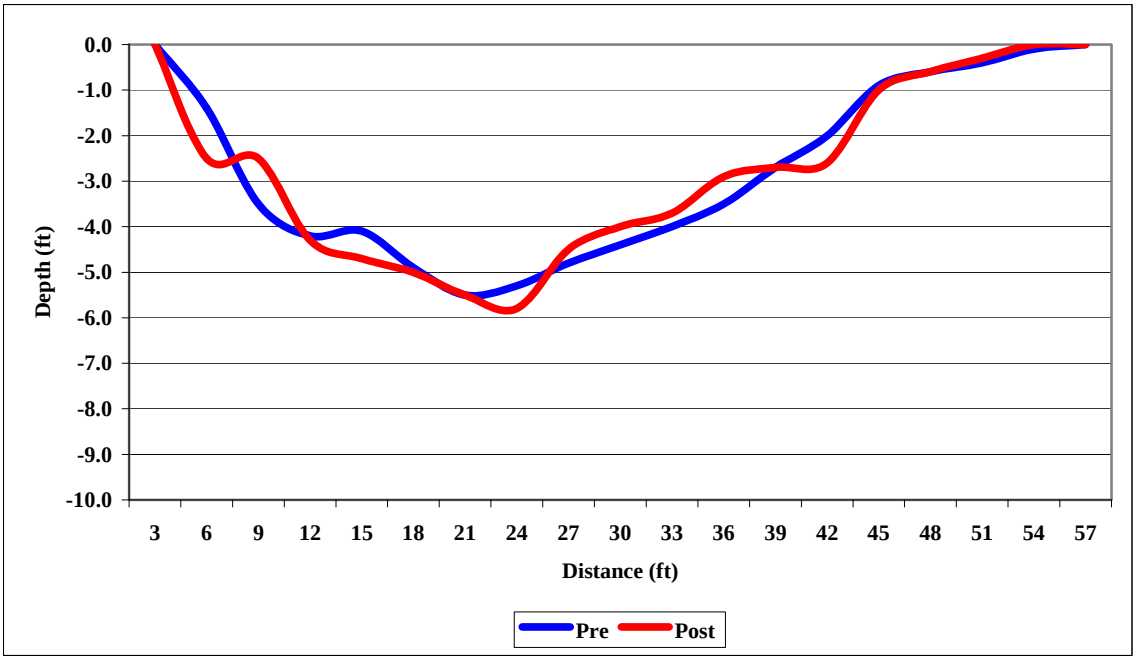


Appendix F-29. Pre and Post cross sections at Flatwater 3 Transect 3 – Healdsburg Reach

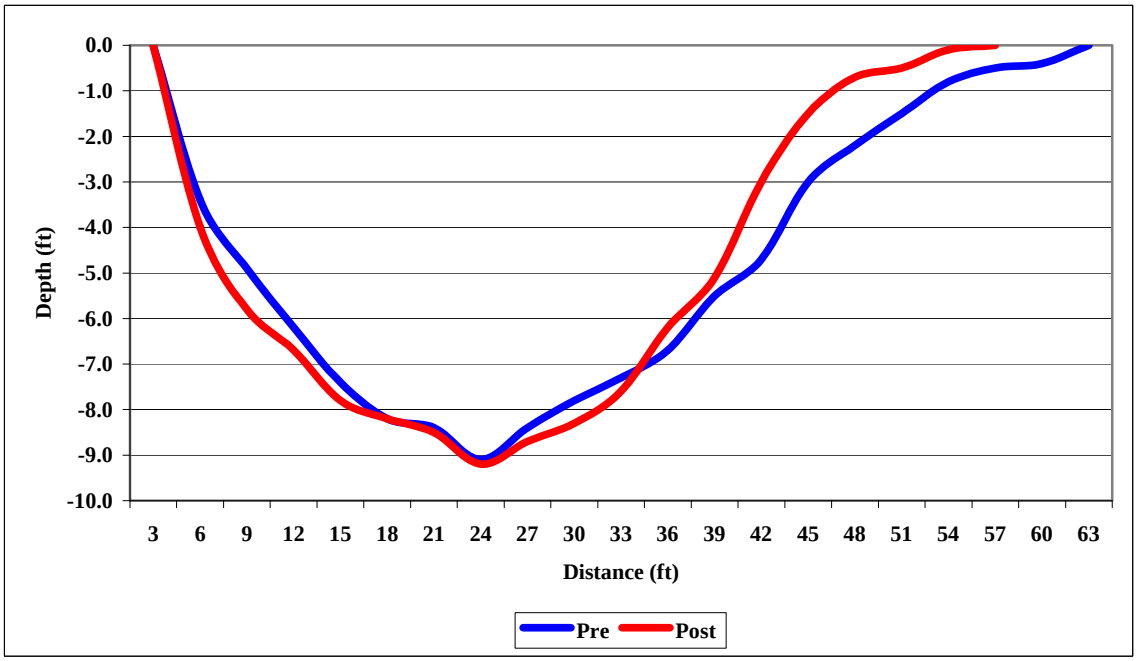
APPENDIX G

BELOW DRY CREEK REACH CROSS SECTIONS

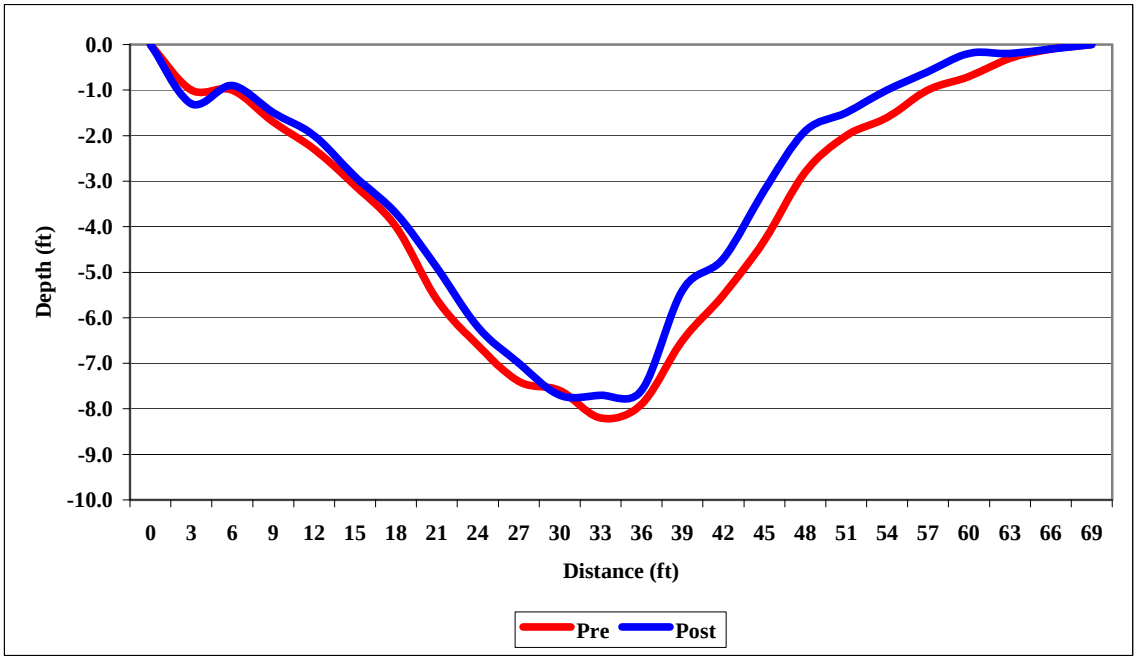
PRE AND POST FLOW REDUCTION SURVEYS



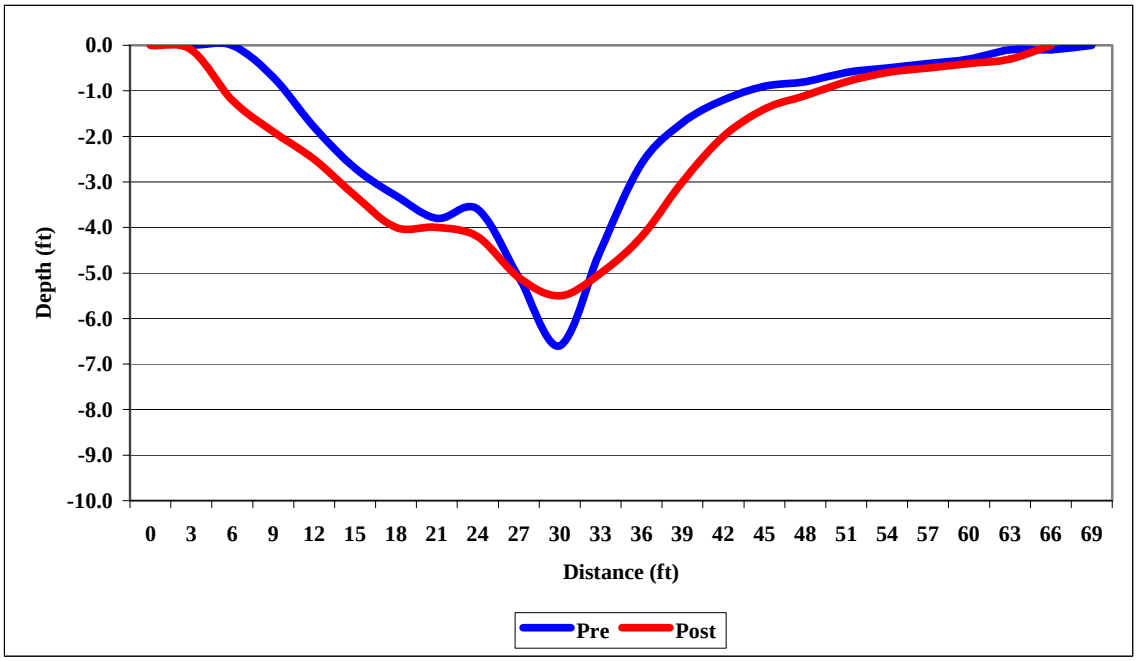
Appendix G-1. Pre and Post cross sections at Pool 1 Transect 1 – Below Dry Creek Reach



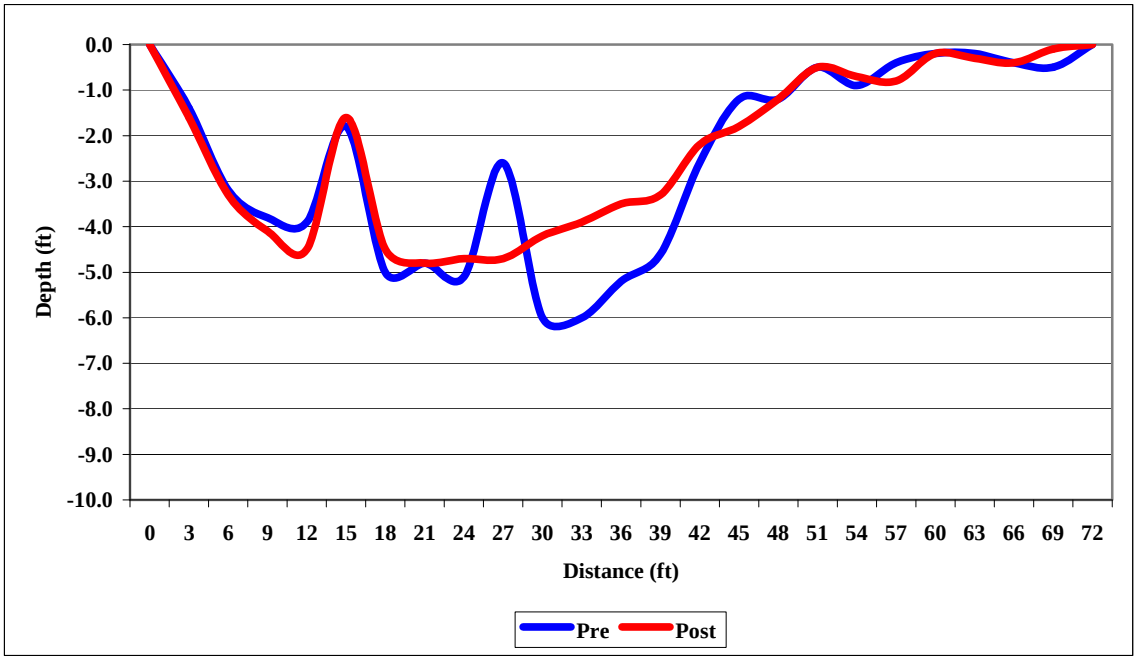
Appendix G-2. Pre and Post cross sections at Pool 1 Transect 2 – Below Dry Creek Reach



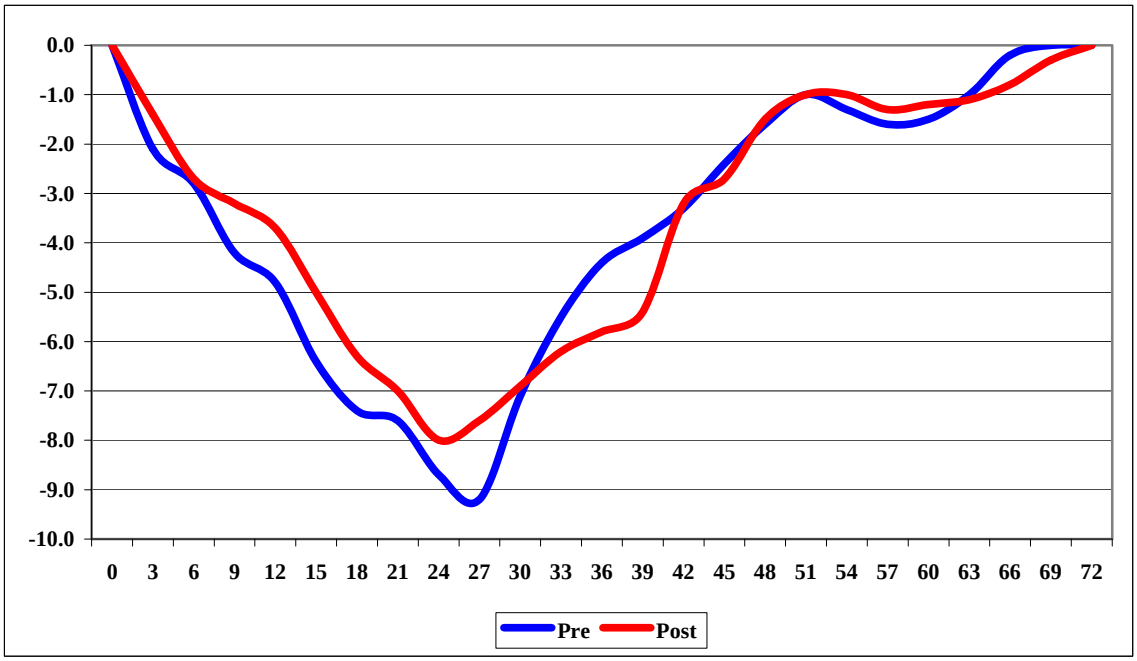
Appendix G-3. Pre and Post cross sections at Pool 1 Transect 3 – Below Dry Creek Reach



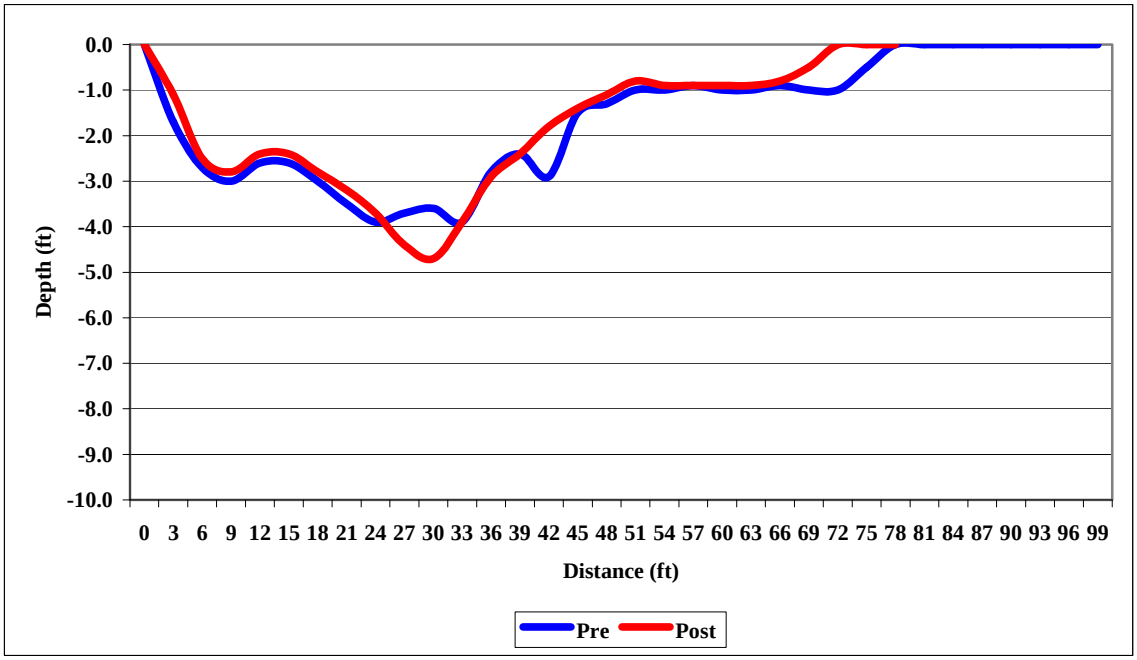
Appendix G-4. Pre and Post cross sections at Pool 2 Transect 1 – Below Dry Creek Reach



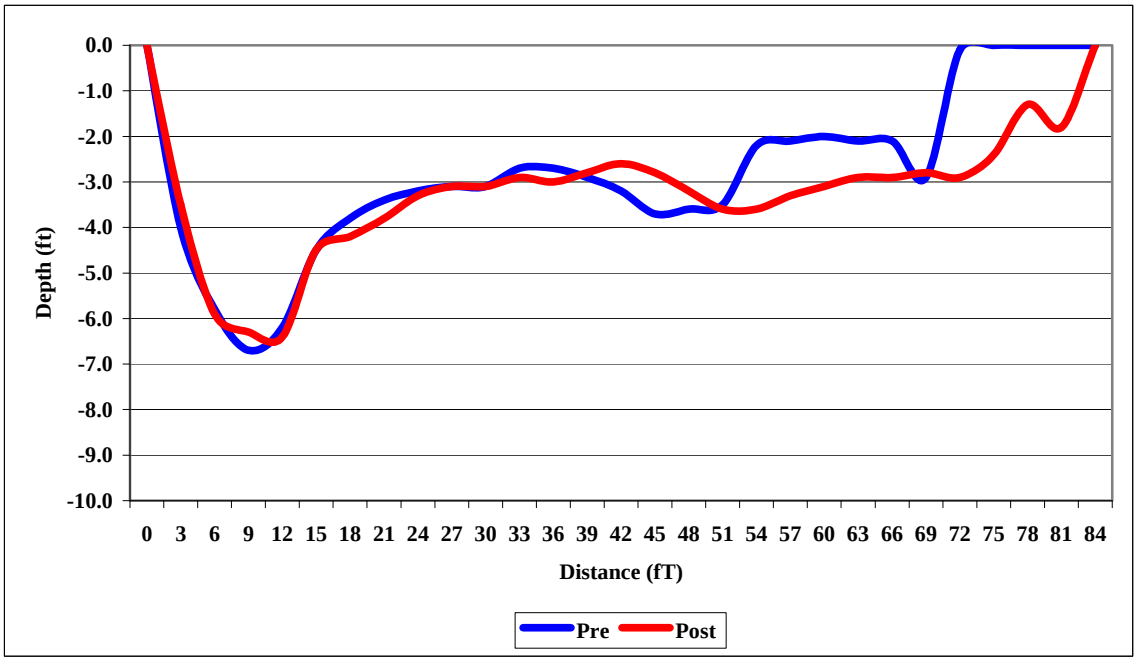
Appendix G-5. Pre and Post cross sections at Pool 2 Transect 2 – Below Dry Creek Reach



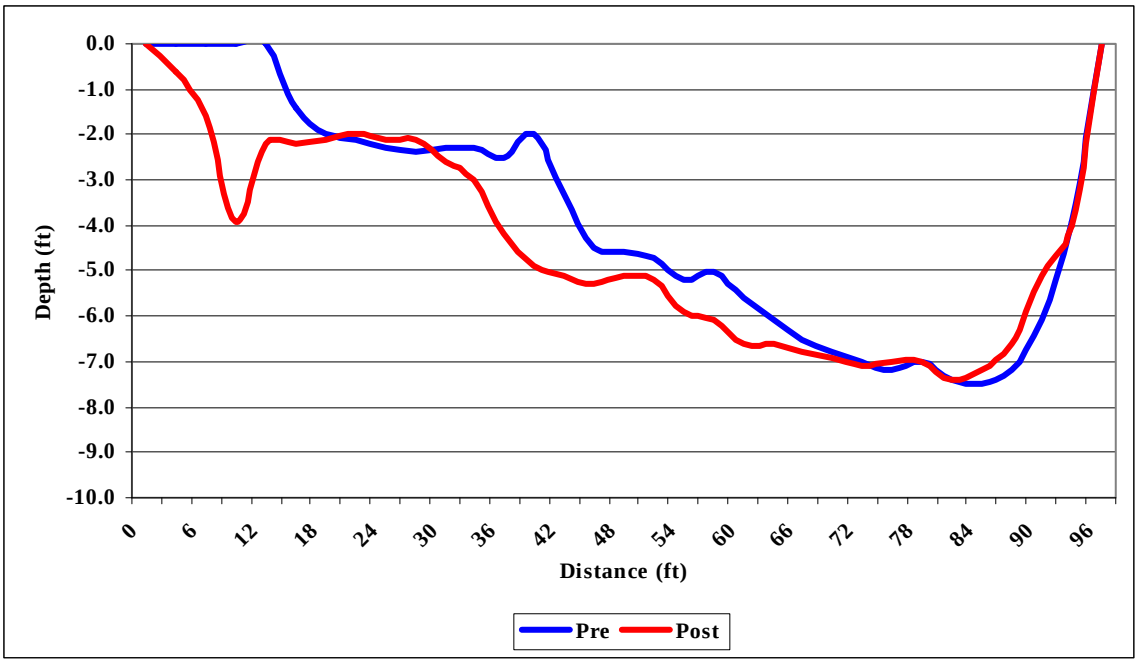
Appendix G-6. Pre and Post cross sections at Pool 2 Transect 3 – Below Dry Creek Reach



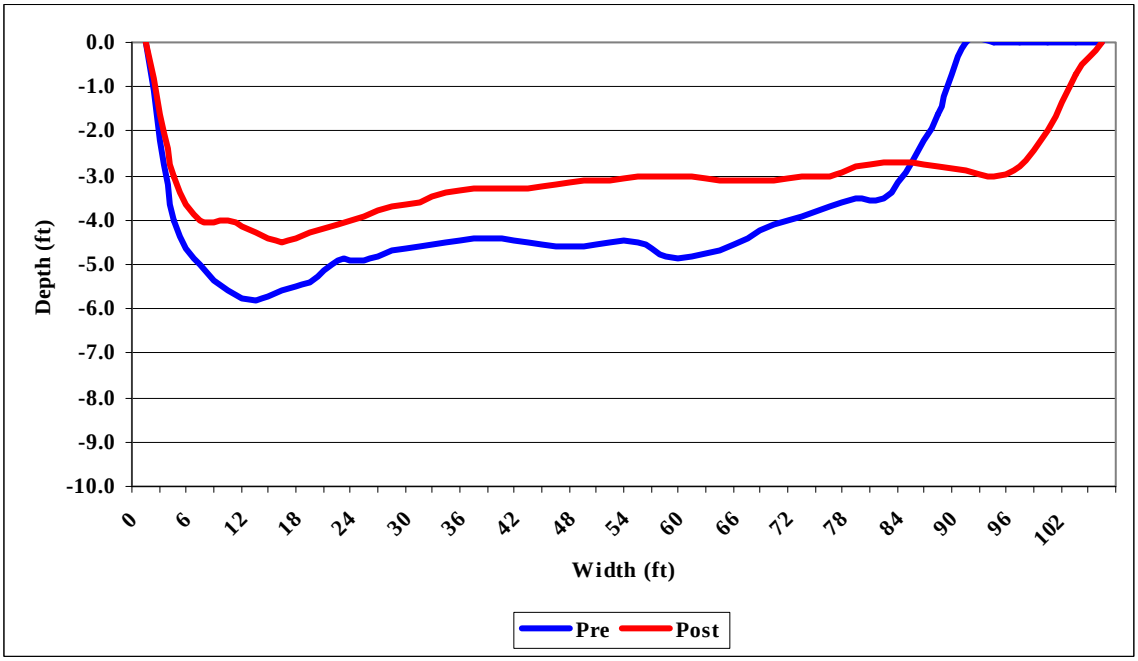
Appendix G-7. Pre and Post cross sections at Pool 2 Transect 4 – Below Dry Creek Reach



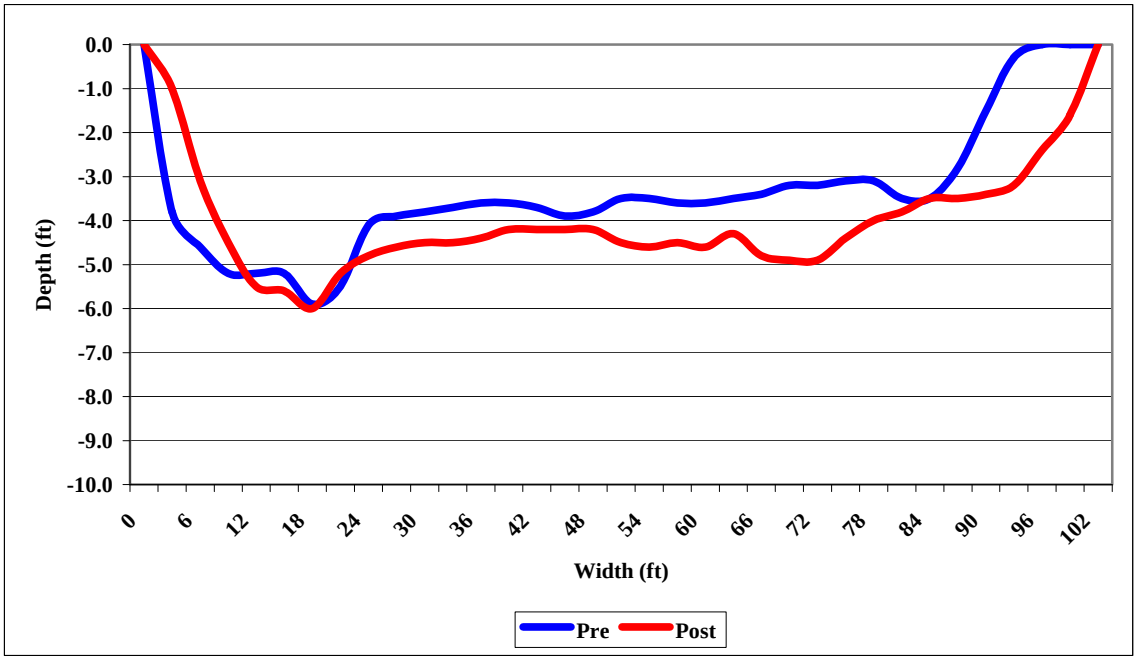
Appendix G-8. Pre and Post cross sections at Pool 3 Transect 1 – Below Dry Creek Reach



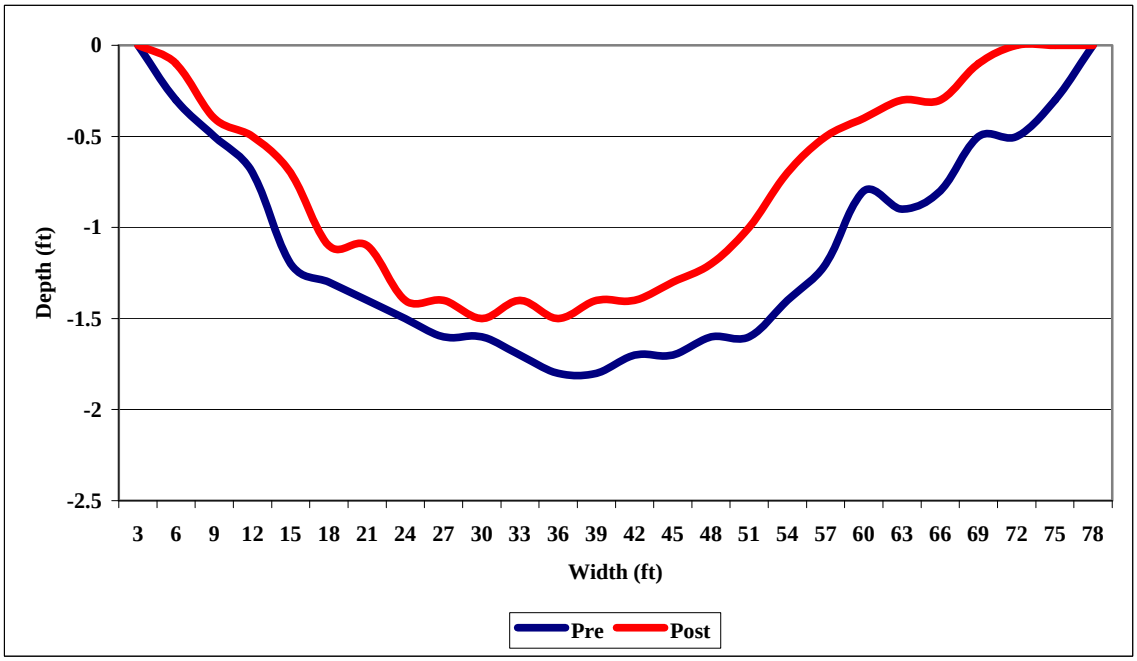
Appendix G-9. Pre and Post cross sections at Pool 3 Transect 2 – Below Dry Creek Reach



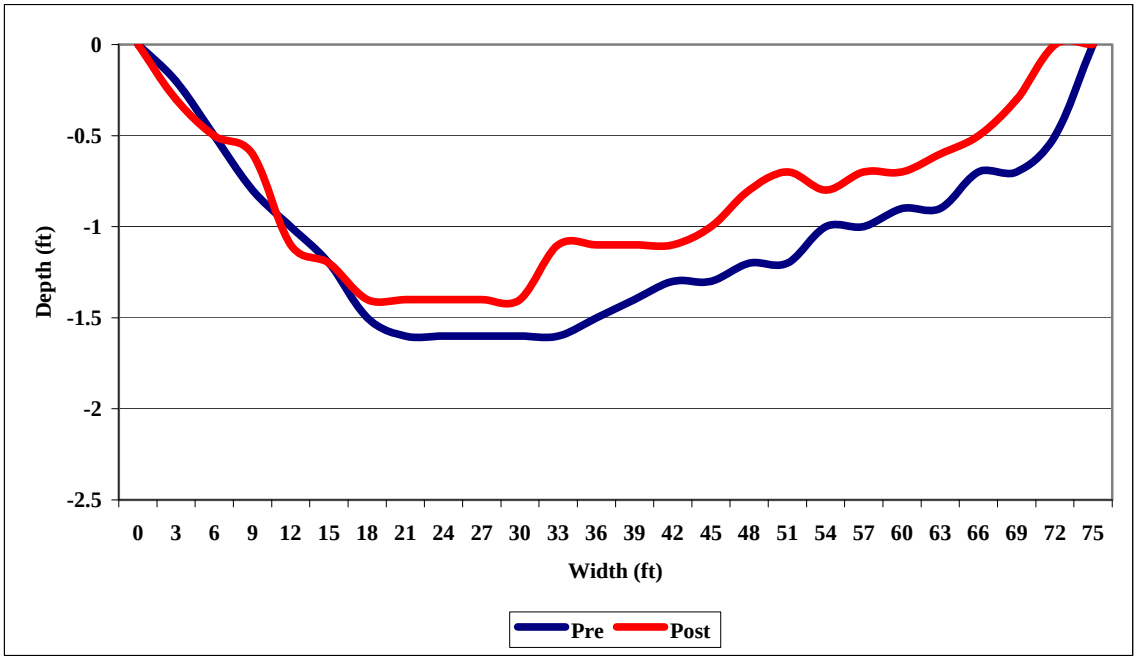
Appendix G-10. Pre and Post cross sections at Pool 3 Transect 3 – Below Dry Creek Reach



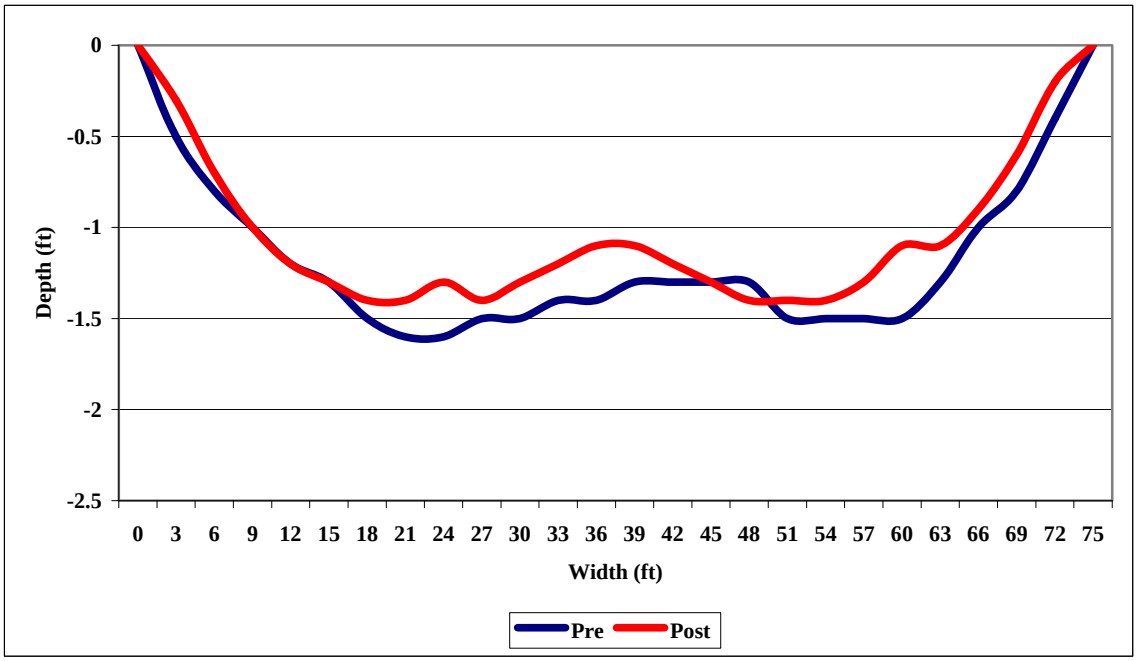
Appendix G-11. Pre and Post cross sections at Pool 3 Transect 4 – Below Dry Creek Reach



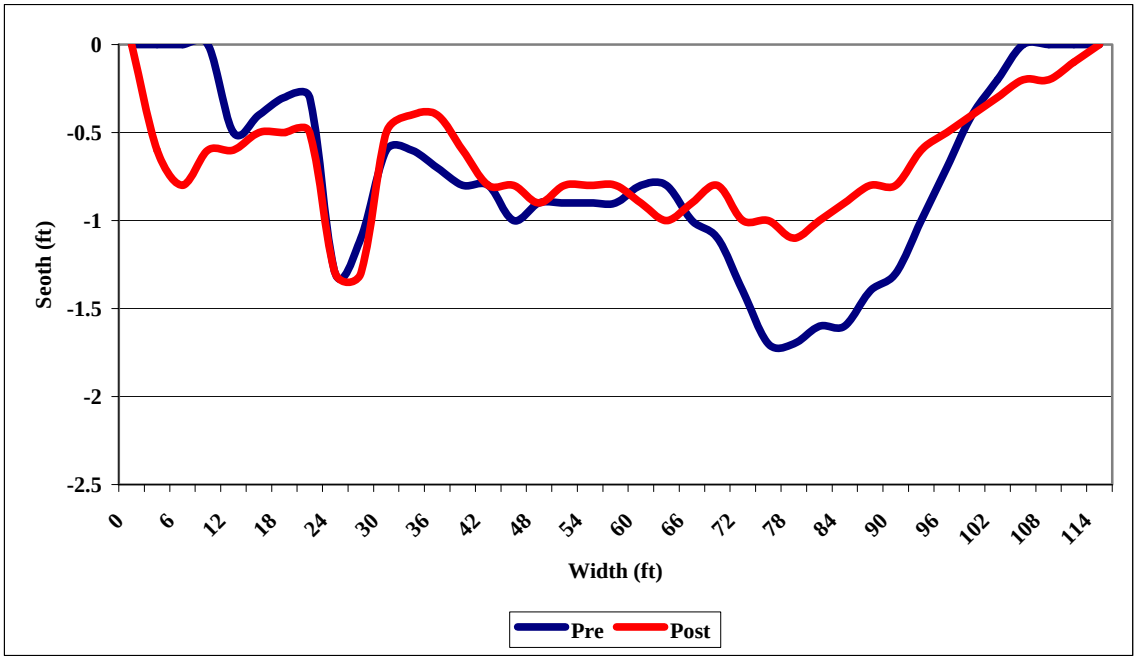
Appendix G-12. Pre and Post cross sections at Riffle 1 Transect 1 – Below Dry Creek Reach



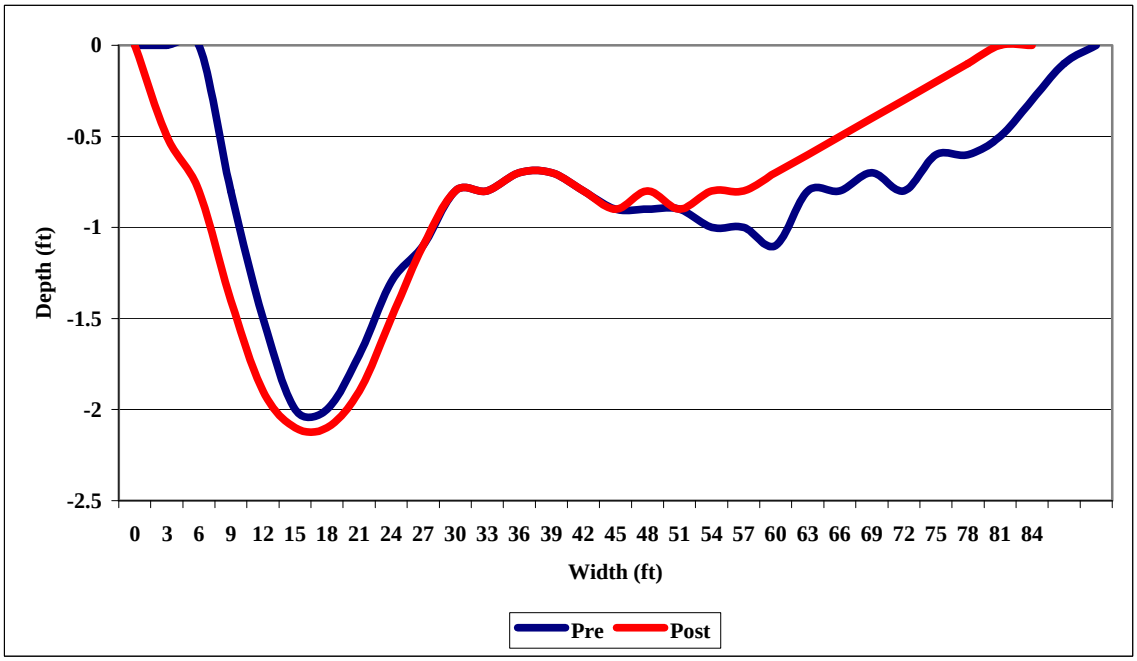
Appendix G-13. Pre and Post cross sections at Riffle 1 Transect 2 – Below Dry Creek Reach



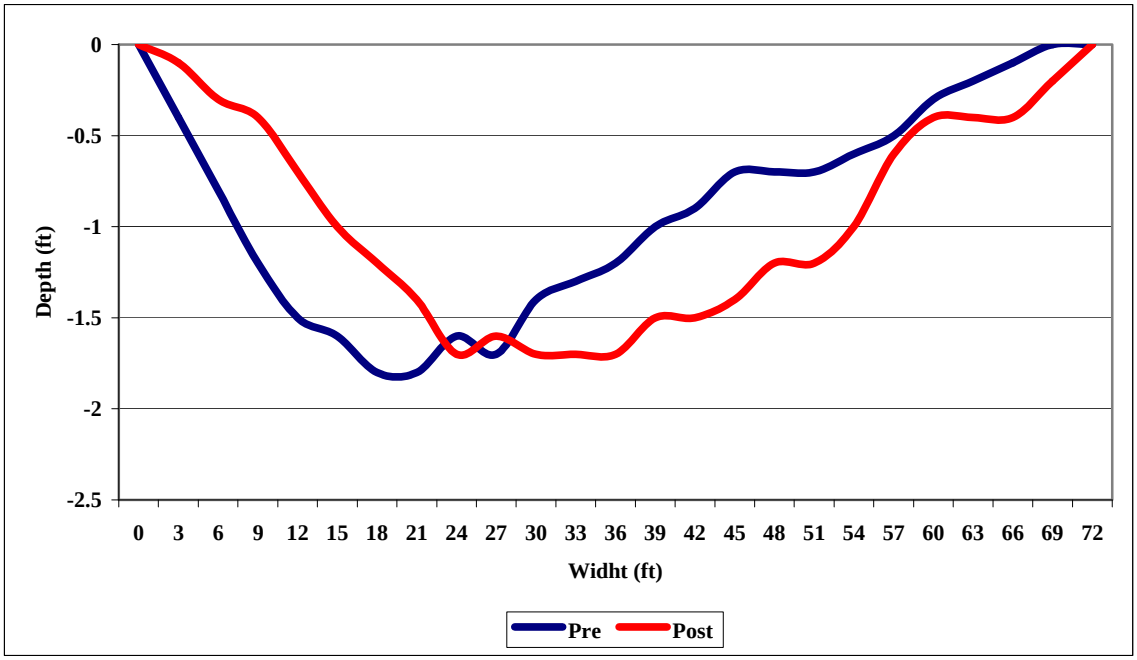
Appendix G-14. Pre and Post cross sections at Riffle 1 Transect 3 – Below Dry Creek Reach



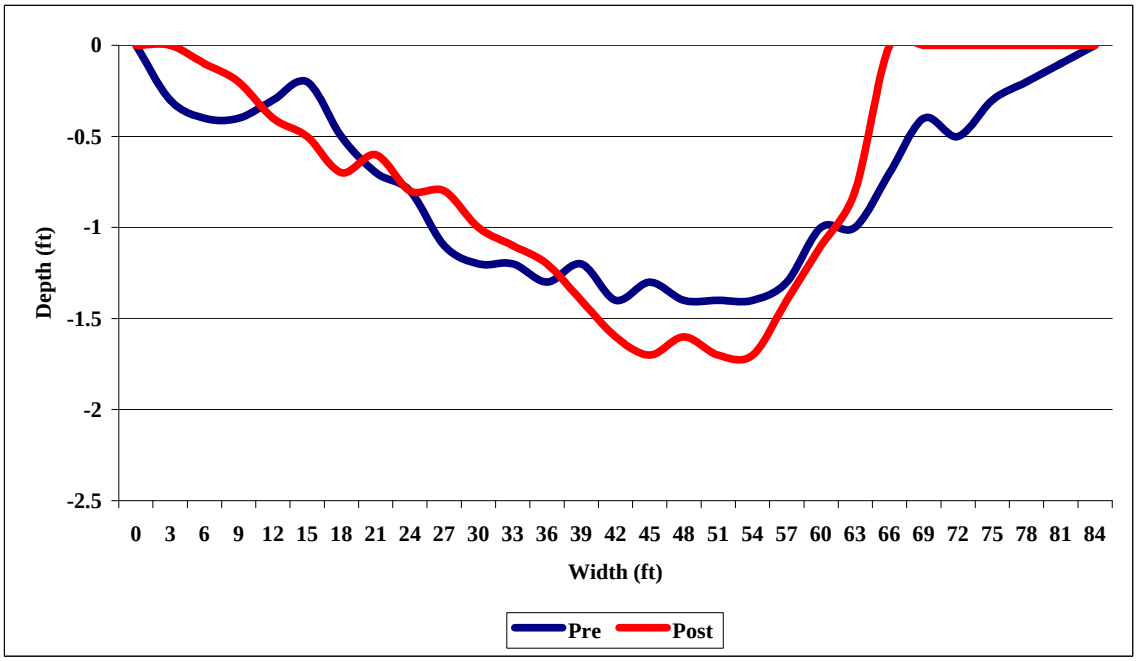
Appendix G-15. Pre and Post cross sections at Riffle 2 Transect 1 – Below Dry Creek Reach



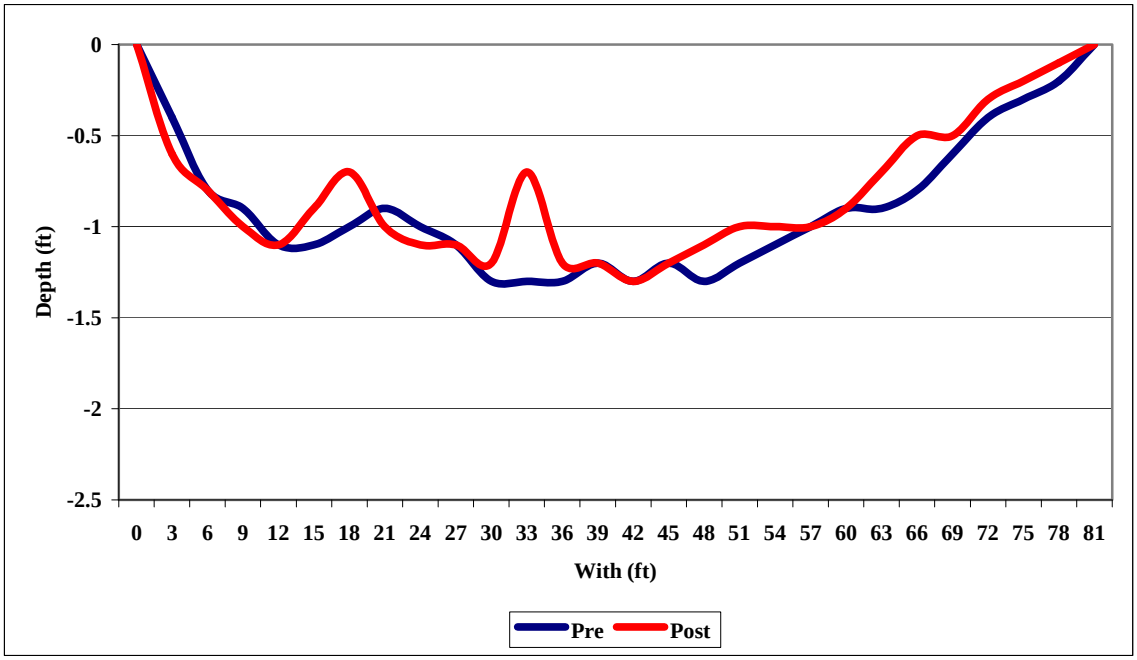
Appendix G-16. Pre and Post cross sections at Riffle 2 Transect 2 – Below Dry Creek Reach



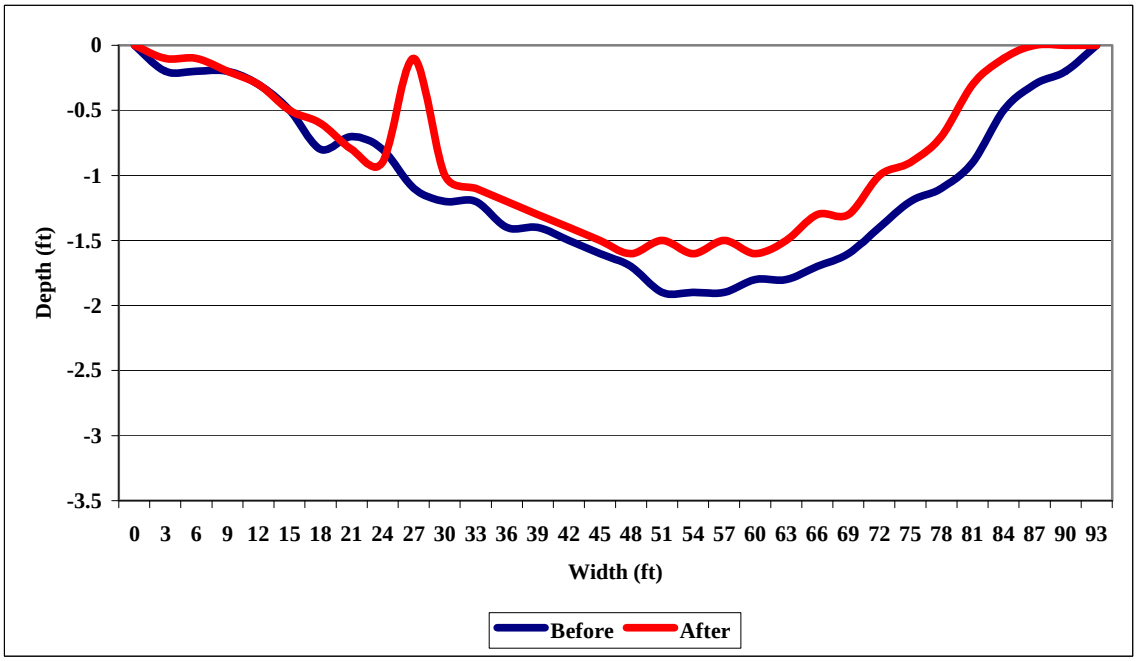
Appendix G-17. Pre and Post cross sections at Riffle 3 Transect 1 – Below Dry Creek Reach



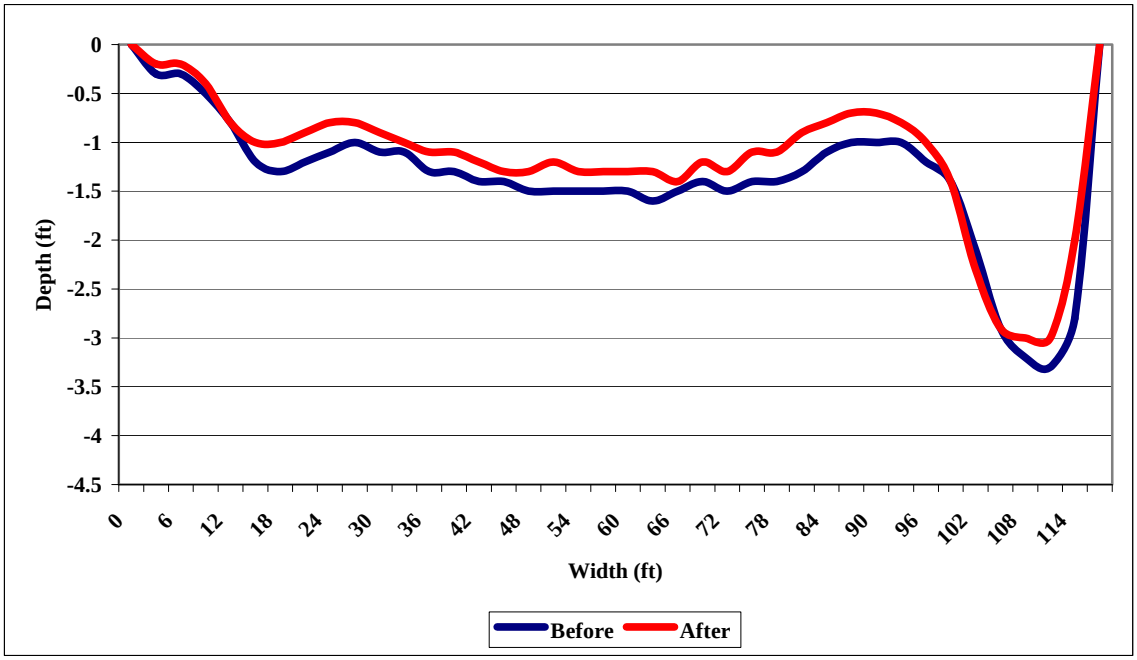
Appendix G-18. Pre and Post cross sections at Riffle 3 Transect 2 – Below Dry Creek Reach



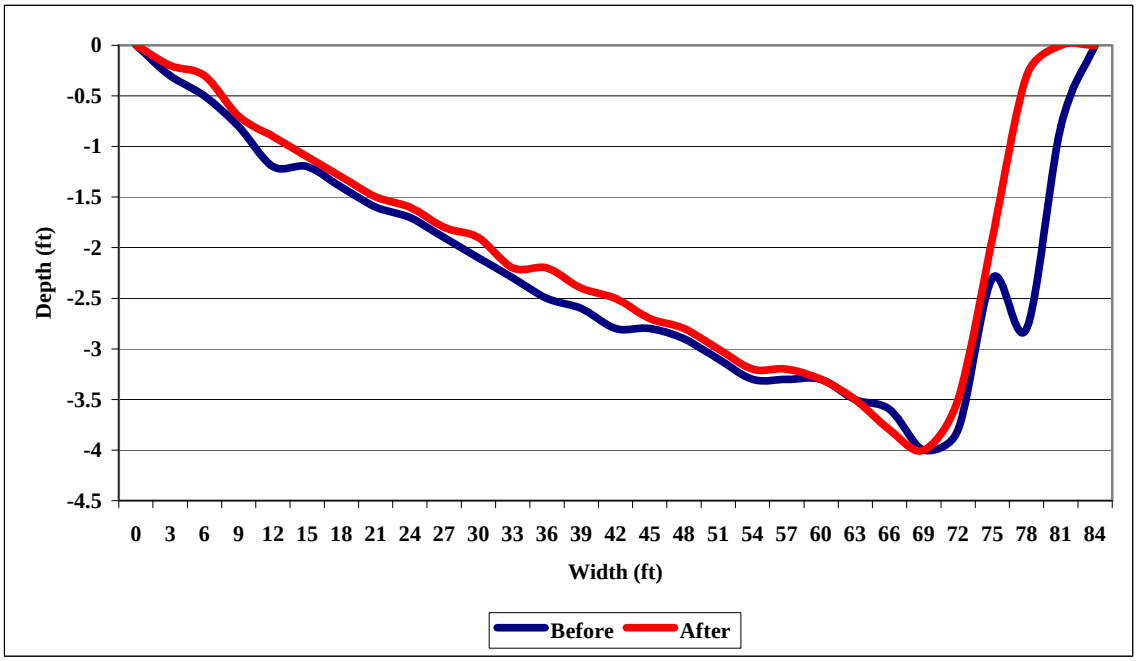
Appendix G-19. Pre and Post cross sections at Riffle 3 Transect 3 – Below Dry Creek Reach



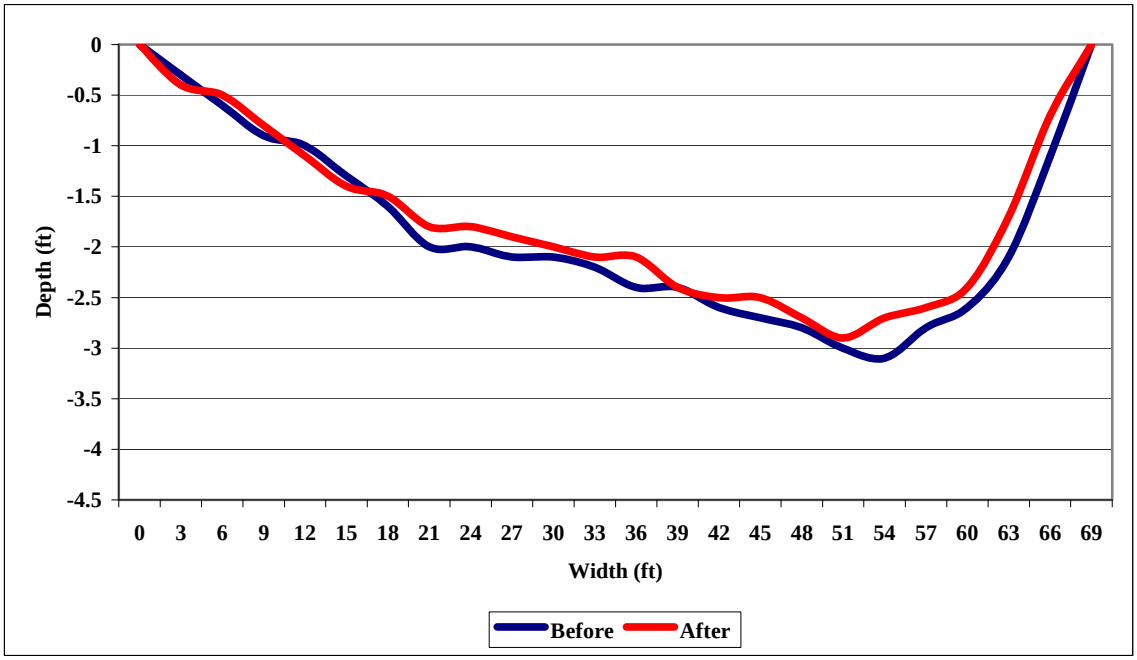
Appendix G-20. Pre and Post cross sections at Flatwater 1 Transect 1 – Below Dry Creek Reach



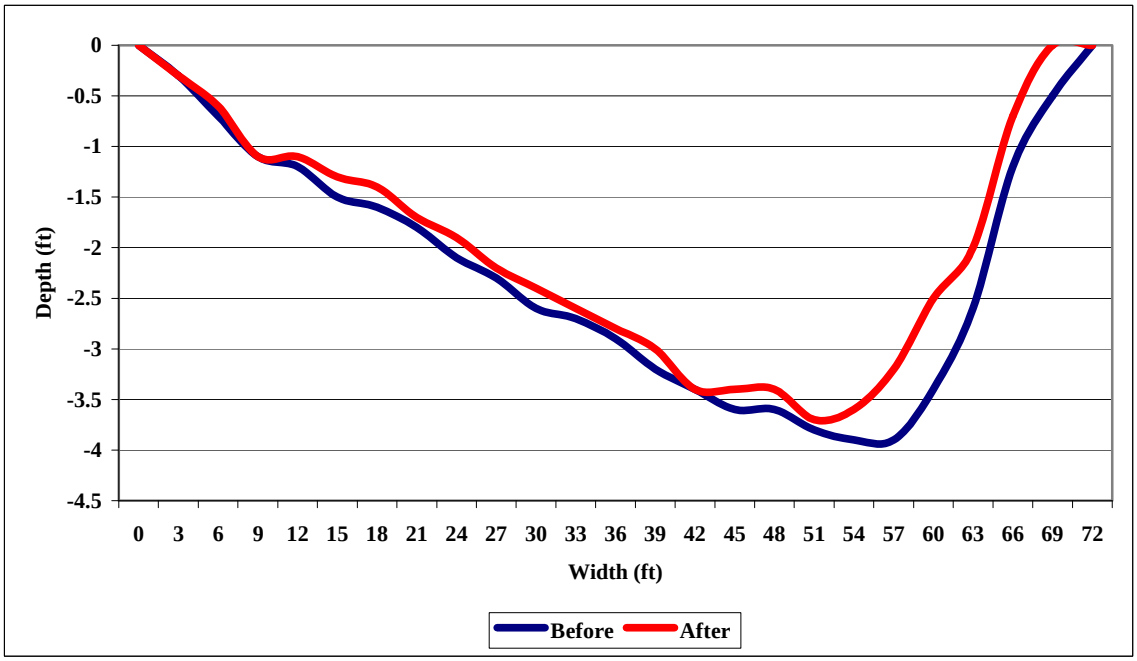
Appendix G-21. Pre and Post cross sections at Flatwater 1 Transect 2 – Below Dry Creek Reach



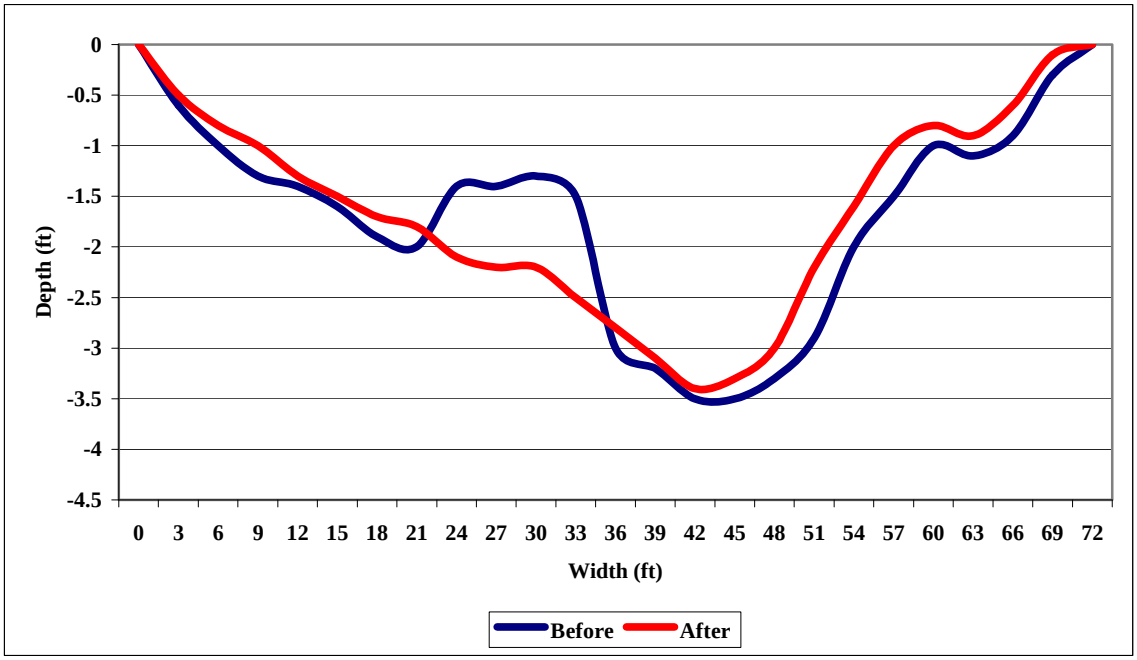
Appendix G-22. Pre and Post cross sections at Flatwater 1 Transect 3 – Below Dry Creek Reach



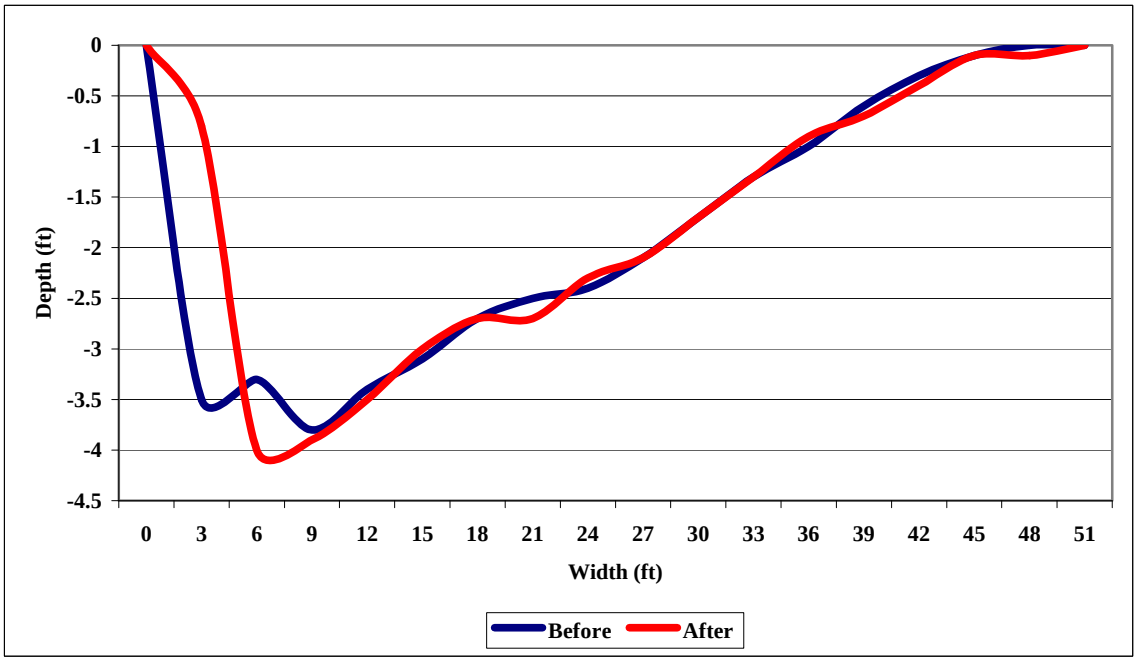
Appendix G-23. Pre and Post cross sections at Flatwater 2 Transect 1 – Below Dry Creek Reach



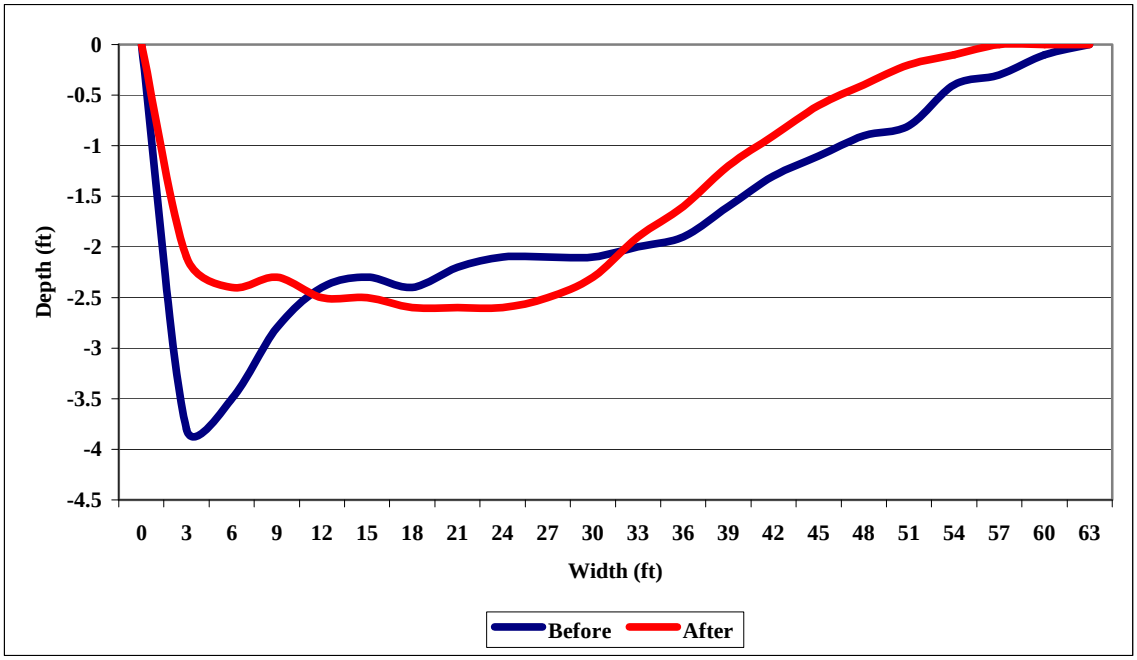
Appendix G-24. Pre and Post cross sections at Flatwater 2 Transect 2 – Below Dry Creek Reach



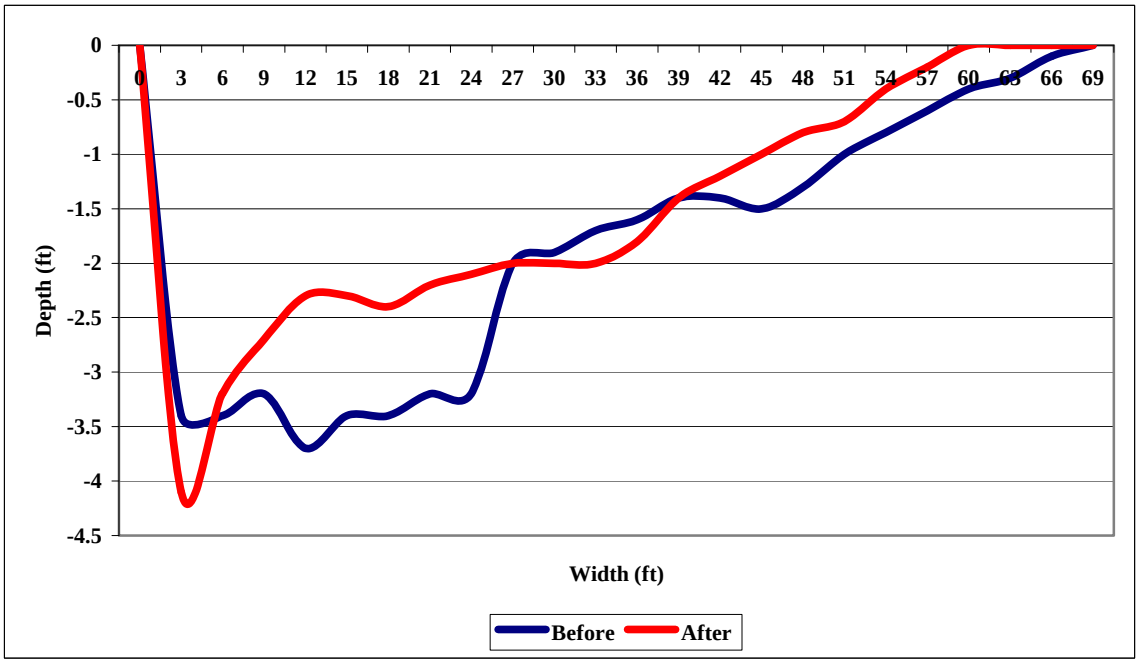
Appendix G-25. Pre and Post cross sections at Flatwater 2 Transect 3 – Below Dry Creek Reach



Appendix G-26. Pre and Post cross sections at Flatwater 3 Transect 1 – Below Dry Creek Reach



Appendix G-27. Pre and Post cross sections at Flatwater 3 Transect 2 – Below Dry Creek Reach



Appendix G-28. Pre and Post cross sections at Flatwater 3 Transect 3 – Below Dry Creek Reach

APPENDIX H

AVERAGE WIDTHS, DEPTHS AND CROSS SECTIONAL AREAS FOR EACH HABITAT UNIT AT EACH OF THE SEVEN REACHES, PRE AND POST FLOW REDUCTION SURVEYS.

Appendix H-1. Average widths, depths and cross sectional areas for Pool Transects measured in the Ukiah Reach. Shaded areas represent transects where the average width, depth, or cross sectional area increased between the Pre and Post surveys.

Transect	Change in flow (cfs)	Width			Depth			Cross section			
		Pre- (ft)	Post (ft)	Difference (ft)	Pre- (ft)	Post (ft)	Difference (ft)	Pre- (ft^2)	Post (ft^2)	Difference (ft^2)	% Change
Pool 1 T-1	4	60	60	0	1.9	1.7	-0.2	113.0	99.6	-13.4	-11.9%
Pool 1 T-2	4	65	64	-1	5.6	5.2	-0.4	116.3	111.4	-4.9	-4.2%
Pool 1 T-3	4	74	66	-8	1.9	1.9	-0.0	220.0	197.7	-22.3	-10.1%
Pool 1 T-4	4	81	76	-5	5.5	5.3	-0.2	205.5	175.3	-30.2	-14.7%
Pool 2 T-2	4	35	35	0	3.0	2.8	-0.2	98.7	93.3	-5.4	-5.5%
Pool 2 T-3	4	32	33	+1	2.7	2.7	0.0	80.3	79.8	-0.5	-0.6%
Pool 2 T-4	4	42	44	+2	2.5	2.8	+0.3	92.2	117.6	+25.4	+27.5%
Pool 3 T-2	9	65	65	0	4.1	4.3	+0.2	258.3	268.7	+10.4	+4.0%
Pool 3 T-3	9	65	62	-3	4.6	4.3	-0.3	278.6	254.1	-24.5	-8.8%
Pool 3 T-4	9	64	65	+1	2.8	3.0	+0.2	178.8	187.2	+8.4	+4.7%
Overall		**58.3**	**57.0**	**-.3**	**3.5**	**3.4**	**-0.1**	**164.2**	**158.5**	**-5.7**	**-2.0%**

Appendix H -2. Average widths, depths and cross sectional areas for Riffle Transects measured in the Ukiah Reach (transects excluded from analysis are presented in Appendix A). Shaded areas represent transects where the average width, depth, or cross sectional area increased between the Pre and Post surveys.

Transect	Change in flow (cfs)	Width			Depth			Cross section			
		Pre- (ft)	Post (ft)	Difference (ft)	Pre- (ft)	Post (ft)	Difference (ft)	Pre- (ft^2)	Post (ft^2)	Difference (ft^2)	% Change
Riffle 1 T-1	-3	53.0	54.0	+.0	1.1	1.1	0.0	54.6	61.0	+6.4	+11.7%
Riffle 2 T-1	-3	94.0	92.0	-2.0	0.6	0.6	0.0	56.1	54.0	-2.1	-3.7%
Riffle 2 T-2	-3	77.0	76.0	-1.0	0.9	0.9	0.0	63.5	65.2	+1.7	+2.7%
Riffle 2 T-3	-3	74.0	73.0	-1.0	0.8	0.8	0.0	56.2	58.0	+1.8	+3.2%
Riffle 3 T-1	+4	34.0	33.5	-0.5	1.2	1.2	0.0	39.3	39.0	-0.3	-0.8%
Riffle 3 T-2	+4	32.0	32.0	-0.0	1.2	1.2	0.0	36.3	37.5	+.2	+3.3%
Riffle 3 T-3	+4	36.0	36.0	0.0	1.5	1.5	0.0	50.4	49.2	-1.2	-2.4%
Overall		**57.1**	**56.6**	**-.5**	**1.0**	**1.0**	**0.0**	**50.9**	**52.0**	**+.1**	**+2.0%**

Appendix H-3. Average widths, depths and cross sectional areas for Flatwater Transects measured in the Ukiah Reach. Shaded areas represent transects where the average width, depth, or cross sectional area increased between the Pre and Post surveys.

Transect	Change in flow (cfs)	Width			Depth			Cross section			
		Pre- (ft)	Post (ft)	Difference (ft)	Pre- (ft)	Post (ft)	Difference (ft)	Pre- (ft^2)	Post (ft^2)	Difference (ft^2)	% Change
FW 1 T-3	-3	72	78	+6.0	1.7	1.7	0.0	122.6	130.2	+7.6	+6.2%
FW 2 T-1	+4	61	61	0.0	0.9	0.9	0.0	52.2	51.9	-0.3	-0.6%
FW 2 T-2	+4	55	56	+1.0	2.5	2.7	+0.2	128.1	151.2	+23.1	+18.0%
FW 2 T-3	+4	58	56	-2.0	2.0	1.9	-0.1	109.7	109.8	+0.1	+0.1%
FW 3 T-1	+4	28	30	+2.0	2.2	2.0	-0.2	59.4	56.6	-2.8	-4.7%
FW 3 T-2	+4	32	34	+2.0	2.2	1.9	-0.3	60.8	69.0	+8.2	+13.5%
FW 3 T-3	+4	35	32	-3.0	2.3	2.2	-0.1	75.0	65.5	-9.5	-12.7%
Overall		**48.7**	**49.6**	**+0.9**	**2.0**	**1.9**	**-0.1**	**86.8**	**90.6**	**+3.8**	**+2.8%**

Appendix H-4. Average widths, depths and cross sectional areas for Pool Transects measured in the Comminsky Station Reach. Shaded areas represent transects where the average width, depth, or cross sectional area increased between the Pre and Post surveys.

Transect	Change in flow (cfs)e	Width			Depth			Cross section			
		Pre (ft)	Post (ft)	Difference (ft)	Pre (ft)	Post (ft)	Difference (ft)	Pre (ft^2)	Post (ft^2)	Difference (ft^2)	% Change
Pool 1 T-1	20	84	85	+1.0	2.5	2.2	-0.3	207.3	180.1	-27.2	-13.1%
Pool 1 T-2	20	116	116	0.0	3.5	3.5	0.0	400.6	398.9	-1.7	-0.4%
Pool 1 T-3	20	110	108	-2.0	3.4	3.2	-0.2	379	343.8	-35.2	-9.3%
Pool 1 T-4	20	75	83	+8.0	4.6	4.4	-0.2	334.8	339.1	+4.3	+1.3%
Pool 2 T-2	20	64	65	+1.0	3.6	3.4	-0.2	117.9	113.1	-4.8	-4.1%
Pool 3 T-1	20	63	70	+7.0	3.8	3.6	-0.2	230.7	248.7	+18.0	+7.8%
Pool 3 T-2	20	76	64	-12.0	5.9	5.5	-0.4	426.3	366	-60.3	-14.1%
Pool 3 T-3	20	96	101	+5.0	3.6	3.5	-0.1	331.5	334.2	+2.7	+0.8%
Pool 3 T-4	20	117	119	+2.0	3.0	3.0	-0.0	345	356.4	+11.4	+3.3%
Overall		**89.0**	**90.1**	**+1.1**	**3.8**	**3.6**	**-0.2**	**308.1**	**297.8**	**-10.3**	**-3.3%**

Appendix H-5. **Average widths, depths and cross sectional areas for Riffle Transects measured in the Comminsky Station Reach. Shaded areas represent transects where the average width, depth, or cross sectional area increased between the Pre and Post surveys.**

Transect	Change in flow (cfs)	Width			Depth			Cross section			
		Pre (ft)	Post (ft)	Difference (ft)	Pre (ft)	Post (ft)	Difference	Pre (ft^2)	Post (ft^2)	Difference (ft^2)	% Change
Riffle 1 T-1	20	120.0	122.0	+2.0	0.7	0.6	-0.1	85.2	76.3	-8.9	-10.4%
Riffle 1 T-2	20	91.0	91.0	0.0	0.7	0.6	-0.1	57.6	50.4	-7.2	-12.5%
Riffle 1 T-3	20	81.0	79.0	-2.0	0.6	0.5	-0.1	44.4	40.5	-3.9	-8.8%
Riffle 2 T-1	20	72.0	70.0	-2.0	0.9	1.1	+0.2	62.7	72.9	+10.2	+16.3%
Riffle 2 T-2	20	60.2	62.0	+1.8	1.2	1.2	-0.0	74.7	71.8	-2.9	-3.9%
Riffle 2 T-3	20	64.0	67.0	+3.0	1.7	1.5	-0.2	105.2	78.8	-26.4	-25.1%
Riffle 3 T-1	20	28.0	26.0	-2.0	1.1	0.9	-0.2	33.9	27.6	-6.3	-18.6%
Riffle 3 T-2	20	36.0	34.0	-2.0	1.4	1.2	-0.2	50.7	41.7	-9.0	-17.8%
Riffle 3 T-3	20	34.0	33.0	-1.0	2.3	2.0	-0.3	72.5	64.5	-8.0	-11.0%
Overall		**65.1**	**64.9**	**-0.2**	**1.2**	**1.1**	**0.1**	**65.2**	**58.3**	**-6.9**	**-10.6%**

Appendix H-6. **Average widths, depths and cross sectional areas for Flatwater Transects measured in the Comminsky Station Reach. Shaded areas represent transects where the average width, depth, or cross sectional area increased between the Pre and Post surveys.**

Transect	Change in flow (cfs)	Width			Depth			Cross section			
		Pre (ft)	Post (ft)	Difference (ft)	Pre (ft)	Post (ft)	Difference (ft)	Pre (ft^2)	Post (ft^2)	Difference (ft^2)	% Change
FW 1, T-1	20	83	81	-2.0	3.1	2.9	-0.2	248.7	231.6	-17.1	-6.9%
FW 1, T-2	20	108	113	+5.0	2.8	2.5	-0.3	311.7	282.9	-28.8	-9.2%
FW 2, T-1	20	71	71	-0.0	1.1	1.0	-0.1	72.9	67.2	-5.7	-7.8%
FW 2, T-2	20	52	53	+1.0	1.4	1.2	-0.2	70.4	62.4	-8.0	-11.4%
FW 2, T-3	20	52	55	+3.0	1.6	1.5	-0.1	80.7	76.2	-4.5	-5.6%
FW 3, T-1	20	61	59	-2.0	2.6	2.6	0.0	156.4	151.2	-5.2	-3.3%
FW 3, T-2	20	57	58	+1.0	1.7	1.6	-0.1	95.7	93.6	-2.1	-2.2%
FW 3, T-3	20	61	64	+3.0	2.0	1.9	-0.1	119.1	102.6	-16.5	-13.9%
Overall		**68.1**	**69.3**	**+0.8**	**2.0**	**1.9**	**-0.1**	**144.5**	**133.5**	**-11.0**	**-7.6%**

Appendix H-7. **Average widths, depths and cross sectional areas for Pool Transects measured in the Cloverdale Reach. Shaded areas represent transects where the average width, depth, or cross sectional area increased between the Pre and Post surveys.**

Transect	Change in flow (cfs)e	Width			Depth			Cross section			
		Pre (ft)	Post (ft)	Difference (ft)	Pre (ft)	Post (ft)	Difference (ft)	Pre (ft^2)	Post (ft^2)	Difference (ft^2)	% Change
Pool 1 T-1	17	107	102.5	-4.5	1.8	1.6	-0.2	184.1	163.5	-20.6	-11.2%
Pool 1 T-2	17	82	85	+3.0	1.8	1.8	0.0	141.8	148.5	+6.7	+4.7%
Pool 1 T-3	17	75	73	-2.0	2.1	2.0	-0.1	166.1	146.4	-19.7	-11.9%
Pool 1 T-4	17	82	79	-3.0	1.9	1.8	-0.1	142.2	141.1	-1.1	-0.8%
Pool 2 T-1	17	102	82	-20.0	1.9	1.8	-0.1	161.1	144.3	-16.8	-10.4%
Pool 2 T-2	17	82	78	-4.0	2.2	2.1	-0.1	178.8	164.1	-14.7	-8.2%
Pool 2 T-3	17	92	84	-8.0	2.5	2.3	-0.2	222.6	206.1	-16.5	-7.4%
Pool 2 T-4	17	98	91	-7.0	2.0	2.0	0.0	188.8	182.3	-6.5	3.4%
Pool 3 T-1	17	62	55	-7.0	2.8	3.4	+0.6	167.7	166.8	-0.9	-0.5%
Pool 3 T-2	17	46	44	-2.0	2.9	3.0	+0.1	113.1	127.5	+14.4	+12.7%
Pool 3 T-3	17	48	53	+5.0	3.1	3.2	+0.1	159.3	160.5	+1.2	+0.8%
Pool 3 T-4	17	51	61	+10.0	3.7	3.5	-0.2	188.7	186.9	-1.8	-1.0%
Overall		**77.3**	**74.0**	**-3.3**	**2.4**	**2.4**	**0.0**	**167.9**	**161.5**	**-11.0**	**-3.8%**

Appendix H-8. **Average widths, depths and cross sectional areas for Riffle Transects measured in the Cloverdale Reach. Shaded areas represent transects where the average width, depth, or cross sectional area increased between the Pre and Post surveys.**

Transect	Change in flow (cfs)	Width			Depth			Cross section			
		Pre (ft)	Post (ft)	Difference (ft)	Pre (ft)	Post (ft)	Difference (ft)	Pre (ft^2)	Post (ft^2)	Difference (ft^2)	% Change
Riffle 1 T-1	17	142	152	+10.0	0.9	0.6	-0.3	102.6	66.3	-36.3	-35.4%
Riffle 1 T-2	17	181	179	-2.0	0.7	0.6	-0.1	49.8	40.8	-9.0	-18.1%
Riffle 2 T-1	17	81	80	-1.0	1.1	0.9	-0.2	80.4	68.1	-12.3	-15.3%
Riffle 2 T-3	17	39	38	-1.0	1.8	1.6	-0.2	66.3	57.3	-9.0	-13.6%
Riffle 3, T-2	17	65	58	-7.0	0.8	0.8	0.0	45.0	37.2	-7.8	-17.3%
Riffle 3 T-3	17	51	54	+3.0	1.2	1.1	-0.1	59.1	60.8	+1.7	+2.9%
Overall		**92.9**	**92.8**	**-0.1**	**1.1**	**0.9**	**-0.2**	**67.2**	**55.1**	**-12.1**	**-18.0%**

Appendix H-9. Average widths, depths and cross sectional areas for Flatwater Transects measured in the Cloverdale Reach. Shaded areas represent transects where the average width, depth, or cross sectional area increased between the Pre and Post surveys.

Transect	Change in flow (cfs)	Width			Depth			Cross section			
		Pre (ft)	Post (ft)	Difference (ft)	Pre (ft)	Post (ft)	Difference (ft)	Pre (ft^2)	Post (ft^2)	Difference (ft^2)	% Change
FW 1 T-1	17	84	80	-4.0	0.9	0.9	-0	79.5	64.5	-15.0	-18.9%
FW 1 T-2	17	73	73	-0.0	2.2	1.9	-0.3	147.3	134.4	-12.9	-8.8%
FW 1 T-3	17	129	123	-6.0	1.4	1.3	-0.1	171.9	159	-12.9	-7.5%
FW 2 T-1	17	51	55	+4.0	1.5	1.6	+0.1	83.4	85.2	+1.8	+2.2%
FW 2 T-2	17	67	70	+3.0	1.8	1.6	-0.2	116.1	111.6	-4.5	-3.9%
FW 2 T-3	17	54	62	+8.0	1.6	1.7	+0.1	90.0	98.4	+8.4	+9.3%
FW 3 T-1	17	116	109	-7.0	1.1	0.9	-0.2	120.9	93.9	-27.0	-22.3%
FW 3 T-2	17	132	130	-2.0	1.0	0.9	-0.1	127.2	120.9	-6.3	-5.0%
FW 3 T-3	17	116	112	-4.0	1.3	1.2	-0.1	151.5	123.3	-28.2	-18.6%
Overall		**91.3**	**90.4**	**-0.9**	**1.4**	**1.3**	**-0.1**	**120.9**	**110.1**	**-15.3**	**-8.9%**

Appendix H-10. Average widths, depths and cross sectional areas for Pool Transects measured in the Geyserville Reach. Shaded areas represent transects where the average width, depth, or cross sectional area increased between the Pre and Post surveys.

Transect	Change in flow (cfs)	Width			Depth			Cross section			
		Pre (ft)	Post (ft)	Difference (ft)	Pre (ft)	Post (ft)	Difference (ft)	Pre (ft^2)	Post (ft^2)	Difference (ft^2)	% Change
Pool 1 T-1	13	65.0	61.0	-4.0	2.3	2.5	+0.2	131.4	147	+15.6	+11.9%
Pool 1 T-2	13	63.0	65.0	+2.0	3.9	3.7	-0.2	235.2	217.2	-18.0	-7.7%
Pool 1 T-3	13	75.0	70.0	-5.0	2.8	3.0	+0.2	166.8	178.8	+12.0	+7.2%
Pool 1 T-4	13	84.0	79.0	-5.0	1.6	1.4	-0.2	132.9	108.0	-24.9	-18.7%
Pool 2 T-1	13	58.0	57.0	-1.0	2.8	2.5	-0.3	157.2	136.8	-20.4	-13.0%
Pool 2 T-2	13	73.0	74.0	+1.0	2.7	2.3	-0.4	183.9	156.0	-27.9	-15.2%
Pool 2 T-3	13	83.0	79.0	-4.0	1.8	1.7	-0.1	146.1	129.9	-16.2	-11.1%
Pool 2 T-4	13	84.0	83.0	-1.0	1.5	1.2	-0.3	127.5	104.1	-23.4	-18.4%
Pool 3 T-2	13	64.0	57.0	-7.0	3.6	3.4	-0.2	215.7	191.4	-24.3	-11.3%
Pool 3 T-3	13	63.0	64.0	+1.0	2.9	2.9	0.0	184.2	181.5	-2.7	-1.5%
Pool 3 T-4	13	67.0	60.0	-7.0	2.1	1.9	-0.2	138.6	107.4	-31.2	-22.5%
Overall		**70.8**	**68.1**	**-2.7**	**2.5**	**2.4**	**-0.1**	**165.4**	**150.7**	**-14.7**	**-8.9%**

Appendix H-11. Average widths, depths and cross sectional areas for Riffle Transects measured in the Geyserville Reach. Shaded areas represent transects where the average width, depth, or cross sectional area increased between the Pre and Post surveys.

Transect	Change in flow (cfs)	Width			Depth			Cross section			
		Pre (ft)	Post (ft)	Difference (ft)	Pre (ft)	Post (ft)	Difference (ft)	Pre (ft^2)	Post (ft^2)	Difference (ft^2)	% Change
Riffle 1 T-1	13	47	42	-5	0.9	0.7	-0.2	39.3	27	-12.3	-31.3%
Riffle 1 T-2	13	53	49	-4	1.0	0.8	-0.2	53.1	39.6	-13.5	-25.4%
Riffle 1 T-3	13	48	47	-1	1.4	0.9	-0.5	66.9	42.3	-24.6	-36.8%
Riffle 2 T-1	13	94	89	-5	0.6	0.5	-0.1	58.5	42.3	-16.2	-27.7%
Riffle 2 T-3	13	55	47	-8	0.9	0.8	-0.1	49.5	32.1	-17.4	-35.2%
Riffle 3 T-1	13	50	40	-10	0.8	0.7	-0.1	36.6	28.2	-8.4	-23.0%
Riffle 3 T-2	13	42	36	-6	1.3	1.1	-0.2	49.2	35.1	-14.1	-28.7%
Riffle 3 T-3	13	43	37	-6	1.3	1.2	-0.1	54	41.7	-12.3	-22.8%
Overall		**54.0**	**48.4**	**-5.6**	**1.0**	**0.8**	**-0.2**	**50.9**	**36.0**	**-14.9**	**-29.2%**

Appendix H-12. Average widths, depths and cross sectional areas for Flatwater Transects measured in the Geyserville Reach. Shaded areas represent transects where the average width, depth, or cross sectional area increased between the Pre and Post surveys.

Transect	Change in flow (cfs)	Width			Depth			Cross section			
		Pre (ft)	Post (ft)	Difference (ft)	Pre (ft)	Post (ft)	Difference (ft)	Pre (ft^2)	Post (ft^2)	Difference (ft^2)	% Change
FW 1 T-1	13	55	49	-6.0	2.4	2.0	-0.4	127.5	100.5	-27.0	-21.2%
FW 1 T-2	13	68	61	-7.0	1.7	1.4	-0.3	149.1	96.9	-52.2	-35.0%
FW 1 T-3	13	59	57	-2.0	1.7	1.4	-0.3	89.4	81.3	-8.1	-9.1%
FW 2 T-1	13	59	59	0.0	1.5	1.2	-0.3	75.9	66.9	-9.0	-11.9%
FW 2 T-2	13	63	63	0.0	2.0	1.8	-0.2	119.7	106.2	-13.5	-11.3%
FW 2 T-3	13	64	62	-2.0	2.0	1.8	-0.2	114.9	109.2	-5.7	-5.0%
FW 3 T-1	13	63.5	52	-11.5	1.4	1.6	+0.2	87.3	75.9	-11.4	-13.1%
Overall		**61.6**	**57.6**	**-4.0**	**1.8**	**1.6**	**-0.2**	**109.1**	**91.0**	**-18.1**	**-16.6%**

Appendix H-13. Average widths, depths and cross sectional areas for Pool Transects measured in the Diggers Bend Reach. Shaded areas represent transects where the average width, depth, or cross sectional area increased between the Pre and Post surveys.

Transect	Change in flow (cfs)	Width			Depth			Cross section			
		Pre (ft)	Post (ft)	Difference (ft)	Pre (ft)	Post (ft)	Difference (ft)	Pre (ft^2)	Post (ft^2)	Difference (ft^2)	% Change
Pool 1 T-1	74	54	54	0	2.5	2.5	-0.0	112.5	114.0	+1.5	+1.3%
Pool 1 T-2	74	68	66	-2	4.6	4.2	-0.4	261.0	223.2	-37.8	-14.5%
Pool 1 T-3	74	61	58	-3	4.9	4.6	-0.3	251.1	234.6	-16.5	-6.6%
Pool 1 T-4	74	73	67	-6	1.7	1.8	+0.1	125.1	121.8	-3.3	-2.6%
Pool 2 T-1	74	142	138	-4	6.0	6.0	-0.0	831.9	823.5	-8.4	-1.0%
Pool 2 T-2	74	143	139	-4	4.5	4.3	-0.2	607.8	594.6	-13.2	-2.2%
Pool 2 T-3	74	122	126	+4	8.7	8.8	+0.1	915.3	944.4	+29.1	+3.2%
Pool 3 T-1	74	75	68	-7	3.1	3.1	-0.0	229.2	184.5	-44.7	-19.5%
Pool 3 T-2	74	69	69	0	3.3	3.6	+0.3	189.9	200.4	+10.5	+5.5%
Pool 3 T-3	74	78	75	-3	3.6	2.9	-0.7	213.0	180.0	-33.0	-15.5%
Pool 3 T-4	74	85	89	+4	2.4	1.9	-0.5	194.4	164.7	-29.7	-15.3%
Overall		**88.2**	**86.3**	**-1.9**	**4.1**	**4.0**	**-0.1**	**357.4**	**344.2**	**-13.2**	**-6.1%**

Appendix H-14 Average widths, depths and cross sectional areas for Riffle Transects measured in the Diggers Bend Reach. Shaded areas represent transects where the average width, depth, or cross sectional area increased between the Pre and Post surveys.

Transect	Change in flow (cfs)	Width			Depth			Cross section			
		Pre (ft)	Post (ft)	Difference (ft)	Pre (ft)	Post (ft)	Difference (ft)	Pre (ft^2)	Post (ft^2)	Difference (ft^2)	% Change
Riffle 1 T-1	74	140.0	125.0	-15.0	0.6	0.4	-0.2	89.4	49.8	-39.6	-44.3%
Riffle 1 T-2	74	129.0	117.0	-12.0	0.8	0.5	-0.3	76.5	43.5	-33.0	-43.1%
Riffle 2 T-1	74	91.0	91.0	0.0	1.1	0.7	-0.4	95.7	63.3	-32.4	-33.9%
Riffle 2 T-2	74	106.0	92.0	-14.0	0.9	0.6	-0.3	94.8	59.1	-35.7	-37.7%
Riffle 2 T-3	74	94.0	87.0	-7.0	0.8	0.5	-0.3	78.0	40.8	-37.2	-47.7%
Riffle 3 T-1	74	55.0	47.5	-7.5	1.1	0.7	-0.4	51.6	29.7	-21.9	-42.4%
Riffle 3 T-2	74	56.0	53.0	-3.0	1.1	0.8	-0.3	60.9	40.8	-20.1	-33.0%
Riffle 3 T-3	74	59.0	56.0	-3.0	1.1	0.7	-0.4	60.0	39.3	-20.7	-34.5%
Overall		**91.3**	**83.6**	**-7.7**	**0.9**	**0.6**	**-0.3**	**75.9**	**45.8**	**-30.1**	**-39.6%**

Appendix H-15. Average widths, depths and cross sectional areas for Flatwater Transects measured in the Diggers Bend Reach. Shaded areas represent transects where the average width, depth, or cross sectional area increased between the Pre and Post surveys.

Transect	Change in flow (cfs)	Width			Depth			Cross section			
		Pre (ft)	Post (ft)	Difference (ft)	Pre (ft)	Post (ft)	Difference (ft)	Pre (ft^2)	Post (ft^2)	Difference (ft^2)	% Change
FW 1 T-1	74	58	51	-7.0	2	1.7	-0.3	111.3	86.4	-24.9	-22.4%
FW 1 T-2	74	58	52.5	-5.5	1.6	1.5	-0.1	92.7	78.9	-13.8	-14.9%
FW 1 T-3	74	68	62	-6.0	1.3	1.0	-0.3	88.8	61.8	-27.0	-30.4%
FW 2 T-1	74	79	78	-1.0	1.9	1.7	-0.2	150.6	124.2	-26.4	-17.5%
FW 2 T-2	74	65	62	-3.0	2.7	2.4	-0.3	169.2	146.4	-22.8	-13.5%
FW 2 T-3	74	75	72	-3.0	2.6	2.4	-0.2	188.4	162.9	-25.5	-13.5%
FW 3 T-1	74	113	113	0.0	2.2	1.9	-0.3	247.2	210.0	-37.2	-15.0%
FW 3 T-2	74	120	107	-13.0	1.9	1.7	-0.2	212.7	174.9	-37.8	-17.8%
FW 3 T-3	74	95	91	-4.0	2.0	1.7	-0.3	188.7	154.8	-33.9	-18.0%
Overall		**81.2**	**76.5**	**-4.7**	**2.0**	**1.8**	**-0.2**	**161.1**	**133.4**	**-27.7**	**-17.2%**

Appendix H-16. Average widths, depths and cross sectional areas for Pool Transects measured in the Healdsburg Reach. Shaded areas represent transects where the average width, depth, or cross sectional area increased between the Pre and Post surveys.

Transect	Change in flow (cfs)	Width			Depth			Cross section			
		Pre (ft)	Post (ft)	Difference (ft)	Pre (ft)	Post (ft)	Difference (ft)	Pre (ft^2)	Post (ft^2)	Difference (ft^2)	% Change
Pool 1 T-1	69	86	84	-2	2.8	2.1	-0.7	219.3	172.5	46.8	-21.3%
Pool 1 T-2	69	117	109	-8	3.5	3.4	-0.1	396.6	361.8	34.8	-8.8%
Pool 1 T-3	69	91	92	1	6.1	6.0	-0.1	534.0	536.1	2.1	0.4%
Pool 1 T-4	69	120	115	-5	2.9	2.6	-0.3	336.3	297.0	39.3	-11.7%
Pool 2 T-3	69	78	79.5	1.5	3.8	3.3	-0.5	282.9	253.5	29.4	-10.4%
Pool 2 T-4	69	79	78	-1	2.3	1.9	-0.4	175.5	144.3	31.2	-17.8%
Pool 3 T-1	69	134	124	-10	1.6	1.4	-0.2	206.4	172.2	34.2	-16.6%
Pool 3 T-2	69	105	96	-9	2.0	1.7	-0.3	227.4	160.8	66.6	-29.3%
Pool 3 T-3	69	94	90	-4	2.0	1.9	-0.1	190.5	173.7	16.8	-8.8%
Pool 3 T-4	69	125	114	-11	1.7	1.7	0.0	211.8	195.9	15.9	-7.5%
Overall		**102.9**	**98.2**	**-4.8**	**2.9**	**2.6**	**-0.3**	**278.1**	**246.8**	**31.3**	**-13.2%**

Appendix H-17. Average widths, depths and cross sectional areas for Riffle Transects measured in the Healdsburg Reach. Shaded areas represent transects where the average width, depth, or cross sectional area increased between the Pre and Post surveys.

Transect	Change in flow (cfs)		Width				Depth				Cross section			
			Pre (ft)	Post (ft)	Difference (ft)		Pre (ft)	Post (ft)	Difference (ft)		Pre (ft^2)	Post (ft^2)	Difference (ft^2)	% Change
Riffle 1 T-1	69		46	40	-6		1.3	1.0	-0.3		58.5	32.4	-26.1	-44.6%
Riffle 1 T-2	69		42	41	-1		1.1	1.1	-0.1		51.6	41.7	-9.9	-19.2%
Riffle 1 T-3	69		50	43	-7		1.1	0.8	-0.3		51.6	33.6	-18	-34.9%
Riffle 2 T-1	69		50	49	-1		1.1	0.7	-0.4		54.0	32.7	-21.3	-39.4%
Riffle 2 T-2	69		48	42	-6		1.2	0.9	-0.4		60.0	36.0	-24	-40.0%
Overall			**47.2**	**43**	**-4.2**		**1.2**	**0.9**	**-0.3**		**55.1**	**35.3**	**-19.9**	**-36.0%**

Appendix H-18. Average widths, depths and cross sectional areas for Flatwater Transects measured in the Healdsburg Reach. Shaded areas represent transects where the average width, depth, or cross sectional area increased between the Pre and Post surveys.

Transect	Change in flow (cfs)		Width				Depth				Cross section			
			Pre (ft)	Post (ft)	Difference (ft)		Pre (ft)	Post (ft)	Difference (ft)		Pre (ft^2)	Post (ft^2)	Difference (ft^2)	% Change
FW 1 T-1	69		73	72	-1		1.5	1.1	-0.4		108.0	77.4	-30.6	-28.3%
FW 1 T-2	69		73	68	-5		1.5	1.0	-0.5		94.5	63.3	-31.2	-33.0%
FW 1 T-3	69		89	87	-2		1.1	0.8	-0.3		111.0	72.9	-38.1	-34.3%
FW 2 T-1	69		106	106	0		0.9	0.6	-0.2		92.4	66.3	-26.1	-28.2%
FW 2 T-2	69		78	69	-9		1.1	0.8	-0.3		138.0	104.4	-33.6	-24.3%
FW 3 T-1	69		64	65	+1		1.3	1.3	0.0		79.2	82.8	+3.6	+4.5%
FW 3 T-2	69		55	53	-2		1.3	1.0	-0.3		69.3	51.3	-18.0	-26.0%
FW 3 T-3	69		53	48	-5		1.2	1.0	-0.2		63.0	45.9	-17.1	-27.1%
Overall			**73.9**	**71.0**	**-2.9**		**1.2**	**0.9**	**-0.3**		**94.4**	**70.5**	**-23.9**	**-24.6%**

Appendix H-19. Average widths, depths and cross sectional areas for Pool Transects measured in the Below Dry Creek Reach. Shaded areas represent transects where the average width, depth, or cross sectional area increased between the Pre and Post surveys.

Transect	Change in flow (cfs) Before		Width				Depth				Cross section			
			Pre (ft)	Post (ft)	Difference (ft)		Pre (ft)	Post (ft)	Difference (ft)		Pre (ft^2)	Post (ft^2)	Difference (ft^2)	% Change
Pool 1 T-1	41		55	51	-4		3.1	3.3	+0.2		157	158	+1.0	+0.6%
Pool 1 T-2	41		67	60	-7		5.1	4.8	-0.3		289	276	-13.0	-4.5%
Pool 1 T-3	41		66	66	0		3.7	3.3	-0.4		244	217	-27.0	-11.1%
Pool 2 T-1	52		72	63	-9		2.1	2.4	+0.3		124	153	+29.0	+23.4%
Pool 2 T-2	52		72	72	0		2.7	2.5	-0.2		185	171	-14	-7.6%
Pool 2 T-3	52		67	69	+2		4.0	3.6	-0.4		264	250	-14	-5.3%
Pool 2 T-4	52		75	70	-5		2.1	2.1	0.0		156	148.0	-8.0	-5.1%
Pool 3 T-1	52		80	82	+2		3.3	3.4	+0.1		239	260	+21	+8.8%
Pool 3 T-2	52		96	94	-2		4.6	4.5	-0.1		375	365	-10	-2.7%
Overall			**71.9**	**69.6**	**-2.3**		**3.6**	**3.5**	**-0.1**		**234.6**	**231.3**	**-3.4**	**-0.2%**

Appendix H-20. Average widths, depths and cross sectional areas for Riffle Transects measured in the Below Dry Creek Reach. Shaded areas represent transects where the average width, depth, or cross sectional area increased between the Pre and Post surveys.

Transect	Change in flow (cfs)		Width				Depth				Cross section			
	Before		Pre (ft)	Post (ft)	Difference (ft)		Pre (ft)	Post (ft)	Difference (ft)		Pre (ft^2)	Post (ft^2)	Difference (ft^2)	% Change
R1, T-1	72		72	67	-5		1.2	0.9	-0.3		85.0	59.0	-26	-30.6%
R1, T-2	72		75	71	-4		1.1	0.9	-0.2		80.4	63.6	-16.8	-20.9%
R1, T-3	72		77	73	-4		1.3	1.1	-0.2		90.0	80.0	-10.0	-11.1%
R2, T-2	36		86	80	-6		0.9	0.9	0.0		76.0	72.0	-4.0	-5.3%
R3, T-2	5		83	64	-19		0.8	1.0	+0.2		66.0	61.0	-5.0	-7.6%
R3, T-3	5		82	79	-3		0.9	0.9	0.0		74.0	67.0	-7.0	-9.5%
Overall[1]			**74.7**	**70.3**	**-4.3**		**1.2**	**1.0**	**-0.2**		**85.1**	**67.5**	**-17.6**	**-20.7%**

[1]Includes data from Riffle 1, only

Appendix H-21. Average widths, depths and cross sectional areas for Flatwater Transects measured in the Below Dry Creek Reach. Shaded areas represent transects where the average width, depth, or cross sectional area increased between the Pre and Post surveys.

Transect	Change in flow (cfs)		Width				Depth				Cross section			
	Before		Pre (ft)	Post (ft)	Difference (ft)		Pre (ft)	Post (ft)	Difference (ft)		Pre (ft^2)	Post (ft^2)	Difference (ft^2)	% Change
FW 1, T-1	72		92	85	-7		1.1	0.9	-0.2		99.0	78.0	-21.0	-21.2%
FW 1, T-2	72		117	108	-9		1.4	1.2	-0.2		162.0	138.0	-24.0	-14.8%
FW 1, T-3	72		82	81	-1		2.3	2.1	-0.2		187.0	167.0	-20.0	-10.7%
FW 2, T-1	72		72	68	-4		2.0	1.8	-0.2		131.0	122.0	-9.0	-6.9%
FW 2, T-2	72		71	68	-3		2.3	2.2	-0.1		162.0	145.0	-17.0	-10.5%
FW 2, T-3	72		71	69	-2		1.8	1.8	0.0		125.0	121.0	-4.0	-3.2%
FW 3, T-1	5		48	46	-2		2.1	1.9	-0.2		95.4	90.6	-4.8	-5.0%
FW 3, T-2	5		62	56	-6		1.8	1.7	-0.1		108.0	94.0	-14.0	-13.0%
FW 3, T-3	5		68	60	-8		2.0	1.7	-0.3		129.0	104.0	-25.0	-19.4%
Overall[1]			**84.2**	**79.8**	**-4.4**		**1.8**	**1.7**	**-0.1**		**144.3**	**128.5**	**-15.8**	**-11.0%**

[1]Includes data from Flatwater 1 and 2, only

Appendix I. List of transects excluded from analysis[1].

Reach	Transect excluded
Ukiah	Pool 2 – Transect 1 Pool 3 – Transect 1 Riffle 1 Transect 1 Riffle 1 Transect 2 Flatwater 1 Transect 1 Flatwater 1 – Transect 2
Comminsky Station	Pool 2 – Transect 1 Pool 2 – Transect 3 Flatwater 1 Transect 3
Cloverdale	Riffle 2 – Transect 2 Riffle 3 – Transect 1
Geyserville	Pool 3 – Transect 1 Riffle 2 – Transect 2 Flatwater 3 – Transect 2 Flatwater 3 – Transect 3
Diggers Bend	All used
Healdsburg	Pool 2 – Transect 1 Pool 2 – Transect 2 Riffle 1 – Transect 1 Riffle 1 – Transect 2 Riffle 1 – Transect 3 Flatwater 2 – Transect 3
Below Dry Creek	Pool 3 – Transect 3 Pool 3 Transect 4 Riffle 2 – Transect 1 Riffle 3 – Transect 1

[1]Physical habitat variables measured at each transect during the Pre and Post flow reduction surveys were compared. In cases where the contours (cross sections) clearly did not match, we excluded the data from the analysis. As stated in the report, GPS coordinates were collected at each transect, and each transect was marked with flagging. However, at some stations, the flagging was removed, and at other stations GPS coordinates were insufficient to exactly replicate some transects.

Appendix B-9

Summary Results of Water Quality Monitoring to Meet State Water Resources Control Board Order WR 2009 – 0034 EXEC

Sonoma County Water Agency
Temperature and Water Quality Monitoring Summary Report
For the Russian River during April – October 2009

Background

A Temperature and Water Quality Monitoring Plan was submitted in accordance with State Water Resources Control Board (State Board) Division of Water Rights Order WR 2009-0027-DWR (Order), approving a Temporary Urgency Change in Permits 12947A, 12949, 12950, and 16596 for Sonoma County Water Agency (Agency). Provision 8 of the Order required the Agency to prepare a Temperature Monitoring Plan and Provision 9 required the Agency to prepare a Water Quality Monitoring Plan for the Russian River and Lake Mendocino. On April 20, 2009, the Agency submitted a plan to meet the requirements of Order WR 2009-0027-DWR. Following public comment during a public workshop on May 6, 2009 and comments relative to the original plan, the State Board asked the Agency to revise the plan following consultation with the North Coast Regional Water Quality Control Board (NCRWQCB), NOAA National Marine Fisheries Service (NMFS) and the California Department of Fish and Game (DFG).

On May 14, 2009, the Agency consulted with staff from the County of Sonoma – Health Services Environmental Health Division (DEH), NCRWQCB, NMFS, DFG with staff from the State Board and DFG also present via teleconference. The review of comments received and consultation with all parties noted above resulted in a revised sampling and monitoring plan. The monitoring plan, deviations and results are summarized in this report.

Summary

The monitoring plan incorporated the use of both permanent and seasonal instrumentation to collect real time water quality information. The monitoring plan also included the evaluation of water quality through sampling and analysis for public health guidance and overall water quality conditions.

Real time water quality data (pH, temperature, dissolved oxygen content, specific conductivity, turbidity, and depth) was monitored at 16 locations along the Russian River using YSI Sondes. In addition, over 300 bacteriological samples (total coliform, *E. coli* and Enterococcus) and 130 nutrient samples (Ammonia-N; Nitrate-N; Total Organic Nitrogen; Total Phosphorous; and chlorophyll-a) were collected between May 28 and October 2 at the same locations. Monitoring results were posted to the Agency website as soon as the results were received. A summary of the monitoring results has been compiled into a electronic data matrix for submittal to the SWRCB, NCRWQCB and DEH. The matrix will also be available electronically via the Agency's website.

The 2009 sampling locations are shown in Attachment A and a detailed summary of the sampling program is provided as Attachment B.

Permanent and Seasonal Realtime Water Quality Monitoring

In coordination with the United States Geological Survey (USGS) the Agency maintains five multi-parameter YSI water quality Sondes on the Russian River located at Hopland, Diggers Bend in Healdsburg, the Agencies river diversion facility (RDS) at Mirabel, Hacienda Bridge and Johnson's Beach. These five Sondes are referred to as "permanent" as the Agency maintains them as part of its early warning detection system. The Sondes measure and record real time readings of water pH, temperature, dissolved oxygen content (DO), specific conductivity, turbidity, and depth, every 15 minutes and transmit the raw data via telemetry to the Agencies operations center. In addition, the Hopland, Diggers Bend and Hacienda Beach data is provided by the USGS on its "Real-time Data for California" website. During the time period of the Order the Agency offered an "email subscription" to the public if they wished to receive the data via email.

In addition to the permanent Sondes, the Agency seasonally deploys Sondes at various locations within the watershed. This year the Agency in cooperation with the USGS installed seasonal Sondes with real-time telemetry at the USGS river gage station north of Cloverdale at Commisky Station Road and at a new gage station at the Alexander Valley Road Bridge (aka near Jimtown). The Sonde at the new Riverfront Park gage could not be located in an acceptable location to transmit real-time data, consequently, Agency staff retrieved the electronic data approximately weekly . The Alexander Valley Road Bridge Sonde had problems with the turbidity sensor and the USGS determined that the turbidity data was not acceptable to be released. The Agency would like to recognize the USGS for its outstanding efforts in installing and maintaining the Sondes at Cloverdale and Alexander Valley Road Bridge. These Sondes were not part of their projected workload and the Agency realizes that they were heavily burdened with ongoing activities in many other coastal watersheds.

In coordination with the NCRWQCB the Agency deployed seasonal Sondes in the upper reach of the Russian River below Coyote Dam. The Sondes were deployed in the east fork of the Russian River below the Lake Mendocino outfall and just below the confluence of the east and west forks of the Russian River. The Sondes required kayaking the river to deploy and collect data, thus the data was collected approximately every three weeks.

As part of its estuary monitoring program the Agency installs seasonal Sondes in the lower portion of the Russian River below Duncans Mills. Sondes were deployed at Freezeout Creek, Heron Rookery, Sheephouse Creek, Bridgehaven, Patty's Rock and at the mouth of the Russian River at Jenner. These sondes collected water pH, temperature, DO, specific conductivity, salinity, and depth, every hour. Monitoring at these locations is performed at more than one depth. Usually a surface location of approximately 1 meter in depth and a second at approximatley 3 – 6 meters in depth.

Water Quality Sampling

The NCRWQCB in cooperation with the DEH conducts seasonal bacteriological and general water quality sampling at Russian River beaches which experience the greatest body contact recreation. To support the NCRWQCB, the Agency supplemented the seasonal program with an extensive bacteriological and nutrient sampling program.

The NCRWQCB seasonal sampling locations consist of: Camp Rose; Memorial Beach; Steelhead Beach; Forestville Access Beach; Johnson's Beach; and Monte Rio Beach. In addition to the seasonal sampling locations noted above, the Agency conducted supplemental weekly bacteriological sampling at: the Russian River near Commisky Station Road (Mendocino County); Cloverdale River Park; Geyserville Hwy 128 bridge; Alexander Valley Road bridge; and at Hacienda Bridge. These locations were selected as additional public recreational sites in consultation with NCRWQCB, NMF's DEH and DFG. During the course of the sampling program the Hacienda Bridge site was relocated to the newly opened Sunset Beach River Park, which is just downstream. Over 300 bacteriological samples were collected and analyzed between May 28 and October 2, 2009. The samples were analyzed by the Sonoma County Public Health Laboratory using the Colilert-18 quantitray MPN method for total coliform and *E. coli* and the Enterolert quantitray method for Enterococcus. Daily sampling was conducted following an acute exceedance of the California Department of Health Services – Draft Guidance for Fresh Water Beaches and continued until a "less than" result was confirmed or weekend laboratory staffing could not be coordinated within the required holding time. Agency staff collecting water quality samples also performed photo documentation and recorded observations during each weekly sampling event.

Both the seasonal and supplemental bacteriological monitoring programs experienced numerically low acute exceedances of the Enterococcus draft guidance limits both before and during "low-flows". These exceedances while often just over the draft guidance limits required DEH to post beaches with unsafe for swimming or recreational use warnings. Staff at DEH, the NCRWQCB and the Agency responded to numerous calls from the general public during these episodes. Conclusions or correlations relative to the Enterococcus exceedances is difficult to undertake given the extreme variability of the river system, weather patterns and recreational use. In contrast there were very few total coliform and *E. coli* exceedances experienced during the same period. Agency, DEH and NCRWQCB staff will be discussing future bacteriological sampling programs and the necessity to analyze for all three bacteriological indicators.

In addition to the bacteriological sampling and in consultation with the NCRWQCB, NMFS and DFG, the Agency collected water samples for nutrient analysis at the following locations: Lake Mendocino outfall; Russian River near Commisky Station Road (aka Russian R NR Cloverdale); Alexander Valley Road bridge; Healdsburg Veterans Memorial Beach; Hacienda bridge; and Monte Rio Beach. Water samples were collected weekly and analyzed for: Ammonia-N; Nitrate-N; Total Organic Nitrogen; and Total Phosphorous. In addition, chlorophyll-a was analyzed for all stations except the Lake Mendocino outfall. Results from the nutrient analysis indicated that there was no elevated concentration of nutrients during the monitoring period and in almost all instances results were below method detection limits.

The Agency also conducted a separate but related estuary bacteriological and nutrient sampling program. Agency staff collected bacteriological and nutrient samples once every three weeks at three locations in the estuary: (1) Freezeout Creek below Duncans Mills; (2) Bridgehaven; and (3) River mouth at Jenner. Similar to the previously described bacteriological and nutrient constituents the estuary samples were analyzed for total coliform and *E.* coli using the Colilert-18 quantitray MPN method and Enterococcus using the Enterolert quantitray method. Nutrients analyzed were consistent as described previously. Bacteriological monitoring in the estuary was not meant to supplement the NCRWQCB and DEH seasonal sampling program nor to consider results relative to the draft DPH guidance but rather to provide data more informational in nature.

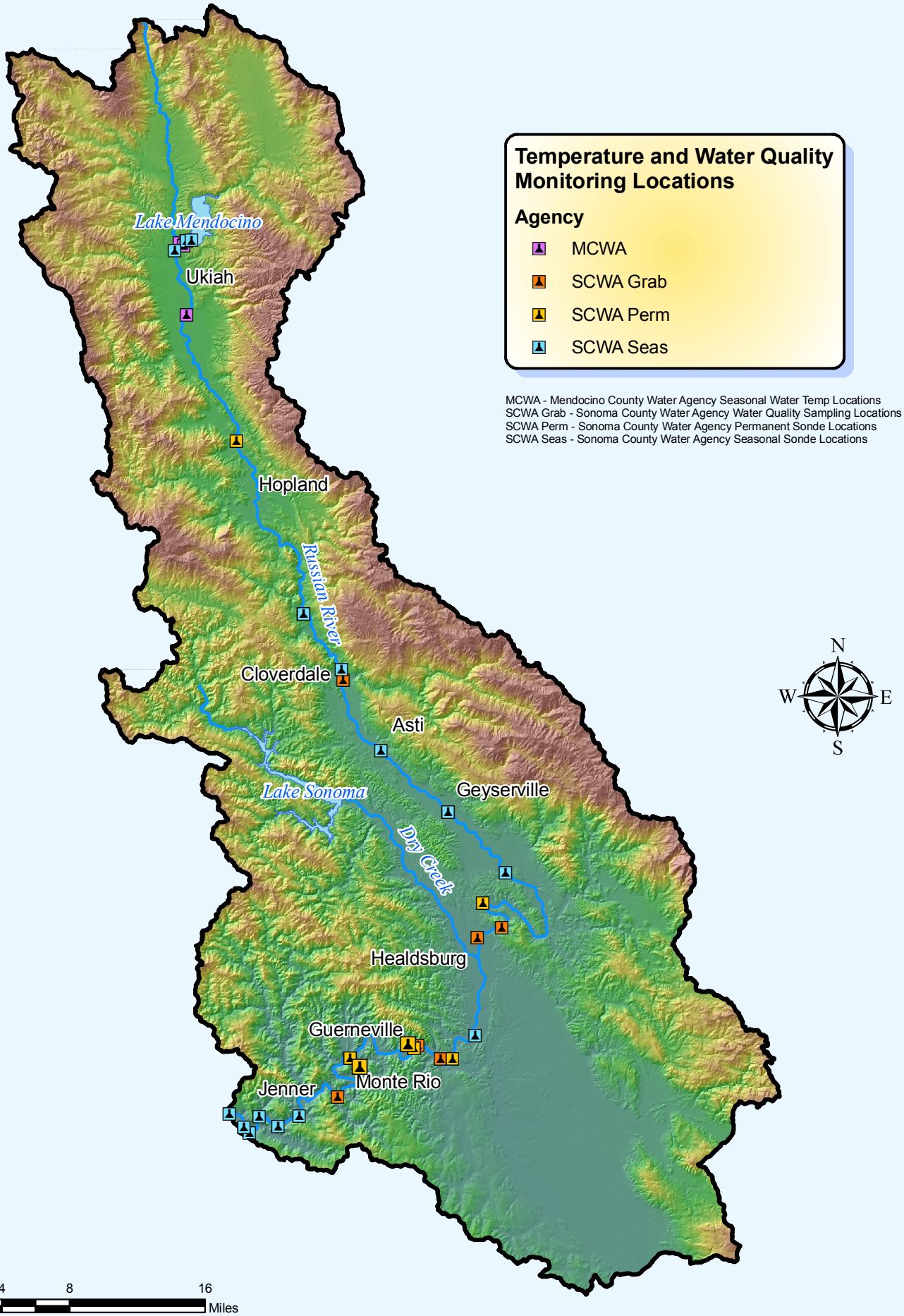
The NCRWQCB and the Agency also collaborated on vertical profiling of Lake Mendocino for temperature and dissolved oxygen at or near the tower structure. The profiling was conducted on a monthly basis and alternated between Agency and NCRWQCB staff.

Sonoma and Mendocino County Water Agency Seasonal Water Temperature Collection

In addition to temperature data collected by the Sondes, the Agency deployed seasonal water temperature sensors at Preston, Asti and Geyserville. In addition, the Mendocino County Water Agency (MCWA) deployed seasonal water temperature sensors at numerous locations throughout the watershed. In the Russian River they deployed sensors in several locations including the East Fork of the Russian River below Coyote Dam, in the West Fork of the Russian River below Lake Mendocino Drive, in the Russian River at Talmage Road and in the Russian River at Commisky Station Road. The MCWA has provided the raw data to the Agency and it is included in the electronic matrix.

Reporting

Upon receiving the bacteriological results the Agency updated its website with the newest data. Laboratory results from the nutrient and chlorophyll-a sampling were also posted on the Agencies website upon receipt of the written laboratory report. Links to online stream gage and Sonde data were also included on the Agencies website Per the Order a written report will be submitted to the NCRWQCB and DEH summarizing all collected data by the end of December.



2009 Temporary Urgency Change Order

Russian River Watershed, CA

Attachment A

SONOMA COUNTY WATER AGENCY

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Attachment B

Summary of Water Quality and Temperature Monitoring

Instrument or sensor based sampling

Location	depth	temperature	DO	pH	turbidity	specific conductance	salinity	sampling frequency	telemtry?	duration
SCWA Permanent and Seasonal Sonde YSI Water Quality Samplers										
Lake Mendocino Outfall	x	x	x	x		x	x	1 hour	n	May - Oct
Westfork Confluence***	x	x	x	x		x	x	1 hour	n	upon install - Oct
Hopland USGS site	x	x	x	x	x	x		15 min	y	permanent
RR near Cloverdale USGS site*	x	x	x	x	x	x		15 min	y	upon install - Oct
Alexander Valley Road Bridge*	x	x	x	x	x	x		15 min	y	upon install - Oct
Digger's Bend	x	x	x	x	x	x		15 min	y	permanent
Riverfront Park*	x	x	x	x	x	x		15 min	y	upon install - Oct
Mirabel (SCWA RDS Facility)	x	x	x	x	x	x		15 min	y	permanent
Hacienda Bridge	x	x	x	x	x	x		15 min	y	permanent
Johnson's Beach	x	x	x	x	x	x		15 min	y	permanent
Freezeout Creek	x	x	x	x		x	x	1 hour	n	April - Dec**
Heron Rookery	x	x	x	x		x	x	1 hour	n	April - Dec**
Sheephouse Creek	x	x	x	x		x	x	1 hour	n	April - Dec**
Bridgehaven	x	x	x	x		x	x	1 hour	n	May - Dec**
Patty's Rock	x	x	x	x		x	x	1 hour	n	April - Dec**
Mouth @ Jenner	x	x	x	x		x	x	1 hour	n	April - Dec**

***sondes at RR near Cloverdale, Alexander Valley Road Bridge and Riverfront Park are pending USGS installations**
****Dec removal is storm and high river dependant**
***** sonde at Westfork confluence is pending site access**

SCWA Seasonal water temp locations										
Preston		x						15 min	n	June - Oct
Asti		x						15 min	n	June - Oct
Geyserville		x						15 min	n	June - Oct

MCWA Seasonal water temp locations										
EF Russian River below dam		x						90 min	n	June - Oct
WF Russian River		x						90 min	n	June - Oct
Russian River at Talmage Rd		x						90 min	n	June - Oct
Russian River at Commisky		x						90 min	n	June - Oct

Grab Sampling Program

Location	total coliform / *E. coli*	enterococcus	chlorophyll-a	temperature	DO	pH	turbidity	nutrients*	conductivity	Duration
SCWA Urgency Change Order Bacterialogical, Nutrient and Water Quality Grab Sampling										
Lake Mendocino Outfall								x		May 28 - Oct 1
RR near Cloverdale USGS site	x	x	x	x	x			x		May 28 - Oct 1
Cloverdale River Park	x	x		x	x					May 28 - Oct 1
Geyserville Hwy 128 Bridge	x	x		x	x					May 28 - Oct 1
Alexander Valley Road Bridge	x	x	x	x	x			x		May 28 - Oct 1
Camp Rose Rd. (Fitch Mountain)**	x	x		x	x					May 28 - Oct 1
Healdsburg Veterans Memorial Beach**	x	x	x	x	x			x		May 28 - Oct 1
Steelhead Beach**	x	x		x	x					May 28 - Oct 1
Forestville Access Beach**	x	x		x	x					May 28 - Oct 1
Hacienda Bridge	x	x	x	x	x			x		May 28 - Oct 1
Johnson's Beach**	x	x	x	x	x			x		May 28 - Oct 1
Monte Rio Beach (multiple sites)**	x	x		x	x					May 28 - Oct 1

***nutrients include Ammonia-N, Nitrate-N, Total Organic Nitrogen, Total Phosphorous**
Note - SCWA samples Thursday weekly following Memorial Day until end of Order, daily sampling will follow acute exceedance of the California Department of Health Services - Draft Guidance for Fresh Water Beaches
****The NCRWQCB and Sonoma County Environmental Health Department conduct seasonal bacterialogical sampling at these locations weekly from the Tuesday following Memorial Day until the Tuesday following Labor Day**

SCWA Seasonal Estuary bacterial and nutrient grab sampling										
Freezeout Creek (below Duncans Mills)	x	x	x	x	x			x		June - Oct
Bridgehaven	x	x	x	x	x			x		June - Oct
Mouth @ Jenner	x	x	x	x	x			x		June - Oct

Note - SCWA samples once every three weeks for nutrients and total / *E. coli* and Enterococcus

SCWA/NCRWQCB Vertical Temperature Profiles										
Lake Mendocino (2-4 locations)				x	x	x			x	May - September

Note - SCWA and NCRWQCB alternate conducting monthly vertical temperature profiles

Appendix B-10

Plans and Results of Water conservation requirements for Order WR 2009-034_EXEC

State Water Resources Control Board
Order WR 2009-0034-EXEC

Term 16 Water Conservation Status Report

December 31, 2009

Prepared by

Sonoma County Water Agency
404 Aviation Blvd
Santa Rosa, CA 95403

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1 Introduction and Purpose

This report has been prepared by the Sonoma County Water Agency (Agency) to fulfill the requirements of Term 16 of the State Water Resources Control Board (State Board) Order WR 2009-0034 EXEC (Order).

Term 16 of this order directs the Agency to take the following actions:

> SCWA shall prepare a Water Conservation Status Report for SCWA's service area and other areas served by Lake Mendocino. The report shall specify the water conservation measures being implemented in the areas served by Lake Mendocino and shall specify the water savings resulting from the measures during the term of this temporary urgency change. The report shall be submitted to the Deputy Director by December 31, 2009. The scope and content of the report shall be similar to the report submitted to comply with WR Order 2007-0022.

This Water Conservation Status Report is filed by the Agency in response to Term 16. The information contained in this report has been provided to the Agency by its customers and contractors.

1.1 Background on the 2009 Temporary Urgency Change Petition

During the spring of 2009, Agency hydrologic analysis indicated that projections for Lake Mendocino water levels in 2009 were far worse than they were in water year 2007, which was the last time the State Board approved a temporary urgency change reducing the Russian River instream flow requirements. As of April 1, 2009, storage levels in Lake Mendocino were approximately 53,000 acre-feet (AF), roughly 20,000 AF less than in 2007. During water years 2002, 2004 and 2007, hydrologic conditions in the Eel and Russian River watersheds caused Lake Mendocino storage levels to decline to dangerously low levels by the end of the dry season. Recreation at Lake Mendocino was severely impaired, and serious risks existed for water supply and state and federally listed Russian River salmonid fishery resources, particularly adult Chinook salmon.

In June 2004, the Federal Energy Regulatory Commission (FERC) directed Pacific Gas & Electric Company (PG&E) to reduce the amount of water diverted through its Potter Valley Project (PVP) tunnel into the Russian River, further reducing flow to Lake Mendocino. Between water year 2007 and water year 2009, approximately 24,000 AF less water flowed through the PVP tunnel and into Lake Mendocino

Without the requested reductions in the instream flow requirements, Agency hydrologic analysis predicted that Lake Mendocino storage would drop to 10,000 AF by mid-August 2009 and go dry by the end of September.

In 1986, when Decision 1610 was adopted, the State Board recognized that conditions could change and expressly reserved jurisdiction to modify the minimum flow requirements in the Agency's water-rights permits. Since 1986, PVP diversions have decreased, demands on the Russian River system have increased, and three fish species have been listed as threatened or endangered under the federal Endangered Species Act. Additionally, the evidence from water years 2002, 2004 and 2007 demonstrates that reductions in the minimum instream flow requirements can preserve water in storage to protect the Chinook salmon during migration and spawning, while still maintaining recreational values and water quality in the Russian River.

The report filed by the Agency with its April 6, 2009 temporary urgency change petition provided the information upon which the Agency based its decision to file the petition with the State Board to temporarily reduce the instream flow requirements in the mainstem Russian River. The Agency's petition requested that minimum flows from the Russian River be established based on dry year criteria for the period from April 6, 2009 to October 2, 2009 and critical year criteria for the period from July 1 to October 2, 2009 in the event that storage in Lake Mendocino was below 65,630 AF as of July 1, 2009. No changes to the instream flow requirements for Dry Creek were requested.

2 State Board Order Requirements for 2009

On April 6, 2009, Victoria A. Whitney, SWRCB Chief, Division of Water Rights, issued Order WR 2009-0027, which granted the Agency's petition, subject to terms and conditions. After a workshop and public comment, on May 28, 2009 an amended order (WR 2009-0034 EXEC) was issued by State Board Member Arthur G. Baggett, Jr., which modified some of the terms and conditions.

As stated in the introduction of this report, Term 16 of the order directs the Agency to prepare a water conservation status report specifying "the water conservation measures being implemented in the areas served by Lake Mendocino and shall specify the water savings resulting from the measures during the term of this temporary urgency change." However, several other terms of the order have had a direct effect on water conservation efforts. These other terms are briefly discussed in the following paragraphs.

2.1 Term 12: Twenty-five Percent Reduction in Russian River Diversions

Term 12 of the amended order required that the Agency reduce its diversions from the Russian River at its Wohler-Mirabel facilities by 25 percent from June 15, 2009 until expiration of the order on October 2, 2009. This reduction would be calculated based on the actual diversion in 2009 as compared to the actual diversion from June 15, 2004 through October 2, 2004. The Agency's actual Russian River diversions at its Wohler- Mirabel facilities were approximately 35% lower during this period of 2009 than during the corresponding period of 2004, more than meeting the requirements of Term 12. The reduced diversion of Russian River water, however, has resulted in a loss in revenue to the Agency of approximately $2.6 million dollars relative to the Agency's budget, hampering the ability of the Agency to fully fund water conservation, water resource planning, and reliability programs.

2.2 Term 13: Irrigation Ban on Commercial Turf Grass

Term 13 required the Agency to prohibit irrigation of commercial turf grass within the Agency's service area from June 15, 2009 through October 2, 2009, unless irrigation was managed in conformance with a water budget designed to achieve the maximum applied water allowance (MAWA) using a factor of 75% of ETo. This term did not apply to commercial turf irrigated exclusively with recycled water.

2.3 Term 15: Plan to Obtain Cooperation and Participation of Agriculture and Municipal Water Users

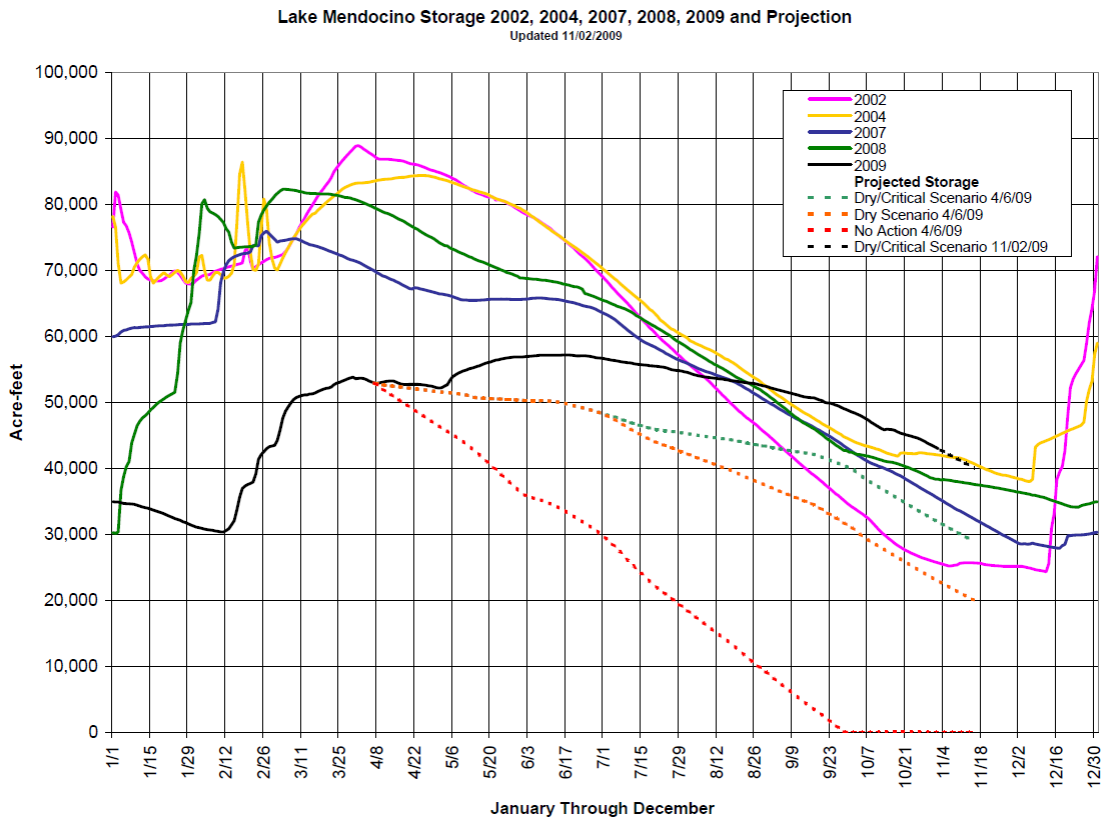
Term 15 of this order required the Agency to submit a plan to the State Board to obtain the cooperation and participation of agricultural and municipal Russian River water users to reach a water conservation goal of 25 percent in Sonoma County and 50 percent in Mendocino County. That plan was submitted to the State Board on May 6, 2009. The Agency also filed four monthly progress reports with the State Board on July 15, August 15, September 15, and October 19, 2009.

3 Water Conservation Status Summary

Order WR 2009-0034-EXEC and its implementation were beneficial, and Lake Mendocino storage never dropped below 30,375 AF. Although the overall water usage reduction goals of 25% in Sonoma County and 50% reduction in Mendocino were not met, the Agency more than achieved the Term 12 25% diversion reduction requirement. Without the order, the Agency would have had to release significant amounts of additional water from Lake Mendocino to meet minimum flow requirements and, as a result, less water would have been retained in Lake

Mendocino to be available for fisheries purposes during November and December 2009. As Figure 1 shows , the authorized change in flow requirements, the early May and October rainfall, together with the reductions in diversions by other Russian River diverters, resulted in an October 3, 2009 Lake Mendocino storage of 45,459 AF.

Figure 1. Lake Mendocino Storage and Total Diversion Reductions



4 Agency Public Outreach Measures

Since adoption of Order WR 2009-0034-EXEC, the Agency has increased its efforts to assist its retail customers with their water conservation and water waste reduction programs. The Agency coordinated and hosted monthly water conservation meetings for water conservation representatives from Marin, Sonoma, and Mendocino Counties.

The Agency and its retail contractors, including the cities of Santa Rosa, Windsor, Rohnert Park, Cotati, Petaluma, Sonoma and the Valley of the Moon and North Marin Water

Districts, as well as Upper Russian River Water Districts participated in the statewide "Save Our Water" conservation campaign this year. The campaign educates Californians about ongoing local and statewide water supply challenges and promotes conservation through public service announcements, educational outreach, and a comprehensive Web site. Local advertisements feature a variety of outdoor water conservation tips and ask residents to reduce their water use by 25 percent. The campaign is organized by the California Department of Water Resources and the Association of California Water Agencies, and supported by Governor Schwarzenegger. The advertisements are running on local radio stations, banners in local malls and transit buses, along with a movie theater trailer playing in local theaters. To view the ads, visit www.sonomacountywater.org. Additional information about the "Save Our Water" campaign can be found at www.saveourh2o.org.

In addition, there has been a substantial amount of local press coverage, which helps keep the water shortage emergency a priority for the residents and businesses in the three counties (see http://www.scwa.ca.gov/news).

To help get the word out regionally about the State Board requirements and relevant current events, the Agency developed a dedicated "2009 State Board Order" link on the Agency website. The 2009 State Board Order webpage contains the State Board documents (Orders, meeting and workshop notices), Agency documents/presentations (water quality and temperature monitoring, fishery and water conservation plans, staff presentations and letters) and Russian River water quality information (weekly bacteria and nutrient samples).

In addition, the Agency ran a weekly water storage report in the legal paper of notice, the *Santa Rosa Press Democrat*. This weekly water storage report educated the public about storage levels in Lake Mendocino and provided updated information on the State Order, water use, and conservation tips. The Agency's *SCWA E-News* electronic newsletter was distributed monthly as well, with water storage trends and conservation tips.

Table 1, below, shows the Agency's media plan as presented in the Term 15 report and subsequent milestone reports. Appendix C – Sonoma County Water Agency Public Outreach, contains a detailed schedule of advertisements, earned media coverage, special events and conservation campaign literature produced and published in response to Order WR 2009-0034 EXEC.

Table 1. Agency's 2009 Water Conservation Media Plan

Radio	Maverick Media (101.7 Fox, 1350 KSRO, 92.9 Froggy, 97.7 River, 104.9 Mix)
Television	NBC Bay Area "Water matters" segment
Print	Press Democrat - includes weekly water storage ad
Movies	Santa Rosa/ Windsor theaters
Multicultural Outreach	Radio (89.1 KBBF, 1490 AM La Vaquera, Exitos, 107.1 Lazer, 104.1, Mejor)
Bus Panels	Sonoma County Transit – 15 back panels
Mall Banners	Santa Rosa Plaza and Coddingtown Mall
Sonoma County Fair	Signage and booth
Park and Ride Kiosks	Signage

5 Water Conservation in All Areas Served by Lake Mendocino

This section describes the water conservation measures implemented in the Agency's service area by its retail customers and other areas served by Lake Mendocino. It summarizes the information provided to the Agency for the State Board Order Term 15 Milestone reports. The actual documents provided to the Agency are located on the Agency's webpage for the Term 15 Status Reports at www.scwa.ca.gov/stateboard2009. [1]

Located at the end of this report, Appendix B -- Other County, City, and Water District Ordinances and Resolutions, contains copies of formal resolutions and ordinances adopted by counties, cities, and water districts in response to Order WR 2009-0034 EXEC.

[1] Navigate to "Milestone 1 Reports," and click on the "View detailed information and background documents" tag for the Retail, Business or Vintners section, depending on which documents you would like to see.

The Agency's own water conservation programs are discussed below in Section 6. Appendix A contains a draft of the Sonoma County Water Efficient Landscape Ordinance.

5.1 Agency Retail Prime Customers: Existing Measures and Emergency Measures Implemented

5.1.1 City of Cotati

5.1.1.1 Existing Measures:

The City of Cotati's existing water conservation measures include:

- Water budgets for all users in all customer classes.
- Cash for Grass lawn retrofit rebate program.
- Updated the City Municipal Code to mandate US EPA WaterSense toilets (1.28 gallon per flush) for new construction or retrofits.
- Directly contacting customers who may still have older toilets that use more than 1.6 gallons per flush.
- A pilot project to install automatic meter reading (AMR) devices on water meters to allow customers to monitor water consumption by the gallon, in real time.

5.1.1.2 Emergency Measures Implemented:

On May 27, 2009 the City of Cotati implemented a 20% voluntary conservation reduction program and eliminated all turf irrigation at commercial irrigation accounts.

- The City also provided community education and outreach through flyers, workshops, and community canvassing with the help of Daily Acts (a local group dedicated to sustainability and conservation issues)

5.1.2 City of Petaluma

5.1.2.1 Existing Measures:

The City of Petaluma provided its Water Conservation Plan to the Agency. In addition, on February 5, 2009 the City Council of Petaluma modified its municipal code to add a chapter on water conservation regulations. The City of Petaluma's existing water conservation measures include:

- Nineteen progressive water conservation programs that will provide 495 million gallons of water savings through the year 2025.
- A water recycling expansion program which will offset consumption of potable water by 650 million gallons through the year 2025.

5.1.2.2 Emergency Measures Implemented:

- Implemented Stage One of its Water Shortage Contingency Plan.
- Implemented a media campaign, advertising in newspapers, movie theaters, and via direct mail to all Petaluma water and wastewater customers.
- Conducted three water conservation seminars with attendance over 120 people.

- Conducted 129 single family residence WaterWise HouseCalls.
- Issued 21 residential washing machine rebates and 26 high efficiency toilet (HET) rebates.
- Completed a sheet mulching along Sonoma Mountain Parkway. Approximately 25,000 square feet of non-recreational turf was sheet mulched.
- Completed a one acre sheet mulching project at City Hall. Rain water catchment and small community gardens will also be incorporated into the new landscape.

5.1.3 City of Rohnert Park

5.1.3.1 Existing Measures:

The City of Rohnert Park provided to the Agency copies of its Water Shortage Emergency Plan and Water Waste Regulation Ordinances adopted in 2004 and Rules and Regulations regarding the Sale of Water in the City of Rohnert Park Resolution adopted in 2005.

5.1.3.2 Emergency Measures Implemented:

- Provided presentations and updates on water shortage and water conservation activities to the Rohnert Park City Council and to city employees at department meetings and staff meetings.
- Informed commercial accounts of the State Board Order requirements regarding commercial turf irrigation.

5.1.4 City of Santa Rosa

5.1.4.1 Existing Measures:

The City of Santa Rosa provided its Urban Water Shortage Contingency Plan (UWSCP) and Water Efficient Landscape Policy Resolution to the Agency. On February 24, 2009, the Santa Rosa City Council adopted Stage 1 of its UWSCP, requesting a 15% reduction of water use.

The City of Santa Rosa's existing water conservation programs include:

- High Efficiency Toilet program.
- Residential and commercial audits.
- High efficiency washing machine rebate programs.
- The green exchange rebate program.
- Educational and marketing information.
- Staffing the City's water conservation hotline.

5.1.4.2 Emergency Measures Implemented:

- As part of a public hearing, drought rates were adopted on April 21, 2009.
- Mailed informational letters to approximately 52,000 water customers and approximately 16,000 residents of all master-meter complexes, regarding water supply status, the adoption of Stage 1 of its UWSCP, and describing additional stages of the City's UWSCP.

- Mailed to restaurants new "Water-On-Request" placards and information on the UWSCP and the Stage 1 prohibition on providing water unless requested.
- Mailed approximately 85,000 Home Water Use Survey Kits, which included a step-by-step guide for customers on how to do an indoor and outdoor audit, flow bags, toilet tabs and information on the water supply status.
- Informed commercial accounts of the State Board Order requirements regarding commercial turf irrigation.
- Implemented a daily water watch patrol to identify and correct water waste violations. 352 water waste letters were sent out from June 1st to October 2nd.
- Developed two newsletters on the water shortage, utility bill inserts on its Green Exchange Rebate Program and Water Wise Gardening Series, and utility bill inserts on the water shortage**.**
- Updated the City's new account letter to provide water shortage information, including all of the City's water conservation programs as well as information on their water use efficiency calculator www.srcity.org/watercalculator. Approximately 700 letters per month are sent.
- Updated its dedicated website for water shortage information – www.srcity.org/watershortage. Provided updated information about the water shortage on its social networking websites, including Facebook, MySpace, and Twitter.
- Provided presentations and updates on water shortage and water conservation activities to the Santa Rosa City Council in August and September, to its Board of Public Utilities in August and September, to city employees at department meetings and staff meetings.
- Participated in various events including downtown markets in August, the City's Green Vendor Fair in September, and sent out marketing information and began preparing for 3 residential water wise gardening classes which will be held in October 2009.

5.1.5 City of Sonoma

5.1.5.1 Existing Measures:

The City of Sonoma provided the documents below to the Agency. All were in effect prior to the State Board Order.

- Water Shortage and Conservation Plan Ordinance
- Stage 2 Mandatory Water Conservation Ordinance
- Resolution of the City of Sonoma, "Establishing Permitted Days of Residential and Commercial Irrigation"

5.1.5.2 Emergency Measures Implemented:

- On May 14, 2009, the City of Sonoma issued a revised 2009 Water Shortage Response Plan.
- The City of Sonoma implemented stage 2 restrictions with dedicated irrigation days, a public outreach plan (including a new water conservation web site

(www.sonomaconserves.org), water conservation measures for City facilities and customers, and analysis cost/benefit of monthly billing.
- The City investigated, inspected and sought correction at multiple residences where irrigation waste occurred.
- The City included three water conservation articles in local papers from July through August.

5.1.6 North Marin Water District

5.1.6.1 Existing Measures:

North Marin Water District (NMWD) provided its Emergency Water Conservation Ordinance, which went into effect on March 1, 2009, prior to the State Board Order. This ordinance contains water waste, non-essential use prohibitions/restrictions and enforcement procedures.

The NMWD's existing water conservation measures include:

- Cash for Grass (turf replacement rebate).
- High Efficiency Toilet and Clothes Washer rebate programs.
- Water Smart Home Surveys.
- Water Smart Irrigation Controller and Landscape Efficiency rebates.
- Large landscape water use efficiency auditing and budgeting.
- Commercial water use efficiency auditing.
- Pool cover and toilet flapper rebates.

5.1.6.2 Emergency Measures Implemented:

- On May 19, 2009 NMWD Board approved a 25% Mandatory Conservation reduction.
- NMWD's *Water Line* newsletter was sent to all residential customers, containing an individualized graph which showed each customer's 2004 usage, 2008 usage and the 25% reduction target goal (from the 2004 usage).
- NMWD sent a letter to all commercial customers within the North Marin Water District service area, informing them of 2009 Water Use Restrictions (including those on commercial turf).
- NMWD met with six non-residential high-water users in the service area to discuss the reduction mandates and water waste prevention. In addition, NMWD has audited four other large water users for both indoor and outdoor water use efficiency, in direct response to the 25% water conservation mandate.
- NMWD has advertised its Save Our Water campaign with a large banner is hung from a District building, which is highly visible from Highway 101. It also runs weekly water conservation ads in the *Novato Advance* newspaper.

5.1.7 Town of Windsor

5.1.7.1 Existing Measures:

The Town's existing water conservation measures include:

- High efficiency toilet rebates
- High efficiency clothes washer rebates
- Water efficient landscape rebates for irrigation equipment upgrades
- Turf grass replacement rebates
- Water efficient technology rebates for businesses
- Residential water use assessments
- Business water audits
- Free water saving showerheads, faucet aerators, & hose nozzles
- Residential & commercial irrigation audits

5.1.7.2 Emergency Measures Implemented:

- The Town of Windsor passed a resolution effective July 1, 2009, declaring a Stage 2 Water Shortage Emergency condition. The resolution mandated an overall 25% reduction in water use compared to 2004 and limited residential irrigation to three days per week with irrigation days specified by location within the Town.
- Public outreach and education continued through bi-monthly bill inserts, direct mail postcards, banners in prominent locations, phone outreach to businesses, an information kiosk at weekly Town Green music events, and a public access television slideshow.
- The water fountain on the Town Green was drained, signage erected and press releases issued to raise water conservation awareness.
- The Town created an inter-departmental water conservation team comprised of staff members from Planning, Parks, Community Services, Public Works and Utility Billing to work in concert to achieve the water savings mandated by the order.
- Town staff worked with the Airport Business Center Property Owners' Association and business owners to meet the Town's 50% reduction mandate for commercial irrigation.

5.1.8 Valley of the Moon District

5.1.8.1 Existing Measures:

The Valley of the Moon Water District (VOMWD) provided its Waste Water Prohibition Ordinance to the Agency. In addition, VOMWD continues to implement the California Urban Water Conservation Council's best management practices.

5.1.8.2 Emergency Measures Implemented:

- The VOMWD passed its Conservation Measure Ordinance on March 3, 2009. VOMWD's ordinance includes a system-wide water savings goal of 15%, and a 20% reduction goal of water used for irrigation.

5.2 Other Agency Customers: Existing Measures and Emergency Measures Implemented

5.2.1 Cal-American Water Co.

5.2.1.1 Existing Measures:

Cal Am implemented a 3-tier rate structure for residential customers to encourage water conservation on February 7, 2009. On March 30, 2009, Cal Am enacted voluntary water conservation measures in accordance with its tariffs on file with the California Public Utility Commission (CPUC). Cal Am will continue to implement its active public outreach program.

5.2.1.2 Emergency Measures Implemented:

- Cal Am mailed a 2009 Conservation Newsletter to all Larkfield customers, providing conservation tips, information on rebate programs, and offers for free conservation devices and WaterSmart surveys. It also included a magnet with an outdoor watering reminder and water conservation contact phone numbers.
- Cal Am completed several commercial and residential water audits in August. It also continues to sponsor toilet and clothes washer rebate programs.
- Cal Am's direct install program retrofitted the entire Creekside Apartment complex with 1.28 GPF toilets

5.2.2 Penngrove Water Co.

5.2.2.1 Existing Measures:

- None reported.

5.2.2.2 Emergency Measures Implemented:

- The Penngrove Water Co. filed a letter with the CPUC requesting a third conservation billing tier.

5.3 Other Municipal Water Users: Existing Measures and Emergency Measures Implemented

5.3.1 Camp Meeker Recreation and Parks District

5.3.1.1 Existing Measures:

Camp Meeker Recreation and Parks District's Board stated that its low daily usage per service, which ranges between 120 gallons per day per service to 160 gallons per day per service, demonstrates adequate water conservation.

5.3.1.2 Emergency Measures Implemented:

- None reported.

5.3.2 City of Ukiah

5.3.2.1 Existing Measures:

The City of Ukiah provided its Water Conservation Program to the Agency. The existing program had already included alternate watering days for outside irrigation. On March 4, 2009, the City Council passed a resolution to develop and construct the Gobbi Street well under emergency public project bid procedures.

5.3.2.2 Emergency Measures Implemented:

- On April 15, 2009, the City Council adopted an Emergency Water Shortage Emergency Declaration, which would allow the City Council to institute a number of measures to meet water conservation efforts short of instituting a Stage 2 declaration under the City's current drought ordinance.
- On June 17, 2009, the City of Ukiah's council announced new water conservation measures, prohibiting numerous water wasting activities.
- Enforcement of these mandatory restrictions ranged from an educational visit and letter to service shutoff and reconnection fee.

5.3.3 Gill Creek Mutual Water Co.

5.3.3.1 Existing Measures:

- Customers are urged to set landscape irrigation systems to run only at night.
- Customers have been asked to call the manager if they see water escaping the system.
- During drought circumstances, customers are requested to reduce their usage as much as possible.

5.3.3.2 Emergency Measures Implemented:

At its May 2, 2009 annual meeting, Gill Creek Mutual Water Co. made the following suggestions to its members:

- Stop using sprinklers.
- Prohibit car washing unless hose is equipped with a shut-off nozzle.
- Limit toilet flushing.
- Adopt "Navy shower" habits.

- Encourage drip irrigation.
- Use gray water from washing machines to irrigate shrubs and trees.

5.3.4 Geyserville Water Works

5.3.4.1 Existing Measures:

- Customers were notified in March about drought conditions and the possibility of water rationing due to the State Board Order.

5.3.4.2 Emergency Measures Implemented:

- The method used to identify and prevent waste were customer meter comparison, regular policing and neighborhood watch.
- A notice of comparison methods along with conservation tips was sent to all customers in the May 20th billing.
- Notices were sent in each billing as the summer progressed.
- Customers not getting the message were contacted personally.

5.3.5 City of Healdsburg

5.3.5.1 Existing Measures:

- The City Council adopted Resolution 33-2009 on which called for specific voluntary water conservation measures. This was well before State Board adopted WR 2009-0027-DWR. Its water conservation plan is available at the Agency's website.

5.3.5.2 Emergency Measures Implemented:

- The City has posted a water conservation page which includes a link to the resolution and voluntary measures. The City resolution calls for a more aggressive reduction goal of 20% below 2008 levels. The page is directly linked from the City's home page.

5.3.6 Holland Heights Mutual Water Co.

5.3.6.1 Existing Measures:

All Holland Heights Mutual Water Co. customers are metered, so excessive water use is immediately apparent. The billing system is tiered, so large water users pay more, and have a financial incentive to avoid waste or unreasonable use.

5.3.6.2 Emergency Measures Implemented:

- Holland Heights Mutual Water Co. called for voluntary water conservation in all areas of water use, emphasizing outdoor irrigation and swimming pools.

5.3.7 Madrone Mutual Water Co.

5.3.7.1 Existing Measures:

Madrone Mutual Water Co. is a volunteer run organization that depends on the community to reduce water usage. It installed water meters in late 2006 and has been monitoring usage on a monthly basis.

5.3.7.2 Emergency Measures Implemented:

None reported.

5.3.8 Mendocino County Water District

5.3.8.1 Existing Measures:

- The MCWA promotes water conservation and supports the local water districts in their efforts to reduce usage.
- In March 2009 the Mendocino County Board of Supervisors proclaimed "an emergency situation due to drought conditions."

5.3.8.2 Emergency Measures Implemented:

On July 14, 2009, the Mendocino County Board of Supervisors passed the "Emergency Water Conservation" ordinance to support and cooperate with the State Board's goal of 50 percent reduction from all users of the Lake Mendocino water supply in Mendocino County. In addition,

- The Upper Russian River Water Districts joined the state of California's "Save Our Water" Program, investing in high visibility advertising, public service announcements, and other public outreach measures.

- MCWA and Ukiah Valley TV (www.ukiahvalley.tv) produced and aired an interior water audit training program.
- MCWA and Mendocino County staff attended multiple trainings, including the "Landscape Watering during Times of Drought" workshop in Santa Rosa and a rain harvest workshop in Fort Bragg.
- MCWA staff prepared a cost benefit analysis for the Mendocino County Board of Supervisors to retrofit the county jail laundry facility with an ozone treatment system, which could save over 400,000 gallons of water per year.

5.3.9 Mt. Weske Estates Water Co.

5.3.9.1 Existing Measures:

Current water conservation measures implemented by Mt. Weske Estates Water Co. include:

- A three-tiered water rate system
- Drip irrigation systems
- No large turf areas

5.3.9.2 Emergency Measures Implemented:

None reported.

5.3.10 Palomino Lakes Mutual Water Co.

5.3.10.1 Existing Measures:

The Palomino Lakes Mutual Water Co. (PLMWC) adopted emergency rules for its users prior to the State Board Order. In addition, PLMWC has had a tiered billing system and a leak detection/prevention program since 2003.

5.3.10.2 Emergency Measures Implemented:

- Increased meter readings to quickly spot and correct problems.
- Emphasis on public education and awareness of water conservation.
- Increased signage to promote water conservation.
- The PLMWC website features water conservation prominently and also provides a link to the Agency website.

5.3.11 Redwood Valley County Water District

5.3.11.1 Existing Measures:

Redwood Valley County Water District (RVCWD) provided the Agency with its Water Conservation Plan. RVCWD passed a combined water shortage and water waste prohibition ordinance in July 2007. In December 2007, it declared a water shortage emergency December 2007 and enacted stage 1 voluntary reduction along with eliminating waste. These actions resulted in an average of 25% reduction of water use during 2008.

5.3.11.2 Emergency Measures Implemented

- On May 1, 2009, RVCWD enacted stage 4 mandatory 50% reduction for urban water users effective.
- On May 4, 2009 the RVCWD Board held two special meetings to advise all agricultural accounts that water service would be terminated if water use was over the contracted water amount, and over 50% of historical usage. At least 35 of the Districts 200 agricultural accounts were terminated during the term of this order.

- Mailed a survey to all customers regarding future water supply and water conservation. 500 of the 1,400 surveys mailed were returned.
- Joined with the Mendocino County Water Agency and the Upper Russian River Water Districts to promote water conservation awareness by advertising on the Mendocino Transit Authority buses.

5.3.12 River Bend Resort

River Bend Resort is an RV/camping facility that has seen a significant reduction in business due to the economic downturn. Its usage summary can be viewed at www.scwa.ca.gov.

5.3.12.1 Existing Measures:

- Installed low flow showerheads
- Installed forced-flush toilets
- Use of waterless portable bathrooms

5.3.12.2 Emergency Measures Implemented:

- Increased system monitoring and tenant monitoring

5.3.13 Russian River County Water District/Russian River Utility

5.3.13.1 Existing Measures:

The Russian River County Water District provided documentation to the Agency, which can be viewed at www.scwa.ca.gov. Its existing water conservation program includes HET toilet distributions.

5.3.13.2 Emergency Measures Implemented:

Showerheads, sink flow restrictors, and conservation literature were distributed at a Board meeting in May to interested customers.

5.3.14 South Cloverdale Water District

5.3.14.1 Existing Measures:

None reported.

5.3.14.2 Emergency Measures Implemented:

Distributed conservation materials to all customers asking for their help in reducing water usage by a minimum of 25%.

5.3.15 Sweetwater Springs Water District

5.3.15.1 Existing Measures:

The Sweetwater Springs Water District provided the Agency with a copy of its Water Conservation Program. In February 2009, Sweetwater Springs Water District mailed a letter

describing the impact of the current drought on its customers. This letter also included a list of recommendations for wise water use.

5.3.15.2 Emergency Measures Implemented:

- Introduced a 4-tier rate structure to encourage wise water use
- Increased water rates in July of 2009
- Invested considerable staff time addressing customer requests for information, assistance, and in repairing water system leaks

5.3.16 VCA Forestville Animal Hospital

5.3.16.1 Existing Measures:

VCA reported repair of a significant system leak resulted in a large water savings.

5.3.16.2 Emergency Measures Implemented:

- Increased system monitoring and maintenance.

5.4 Agricultural Water Users

5.4.1 Overview

The 2009 growing season featured mild weather. The 2-3 inches of rainfall received during early May allowed growers to delay irrigation until early to late July. The mild spring temperatures brought only about 57% of the frost events relative to 2008 reducing the need to utilize water for frost protection. Furthermore, outreach efforts asking growers to individually measure onsite temperature and dew point, combined with guidelines about system startup thresholds resulted in the elimination of numerous overhead sprinkler episodes during the spring. There were no severe heat events, and growers did not need to resort to extra irrigation applications or overhead sprinklers to protect their vines and fruit from heat damage. In addition, the harvest tended to be about 7 to 10 days early this year which reduced the need for late-season irrigation applications. Overall, the heavy late-spring rainfall combined with the mild weather and relatively early harvest reduced demands for water use by vineyards. As a result, according to viticulture expert Dr. Mark Greenspan, it can be expected that vineyards were able to conserve from 25% to 35% of their normal water usage. Extensive efforts were made to reduce the need for post-harvest irrigation and prevent late-season consumption of water resources. Growers have been educated as to the need to irrigate only vines with active foliage and to avoid heavy applications of water through overhead sprinklers.

5.4.2 Meetings and Seminars

- Dollars and $ense seminar attended by nearly 400 growers in January 2009 included "Climate Variability and Changes in the North Coast Wine Regions of California," by Dr.

Gregory Jones, Southern Oregon University, that presented information on rainfall and frost patterns, including predictions for 2009.

- Sonoma County Water Agency made a presentation to the Sonoma County Winegrape Commission Board titled "Water Supply Strategies for the Future."
- Dr. Mark Greenspan addressed growers at the August 6, 2009 Integrated Pest Management (IPM)/Organic Field Day that attracted nearly 150 growers and focused on fall irrigation practices and water conservation opportunities.
- A lecture was presented entitled "Sonoma County Collaborative Effort to Protect Water, Agriculture and Salmon Population."

5.4.3 Vineyard Irrigation and Cooling Water Conservation Demonstration Program

On April 29, 2009, the Agency broke ground on two vineyard water conservation demonstration projects that continued throughout the State Board order term 15. The demonstration projects utilized state-of-the-art irrigation and cooling technologies and best management practices to illustrate how water and energy could be conserved in vineyards. The demonstration projects took place at Hoot Owl Creek/Alexander Valley Vineyards. Viticulture consultant Mark Greenspan of Advanced Viticulture, LLC implemented the demonstration projects.

The purpose of the demonstration projects was to provide a venue for both education and two-way communication on the subject of vineyard water use, and to show growers how they can easily save water, energy and money while still producing excellent wine grapes. These events allowed grape growers and those interested in attending the opportunity to speak with the technicians who have developed and implemented the demonstration program. These events provided hands-on demonstration, educational materials, and enhanced awareness regarding water conservation and the State Order.

The Agency hosted demonstrations on the following days:

1. July 6, 2009: 130 attendees
2. August 12, 2009: 100 attendees

5.4.4 Vineyard Consultant Services and Outreach

The Sonoma County Winegrape Commission has had extensive outreach to growers, informing them of the need for water conservation in 2009. This includes conservation during the frost season and for irrigation. Those communications include the following:

- Spring *Vine Times* newsletter sent to over 3200 growers, suppliers, public officials and media and businesses in Sonoma County seasonally, promoting demonstration events.
- "Frost Protection & Water Conservation," by Dr. Mark Greenspan, frost protection Best Management Practices.
- "President's Report," by Nick Frey, informed growers of the need to conserve water this year.

- Posted frost protection BMPs and water conservation tips on the Commission website: http://www.sonomawinegrape.org/conserving-water-in-2009 and http://www.sonomawinegrape.org/frost-protection-and-endangered-coho.

- Included Dr. Mark Greenspan in monthly Integrated Pest Management (IPM) grower meetings from April – July with over 100 growers attending each month.
- Promoted Water Conservation Field Days.
- The Commission has regularly e-mailed growers about water conservation.
- E-blasts to growers alerting them to emergency water shortfalls or upcoming demonstrations as well as conservation BMPs relevant to the season i.e. post-harvest irrigation.
- A grant from USDA Risk Management Agency was achieved to educate growers on water conservation and risk management strategies for 2010. That includes crop insurance in case water for frost protection or irrigation is limited again in 2010.

5.4.5 Individual Vineyards and Wineries Submitting Additional Information

Fetzer Vineyards reported that it has been implementing aggressive water conservation projects and that water use at Fetzer Vineyards has declined 24% or 8 million gallons per year since 1999.

Field Stone Winery and Vineyard reported that it reduced water use by 21% in 2007, and it continue to manage the winery and vineyard with many water conservation practices (such as drip irrigation, deficit irrigation, dry farming, no overhead vine cooling or frost protection) integrated into their viticulture practices.

Korbel Brothers reported many measures to achieve additional reduction in water use. For example, three of its six groundskeepers have become Qualified Water Efficient Landscapers; its older spray water system (40% efficient) has been replaced with drip systems (90% efficient); irrigation controllers have been reprogrammed to reduce the amount of run-off and run times were re-set to a seasonal water budget.

Murphy Vineyards reported it will achieve a 25% or higher reduction in water use by employing minimal landscaping and no turf around the tasting room entrance, and the use of low water volume barrel washers.

6 Sonoma County Water Agency Conservation Measures

6.1 Water Conservation Ordinance

The Agency and County of Sonoma staff worked collaboratively to prepare a draft Sonoma County water conservation ordinance. If adopted by the Board of Supervisors, this draft

ordinance would affect new construction and remodels connected to water or sewer service in the County of Sonoma service area and require water conserving devices be installed to reduce water consumption.

The draft ordinance is currently under review. The ordinance may be considered by the Board of Supervisors in early 2010.

6.2 Water Efficient Landscape Ordinance

Under AB 325, the California Department of Water Resources required local planning agencies to adopt the state's Model Water Efficient Landscape Ordinance or an equivalent version in the early 1990's.

In 2007, AB 1881 passed directing the Department of Water Resources staff to revise its Model Water Efficient Landscape Ordinance to include higher landscape water efficient standards. The new state law requires planning agencies to revise their landscape ordinances to be equal to the new revised Model Landscape Ordinance or one that is more restrictive by January 1, 2010.

In the hopes of streamlining compliance with the Ordinance for applicants and enforcement of the Ordinance for local planning department staff, a local Water Efficient Landscape Ordinance committee was created in March 2009. This committee was led by staff from the City of Santa Rosa and the Agency. The attendees have background and knowledge in the following areas: local planning, building inspection, engineering, landscape design and architecture, landscape installation and maintenance, water conservation, environmental and construction.

Agency and County of Sonoma staff finalized the Water Efficient Landscape Ordinance in November 2009. The Ordinance and Resolution are scheduled to be brought before the Sonoma County Board of Supervisors for adoption at their December 8, 2009 meeting.

A copy of this ordinance is included in Appendix A of this document.

6.3 Qualified Water Efficient Landscaper (QWEL)

The Qualified Water-Efficient Landscaper (QWEL) is an irrigation auditor training program recognized by the United States Environmental Protection Agency's WaterSense Program. The program provides twenty hours of educational materials designed to provide a better understanding of landscape water management for the landscape industry.

The Agency held five QWEL classes during the duration of the order. The QWEL training is comprised of 12 classes, for a total of 20 hours of hands-on education that focuses on all aspects of the landscape as they relate to water conservation (e.g., irrigation equipment, design, plant selection, soil types, irrigation audits, water budgets, irrigation scheduling). The QWEL training graduated seventy-nine Sonoma and Marin county landscape professionals for the duration of the order.

In addition, the Agency sponsored the first ever QWEL "Train the Trainer" event that was offered to water management professionals (agencies, cities, private individuals) so they may bring the QWEL trainings to their local areas. An abbreviated version of QWEL was presented along with insight on how to best teach and market QWEL. Thirteen attendees passed the course to become QWEL trainers.

6.4 GreenPlumbers® USA Workshops

Five GreenPlumbers® workshops were hosted by the Agency during the duration of the order. GreenPlumbers® is a global brand formed by the Master Plumbers & Mechanical Services Association (MPMSAA) in Australia in 2000, as a result of the severe drought that continues in that country today. The goal of the GreenPlumbers® is to assist households and businesses in monitoring their water and energy consumption, providing accountability and encouragement for maintained efficiencies.

GreenPlumbers® work with local and state jurisdictions, utilities, and water agencies to present training workshops across the nation. The training consists of a five-part accreditation in environmental and technical issues including Climate Care, Caring for Our Water, Solar Hot Water, Water Efficient Technologies, and Inspection Report Service. The Agency hosted all five of these trainings beginning in May and the last one in August; there were a total of 174 attendees.

6.5 Sanitation District Programs

The Agency implemented a Direct Install Program for Sonoma Valley County Sanitation District customers in June, 2009. The same program was approved by the Board of Directors in August 2009 for all other sanitation districts and zones in Sonoma County, including: Airport / Larkfield / Wikiup Sanitation Zone, Geyserville Sanitation Zone, Occidental Sanitation District, Penngrove Sanitation Zone, Russian River County Sanitation District and Sea Ranch Sanitation Zone.

The program allows commercial, residential and multi-family customers to have high-efficiency plumbing fixtures (toilets, urinals, faucet aerators, showerheads) installed at no cost. For customers wishing to upgrade the fixtures, a rebate program is available.

The direct install program has successfully replaced 956 toilets on 393 commercial, multi-family, and residential sites since September 2009. This will bring an approximate annual water savings of 34 AF.

6.5.1 Water Efficiency Rebate Programs

The Agency has implemented a Water Efficiency Rebate Program to encourage sanitation district customers to save water indoors. Customers connected to the following sanitation districts are eligible for the rebates:

- Airport / Larkfield / Wikiup Sanitation Zone

- Geyserville Sanitation Zone
- Occidental County Sanitation District
- Penngrove Sanitation Zone
- Russian River County Sanitation District
- Sonoma Valley County Sanitation District
- South Park County Sanitation District

6.5.2 Homeowner Rebates Available

The program offers rebates on High-Efficiency clothes washers and High-Efficiency Toilets (HET) to home owners.

6.5.3 Commercial Customer Rebates Available

The following rebates are offered to commercial sanitation district customers:

- High-Efficiency Toilet – up to $300
- High-Efficiency Urinal – up to $300
- High-Efficiency Clothes Washers – up to $125
- Water Efficient Ice Machines – up to $600
- Connectionless Food Steamers – up to $200
- Medical Equipment Steam Sterilizers – up to $700
- Dry Vacuum Pumps – up to $250
- Pressurized Water Brooms – up to $700
- Cooling Tower pH Controllers – up to $1,500
- Cooling Tower Conductivity Controllers – up to $5,000
- Sustained Reduction – Rebate based on the water savings achieved through permanent equipment upgrades.

6.5.4 High-Efficiency Fixture Direct-Install Program

In addition, the Agency has implemented the High-Efficiency Fixture Direct-Install Program (HEFDIP) in certain sanitation districts. The Agency reimburses participating local plumbers to install high-efficiency plumbing fixtures (toilets, urinals, faucet aerators, showerheads) at no cost to commercial, industrial, institutional, residential and multi-family customers.

The program includes:

- Replacement of at least one high-flush toilet (3.5 GPF or more) with a high-efficiency toilet (1.28 GPF or less) from the Qualifying HET Model List or
- Replacement of at least one urinal (1.0 GPF or more) with a high efficiency urinal (0.125 GPF or less) from the Qualifying HEU Model List

In addition, the program offers the following free services:

- Replacement of all high-flow faucet aerators with high efficiency models (1.5 GPM or less)

- Replacement of all high-flow showerheads with high efficiency models (1.5 GPM or less).

Customers connected to the following sanitation districts are eligible for HEFDIP:

- Airport/Larkfield / Wikiup Sanitation Zone
- Geyserville Sanitation Zone
- Occidental County Sanitation District
- Penngrove Sanitation Zone
- Russian River County Sanitation District
- Sea Ranch Sanitation Zone
- Sonoma Valley County Sanitation District

6.6 Development of Low Impact Development (LID) Standards and Best Management Practices (BMPs)

The Agency is developing a Low Impact Development (LID) guide that will integrate water resource planning and watershed management practices. There are many drivers for this effort, including requirements from the North Coast Regional Water Quality Control Board, the need to update our Flood Control and Design Criteria manual, anticipated IRWM planning LID requirements for Proposition 84 funding, the Agency's own sustainability initiative, and the current water supply challenges.

The LID guide will provide low impact standards and Best Management Practices (BMPs) for stormwater and runoff management, water conservation and efficiency, water and energy savings, and water reuse. Once fully developed, these standards and BMPs will be applied internally to support Agency operations, and could guide development projects in the County of Sonoma.

The LID guide will provide ways to reduce other development impacts by conserving water demand, finding opportunities to reuse water, and providing energy savings through additional water conservation measures. Taken together, these LID strategies, along with on-site storm water reduction and off-site runoff management, are intended to provide an integrated plan to reduce impacts throughout the hydrologic cycle.

The Agency's LID team is working with representatives from the North Coast and San Francisco Bay Regional Water Quality Control Boards, as well as the City of Santa Rosa and Sonoma County, to develop the LID guide.

7 Water Savings Resulting from Measures Implemented

The following tables present statistical analyses of actual water savings due to implementation of the Order, and also provide a comparison between the water use in 2004 and 2009. All data presented was self-reported by the respective municipality or water district.

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Table 2. Retail Prime Customer/Contractor Statistics: 2004 – 2009

	2004 June through September				2009 June through September					
	SCWA (1) (in AF)	Local (in AF)	Total (in AF)	No. of Services	SCWA (1) (in AF)	Local (in AF)	Total (in AF)	No. of Services	2004 to 2009 % Change in Water Use	2004 to 2009 % Change in Service Connections
Santa Rosa	11,536	0	11,536	48,665	8,042	956	8,998	51,131	-22.00%	5.10%
Petaluma	5,413	0	5,413	18,869	3,349	508	3,857	19,300	-28.70%	2.30%
North Marin (2)	4,350	832	5,182	19,117	2,900	1,514	4,414	20,416	-14.80%	6.80%
Rohnert Park	1,847	1,170	3,017	8,700	775	1,253	2,028	8,849	-32.80%	1.70%
VOMWD	1,408	247	1,655	6,771	893	265	1,158	6,900	-30.00%	1.90%
Sonoma	1,124	38	1,163	4,050	818	157	975	4,696	-16.10%	16.00%
Cotati	526	60	586	2,370	333	142	475	2,572	-18.90%	8.50%
Windsor	2,190	13	2,203	8,372	1,764	0	1,764	9,511	-19.90%	13.60%
MMWD (3)	1,851	11,832	13,683	61,336	1,091	10,784	11,875	61,018	-13.20%	-0.50%
Total	**30,246**	**14,192**	**44,438**	**178,250**	**19,965**	**15,579**	**35,544**	**184,393**	**-20.00%**	**3.40%**

(1) Delivered water from Agency
(2) North Marin June 2009 - Local Supply reflects 358 AF sold to MMWD
(3) MMWD June 2009 -Local Supply reflects 358 AF purchased from North Marin

Table 3. Retail Prime Customer/Contractor Recycled Water Use Statistics

	2004: June through September	2009: June through September
Santa Rosa	187	186
Petaluma	178	413
North Marin	0	144
Rohnert Park	590	609
VOMWD	0	0
Sonoma	0	0
Cotati	0	0
Windsor	535	351
MMWD	385	390
TOTAL	**1,875**	**2,093**

Table 4. Other Agency Customers and Municipal Users of Russian River Water

RR Water Purveyors	Jun-04	Jun-09	Percent Savings	Jul-04	Jul-09	Percent Savings	Aug-04	Aug-09	Percent Savings	Sep-04	Sep-09	Percent Savings	2004 Total	2009 Total	Percent Savings
Airport Green Business Center	Not reported	Not reported	---	4540	2333	48.61%	7139	3909	45.24%	7602	3256	57.17%	19281	9498	50.74%
Cal American Water (MG) Total System	58.106	40.206	30.81%	47.802	35.683	25.35%	46.579	43.91	5.73%	58.895	31.906	45.83%	211.382	151.705	28.23%
Cal American Water (MG) SCWA purchased water	15.271	9.103	40.39%	25.016	15.966	36.18%	25.255	19.673	22.10%	33.147	13.309	59.85%	98.689	58.051	41.18%
Calpella County Water District (gal)	3221400	2834100	12.02%	4138800	3335500	19.41%	4388500	2844700	35.18%	3271200	2630500	19.59%	15019900	11644800	22.47%
Camp Meeker (MG)	1.57	1.196	23.82%	2.01	1.576	21.59%	1.98	1.403	29.14%	1.77	1.604	9.38%	8.75	6.809	22.18%
Geyserville Water Works (MG)	7.81	7.2	7.81%	7.68	6.05	21.22%	9.61	5.34	44.43%	6.84	4.98	27.19%	31.94	23.57	26.21%
Gill Creek (gal)	2071000	1772000	14.43%	2418700	2004400	17.13%	2352200	2059400	12.44%	2724270	1972400	27.59%	12625570	10265900	18.69%
City of Healdsburg (MG)	103.61	74.09	28.49%	110.13	88.35	19.78%	112.09	88.35	21.18%	107.85	81.99	23.98%	433.68	332.78	23.27%
Occidental CSD (MG)	0.814	0.503	38.21%	1.093	0.693	36.60%	0.875	0.645	26.29%	1.093	0.748	31.56%	4.732	3.027	36.03%
Palomino Lake Mutual Water District (gal)	2,408,700	997,465	58.59%	1,982,470	1,154,720	41.75%	1833934	1235623	32.62%	1,781,535	1,089,075	38.87%	5597939	3479418	37.84%
Penngrove Water Company (cu.ft.)	Not reported	Not reported	---	1,266,000	1,061,000	16.19%	Not reported	Not reported	---	1,186,298	881,342	25.71%	Not reported	Not reported	---

RR Water Purveyors	Jun-04	Jun-09	Percent Savings	Jul-04	Jul-09	Percent Savings	Aug-04	Aug-09	Percent Savings	Sep-04	Sep-09	Percent Savings	2004 Total	2009 Total	Percent Savings
Redwood Valley County Water District (AF)	325.64	82.48	74.67%	430.78	157.54	63.43%	361.24	190.04	47.39%	287.21	143.88	49.90%	1740.17	809.51	53.48%
River Estates Mutual Water Corporation (gal)	1,892,500	1,107,500	41.48%	2244200	1253300	44.15%	2019900	1295300	35.87%	1803700	1244800	30.99%	7960300	4900900	38.43%
Rogina Water Company	Not reported	Not reported	---	Not reported	Not reported	---	Not reported	Not reported	---	Not reported	Not reported	30.00%	Not reported	Not reported	---
Russian River County Water District (MG)	10.35	6.179	40.30%	11.02	8.127	26.25%	10.81	7.979	26.19%	10.47	9.453	9.71%	51.97	37.83	27.21%
South Cloverdale Water District (MG)	2.09	1.26	39.71%	2.78	2.36	15.11%	2.14	2.05	4.21%	2.5	2.44	2.40%	12.6	10.1	19.84%
Sweetwater Springs Water District Sales (AF)	77.1	48.3	37.35%	95.5	81.6	14.55%	81.1	69.6	14.18%	88.5	74.6	15.71%	453.9	370.8	18.31%
Sweetwater Springs Water District Production (AF)	106	92.4	12.83%	113	101	10.62%	108	92	14.81%	104	79.1	23.94%	522.5	446.6	14.53%
City of Ukiah (MG)	129.493	103.644	19.96%	151.276	113.988	24.65%	147.366	106.089	28.01%	129.645	83.698	35.44%	739.477	523.882	29.16%
Willow County Water District (gal)	34,664,100	25,888,800	25.32%	47,926,000	30,547,000	36.26%	48,046,800	29,832,000	37.91%	56,215,900	30,305,400	46.09%	1.87E+08	1.17E+08	37.61%

7.1 CII Turf Ban

Term 13 of Order WR 2009-0034-EXEC directed the Agency to prohibit irrigation of commercial turf grass within the Agency's service area for the period of June 15, 2009 through October 2, 2009 unless irrigation was managed in conformance with a water budget designed to achieve a maximum applied water allowance of 75% of ETo.

Although most of the Agency's retail contractors have assigned water budgets to their dedicated irrigation customers, specific irrigation savings resulting from the requirements of Term 13 are difficult to quantify given the specificity of the turf definition and given that water use from a given dedicated irrigation customer will reflect irrigation of the entire landscape, not just the turf areas as defined in the order.

Therefore, water savings directly attributed to the irrigation ban on commercial turf could not be included in this report. Retail contractors and the Airport Business Center Property Owners' Association did, however, take measures to alert customers regarding the irrigation limitations and request that they maintain their landscapes within 75% of ETo.

The following sections describe actions taken in direct response to Term 13 turf ban.

7.1.1 California American Water (Cal Am)

Cal Am contacted all its customers with commercial turf and notified them of the watering prohibitions/water budget requirements and scheduled water audits for each of those properties.

7.1.2 City of Cotati

The City required water budgets for all commercial and multi-family irrigation accounts, in accordance with the State Board order.

7.1.3 City of Petaluma

The City reduced irrigation of city-owned turf areas that were not considered recreational turf areas. The Cavanaugh Recreation Center turf area was completely eliminated (over 3,000 square feet) by using the sheet-mulching technique. The Sonoma Mountain Parkway Landscape Assessment District turf area irrigation was turned off and sheet mulched. The City is exploring other non-recreational turf areas to eliminate. In addition, City staff reduced and/or turned off turf irrigation on city park turf areas using the city's new WeatherTrak smart irrigation controllers that are installed in all city parks. The City purchased the two-way communication feature offered by WeatherTrak which allows theCity to use a desktop computer to quickly alter the irrigation program for turf-only areas.

7.1.4 City of Santa Rosa

The City of Santa Rosa has a water budget-based tiered water rate structure for Dedicated Irrigation Customers that targets outdoor water use, and is based on landscape measurements

and real-time ETo data from its CIMIS station. The City reported that its rate structure complies with the maximum applied water allowance (MAWA) defined in Term 13 of the Revised Order.

In response to the State Board Order Term 13, the City completed the following water conservation activities for commercial landscape customers:

- In April, sent a customized letter to all City of Santa Rosa water customers informing them of the water supply status, the adoption of Stage 1 of its UWSCP, describing additional stages of the City's UWSCP and the allocation customers would receive under the various Stages of the UWSCP.
- In June, sent an additional letter to the commercial accounts regarding the State Board Order requirements regarding commercial turf irrigation.
- In July, held a 2-hour workshop entitled "Landscape Water Management during Times of Drought," targeting landscapers and commercial property managers and owners. Workshop included information on the water supply shortage, how to calculate a water budget, and various water conservation programs and assistance available.
- Reviewed Dedicated Irrigation Customers water use on a monthly basis and made phone calls to 354customers that hit Tier 3 each month.
- As part of the Water Waste Patrol, 65 incidents and follow up letters were sent to commercial customers.
- Completed 273 non-residential landscape audits.
- Rebated the removal of 110,000 square feet of commercial turf as part of its Green Exchange Rebate program.

7.1.5 City of Sonoma

On April 15, 2009 the Sonoma City Council passed a resolution which declared a Stage 2 Mandatory Water Conservation Ordinance through October 2, 2009 with a reduction goal of 25%. With that, the City reduced irrigation in City parks by 30%, shut off irrigation to public parkway strips, reduced allowable landscape irrigation days and times, stepped up water waste enforcement, mailed water conservation letters to all customers and a separate letter to its commercial irrigation customers and its top 100 water users asking them to reduce water use by 25%.

- The City's commercial customers were notified from the beginning and they did comply with the 25% reduction.
- No irrigation customers were turned off or fined for excessive irrigation use.
- The City of Sonoma reported an overall reduction in irrigation use as follows for the period of the Order:

  June: 58%

July: 25%
August: 43%
September: 25%
October: 32%

7.1.6 North Marin Water District

North Marin Water District (NMWD) targeted all non-residential accounts through a direct mail letter, including all commercial, government and dedicated irrigation meters, notifying them of the required 25% reduction in 2009 water usage compared to use in 2004 (1407 letters were mailed). NMWD also changed all of its dedicated irrigation water budget calculations to use 75% of ETo. NMWD maintained an e-mail list of the large irrigation water users and used this interaction to request large landscape accounts shut off during requested reduction periods when agency finished water storage dipped during heat waves. NMWD also completed 14 large landscape audits (focusing on the Novato Unified School District).

NMWD made phone calls or e-mails to customers alerting them to the failure to comply and requesting adjustments be made to comply. Door hangers and customer letters were also sent regarding water waste or non-essential use violations.

NMWD analyzed metered water use for all commercial (includes mixed use meters) and commercial irrigation meters and determined that a 30% overall reduction in water use occurred when comparing use from these two customer categories in 2004 to 2009 (for the period of June 1 through October 6). Commercial dedicated irrigation meters saw a 43% reduction when analyzed separately.

7.1.7 Marin Municipal Water District

In relation to the commercial irrigation sector, all of MMWDs irrigation water meters have water budgets, many are ET based and within the 75% ETo threshold and some are called historic water budgets because they were based on historic water use. MMWD does not yet know how many of each exists, so it is not possible for MMWD to report the number accurately.

MMWD had ongoing efficient irrigation equipment incentives and survey programs in place.

MMWD's rate structure is based on a progressive price structure for irrigation usage and uses pricing to encourage responsible water use. This tier structure was in place and no customers had their water turned off or were fined.

MMWD's Irrigation Tier Structure is described as follows: If irrigation use is equivalent to 85% of the maximum water budget it is charged at tier 1 (the lowest) rate. Water use between 86% and 150% is charged at Tier 2 (2x tier 1) and all use above that is charged at Tier 3 (4x tier 1).

During 2009, irrigation customers who participated in Conservation Programs reduced their consumption by 23-32% compared to the same time period in 2007. This corresponds with a 10-

fold increase in efficient irrigation equipment rebates and twice the number of landscape site surveys.

7.1.8 Town of Windsor

All of the Town-maintained landscaping that was irrigated with potable water was reduced to meet a 50% reduction in irrigation water use as outlined in the Town's resolution declaring a Stage Two Water Shortage Emergency.

Town staff worked with the Airport Business Center Property Owners' Association and business owners to meet the Town's 50% reduction mandate for commercial irrigation. Staff contacted several businesses not meeting the goal, which helped identify several irrigation system malfunctions and/or reinforced the need for businesses to make immediate changes to scheduling practices as a condition for the continued provision of irrigation water service. The businesses that were contacted were responsive to making the requested repairs and/or changes to irrigation schedules. Some businesses with increased water use had added new buildings or modified landscaping since the 2004 baseline year.

The Town's Water Efficient Landscape program provided incentives to 14 participants in July that removed or transformed over 7000 square feet of turf to low water use landscapes. Since last summer's program inception over 30,000 square feet of turf has been replaced with low or no water use landscaping.

7.1.9 Airport Business Center Property Owner's Association

QWEL Training Program - All landscape supervisors that service turf at the Airport Business Center Property Owners' Association have completed the QWEL Training Program Courses.

Reporting Usage - The Airport Business Center Property Owners' Association submitted a report based upon the 2004 water numbers available. For the month of September 2009 the 1,000,000 + square feet of commercial landscaping achieved 56.99% reduction in water usage. These numbers were based on available 2004 usage. Overall the Airport Business Center Property Owners' Association achieved a 50.74% savings since July 16th, 2009.

Table 5. Airport Business Center: 2004 – 2009 Comparison of Metered Water Consumption

Airport Business Center COMPARISON OF 2009 METERED CONSUMPTION TO 2004 METERED CONSUMPTION				
PERIOD	**2004 (1000G)**	**2009 (1000G)**	**% SAVINGS**	**% CUMULATIVE REDUCTIONS**
July 16- August 3	4540	2333	48.61%	48.61%
August 3- August 20	4288	2483	42.09%	45.45%
August 20- September 1	2851	1426	49.97%	46.56%
September 1- September 15	3326	1479	55.53%	48.55%
September 15- October 2	4276	1777	58.45%	50.74%

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Appendix A – Sonoma County Water Efficient Landscape Ordinance

ORDINANCE NO. _____

AN ORDINANCE OF THE BOARD OF SUPERVISORS OF THE COUNTY OF SONOMA, STATE OF CALIFORNIA, ADDING CHAPTER 7D3 TO THE SONOMA COUNTY CODE TO REGULATE WATER EFFICIENT LANDSCAPE, AND ESTABLISHING A FEE FOR PROCESSING LANDSCAPE PERMIT APPLICATIONS

The Board of Supervisors of the County of Sonoma, State of California, ordains as follows:

SECTION I. Chapter 7D3 is added to the Sonoma County Code, to read:

CHAPTER 7D3
WATER EFFICIENT LANDSCAPE

Sec. 7D3-1. Title and authority.

This chapter is and may be cited as the Sonoma County Water Efficient Landscape Regulations. This chapter is enacted pursuant to the Water Conservation in Landscaping Act (Government Code section 65591 et seq.).

Sec. 7D3-2. Purpose.

This chapter is enacted for the purpose of regulating the design, installation, and maintenance of new and rehabilitated landscapes.

Sec. 7D-3. Applicability.

A. The provisions of this chapter shall apply to all of the following landscape projects:

1. New and rehabilitated landscapes in multi-family residential, commercial, industrial, agricultural processing, and public agency projects requiring a building or grading permit or design review.

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2. New and rehabilitated landscapes that are developer-installed in single-family residential projects requiring a building or grading permit or design review.

3. New and rehabilitated landscapes that are homeowner-provided and/or homeowner-hired in single-family residential projects involving new buildings or additions over 400 square feet and requiring a building or grading permit or design review, except where the landscape area is less than 5,000 square feet, turf is limited to no more than 600 square feet, and an irrigation system is installed and operated by a weather-based self-adjusting irrigation controller with a rain sensor.

B. The provisions of this chapter shall not apply to any of the following:

1. Registered local, state, or federal historical sites.

2. Ecological restoration projects that do not require a permanent irrigation system.

3. Mined-land reclamation projects that do not require a permanent irrigation system.

4. Plant collections, as part of botanical gardens and arboretums open to the public.

Sec. 7D-4. Landscape permit.

A. A landscape permit shall be required prior to commencing any construction on a landscape project subject to the provisions of this chapter.

B. A landscape permit application shall be filed with the department on a county application form. Each landscape permit application shall include all required fees and/or deposits, and all plans and specifications, and other information, materials, and submittals required by the department.

C. A landscape permit application may only be filed by the owner or authorized agent of the owner of the subject property, or other person with the written consent of the property owner.

D. A landscape permit application shall be approved and a landscape permit issued when the director verifies that the proposed landscape project complies with the

provisions of this chapter, other applicable provisions of this code, and the conditions of any applicable land use permit or other entitlement.

Sec. 7D-5. Application fees.

A. The board of supervisors shall establish a schedule of fees for the processing of landscape permit applications.

B. No landscape permit application shall be deemed complete, and processing shall not commence on any landscape permit application until all required fees and/or deposits have been paid.

Sec. 7D-6. Inspections.

Landscape projects subject to the provisions of this chapter shall be subject to inspection as required by the director to verify compliance with the approved plans. No landscape project applicant shall be deemed to have complied with the provisions of this chapter until a final inspection of the work has been completed by the director. Inspections shall not be construed to approve a violation of the provisions of this chapter or other provisions of this code. Inspections presuming to give authority to violate or cancel the provisions of this chapter or other provisions of this code shall not be valid.

Sec. 7D-7. Water efficient landscape standards.

All landscape projects subject to the provisions of this chapter shall comply with the following standards.

A. Plants.

1. Selected plants shall not cause the estimated annual applied water use to exceed the maximum applied water allowance.

2. Plants with similar water use needs shall be grouped together in distinct hydrozones and where irrigation is required the distinct hydrozones shall be irrigated with separate valves.

a. Low and moderate water use plants can be mixed, but the entire hydrozone shall be classified as moderate water use for maximum applied water allowance calculations.

b. High water use plants shall not be mixed with low or moderate water use plants.

3. All non-turf plants shall be selected, spaced, and planted appropriately based upon their adaptability to the climatic, geologic, and topographical conditions of the project site.

4. Turf shall not be planted in the following conditions:

a. Slopes exceeding 10 percent.

b. Planting areas 8 feet wide or less.

c. Street medians, traffic islands, planter strips, or bulbouts of any size.

5. Invasive plants are prohibited.

B. Soil Amendments, conditioning, and mulching.

1. A minimum of 8 inches of non-mechanically compacted soil shall be available for water absorption and root growth in planted areas.

2. Compost or natural fertilizer shall be incorporated into the soil to a minimum depth of 8 inches at a minimum rate of 6 cubic yards per 1000 square feet, or according to specific amendment recommendations from a soils laboratory report.

3. A minimum 3 inch layer of mulch shall be applied on all exposed soil surfaces of planting areas except in turf areas, creeping or rooting groundcover, or direct seeding applications.

C. Water features.

1. Recirculating water systems shall be used for all water features.

2. Recycled water shall be used when available on site.

D. Irrigation systems.

1. All irrigation systems shall be designed and installed to meet irrigation efficiency criteria as described in the maximum applied water allowance.

2. A dedicated irrigation meter or sub-meter shall be required.

3. Irrigation systems with meters 1.5 inches or greater shall have a high-flow sensor that can detect high flow conditions and have the capability to shut off the irrigation system automatically.

4. Isolation valves shall be installed at the point of connection and before each valve or valve manifold.

5. Weather-based self-adjusting irrigation controllers with rain sensors shall be required.

6. Pressure regulation and/or booster pumps shall be installed so that all components of the irrigation system operate at the manufacturer's recommended optimal pressure.

7. Irrigation systems shall be designed to prevent runoff or overspray onto non-targeted areas.

8. Point source irrigation is required where plant height at maturity will affect the uniformity of an overhead system.

9. A 24-inch setback of overhead irrigation shall be required where turf is directly adjacent to a continuous hardscape that flows into the curb and gutter.

10. Slopes greater than 15 percent shall be irrigated with point source or other low-volume irrigation technology.

11. Separate valves shall be used to irrigate hydrozones with high water use plants and moderate or low water use plants.

12. Trees shall be placed on separate valves except when planted in turf areas.

13. Sprinkler heads, rotors, and other emission devices on one valve shall have matched precipitation rates.

14. Head to head coverage shall be required unless otherwise directed by the manufacturer's specifications.

15. Swing joints or other riser protection components shall be required on all risers.

16. Check valves shall be installed to prevent low-head drainage.

Sec. 7D-6. Glossary.

As used in this chapter, the following terms and phrases shall have the meanings ascribed to them in this section, unless the context in which they are used clearly requires otherwise. The definition of a term or phrase applies to any of that term's or phrase's variants.

"Building Permit" means any building permit under Chapter 7 of this code.

"Booster Pump" means a pump used where the normal water system pressure is low and needs to be increased.

"California Invasive Plant Inventory" means the California Invasive Plant Inventory maintained by the California Invasive Plant Council.

"Check Valve" means a valve located under a sprinkler head, or other location in the irrigation system, to hold water in the system to prevent drainage from sprinkler heads when the sprinkler is off.

"Compost" means the decayed remains of organic matter that has rotted into a natural fertilizer.

"Department" means the Permit and Resource Management Department.

"Design Review" means any design review under Chapter 26 or 26C of this code.

"Director" means the Director of the Permit and Resource Management Department or his or her authorized representative.

"Ecological Restoration Project" means a project where the site is intentionally altered to establish a defined, indigenous, historic ecosystem.

"ET Adjustment Factor" means a factor of 0.6, that, when applied to reference evapotranspiration, adjusts for plant factors and irrigation efficiency.

"Flow Rate" means the rate at which water flows through pipes, valves, and emission devices, measured in gallons per minute, gallons per hour, or cubic feet per second.

"Grading Permit" means any grading permit under Chapter 11 of this code.

"Hardscape" means any durable material (pervious and non-pervious).

"Head to Head Coverage" means full coverage from one sprinkler head to the next.

"High-Flow Sensor" means a device for sensing the rate of fluid flow.

"High Water Use Plant" mean any plant categorized as high water need by the Water Use Classification of Landscape Species Guide.

"Hydrozone" means a portion of the landscape area having plants with similar water needs that are served by a valve or set of valves with the same schedule.

"Invasive Plant" means any plant listed on the California Invasive Plant Inventory.

"Irrigation Efficiency" means the measurement of the amount of water beneficially used divided by the amount of water applied. Irrigation efficiency is derived from measurements and estimates of irrigation system characteristics and management practices. The minimum average irrigation efficiency for purposes of this chapter is 0.71.

"Irrigation Meter" means a separate meter that measures the amount of water used for items such as lawns, washing exterior surfaces, washing vehicles, or filling pools.

"Isolation Valve" means a valve used to isolate a portion of the piping system.

"Landscape Area" means the dedicated landscape area on a property. Water features are included in the calculation of the landscape area. Areas dedicated to

agricultural cultivation are not included. The landscape area does not include footprints of buildings or structures, sidewalks, driveways, parking lots, decks, patios, gravel or stone walks, other pervious or non-pervious hardscapes, and other nonirrigated areas designated for non-development (e.g., open spaces and existing native vegetation).

"Land Use Permit" means any ministerial or discretionary permit or approval granted by the county pursuant to Chapter 26 or 26C of this code to use a specific site for a particular purpose.

"Low-Head Drainage" means water that flows out of the system after the valve turns off due to elevation changes within the system.

"Low Water Use Plant" means any plant categorized as low water need by the Water Use Classification of Landscape Species Guide.

"Maximum Applied Water Allowance" means the upper limit of annual applied water for the established landscape area. It is based upon the area's reference evapotranspiration, the ET adjustment factor, and the size of the landscape area. The estimated total water use shall not exceed the maximum applied water allowance

"Mined-Land Reclamation Project" means any surface mining operation with a reclamation plan approved in accordance with Chapter 26A of this code.

"Moderate Water Use Plant" means any plant categorized as moderate water need by the Water Use Classification of Landscape Species Guide.

"Mulch" means any organic material such as leaves, bark, straw, compost or inorganic mineral materials such as rocks, gravel, and decomposed granite left loose and applied to the soil surface for the beneficial purposes of reducing evaporation, suppressing weeds, moderating soil temperature and preventing soil erosion.

"New Landscape" means any new landscaping project.

"Non-pervious" means any surface or material that does not allow the passage of water through the material and into the underlying soil.

"Overhead Irrigation" means systems that deliver water through the air (e.g., pop-ups, impulse sprinklers, spray heads, rotors, micro-sprays, etc).

"Overspray" means the irrigation water that is delivered beyond the landscape area, wetting pavements, walks, structures, or other non-landscaped areas.

"Pervious" means any surface or material that allows the passage of water through the material and into the underlying soil.

"Plant Factor" means a factor that, when multiplied by reference evapotranspiration, estimates the amount of water used by needed plants. Plant factors cited in this chapter are derived from the Department of Water Resources 2000 publication "Water Use Classification of Landscape Species."

"Precipitation Rate" means the rate of application of water measured in inches per hour.

"Point of Connection" means the point at which an irrigation system taps into the main water supply line.

"Point Source Irrigation" means any non-spray low volume irrigation system utilizing emission devices with a flow rate measured in gallons per hour. Low volume irrigation systems are specifically designed to apply small volumes of water slowly at or near the root zone of plants.

"Pressure Regulation" means a valve that automatically reduces the pressure in a pipe.

"Rain Sensor" means a system component that automatically shuts off and suspends the irrigation system when it rains.

"Recycled Water" means non-potable water that meets California Department of Public Health statewide uniform criteria for disinfected tertiary recycled water. Recycled water is also known as reclaimed water.

"Reference Evapotranspiration" means a standard measurement of environmental parameters that affect the water use of plants, and is an estimate of the evapotranspiration of a large field of four- to seven-inch tall, cool-season grass that is well watered.

"Rehabilitated Landscape" means any re-landscaping project.

"Runoff" means water that is not absorbed by the soil or landscape to which it is applied and flows from the landscape area.

"Soils Laboratory Report" means the analysis of a soil sample to determine nutrient content, composition, and other characteristics, including contaminants.

"Sprinkler Head" means a device that delivers water through a nozzle.

"Swing Joint" means an irrigation component that provides a flexible, leak-free connection between the emission device and lateral pipeline to allow movement in any direction and to prevent equipment damage.

"Valve" means a device used to control the flow of water in the irrigation system.

"Valve Manifold" means a one-piece manifold for use in a sprinkler valve assembly that includes an intake pipe having a water inlet and a plurality of ports adapted for fluid connection to inlets.

"Water Feature" means a design element where open water performs an aesthetic or recreational function. Water features include ponds, lakes, waterfalls, fountains, artificial streams, spas, and swimming pools (where water is artificially supplied). The surface area of water features is included in the high water use hydrozone of the landscape area.

"Weather-Based Self-Adjusting Irrigation Controller means a system component that uses local weather and landscape conditions to automatically adjust irrigation schedules to actual conditions on the site or historical weather data.

"Water Use Classification of Landscape Species Guide" means the Water Use Classification of Landscape Species Guide published by the University of California Cooperative Extension, the Department of Water Resources, and the Bureau of Reclamation, as it currently exists or may be amended in the future.

SECTION II. The fee schedule set forth in Exhibit "A" of Ordinance No. 5834 is amended to add the following fee under the Project Review Application Fee Schedule:

Landscape Permit	$350.00

SECTION III. The provisions of Section I of this ordinance shall not apply to new or rehabilitated landscape in any single-family or multi-family residential, commercial, industrial, agricultural processing, or public agency project for which an application for a building or grading permit or design review was accepted as complete for filing prior to the effective date of this ordinance.

SECTION IV. The provisions of Section I of this ordinance are intended to supercede and replace Section 26-88-110 of the Sonoma County Code (Low Water Use Landscaping). The Director of the Permit and Resource Management Department is directed in initiate proceedings to repeal Section 26-88-110 of the Sonoma County Code. Until repealed, Section 26-88-110 of the Sonoma County Code shall be inoperative.

SECTION V. The Board of Supervisors finds and determines that this ordinance is exempt from the California Environmental Quality Act ("CEQA") pursuant to Sections 15307 and 15308 of the State CEQA Guidelines as an action taken to assure the maintenance, restoration, enhancement, and protection of natural resources and the environment where the regulatory process involves procedures for protection of the environment, and pursuant to Section 15061(b)(3) of the State CEQA Guidelines because it can be seen with certainty that there is no possibility that this ordinance may have a significant effect on the environment. The basis for this determination is that this ordinance does not in itself approve any construction activities, but instead establishes standards, permit requirements, and other measures that regulate the design, installation, and maintenance of new and rehabilitated landscapes more stringently than existing codes. These standards, permit requirements, and other measures will not result in any direct physical change to the environment on their own, and will instead assure the maintenance, restoration, enhancement, and protection of natural resources and the environment by strengthening existing environmental standards and establishing new limitations. The Director of the Permit and Resource Management Department is directed to file a notice of exemption in accordance with CEQA and the State CEQA Guidelines.

SECTION VI. If any section, subsection, sentence, clause, or phrase of this ordinance is for any reason held to be unconstitutional or invalid, such decision shall not affect the validity of the remaining portion of this ordinance. The Board of Supervisors hereby declares that it would have passed this ordinance and every section, subsection, sentence, clause or phrase thereof, irrespective of the fact that any one or more sections, subsections, sentences, clauses or phrases be declared unconstitutional or invalid.

SECTION VII. This ordinance shall be and the same is hereby declared to be in full force and effect from and after thirty (30) days after the date of its passage and shall be published once before the expiration of fifteen (15) days after said passage, with the names of the Supervisors voting for or against the same, in *The Press Democrat*, a newspaper of general circulation published in the County of Sonoma, State of California.

In regular session of the Board of Supervisors of the County of Sonoma introduced on the ___th day of _____, 2009, and finally passed and adopted this ___th

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day of _____, 2009, on regular roll call of the members of said Board by the following vote:

SUPERVISORS:

BROWN _____ KERNS_____ Zane: _____ Carrillo: _____ Kelley: _____

AYES _____ NOES _____ ABSTAIN _____ ABSENT _____

WHEREUPON, the Chair declared the above and foregoing ordinance duly adopted and

SO ORDERED.

_____
Chair, Board of Supervisors
County of Sonoma

ATTEST:

_____
Chris Thomas, Acting Clerk of
the Board of Supervisors

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Appendix B -- Other County, City, and Water District Ordinances and Resolutions

This appendix contains the following documents:

1. **City of Petaluma Ordinance No. 2316 N.C.S:** Ordinance Repealing Certain Sections and Adding Chapter 15.17, Water Conservation Regulations, to the Petaluma Municipal Code.
2. **City of Rohnert Park Resolution No. 2005-86:** Resolution Adopting Rules and Regulations Regulating the Sale of Water in the City of Rohnert Park
3. **City of Rohnert Park Ordinance No. 724:** Ordinance Amending Title 13 of the Rohnert Park Municipal Code to Establish a Water Shortage Emergency Plan
4. **City of Santa Rosa Resolution No. 27308:** Resolution Declaring a Water Shortage Emergency, Implementing Stage 1 of the City's Urban Water Shortage Contingency Plan
5. **City of Santa Rosa Council Policy No. 200-20:** Resolution Declaring a Water Shortage
6. **City of Sonoma Ordinance No. 02-2009:** Ordinance Amending Title 13 of the Sonoma Municipal Code, Adding Chapter 13.10, "Water Shortage and Conservation Plan."
7. **City of Sonoma Resolution No. 14-2009:** Resolution Declaring Stage 2, Mandatory Water Conservation through October 2, 2009.
8. **City of Sonoma Resolution No. 15 - 2009:** Resolution Establishing Permitted Days of Residential Irrigation
9. **Mendocino County Ordinance No. 4224:** Urgency Ordinance Adding Chapter 7.10 to the Mendocino County Code, Entitled "Emergency Water Conservation"
10. **North Marin Water District Ordinance No. 22:** Emergency Water Conservation Ordinance
11. **Sweetwater Springs Water District Resolution No. 09-14:** Resolution Approving the Sweetwater Springs Water Conservation Plan
12. **Valley of the Moon Water District Ordinance No. 1007:** Ordinance Instituting Water Waste Prohibitions
13. **Valley of the Moon Water District Ordinance No. 1009:** Ordinance Establishing Water Conservation Measures
14. **Town of Windsor Resolution No. 2493-09:** Resolution Declaring Stage 2 Water Shortage Conditions and Directing Implementation of Mandatory Water Demand Reduction Measures

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EFFECTIVE DATE OF ORDINANCE
February 5, 2009

ORDINANCE NO. 2316 N.C.S.

Introduced by Tiffany Renée

Seconded by Teresa Barrett

AN ORDINANCE OF THE COUNCIL OF THE CITY OF PETALUMA REPEALING SECTIONS 15.12.071, 15.12.072, 15.12.073, 15.12.074, 15.12.075, 15, 12.076, 15.12.077 AND 15.12.078 OF CHAPTER 15.12 AND ADDING CHAPTER 15.17, WATER CONSERVATION REGULATIONS, TO THE PETALUMA MUNICIPAL CODE

WHEREAS, in 1928 the California Legislature mandated, under the State's constitution, that water will not be wasted but put to reasonable and beneficial uses setting the foundation for future water conservation regulations and programs; and,

WHEREAS, in 1983 the California Legislature passed the Urban Water Management Planning Act acknowledging the importance of water conservation and demand management as essential components of water planning; and,

WHEREAS, the City of Petaluma recognizes that water is an essential and limited resource; and,

WHEREAS, the City of Petaluma has historically undertaken a proactive water conservation program to improve the water use efficiency of its customers; and,

WHEREAS, the City of Petaluma jump-started its water conservation program in October 1999 by supplying 1000 ultra low flush residential toilets; and,

WHEREAS, as a signatory to the Memorandum of Understanding Regarding Urban Water Conservation in California as coordinated by the California Urban Water Conservation Council ("CUWCC") since January 1, 2002, the City has continued to incorporate Best Management Practices ("BMP") for efficient water use; and,

WHEREAS, the City of Petaluma General Plan 2025 ("General Plan"), in its Water Demand and Supply Analysis, identifies water conservation as an essential source of water supply to meet potable water demand in the City through 2025; and,

WHEREAS, General Plan Policy 8-P-18, programs A, B, C, D and F call for the reduction of potable water demand through conservation, using BMP, implementation of the City's Water Drought Contingency Plan as needed and revising local ordinances as needed to encourage or require use of water-efficient landscaping and elimination of wasteful uses of water; and,

WHEREAS, the Environmental Impact Report ("EIR") prepared for the General Plan relied on increased water conservation to provide potable water offset as part of its evaluation that there would be an adequate water supply in the City to serve General Plan buildout; and,

WHEREAS, after public review and comment, and in full compliance with the California Environmental Quality Act ("CEQA"), on April 7, 2008, the City Council certified the General Plan EIR by adopting Resolution No. 2008-058 N.C.S.; and,

WHEREAS, on May 19, 2008, the City Council adopted Resolution No. 2008-084 N.C.S. making required findings of fact as to the environmental impacts of the General Plan, finding in part that because of the water conservation and water recycling programs contained in the General Plan, its environmental impact on water supply was less than significant under CEQA; and,

WHEREAS, after the completion of all required environmental review and other public process, the General Plan was adopted by City Council Resolution No. 2008-085 N.C.S. on May 19, 2008; and,

WHEREAS, on September 19, 2005, the City Council authorized the City Manager to execute a professional services agreement with Dodson Engineers for engineering services in support of preparation of a Water Conservation Plan; and,

WHEREAS, to develop the Water Conservation Plan, a project team was selected based on their unique skills and expertise in the field of water conservation; the project team consisted of City staff from the Department of Water Resources and Conservation, Department of Community Development, and Department of Parks and Recreation; landscape and irrigation experts, water conservation experts, financial consultant, and internationally acclaimed consultants such as Bill Maddaus (Maddaus Water Management) and Ned Orrett (Resource Performance Partners) and Dodson-Psomas Engineers with extensive knowledge of the City's demand and supply needs. Together, this team has over 180 years of experience in the area of water conservation; and,

WHEREAS, the Water Conservation Plan team met first on November 14, 2005 to begin the development of the Water Conservation Plan. The team met numerous times over the next two year period with the final team meeting occurring on January 25, 2007. Over this period the team analyzed 202 potential water conservation programs using a highly sophisticated computer model known as Least Cost Planning Decision Support System (DSS). Through this process, the team was able to develop a recommended program that met the water conservation plan goal of saving approximately 495 million gallons per year of potable water at buildout of the City's general plan (2025) by implementing 19 water conservation programs; and,

WHEREAS, on September 10, 2006 the City Council considered a draft Water Conservation Plan ("WCP") and provided Department of Water Resources and Conservation ("WRC") staff with direction for further modification; and,

WHEREAS, on January 28, 2008, the City Council adopted Resolution No. 2008-021 N.C.S., approving the WCP; and,

WHEREAS, adoption of a mandatory Water Conservation Ordinance with development standards, landscape water efficiency standards and water waste prohibitions will carry out General Plan policy, provide careful stewardship of water resources available to the City to

provide for orderly application of water conservation measures;, and will have the positive impact of creating substantial water savings; and,

WHEREAS, the City Council finds that adoption of this ordinance is exempt from CEQA pursuant to Section 15061(b(3) of the CEQA Guidelines (Title 14, Chapter 3 of the California Code of Regulations) because there is no possibility that the activity may have a significant effect on the environment under CEQA.

NOW, THEREFORE, BE IT ORDAINED BY THE COUNCIL OF THE CITY OF PETALUMA AS FOLLOWS:

Section 1. Findings.

The foregoing recitals are true and adopted as findings of the City Council.

Section 2. Repeal of Sections 15.12.071, 15.12.072, 15.12.073, 15.12.074, 15.12.075, 15.12.076, 15.12.077 and 15.12.078.

Sections 15.12.071, 15.12.072, 15.12.073, 15.12.074, 15.12.075, 15.12.076, 15.12.077 and 15.12.078 of the Petaluma Municipal Code are hereby repealed in their entirety.

Section 3. Addition of Chapter 15.17 to Title 15.

Chapter 15.17, Water Conservation Regulations, is hereby added to Title 15 of the Petaluma Municipal Code to read in full as follows:

Chapter 15.17 Water Conservation Regulations

15.17.010 Title and Purpose

This chapter shall be known as and may be cited as the "City of Petaluma Water Conservation Regulations Ordinance." The purpose of this ordinance is to promote the efficient use and reuse of water by all City of Petaluma water service customers by requiring that all new construction projects and existing customers use water as efficiently as possible and comply with new development standards, landscape water use efficiency standards and water waste prohibition regulations.

15.17.020 Definitions

Unless a provision in this Chapter specifies otherwise, the following terms and phrases, as used in these chapters, shall have the meanings hereinafter designated:

A. "Applicant" means the owner(s) of a property subject to compliance with this Ordinance or his or her authorized representative or agent.

B. "Authorized representative" or "Agent" – any person(s) with written authorization from the property owner to sign documents and bind the property owner to compliance with this Chapter.

C. "Check valve" means a valve installed in a lateral line or at individual sprinkler heads in an irrigation system that prevents water from draining out of the irrigation system after the system has been turned off.

D. "City" means the City of Petaluma. The City Council of Petaluma may designate the position(s) or person(s) to whom responsibilities and authority of the City are delegated and may from time to time modify such delegations. Absent any further specific delegation by the City Council, the authority and responsibility set forth in this chapter shall be delegated to the director of water resources and conservation, including his or her designee(s).

E. "Dwelling unit" means a room or group of internally connected rooms that have sleeping, cooking, eating and sanitation facilities, but not more than one kitchen, which constitutes an independent housekeeping unit, occupied or intended for one household on a long-term basis, or such other definition as may be subsequently adopted by the City as part of its zoning ordinance and/or development code.

F. "ET Controller" or "Smart Controller" means an irrigation system controller or timer that automatically adjusts irrigation run times and run days based on data received from local weather stations. ET stands for evapotranspiration which is the amount of water that has evaporated from the soil and has transpired through the plant.

G. "Head-to-head coverage" means coverage resulting from placement of irrigation sprinklers so that the water from one sprinkler throws all the way to adjacent sprinklers.

H. "Hardscaped area" means the inanimate elements of landscaping, especially any masonry work or woodwork, stone walls, concrete or brick patios, tile paths, wooden decks and wooden arbors.

I. "Hydrozone" means a group of plants that have the same or similar water use requirements.

J. "Irrigation season" means the time of year when irrigation first begins at a location and last occurs. The irrigation season in Petaluma is typically March/April through October/November.

K. "Irrigation lateral line" means any point in an irrigation valve circuit that is normally not under constant water pressure. This is normally any point downstream from the irrigation remote control valve or hose bib.

L. "Irrigation mainline" means any point in the irrigation system that is under constant water pressure. This is normally any point downstream of the water meter up to and including the irrigation remote control valve or hose bib.

M. "Master valve" means an irrigation remote control valve that is placed upstream of all other remote control valves and activates and deactivates in conjunction with each subsequent irrigation remote control valve on the irrigation system. The purpose of the master valve is to prevent water waste by acting as a separate automatic shutoff valve should any of the subsequent irrigation remote control valves inadvertently stay open.

N. "Operating pressure" means the pressure in part of a plumbing or irrigation system, when the system is in normal operation.

O. "Overspray" means any water from an irrigation system that lands on an area not intended to be irrigated by the activated valve circuit.

P. "Precipitation rates" means the amount of water applied by an irrigation emission device measured in inches per hour.

Q. "Reference evapotranspiration" means the evapotranspiration, or amount of water that evaporates from the soil and transpires through plant material, that occurs from a standardized "reference" crop such as clipped grass or alfalfa.

R. "Reverse osmosis" means a process by which a solvent such as water is purified of solutes by being forced through a semipermeable membrane through which the solvent, but not the solutes, may pass.

S. "Runoff" means any water from an irrigation system that escapes from an irrigated area onto an area not intended to be irrigated by an activated irrigation valve circuit due to the excessive application of water.

T. "State" means the state of California.

U. "Static water pressure" means the water pressure of a plumbing or irrigation system while the system is not in operation or while no water is moving through the system.

V. "Irrigation valve circuit" means a group of sprinklers that are all turned on and off by the same irrigation valve.

W. "Water factor" means the quotient of the total weighted per-cycle water consumption divided by the capacity of the clothes washer. The lower the value, the more water efficient the clothes washer is.

X. "Water Feature" means any decorative water fountain, pond or other device intended to use water for aesthetic purposes that uses an automatic pump to circulate water.

Y. "Wetted diameter" means the area that is wetted by a single sprinkler device and by a series of overlapping sprinkler devices.

15.17.030 - Development Standards

The development standards established in this section apply to all new commercial, industrial, institutional, agricultural, single-family and multi-family residential construction, including tenant improvements or a change in use requiring any City entitlement or permit for existing commercial, industrial and institutional accounts. The development standards are intended to ensure that all installed water using fixtures, appliances, irrigation systems, and any other water using devices apply water as efficiently as possible.

15.17.030.10 Indoor Water Use Development Standards-New Single Family Residential Construction

Any water using device installed in any new development shall meet the standards of the California Plumbing Code (Part 5, Title 24, California Code of Regulations), and the following:

15.17.030.20 Standards for New Single-Family Residential Construction

1. Water closets must be an approved High Efficiency Toilet (HET) as designated on the City's list of qualifying HET's.

2. Shower heads must not use more than 2 gallons per minute. Where more than one showerhead exits in a shower unit, each showerhead must be plumbed so that each showerhead can be turned on and off independently from each other.

3. Any clothes washing machine provided with the residence must have a water factor of 6 or lower.

4. Lavatory and/or bar faucets must not exceed 1.5 gallons per minute.

5. Kitchen and/or utility sink faucets must not exceed 2.2 gallons per minute.

6. All Dishwashers must have the EPA's Energy Star label.

15.17.030.30 Standards for New Multi-Family Residential Dwellings

1. Water closets must be an approved High Efficiency Toilet (HET) as designated on the City's list of qualifying HET's.

2. Shower heads must not use more than 2 gallons per minute. Where more than one showerhead exits in a shower unit, each showerhead must be plumbed so that each showerhead can be turned on and off independently from each other.

3. Any clothes washing machine installed on the premises must have a water factor of 6 or lower.

4. Lavatory and/or bar faucets must not exceed 1.5 gallons per minute.

5. Kitchen and/or utility sink faucets must not exceed 2.2 gallons per minute.

6. All Dishwashers must have the EPA's Energy Star label.

7. Each dwelling unit must be separately metered or sub-metered.

15.17.030.40 Standards for New Commercial, Industrial, or Institutional (CII) Accounts and Tenant Improvements or Change of Use Requiring Any City Entitlement or Permit for Existing CII Accounts

1. Water closets and/or urinals must be an approved High Efficiency Toilet (HET) as designated on the City's list of qualifying CII HET's.

2. Shower heads must not use more than 2 gallons per minute. Where more than one showerhead exits in a shower unit, each showerhead must be plumbed so that each showerhead can be turned on and off independently from each other.

3. Commercial clothes washing machines shall have a water factor of 4.5 or lower.

4. Lavatory faucets must be self-closing and not exceed 1.5 gallons per minute. All faucets must be equipped with an aeration device.

5. Kitchen and/or utility sink faucets must not exceed 2.2 gallons per minute. All faucets must be equipped with an aeration device.

6. Dishwashers must have the EPA's Energy Star and/or Water Sense designation and must recycle the final rinse into the next wash cycle.

7. Pre-rinse hand-held dish-rinsing wands must not exceed 1.6 gpm and must utilize positive shut-off valves.

8. Cooling Towers (see Section 15.48.070 of this code, Sewer Use and Source Control Regulations).

9. Ice makers must be air-cooled.

10. Any other water using apparatus not mentioned above must use or reuse water as efficiently as possible and must be approved by the City prior to installation.

15.17.040 Standards for New or Renovated Vehicle Wash Facilities.

A. Vehicle wash facilities using conveyorized, touchless, and / or rollover in-bay technology shall reuse a minimum of fifty percent of water from previous vehicle rinses in subsequent washes.

B. Vehicle wash facilities using reverse osmosis to produce water rinse with a lower mineral content shall incorporate the unused concentrate in subsequent vehicle washes.

C. Self-service spray wands shall emit no more than three (3) gallons of water per minute.

15.17.050 Landscape Water Use Efficiency Standards

15.17.050.10 Properties Excluded from Applicability

The landscape water use efficiency standards described herein do not apply to registered historical sites (if the landscape is a part of the historic designation), properties irrigating with private well water, properties irrigated with recycled water or for zoned agricultural cultivation. Owners of these excluded properties are encouraged to implement efficient landscape water use practices.

15.17.050.20 Landscape Water Use Efficiency Standards for all New Single Family Residential ("SFR") and Multi-Family ("MFR") Residential, Commercial, Industrial and Institutional (CII) Landscape Installations

This subsection applies to all new residential and CII landscape installation projects and to CII and MFR projects which propose renovation of 5,000 square feet or more of existing landscaping within one twelve month period.

A. Application Process

Prior to installation of the proposed landscape and/or irrigation project the applicant shall submit to the City a set of scaled landscape and irrigation plans which shall include but not be limited to:

a. A planting plan indicating: location and square footages of turf, high water use plants and low water use plants per water meter; existing plant names and locations; a plant legend indicating Latin and common names of new plants, and sizes and quantities of new plants; hardscaped areas and; swimming pools, spas and water features.

b. An irrigation plan shall be submitted where irrigation hardware other than drip irrigation will be installed. When only drip irrigation will be installed an irrigation plan is not required for submittal. A description of the drip irrigation components shall be sufficient. The description shall include: manufacturer, name and specifications of all drip irrigation components; gallons per hour (gph) per emission device; and number, type, and gph of emission devices per plant size. Where microspray emission devises will be used, the rated gph shall be noted and the area(s) being irrigated under microspray shall be described. A pressure reducing valve must be installed where the operating pressure will exceed the manufactures recommendation of any drip irrigation emission device.

   Where any non-drip irrigation hardware is used an irrigation plan shall be submitted indicating: type(s) and size(s) of irrigation pipe; location, quantity and type of irrigation emission device(s) with manufacturer name and rated specifications of gallons per minute (gpm) of each device; manufacturers recommended operating pressure in pounds per square inch (psi) and precipitation rates for each device; location and type of backflow prevention device and pressure reducing valve(s); valve type(s) and size(s); valve location(s); gallons per minute and valve circuit number for each valve circuit, and; manufacturer's name and type of automatic irrigation controller(s). When more than one water meter exists for a particular landscape, each meter shall be designated and labeled as M-1, M-2, M-3, etc and noted on the irrigation plan. The meter number must be labeled with each valve number when more than one meter exists.

c. A grading and drainage plan indicating site elevations.

B. Plan Review and Landscape Water Budget Assignment

The City, or its agent, will review the submitted set of plans to ensure compliance of the landscape and irrigation standards. For accounts with dedicated irrigation meters, the City will assign a landscape water budget to the project in order to monitor landscape water use and to help determine the amount of water that should be applied to the landscape. The landscape water budget will allocate a determined amount of water to be dedicated to the landscape. The water budget will act as a guide for customers to use to irrigate their landscape. It will also provide a benchmark for evaluating water use efficiency. Any multi-family residential or CII customer who exceeds their water budget by 20% will be in violation of this ordinance and will be subject to enforcement. The landscape water use budget will be implemented upon final project approval.

C. Landscape Water Use Efficiency Standards

a. A dedicated irrigation meter(s) must be installed for all CII and multi-family residential projects. The dedicated irrigation meter shall separate all outdoor irrigation water use from all other water use.

b. Pressure regulation is required where site static water pressure will exceed 80 pounds per square inch (psi).

c. Backflow Prevention devices must be installed where required by state and local codes.

d. A master valve shall be installed after the backflow prevention device and before all irrigation system valves.

e. Soils in landscaped areas must be amended to promote optimal plant health and maximum water infiltration.

f. The use of California native plants is highly encouraged.

g. Plant water use classifications will be determined using the Water Use Classification of Landscape Species (WUCOLS) rating system.

h. Irrigation systems shall be designed and installed to maximize efficiency during operation. System design shall include but not be limited to:

1) All overhead spray irrigation systems other than drip irrigation applications shall be a brake rotary type and be a multi-stream, multi-trajectory rotating stream sprinkler with matched precipitation rates. The sprinkler shall produce and maintain a matched precipitation rate no greater than 0.6" per hour throughout the arc adjustment range and radius adjustment range, (up to 25% of radius reduction), when spaced at 50% of wetted diameter. For applications where the radius is designed to exceed thirty feet, water conserving rotor type sprinkler heads shall be permitted.

2) Individual hydrozones must be irrigated by separate valve circuits.

3) Irrigation systems must be designed and installed to prevent run off and overspray.

4) Check valves must be installed to prevent low head drainage.

5) Head-to-head coverage is required for all turf areas.

i. Turf and High Water Use Plant Restrictions:

1) Turf and high water use plants shall occupy no more than a combined 20% of the total irrigated landscaped area.

2) Turf areas shall not be less than 8 feet wide.

3) Turf is not permissible on slopes greater than 10%.

j. All automatic irrigation controllers must be labeled as ET Controllers or Smart Controllers or otherwise have the ability to automatically adjust irrigation start-times, run-times and/or run days based on local or site specific soil moisture levels, weather and/or reference evapotranspiration data. These controllers or devices must be labeled by the Irrigation Association (IA) as a Smart Water Applications Technology (SWAT) and must have passed the SWAT testing protocols by 100 percent in all testing parameters.

k. A minimum 3 inch layer of porous mulch is required for all irrigated areas other than turf, ground cover, or annual color areas.

l. Rain shut-off devices shall be installed on any controller not equipped to halt irrigation during and after rain as appropriate.

m. All water features must utilize recirculating water.

15.17.050.30 Landscape Water Use Efficiency Standards for *Renovated* Commercial, Industrial and Institutional (CII) and Multi Family Residential (MFR) Landscape Projects

A. Applicability

This section applies to all CII and MFR landscape renovation projects. Renovated landscape construction shall be defined as any landscape project considered for installation where more than 1,000 square feet and up to 5,000 square feet of the existing landscaping will be renovated. CII/MFR landscape renovation projects where more than 5,000 square feet of existing landscaping proposed for renovation within a twelve month period must comply with the standards established in Section 15.17.050.20.

B. Application Process

1. CII/MFR Landscape Renovation Project Description Form

Prior to the demolition and installation of the proposed landscape renovation project, the applicant shall submit to the City the CII/MFR Renovation Project Description form describing the renovation project including square footages of existing landscaping to be renovated and square footages of new landscaping to be installed.

The City, or its agent, will review the submitted form to ensure compliance of the below listed standards. Once the form is reviewed and approved, the City will submit to the applicant an authorization to proceed with the landscape and/or irrigation renovation project.

C. Landscape Water Use Efficiency Standards

a. All landscape and/or irrigation systems shall be installed so as not to violate the City's Water Waste Policy.

1) The City encourages the installation of a dedicated irrigation meter(s) or sub-meter during the renovation process.

b. The use of California native plants is highly encouraged.

c. Irrigation systems shall be designed and installed to ensure the efficient use of water during operation. System design shall include but not be limited to:

1) All overhead spray irrigation systems other than drip irrigation applications shall be a brake rotary type and be a multi-stream, multi-trajectory rotating stream sprinkler with matched precipitation rates. The sprinkler shall produce and maintain a matched precipitation rate no greater than 0.6" per hour throughout the arc adjustment range and radius adjustment range, (up to 25% of radius reduction), when spaced at 50% of wetted diameter. Operating pressure of each sprinkler head shall be at the manufacturer's recommendation for optimal performance. For applications where the radius is designed to exceed thirty feet, water conserving rotor type sprinkler heads shall be permitted.

2) Individual hydrozones must be irrigated by separate valve circuits.

3) Irrigation systems must be designed to prevent run off and overspray.

4) Check valves must be installed to prevent low head drainage.

5) Head-to-head coverage is required for all turf areas.

d. Turf and High Water Use Plant Restrictions:

1) Turf and high water use plants shall occupy no more than a combined 20% of the total renovated landscaped area.

2) Turf areas shall not be less than 8 feet wide.

3) Turf is not permissible on slopes greater than 10%.

e. All automatic irrigation controllers must be labeled as ET Controllers or Smart Controllers or otherwise have the ability to automatically adjust irrigation start-times, run-times and/or run days based on local or site specific moisture levels, weather and/or reference evapotranspiration data. These controllers or devices must be labeled by the Irrigation Association (IA) as a Smart Water Applications Technology (SWAT) and must have passed the SWAT testing protocols by 100 percent in all testing parameters.

f. Rain shut-off devices shall be installed on any controller not equipped to halt irrigation during and after rain as appropriate.

g. A minimum 3 inch layer of porous mulch is required for all irrigated areas other than turf, ground cover, or annual color areas.

h. All water features must utilize recirculating water.

15.17.050.40 Landscape Water Use Efficiency Standards for *New and/or Renovated* Parks/Playgrounds, Golf Courses, School Grounds, Cemeteries and Sports Fields.

A. Applicability and Landscape Water Use Efficiency Standards

The standards established in Sections 15.17.50.20 or 15.17.50.30 apply with the following exceptions:

a. Turf area limits will be waived for parks, playgrounds, golf courses, sports fields and school grounds if it is demonstrated by the applicant to the City's Department of Water Resources and Conservation that the new/renovated turf area is designed for recreational purposes.

b. Renovated cemeteries must demonstrate that new turf or renovated turf will be used for foot traffic or vehicular traffic for cemetery plot access.

15.17.060 Water Budgets for New and Existing Dedicated Irrigation Accounts

The City shall provide any account with a dedicated irrigation meter(s) a landscape water budget. The water budget will be calculated by the City or its agent by measuring the total irrigated landscaped area and the plant type(s) that exist per water meter. Any account assigned a water budget may not exceed the water budget for that billing period by more than 20% during that billing period. Accounts that exceed their water budget by more than 20% will be notified by the City. The City will work with the property owner or its authorized representative to ensure corrective actions are taken. Exceeding an account's water budget by more than 20% more than two times in one twelve month period and/or failure to cooperate with the City in taking corrective action after notification by the City of specific action(s) to be taken shall constitute a violation of this chapter.

15.17.070 Water Waste Prohibition

The purpose this section is to promote water conservation and efficient use of potable water furnished by the City of Petaluma by eliminating nonessential water use and intentional or unintentional water waste when a reasonable alternative solution is available and by prohibiting the use of water equipment that is wasteful.

15.17.070.10 Nonessential Uses Defined and Prohibited.

No customer of the City shall use or permit the use of potable water from the City for residential, commercial, institutional, industrial, agricultural, or other purpose for the following nonessential uses:

1. The washing of sidewalks, walkways, driveways, parking lots and other hard-surfaced areas by direct hosing not equipped with a shutoff nozzle, except as may be necessary to properly dispose of flammable or other dangerous liquids or substances and/or to prevent or eliminate materials dangerous to the public health and safety;

2. The escape of water through breaks or leaks within the customers plumbing or private distribution system for any substantial period of time within which such break or leak should reasonably have been discovered and corrected. It shall be presumed that a period of one (1) hour to stop the flow of water from such break or leak after the consumer discovers such a break or leak or receives notice from the City and seventy-

two (72) hours to correct such break or leak after the consumer discovers such a break or leak or receives notice from the City, is a reasonable time period;

3. Irrigation in a manner or to the extent that allows runoff of water or over-spray of the areas being irrigated. Every customer is deemed to have their irrigation system under control at all times, to know the manner and extent of their water use and any runoff and overspray, and to employ available alternatives to apply irrigation water in an efficient manner;

4. Washing cars, boats, trailers, or other vehicles, equipment and machinery directly with a hose not equipped with a hose-end shutoff nozzle;

5. Using water for non-recycling water features;

6. Using water for single pass evaporative cooling systems for air conditioning in all connections installed after July 1, 2001, unless required for health or safety reasons;

7. Using water for new non-recirculating conveyor car wash systems; Self-service car wash spray wands shall emit no more than three gallons of water per minute;

8. Using water for new non-recirculating industrial clothes wash systems.

9. Dedicated irrigation accounts exceeding the allocated water budget by more than 20% in any billing period.

15.17.070.20 Pressure Regulation

A pressure-regulating valve shall be installed and maintained by the consumer if static service pressure at the meter exceeds 80 pounds per square inch. The pressure-regulating valve shall be located between the meter and the structure valve, and set at not more than 60 pounds per square inch when measured at the structure valve. This requirement may be waived if the consumer presents evidence satisfactory to the City that high pressure is necessary in the design and that no water will be wasted as a result of high-pressure operation.

15.17.070.30 Swimming Pool and Spa Covers

Covers are required for all outdoor swimming pools and spas.

15.17.070.40 Exempt Water Uses

All water use associated with the operation and maintenance of fire suppression equipment or employed by the City for water quality flushing and sanitation purposes shall be exempt from the provisions of this section. Use of water supplied by a private well or from properly authorized recycled water, gray water, or rainwater catchment system is also exempt.

15.17.80 Exceptions

Any customer of the City may make written application for an exception to the Water Conservation Regulations Ordinance. Said application shall describe in detail why applicant believes an exception is justified:

A. The Director of Water Resources and Conservation may grant exceptions for use of water otherwise prohibited by this ordinance if an exception is necessary to avoid an adverse impact on health, sanitation or safety of the applicant or the public, and/or to avoid undue hardship for the applicant or the public. Any exception granted shall not be broader than necessary, or of a duration longer than necessary to avoid the adverse effect on health, sanitation, fire protection or safety and/or to avoid the undue hardship.

B. The decision of the Director of Water Resources and Conservation may be appealed to the City Council by submitting a written appeal to the City Clerk within fifteen (15) calendar days of the date of the decision. Upon granting any appeal, the Council may impose any conditions it determines to be just and proper. Exceptions granted by the Council shall be prepared in writing, and the Council may require the exception be recorded at applicant's expense.

15.17.090 Applicability of Water Shortage Emergency Regulations.

In the event of conflict between the provisions this chapter and the provisions of Chapter 15.18 of this code, the provisions of Chapter 15.18 shall supersede the provisions of this chapter from such time as the City Council has determined and declared by resolution that a water shortage emergency exists pursuant to Chapter 15.18, as it may be subsequently amended, until such time as the declaration of emergency has been suspended by later resolution of the City Council.

15.17.100 Enforcement and Fees

A. Depending on the extent of the water waste, the City may, after written notification to customer and a reasonable time to correct the violation as solely determined by the City, take some or all of the following actions. Seventy-two hours from notice of the violation shall be considered a reasonable time for correction, absent unusual circumstances that lengthen or shorten the reasonable time for correction. Penalties, fees and charges noted below shall be established by resolution of the City:

1. Personal contact with the customer at the address of the water service. If personal contact is unsuccessful, written notice of the violation including a date that the violation is to be corrected may be left on the premises, with a copy of the notice sent by certified mail to the customer.

2. The City may install a flow-restricting device on the service line.

3. The City may levy a water waste fine to the customer.

4. The City may shut off water service, and the charge for same shall be billed to the customer. Except in cases of extreme emergency as solely determined by the City Manager, service shall not be reinstated until verified by the City that the violation has been corrected and all charges and fees have been paid.

B. Depending on the nature and extent of water waste and/or the condition creating water waste, the City may discontinue water services without notice, pursuant to Section 15.12.070, and/or discontinue water services pursuant to Section 15.12.080 of this code.

C. In addition to discontinuance of water services, any violation of this chapter is subject to enforcement as specified in Chapters 1.10 through 1.16 of this code.

Section 4. Repeal of Conflicting Provisions

All existing code provisions, ordinances and parts of ordinances in conflict with the provisions of this ordinance are repealed upon the effective date of this ordinance, except that provision of Chapter 15.18 of this code which conflict with the provisions of this ordinance may be implemented and enforced at any time when the City Council has determined and declared by resolution that a water shortage emergency exists pursuant to Chapter 15.18, as it may be subsequently amended.

Section 5. Severability

If any provision of this ordinance or the application thereof to any person or circumstance is held invalid, the remainder of the ordinance, including the application of such part or provision to other persons or circumstances shall not be affected thereby and shall continue in full force and effect. To this end, provisions of this ordinance are severable. The City Council hereby declares that it would have passed each section, subsection, subdivision, paragraph, sentence, clause, or phrase hereof irrespective of the fact that any one or more sections, subsections, subdivisions, paragraphs, sentences, clauses, or phrases be held unconstitutional, invalid, or unenforceable.

Section 6. Effective Date

This ordinance shall become effective thirty (30) days after the date of its adoption by the Petaluma City Council.

Section 7. Publication

The City Clerk is hereby directed to post and/or publish this ordinance or a synopsis of it for the period and in the manner required by the City Charter.

INTRODUCED and ordered posted/published this 1st day of December, 2008.

ADOPTED this 5th day of January, 2009, by the following vote:

Ayes: Vice Mayor Barrett, Glass, Harris, Healy, Rabbitt, Renée, Mayor Torliatt

Noes: None

Abstain: None

Absent: None

Pamela Torliatt, Mayor

ATTEST:

APPROVED AS TO FORM:

Claire Cooper, City Clerk

Eric W. Danly, City Attorney

RESOLUTION NO. 2005- 86

RESOLUTION ADOPTING RULES AND REGULATIONS REGULATING THE SALE OF WATER IN THE CITY OF ROHNERT PARK

WHEREAS, The City Council of the City of Rohnert Park did, on the 16th day of January 1967 adopt Ordinance No. 76 of said City; and,

WHEREAS, Section 3 of said ordinance No. 76 does provide that the City Council shall adopt rules and regulations, rates, penalties and charges, from time to time by resolution, regulating the sale of water produced by facilities owned and operated by said City; and,

WHEREAS, Title 13 has been amended to provide that the City Council shall ordinance establish rates for the sale of water, and by resolution establish such other charges, rules and regulations as may be necessary for the administration and operation of the Rohnert Park city water system; and,

WHEREAS, the City council has adopted a Per Acre Development Fee and Special Water Connection Fees per Resolution Nos. 98-22 and 98-24, respectively; and

WHEREAS, the City Council has previously adopted Resolution 2003-118 and subsequent amendments thereto adopting rules and regulations regulating the sale of water:

NOW, THEREFORE, BE IT RESOLVED, that the City Council of the City of Rohnert Park does hereby rescind Resolution 2003-118 and subsequent amendments thereto, except as to section 8 thereof, and does hereby adopt the following Rules and Regulations relating to the administration and operation of the water system owned and operated by said city.

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1. GENERAL PROVISIONS:

1.1 The City of Rohnert Park will furnish water service in accordance with the Rules and Regulations hereinafter contained, and in accordance with applicable ordinances, to any property within the corporate limits of the City and to such other premises, properties, areas, or locations as the City Council may from time to time designate.

1.2 Applications for water service will be made. Such application will signify the applicant's willingness and intention to comply will all regulations or rates duly adopted by the City, and to make payment for services rendered.

1.3 If application is made for service to property where no service connection has been installed, but a distribution main is adjacent to the property, the applicant, in addition to making application for service, shall comply with the regulations governing the installation of service connections.

1.4 No consumer shall permit the use or resale of any of the water received by him on any premises other than those specified in his application for service, except by special arrangement with this City.

1.5 Representatives of the City shall carry proper identification upon exhibition of which, they shall have the right of ingress and egress to the customer premises at reasonable hours for any purpose reasonable connected with the furnishing of water service.

1.6 No person shall drill, construct or cause to be constructed any well within the City of Rohnert Park.

2. **TAMPERING WITH CITY PROPERTY:**

2.1 No one except an employee or representative of the City shall at any time in any manner operate the curb or main valves, or remove and/or tamper with locking devices of the City's system; or interfere with meters or their connections, street mains or other parts of the water system.

2.2 Fees for tampering:

First Offense	$100.00
Second Offense	$250.00
Third Offense	$500.00
Subsequent Offenses	$500.00

3. **NONCOMPLIANCE:**

3.1 The City may, unless otherwise provided, discontinue water service to a customer for noncompliance with any of the regulations outlined in this resolution if the customer fails to comply with said regulations within five (5) days after receiving written notice of the City's intention to discontinue service.

3.2 The City may discontinue water service immediately and without notice to the customer when the customer's noncompliance with any of the regulations outlined in this resolution constitutes an immediate danger to the health, safety and welfare of the public and/or to the operation, maintenance, or costs of operation and maintenance of the City's water or sewage systems.

4. **UNSAFE APPARATUS OR PROHIBITED APPARATUS:**

4.1 The City may refuse to furnish water and may discontinue service to any place or premises on the water system where apparatus, appliances, or equipment using water furnished by the City are dangerous, unsafe, or not in conformity with any laws, ordinances and/or rules of the City, County, State or Federal Government. The City of Rohnert Park assumes no liability for inspecting apparatus on the customer's property. The City reserves the right to inspection.

5. **DETRIMENTAL SERVICE:**

5.1 The City may refuse to furnish water and may discontinue service to any customer whose current demand greatly exceeds past averages or seasonal use, and where such current demand threatens the public health, safety of welfare and the City's ability to provide water service to one or more other customers.

6. **WATER WASTING: Regulations for water wasting shall be governed by Title 13 of the Rohnert Park Municipal Code Section 13.62, "Water Waste Regulations."**

7. **RESPONSIBILITY FOR EQUIPMENT:**

7.1 The customer shall, at his own risk and expense, furnish, install and keep in good and safe condition all equipment that may be required for receiving, controlling, applying and utilizing water, and the City shall not be responsible for any loss or damage caused by the improper installation of such equipment, or the negligence or wrongful act of the customer or of any of his tenants, agents, employees, contractors, licensees, or permitees in installing, maintaining, operating or interfering with such equipment

7.2 The City shall not be responsible for damage to property caused by faucets, valves and other equipment that are open when water is turned on at the meter, either originally or when turned on after a temporary shutdown.

8. **[RESERVED]**

9. **EXTENSION OF DISTRIBUTION MAINS:**

9.1 The extension of distribution mains may be accomplished by either the applicant or the City, but in all cases must be approved as to design and location by the City Engineer prior to installation. Where installation is made by the applicant, plans must be prepared by a licensed professional only, and the City will provide inspection services to assure installation according to approved plans. The cost of the extension shall be borne by the applicant. The cost of City inspection shall be borne by the applicant.

9.2 When the City requires the installation of a water main which is larger than that necessary to serve the applicant, the City may, in its sole discretion, enter into an agreement with the applicant whereby the applicant shall recover the excess cost through a refunding arrangement. The refunds may be by way of credits against monies due from applicant for connection charges; from front foot charges received from other persons for connection to said main; or the City may contribute a portion thereof.

9.3 Applicant shall make cash payment or other approved guarantee of the charges specified herein prior to commencement of work. Such deposit or security shall be in an amount equal to the estimated cost, as approved by the City Engineer plus ten percent (10%). Any cash balance remaining upon completion of the work shall be refunded to the applicant.

9.4 The City may enter into an agreement with one or more individuals constructing a water main extension at their own expense whereby a sum not to exceed seventy-five percent (75%) of all charges which the City may collect from other applicants for service off the subject main for a period not to exceed five (5) years may be refunded to the contributor. The total refunds, including any paid under the provisions of Paragraph 9.2, shall in no event exceed the actual cost of the construction of the main.

10. MAINS OUTSIDE CITY LIMITS:

10.1 The extension of water service beyond City limits shall only be permitted upon approval of the City Council. The City council shall not approve the extension of water service unless it finds the City has sufficient water supply and sewer treatment capacity to accommodate its current customers and the growth anticipated per the General Plan.

11. UNLAWFUL TO EXCAVATE:

11.1 It shall be unlawful for any person, firm or corporation to make or cause to be made any connection with or to the City water system unless authorized by the City.

12. OWNERSHIP:

12.1 All meters, meter fittings and reading equipment located on public or private property, are the property of the City and no part of the cost thereof will be refunded to the applicant. The City reserves the right to repair, replace and maintain said service connections, as well as to remove them upon discontinuance of service

12.2 The City owns all distribution pipelines located in streets, highways, public ways, alleys, or right-of-ways which are used to serve the general public, and the owner of the lands upon which future pipelines are to be located, shall as a prerequisite to service grant easements unto the City for said purposes.

13. INSTALLATION OF SERVICE CONNECTIONS:

13.1 Water service connections will be installed in the size and at the location desired by the City and applicant where distribution mains exist and where such requests are in accordance with all regulations. Service connections will be made only to property abutting on public streets, alleys, right-of-ways, or easements.

13.2 Installation charge for meters and laterals if done by the City will be: Actual cost plus fifteen percent (15%).

13.3 Applicant will deposit with the City the estimated cost for installations before installation is made by the City

13.4 Applicant may arrange for the installation of the water service connections by an approved contractor. Said installation will be in accordance with the standards set forth by the City and will be subject to City approval.

13.5 Where the distribution main was previously installed and applicant or property to be served did not participate in the cost thereof, applicant shall be required to pay his or her pro-rata portion of the installation cost of said main prior to receiving service.

14. METERS:

14.1 Meters will be required as a prerequisite to receiving service for all users. For commercial and industrial development, separate meters shall be installed for each portion of the property that is or could be used or occupied by a different customer class.

14.2 Meters will be installed at accessible locations at the curb, or at the property line, or when approved, in other suitable locations, when required under this resolution. Owners shall be responsible for maintaining area around meter to provide adequate access.

14.3 Upon installation, meters will become the property of the City. No rents or other charges will be paid by the City for a meter or other facilities, including housing and connections, located on a customer's premises.

14.4 All meters may be sealed by the City at the time of installation, and no seal shall be altered or broken except by an authorized City employee.

14.5 Meters or services moved for the convenience of the customer will be relocated at the customer's expense. Meters or services moved to protect the City's property will be moved at the City's expense.

14.6 The cost of a change in the size of a meter on an existing service will be paid for by the customer.

14.7 Customers, other separate businesses on the same premises, now receiving water service without meters, shall install meters within a reasonable length of time upon written request to do so from the City.

14.8 All meters will be tested prior to installation by the water meter manufacturer and no meter will be installed unless the accuracy is within one and one-half percent (1.5%) of one hundred percent (100%) accurate. .

14.9 If a customer desires to have the meter serving their premises tested, he/she shall pay a deposit of twenty dollars ($20.00) prior to testing. Should the meter register more than one and one-half percent (1.5%) "fast", the deposit will be refunded, but should the meter register less than one and one-half percent (1.5%) "fast", the deposit will be retained by the City.

14.10 If a meter tested at the request of a customer is found to be more than five percent (5%) slow, the City may bill the customer for the amount of the undercharge based upon corrected meter readings for the period, not exceeding six months, that the meter was in use.

14.11 If a meter is found to be non-registering due to any cause, except the non-use of water, the charges for service will be based on the estimated consumption. Such

estimates shall be made from previous consumption for a comparable period or by such other method as is determined by the City Utility Billing Supervisor.

15. RESPONSIBILITY FOR METERS AND INSTALLATION:

15.1 The customer shall use all reasonable care to prevent damage to the meter or any other facilities loaned by the City that are used in furnishing the service from the time they are installed until they are removed. If meters or other facilities are damaged by the customer, the cost of making repairs shall be paid by the customer, except to the extent that the City caused or contributed to the damage.

16. DAMAGE TO WATER SYSTEM FACILITIES:

16.1 The customer shall be liable for any damage to the City-owned customer water service facilities when such damage is from causes originating on the premises by an act of the customer or his tenants, agents, employees, contractors, licensees or permitees, including the breaking or destruction of locks by the customer or others on or near a meter, and any damage to a meter that may result from hot water or steam from a boiler or heater on the customer's premises. The City shall be reimbursed by the customer for any such damage promptly on presentation of a bill.

17. MAINTENANCE:

17.1 The service connection, including the meter and the meter box, will be repaired and maintained by the City at its own expense. The City, however, shall not be responsible for the installation and maintenance of water lines beyond the end of its service connection. Water lines beyond the City's service connections must be maintained in proper condition by the property owner.

18. GROUNDWIRE ATTACHMENTS:

18.1 All persons are forbidden to attach any ground wire or wires to any plumbing which is or may be connected to a service connection or main belonging to the City; the City will hold the customer liable for any damage to its property occasioned by such ground wire attachments.

19. CONTROL VALVE ON THE CUSTOMER PROPERTY:

19.1 The customer shall provide a valve on his side of the service installation as close as is practical to the meter location, street, highway, alley or easement in which the water main serving the customer's property is located, to control the flow of water to the piping on his premises. The customer shall not use the service curb stop to turn the water on and off for his convenience.

20. CROSS-CONNECTION REGULATIONS:

20.1 The purpose of these regulations are (1) to protect the public water supply against actual or potential cross-connection by isolating within the premises contamination or pollution that may occur because of some undiscovered or unauthorized cross-connection on the premises; (2) to eliminate existing connections between drinking water systems and other sources of water that are not approved as safe and potable for human consumption; (3) to eliminate cross-connection between drinking water systems and other sources of water or process water used for any purpose whatsoever which jeopardize the safety of the drinking water supply; (4) to protect the public potable water supply from the possibility of contamination or pollution by potential intermittent, temporary, and emergency users of the water system, including but not limited to use of fire hydrants and blow-offs; (5) to prevent the making of cross-connections in the future; (6) to provide for the maintenance of a continuing cross-connection control program to effectively prevent the contamination or pollution of the City's potable water system by cross-connections.

20.2 DEFINITIONS FOR CROSS-CONNECTION REGULATIONS:

APPROVED: Accepted by the City as meeting applicable specifications stated in this resolution, or as suitable for the proposed use.

APPROVED WATER SUPPLY: Any water supply approved by or under the public health supervision of a public health agency of the State of California, or its political subdivisions. In determining what constitutes an approved water supply, the State Department of Public Health reserves final judgment as to its safety and potability.

AUXILARY WATER SUPPLY: Any water supply on or available to the premises other than the public water supply.

AWWA STANDARD: An official standard developed and approved by the American Water Works Association (AWWA).

BACKFLOW: The flow of water or other liquids, mixtures or substances, under positive or reduced pressure in the distribution pipes of a potable water supply from any sources other than its intended source.

BACKFLOW PREVENTION ASSEMBLY: An assembly or means designed to prevent backflow or back-siphonage.

(A) **AIR-GAP SEPARATION (AG)** – A physical break between a supply pipe and a receiving vessel. The air-gap shall be at least double the diameter of the supply pipe measured vertically above the top rim of the vessel, in no case less than one inch.

(B) **REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTION ASSEMBLY (RP)** – An assembly consisting of two (2) independently operating check valves with an automatically operating differential relief valve located between the two (2) checks, a tightly closing shut-off valve on each side of the check valve assembly, and properly located test cocks for the testing of each check valve and the relief valve.

(C) **DOUBLE CHECK VALVE ASSEMBLY (DC)** – An assembly of two (2) independently operating, spring loaded check valves with tightly closing shut-off valves on each side of the check valve assembly and properly located test cocks for the testing of each check valve.

BACKPRESSURE: A Condition in which the owner's system pressure is greater than the suppliers' system pressure.

BACK-SIPHONAGE: The flow of water or other liquids, mixtures or substances into the distributing pipes of a potable water supply system from any source other than its intended source caused by a sudden reduction of pressure in the potable water supply system.

CONTAMINANT: A substance that will impair the quality of the water to a degree that it creates a serious health hazard to the public.

CROSS-CONNECTION: As used in this resolution means any unprotected actual or potential connection between a potable water system and any other water source or system, including without limitation by-pass or changeover devices, or other devices through which backflow could occur.

CUSTOMER/USER: Any person obtaining water from the City of Rohnert Park water supply system.

DEGREE OF HAZARD: Derived from an evaluation of the potential risk to public health and the adverse effect of the hazard upon the potable water system.

PUBLIC WORKS UTILITIES SERVICES SUPERVISOR: The Utilities Services Supervisor is hereby vested with the authority and responsibility for the implementation of an effective cross-connection control program and for the enforcement of the provisions of these regulations.

HEALTH AGENCY: The California Department of Health Services.

LOCAL HEALTH AGENCY: The county or city health authority.

OWNER: Any person, who has legal title to, or a right to the use or occupancy of, a property upon which a cross-connection inspection is to be made or upon which a cross-connection is present.

PERSON: Any individual, partnership, company, public or private corporation, political subdivision or agency of the United States State of California or other governmental entity.

POLLUTANT: A foreign substance that, if permitted to get in the public water system, will degrade its quality so as to constitute a moderate hazard, or impair the usefulness or quality of the water to a degree which does not create an actual hazard to the public health but which does adversely and unreasonable affect such water for domestic use.

RECLAIMED WATER: A wastewater which, as a result of treatment, is suitable for uses other than potable use.

SERVICE CONNECTION/USER CONNECTION: The terminal end of a service connection from the public potable water system; i.e., where the City may lose jurisdiction and sanitary control over the water at its point of delivery to the customer's water system. If a meter is installed at the end of the service connection, then the service connection shall mean the downstream end of the meter. There should be no unprotected takeoffs from service line ahead of any meter or backflow prevention assembly located at the point of delivery to the customer's water system. Service connection shall also include water service connection from a fire hydrant and all other temporary or emergency water service connections from the public potable water system.

WATER, NONPOTABLE: Water which is not safe for human consumption or which is of questionable potability.

WATER, POTABLE: Any water which, according federal, state and local regulations and standards, is safe for human consumption.

20.3 CROSS-CONNECTION AND PROTECTION REQUIREMENTS:

20.3.1 The regulations of the California State Department of Health and the Drinking Water Standards of the United States Public Health Service prohibit unprotected cross-connections between the public water supply and any unapproved source of water. All water cross-connections must be approved by the City and a permit issued by the City Building Official prior to installation. To comply with the regulations of the health agencies, the City will require the installation of approved backflow prevention assemblies by and at the expense of the Owner for continued services or before a new service will be granted.

20.3.2 The City will operate a cross-connection control program to include the keeping of necessary records which fulfills the requirements of the California Department of Health Services (CDHS).

20.3.3 If the City requires that the public water supply be protected by a backflow prevention assembly, the Owner shall be responsible for water quality beyond the outlet end of the backflow prevention assembly and should utilize fixture outlet protection for that purpose.

20.4 PERMIT REQUIRED FOR CROSS-CONNECTIONS:

20.4.1 A permit shall be required from the City Public Works Utilities Services Supervisor for any customer requesting connection to the water supply on an intermittent or temporary basis including but not limited to the use of fire hydrants or blow-offs for construction water, flushing lines, or similar purposes.

20.5 WHERE PROTECTION IS REQUIRED:

20.5.1 Each service connection from the City water system for supplying water to premises having an auxiliary water supply shall be protected against backflow of water from the premises into the public water system unless the auxiliary water supply is accepted as an additional source by the City, and is approved by the public health agency having jurisdiction.

20.5.2 Each service connection from the City water system for supplying water to any premises on which any substance is handled under pressure in such fashion as to permit entry into the water system shall be protected against backflow of the water from premises into the public system. This shall include the handling of process waters and waters originating from the City water system which have been subjected to deterioration in sanitary quality.

20.5.3 Backflow prevention assemblies shall be installed on the service connection to any premises that have internal cross-connections unless such cross-connections are abated to the City's satisfaction and approved by the state or local health department.

20.5.4 Backflow prevention assemblies shall be installed on tank trucks and spray tanks of 49 gallons or more, that will connect to the City's system, and shall be inspected and approved by the City prior to making connection.

20.6 TYPE OF PROTECTION REQUIRED:

20.6.1 The type of protection that shall be provided to prevent backflow into the public water supply shall commensurate with the degree of hazard that exists on the customer's premises. The type of protective assembly that may be required (listing in an increasing level of protection) include: Double Check Valve Assembly (DC),

Reduced Pressure Principle Backflow Prevention Assembly (RP), and an Air-Gap Separation (AG). The Owner may choose a higher level of protection than required by the City. The minimum types of backflow protection required to protect the public water supply, at the customer's water connection to premises with varying degrees of hazard are given in Table 1. Situations which are not covered in Table 1 shall be evaluated on a case by case basis and the appropriate backflow protection shall be determined by the City Public Works Utilities Services Supervisor and/or health agency.

TABLE 1
TYPE OF PROTECTION REQUIRED

Degree of Hazard	Minimum Type of Backflow Prevention
(A) Sewage and Hazardous Substances	
(1) Premises where the public water system is used to supplement the reclaimed water supply.	AG
(2) Premises where there are wastewater pumping and/or treatment plants and there is no inter-connection with the potable water system. This does not include a single family residence that has a sewage lift pump. A RP may be provided in lieu of an AG if approved by the City Public Works Utilities Services Supervisor and the health agency.	AG
(3) Premises where reclaimed water is used and there is no interconnection with the potable water system. A RP may be provided in lieu of an AG if approved by the City Public Works Utilities Services Supervisor and the health agency.	AG
(4) Premises where hazardous substances are handled in any manner in which the substances may enter a potable water system. This does not include a single family residence that has a sewage lift pump. A RP may be provided in lieu of an AG if approved by the City Public Works Utilities Services Supervisor and the health agency.	AG
(5) Premises where there are irrigation systems into which fertilizers, herbicides, or pesticides are, or can be, injected.	RP

(B)	Auxiliary Water Supplies:	
	(1) Premises where there is an unapproved auxiliary water supply which is interconnected with the public water system. A RP or DC may be provided in lieu of an AG if approved by the City Public Works Utilities Services Supervisor and the health agency.	AG
	(2) Premises where there is an unapproved auxiliary water supply and there are no interconnections with the public water system. A DC may be provided in lieu of a RP if approved by the City Public Works Utilities Services Supervisor and the health agency.	RP
(C)	Fire Protection Systems:	
	(1) Premises where the fire system is directly supplied from the public water system and there is an approved auxiliary water supply on or to the premises (not interconnected).	DC
	(2) Premises where the fire system is supplied from the public water system and interconnected with an unapproved auxiliary water supply. A RP may be provided in lieu of an AG if approved by the City Public Works Utilities Services Supervisor and the health agency.	AG
	(3) Premises where the fire system is supplied from the public water system and where either elevated storage tanks or fire pumps which take suction from the private reservoirs or tanks are used.	DC
(D)	Premises where entry is restricted so that inspections for cross-connections cannot be made with sufficient frequency or at sufficiently short notice to assure that cross-connections do not exist.	RP
(E)	Premises where there is a repeated history of cross-connections being established or re-established.	RP
(F)	In the case of tankers and spray tanks of 49 gallons or more, including but not limited to fire tankers.	AG/RP

20.7 BACKFLOW PREVENTION ASSEMBLY– Installation & Maintenance:

20.7.1 Wherever backflow protection has been found necessary on a water supply line entering a customer's premises, then any and all water supply lines from the City's mains entering such premises, buildings, or structures shall be protected by an approved backflow prevention assembly. Installation and maintenance of approved backflow prevention assemblies must comply with the following:

A. A permit shall be obtained from the City Building Official prior to installing any backflow prevention assembly.

B. Only backflow prevention assemblies which have been constructed to the applicable AWWA standards and have passed laboratory and field evaluation tests performed by a recognized testing organization which has demonstrated their competency to perform such tests to the State Department of Health Services shall be approved for installation.

C. Backflow prevention assemblies shall be installed per City standards. The City shall have the final authority in determining the required location of a backflow prevention assembly.

D. Section 7605, Title 17 of the California Administrative Code and City of Rohnert Park Rules and Regulations, Section 20, requires that the owners of any premises which, or on account of which, backflow prevention assemblies are installed, shall have the assemblies tested by a person who has demonstrated their competency, according to Section 20.9, in testing of these assemblies to the City. Backflow prevention assemblies must be tested annually and immediately after they are installed, relocated or repaired and they must not be placed back in service unless they are functioning as required. A report of inspection shall be filed with the City each time an assembly is tested. These assemblies shall be serviced, overhauled or replaced whenever they are found to be defective and all cost of testing, repair and maintenance shall be borne by the Owner.

E. Approved backflow prevention assemblies may be inspected and tested periodically by the City.

F. All presently installed backflow prevention assemblies which do not meet the requirements of this section but were approved assemblies for the purposes described herein at the time of installation and which have been properly maintained, shall, except for the maintenance and inspection

requirements under subsections 20.7.1 D., and E., of this resolution, be excluded from the requirements of these rules unless the degree of hazard is such as to supersede the effectiveness of the present backflow prevention assembly as determined by the City Public Works Utilities Services Supervisor. Whenever the existing assembly is moved from the present location or fails initial field tests, the unit shall be replaced at the cost of the Owner by a backflow prevention assembly meeting all requirements of this resolution.

20.8 Timing of installation and responsibility for backflow prevention assemblies for services with existing connections:

20.8.1 The City will conduct a survey of existing connections to determine if an actual or potential cross-connection exists. The owner of existing connections shall allow his/her property to be inspected for possible cross-connections and shall follow the provisions of the City's Cross-Connection Control Program and CDHS regulations if a cross-connection is present.

20.8.2 The City will notify the Owner of these properties by letter if an approved backflow prevention assembly is required. The backflow prevention assembly must be installed within sixty (60) days of notification per City Standards. This time period may be shortened depending upon the degree of hazard involved.

20.8.3 After said sixty (60) days, if the property Owner has not installed the required backflow prevention assembly, the City will have the assembly installed and bill the Owner for the entire amount of installation including all materials, equipment and labor. This amount will become a lien on the real property to which said service was provided per Section 30.13 herein.

20.8.4 The owner, after installation is completed, shall, at his/her expense, maintain, repair and annually test any and all backflow prevention assemblies on his premises according to City Regulations and Standards governing the Cross-Connection Control Program.

20.9 Requirements for Certification as a Backflow Prevention Assembly Tester:

20.9.1 Each applicant for certification as a tester of backflow prevention assemblies shall have a City of Rohnert Park Business License.

20.9.2 Competency in all phases of backflow prevention assembly testing and repair must be demonstrated by means of education and/or experience in order to obtain certification.

20.9.3 The following are minimum requirements:

A. Applicants shall have had at least two (2) years experience in plumbing or pipe fitting or equivalent qualifications.

B. Hold a valid Backflow Prevention Assembly Tester certification from the American Water Works Association (AWWA) California-Nevada Section, or USC Foundation for Cross-Connection Control & Hydraulic Research.

C. Each applicant shall furnish evidence to show that he has available the necessary tools and equipment to properly test such assemblies. He shall be responsible for the competency and accuracy of all tests and reports prepared by him. He shall provide an annual equipment calibration certification to the City for each piece of testing equipment.

20.9.4 The certification issued to any tester is valid for a period of one year and may be revoked, suspended, or not renewed by the City for improper testing, repairs, and/or reporting; or for failure to provide proof of Backflow Prevention Assembly Tester certification and/or annual equipment calibration certification.

21. [RESERVED]

22. PROTECTION AGAINST INTERSTREET MAIN FLOW:

22.1 Two or more services supplying water from different street mains to the same building, structure or premises through which an interstreet main flow may occur, shall have a standard check valve on each water service to be located adjacent to and on the property side of the respective meters. Such check valves shall not be considered adequate if backflow prevention is deemed necessary to protect the City's mains from pollution or contamination but installation of approved backflow assemblies at such meters shall be required to satisfy the requirements for standard check valves.

23. INTERRUPTIONS IN SERVICE:

23.1 The City will not be liable for interruption, shortage, or insufficiency of supply, or for any loss or damage occasioned thereby caused by accidents, or acts of God, fire, strikes, riots, war, power outages or any other causes.

23.2 The City, whenever it shall find it necessary or convenient for the purpose of making repairs or improvements to its system shall have the right to temporarily suspend delivery of water and it shall not be liable for any loss or damage occasioned thereby.

24. **WATER PRESSURE CONDITIONS:**

24.1 All applicants for service connections or water service shall be required to accept such conditions of pressure and service as are provided by the distribution system at the location of the proposed service connection, and to hold the City harmless for any damages arising out of low pressure or high pressure conditions or interruptions in service.

25. **RATES FOR WATER SERVICE:** Rates for water service shall be adopted by ordinance of the City Council.

26. **OUTSIDE CITY SERVICE CHARGE:** Service charges shall be adopted by ordinance of the City Council.

27. **MULTIPLE UNITS:**

27.1 Separate houses, buildings, or business quarters on the same premises, under a single control of management, may be serviced at the option of the applicant, and with City approval, by either of the following methods:

(1) Through a single metered service connection to the entire premises, on which only one minimum charge will be applied.

(2) Through separate connections to each or any unit provided that the pipeline system for each service is independent of the other, and is not interconnected.

27.2 Nothing in this section will be construed as preventing the City from requiring, when it deems appropriate, that separate residential or commercial units even though owned by the same customer be supplied with water through separate meters for each such unit.

28. **DEPOSITS:**

28.1 Each new applicant for water service shall establish and maintain credit to the satisfaction of the City by a cash guarantee deposit or otherwise, before service is rendered.

28.2 The amount of the cash guarantee deposit required by the preceding paragraph shall be an amount determined to be adequate by the Finance Director, but shall be $ 100.00 for all customers. No interest will be paid on cash guarantee deposits.

28.3 Deposits required by this resolution shall be deemed sufficient to cover any deposits required for City sewer service or garbage and trash collection service.

28.4 Deposits made by property owners are refundable after the expiration of one year if the property owners' account has not been in arrears at anytime during the first year of said deposit. If the service is discontinued in less than one year, the

deposit will be applied to the account to offset any outstanding amount due. Credit balances after all charges have been invoiced will be refunded.

28.5 Deposits made by other than property owners shall be applied on account upon termination of service. Credit balances after all charges have been invoiced will be refunded.

28.6 No refunds will be made on the charges for service connections.

28.7 Any deposit eligible for refunding uncalled for within five (5) years from the date when made will become the property of and be retained by the City.

29. APPLICATION OF DEPOSITS TO UNPAID ACCOUNTS:

29.1 Deposits prescribed herein, will be applied to unpaid bills for water service when such service has been discontinued. The City may require the customer to redeposit the amount herein specified before rendering water service again to the customer's new address of service.

30. BILLS AND PAYMENTS:

30.1 Bills for metered residential service will be rendered bi-monthly in arrears unless otherwise provided.

30.2 Bills for commercial and other metered accounts will be rendered bi-monthly in arrears unless otherwise provided.

30.3 Flat rate service shall be by special arrangement only. Bills for flat rate service will not be less than the estimated monthly charge for service. The amount paid in excess of the pro-rated period will be credited against the charge for the succeeding month.

30.4 For metered service the charge will be based on actual consumption.

30.5 If the total period of water use is less than the billing period, the period of water used may be prorated.

30.6 Bills are due upon presentation. Payment may be made at the City Finance Department, either by mail or in person, or at other places designated by the City.

30.7 Bills for all accounts billed in arrears are due and payable upon presentation and become delinquent on the 30th day following the period for which the bill was rendered. Bills not paid by this date shall be subject to a penalty of ten percent (10%).

30.8 Reminder notices may be sent out at the discretion of the Finance Director.

30.9 Delinquent notices will be sent out to those accounts whose balance is past due. If payment is not received within ten (10) days from the date of the delinquent invoice, a Shut-Off Notice will be mailed. Five (5) days will be allowed after the Shut-Off Notice is mailed before service is disconnected for non-payment.

30.10 When an application is made for water service by a former customer who was responsible for and failed to pay all bills for service previously rendered regardless of location or time when incurred, the City may refuse to furnish service to such applicant until the outstanding bills are paid. It may also require, as a guarantee for the payment of future bills, a cash guarantee deposit.

30.11 When water service is discontinued, the City may demand the full amount of both delinquent and current bills be paid in full, and the same shall be paid in full before service is restored.

30.12 Closing bills are due and payable upon presentation. Collection will be made at the time of presentation.

30.13 Where owners of real property fail to pay bills for water service provided to their property, the delinquent amounts shall become a lien on the real property to which said service was provided in accordance with the lien procedures as provided by the laws of the State of California.

30.14 Service may be refused to a property if a balance is still due to the City for prior service provided to the property.

30.15 Each meter on customer's premises will be considered separately.

30.16 A fee of twenty-five dollars ($25.00) will be charged to customers for checks returned by banks for non-payment for any reason.

30.17 Bills for City repair of damage by others to City property shall include the cost of such repair plus ~~seventy~~ thirty-five percent (35%) for City administration and overhead.

31. DISCONTINUANCE OF SERVICE:

31.1 A customer's water service may be discontinued if a bill is not paid within fifteen (15) days after the delinquency notices are mailed.

31.2 Notice of Shut Off for non-payment need not be given to those accounts which are continually in arrears and who indicate that they will make a payment on their account but fail to do so and also for those accounts whose experience rating with the City is poor.

31.3 The City may discontinue Service of water to any premises after reasonable notification if unprotected cross-connections exist on the premises, or if any defect is found in an installed backflow prevention assembly, or if a backflow

prevention assembly has been removed or bypassed. Service will not be restored until such conditions or defects are corrected.

32. RE-ESTABLISHMENT OF CREDIT:

32.1 To re-establish credit, a customer may be required to pay all back bills up to the time service was discontinued. He may also be required to pay re-connection charges of $35.00 if re-connection is completed during business hours and $100.00 if re-connection is after business hours and make a cash deposit as outlined under the regulations herein set forth for deposits for payment of water bills.

33. CUSTOMER'S REQUEST FOR SERVICE DISCONTINUANCE:

33.1 A customer may have his water service discontinued by notifying the City reasonably well in advance of the desired date of discontinuance. He will be required to pay all water charges until the date of discontinuance.

33.2 A customer about to vacate any premises supplied with water by the City shall give notice of his intended removal prior thereto, specifying the date service is desired to be discontinued; otherwise he will be held responsible for all water furnished to such premises until the City has received such notice of removal.

34. TEMPORARY SERVICE:

34.1 Duration of Service – Temporary service connection shall be discontinued and terminated within six (6) months after installation unless the City grants an extension of time in writing.

34.2 Deposit – The applicant will deposit, in advance, the estimated cost of installing and removing the facilities required to furnish said service exclusive of the cost of salvageable material. Upon discontinuance of service the actual cost shall be determined and an adjustment made as an additional charge, refund or credit. If service is supplied through a fire hydrant, the applicant will be charged in accordance with the following rate schedule:

Deposit	$2,500.00
Flat charge per connection, for City inspection, installation and removal of service facilities, including the meter if required.	$ 100.00
Each additional move of facilities to another Location.	$ 30.00

34.3 Installation and Operation. All facilities for temporary service to the customer connection shall be made by the City or a licensed contractor and shall be operated in accordance with instructions.

34.4 Responsibility for Meters and Installation. The customer shall use all possible care to prevent damage to the meter or to any other loaned facilities of the City which are involved in furnishing the temporary service from the time they are installed until they are removed, or until forty-eight (48) hours notice in writing has been given to the City that the contractor or other person is through with the meter or meters and the installation. If the meter or other facilities are damaged, the cost of making repairs shall be paid by the customer.

34.5 Temporary Service from a Fire Hydrant. If temporary service is supplied through a fire hydrant, a permit for the use of the hydrant shall be obtained from the Public Works Utilities Services Supervisor. It is specifically prohibited to operate the valve of any fire hydrant other than by the use of a spanner wrench designed for this purpose.

34.6 Unauthorized Use of Hydrants. Tampering with any fire hydrant for the unauthorized use of water there from, or for any other purpose is a misdemeanor, punishable by law.

34.7 Rates.

34.7.1 The rates for regular service shall be increased by one hundred percent (100%) for temporary hydrant metered service.

34.7.2 The meter rental fee shall be $50 per month.

35. REPEAL OF CONFLICTING RESOLUTIONS:

35.1 All previous City Council actions and all other Resolutions inconsistent with the terms of this Resolution are herewith repealed.

36. SEVERABILITY:

36.1 The City Council hereby declares that every section, paragraph, sentence, clause and phrase is

severable. If any section, paragraph, sentence, clause or phrase of this article is for any reason found to be invalid or unconstitutional, such invalidity, or unconstitutionality shall not affect the validity or constitutionality of the remaining sections, paragraphs, sentences, clauses or phrases.

37. **EFFECTIVE DATE:**

37.1 This Resolution will become effective April 1, 2005.

DULY AND REGULARLY ADOPTED by the Rohnert Park City Council this 22nd day of March 2005.

ATTEST:

CITY OF ROHNERT PARK

Ellen Beardsley

Deputy City Clerk

Mayor Jake Mackenzie

FLORES: AYE	**SMITH: AYE**	**SPRADLIN: AYE**	**VIDAK-MARTINEZ: AYE**	**MACKENZIE: AYE**
	AYES: (5)	**NOES: (0)**	**ABSENT: (0)**	**ABSTAIN: (0)**

ORDINANCE NO. 724

AN ORDINANCE AMENDING TITLE 13 OF THE ROHNERT PARK MUNICIPAL CODE TO ESTABLISH A WATER SHORTAGE EMERGENCY PLAN

WHEREAS, nothing in this ordinance will preclude the City Council from passing an emergency resolution for the immediate curtailment of water use by its customers due to water supply shortages and delivery limitations caused by catastrophic events and conditions, either natural or unnatural.

NOW THEREFORE, the City Council of the City of Rohnert Park does ordain as follows:

SECTION 1. The Municipal Code of the City of Rohnert Park is hereby amended by adding Chapter 13.66 Water Shortage Emergency Plan, to Title 13, Water and Sewers, to read as follows:

Chapter 13.66

WATER SHORTAGE EMERGENCY PLAN

Sections:

13.66.010	Definitions.
13.66.020	Authorization.
13.66.030	Application.
13.66.040	Water waste prohibitions.
13.66.050	Water conservation stages.
13.66.060	Exceptions and application procedures for exceptions.
13.66.070	Violation--Enforcement.
13.66.080	Notice and hearing.
13.66.090	Violation--Additional remedy.

13.66.010 Definitions.

A. The "City" means the City of Rohnert Park acting by and through the City of Rohnert Park public works department as operator of the City of Rohnert Park water system.

B. "Manager" is the city manager of the City of Rohnert Park.

C. "Person" means any person, firm, partnership, association, corporation, company, organization, or governmental entity.

D. "Customer" means any person, whether within or without the geographic boundaries of the City of Rohnert Park, who uses water supplied by the City.

E. "GPD" means gallons per day.

F. "Water" means potable water.

13.66.020 Authorization. The City Manager or his or her designee, is authorized and directed to implement the applicable provisions of this chapter upon adoption of a City Council resolution determining that such implementation is necessary to protect the public health, safety, and welfare.

13.66.030 Application. The provisions of this chapter shall apply to all persons, customers, and property served by the City.

13.66.040 Water Waste Prohibitions. Non-essential uses and exemptions are those set forth in Chapter 13.62 of the Rohnert Park Municipal Code and shall be adhered to notwithstanding any provision in this chapter.

13.66.050 Water conservation stages. No customer of the City shall make, cause, use, or permit the use of water from the City for residential, commercial, industrial, agricultural, governmental, or any other purpose in a manner contrary to any provision of this chapter, or in an amount in excess of that use permitted by either Conservation Stage 2 or 3 when in effect as declared by separate resolution of the City Council, in accordance with the provisions of this Chapter.

A. Stage 1. Voluntary Conservation. In order to achieve an overall system-wide reduction goal of 10 percent, all potable water customers of the City shall be requested to:
    1. Apply irrigation water only during the evening and early morning hours to reduce evaporation losses.
    2. Inspect all irrigation systems, repair leaks, and adjust spray heads to provide optimum coverage and eliminate avoidable over-spray.
    3. For irrigation valves controlling water applied to lawns, vary the minutes of run-time consistent with fluctuations in weather.
    4. Reduce minutes of run-time for each irrigation cycle if water begins to run-off to gutters and ditches before the irrigation cycle is completed.
    5. Utilize water conservation incentive, rebate and giveaway programs to replace water guzzling plumbing fixtures and appliances with water efficient models.
    6. Utilize City information regarding using water efficiently, reading water meters, repairing ordinary leaks, and water efficient landscape.

B. Stage 2. Mandatory Compliance -- Water Alert. The City Council may by resolution declare a Conservation Stage 2 upon recommendation by the City Manager based on water supply and delivery projections by the City Engineer that an overall system-wide reduction of 20 percent is necessary, taking into consideration projections and estimates made by the Sonoma County Water Agency pertaining to the Russian River water

supply. In order to achieve an overall system-wide reduction of 20 percent, the following activities shall be prohibited:

1. Non-essential uses of water, including the following:
   a. Refilling or initial filling of a swimming pool
   b. Non-commercial washing of privately-owned motor vehicles, trailers and boats except from a bucket and except that a hose equipped with a shut-off nozzle may be used to rinse a vehicle.
   d. Any use of water from a fire hydrant except for fighting fires or essential construction needs.
   e. Use of water for dust control at construction sites.
2. Water use by a vehicle washing facility in excess of 20% less than the amount used by it during the corresponding billing period in the prior year.
3. Water use for any non-residential use in excess of 20% less than the amount used by the customer during the corresponding billing period in the prior year.

C. Stage 3. Mandatory Compliance -- Water Emergency. The City Council may by resolution declare a Conservation Stage 3 upon recommendation by the City Manager based on water supply and delivery projections by the City Engineer that an overall system-wide reduction of 30 percent is necessary, taking into consideration projections and estimates made by the Sonoma County Water Agency pertaining to the Russian River water supply. In order to achieve an overall system-wide reduction of 30 percent, the following activities shall be prohibited:
   1. Any activities prohibited during a Conservation Stage 2.
   2. Watering any residential lawn, or any commercial or industrial area lawn irrigated with potable water, at any time day or night.
   3. Planting any new landscaping, except for designated drought resistant landscaping prescribed by the city manager or designated representative.
   4. All day and night-time irrigation sprinkling unless only a hand held nozzle is used. An exception will be made to permit drip irrigation for established perennial plants and trees using manual or automatic time-controlled water application.
   5. Planting of new annual plants, vegetables, flowers or vines may not be planted until the Stage 3 emergency is over.

<u>13.66.060 Exceptions and application procedures for exceptions</u>. Any customer of the City may make written application for an exception. Said application shall describe in detail why applicant believes an exception is justified.

A. The City Manager may grant exceptions for use of water otherwise prohibited by this section upon finding and determining that failure to do so would cause an emergency condition affecting the health, sanitation, fire protection or safety of the applicant or public; or, cause an unnecessary and undue hardship on applicant or the public, including but not limited to, adverse economic impacts, such as loss of production or jobs.

B. The decision of the City Manager may be appealed to the City Council by submitting a written appeal to the City Clerk within fifteen (15) calendar days of the date of the

decision. Upon granting any appeal, the City Council may impose any conditions it determines to be just and proper. Exceptions granted by the City Council shall be prepared in writing and the City Council may require the exception be recorded at applicant's expense.

13.66.070 Violation--Enforcement. The violation of each provision of this chapter, and each separate violation thereof, shall be deemed a separate offense, and shall be enforced as an infraction in accordance with Chapter 1.24 of the Rohnert Park Municipal Code. The City may take some or all of the following actions. Fees and charges for the activities below may be established by resolution of the City Council.

A. Personal contact with the customer at the address of the water service. If personal contact is unsuccessful, written notice of the violation including a date that the violation is to be corrected may be left on the premises, with a copy of the notice sent by certified mail to the customer.
B. Written notice to the customer of the water waste violation including a specified period of time to correct the violation.
C. After notice and a hearing provided in accordance with section 13.66.080 below, the City Council may authorize the installation of a flow-restricting device on the service line and require payment of a fee in amount set by City Council resolution.
D. The City Council may charge a water waste fee to the customer in an amount set by City Council resolution.
E. After notice and a hearing provided in accordance with section 13.66.080 below, the City Council may authorize termination of water service and the charge for same shall be billed to the customer. Except in cases of extreme emergency as solely determined by the City Manager, service shall not be reinstated until verified by the City Manager that the violation has been corrected and all charges and fees have been paid.

13.66.080 Notice and hearing. Before either installing a water restrictor or terminating water service, the City shall give written notice to the person responsible for the service connection to be either restricted or terminated of its intention to do so. The person or persons to whom notice is given shall have five business days from the date of service of the notice to request a hearing before the city manager or his or her designee in order to present any and all evidence they may have as to why a restrictor should not be installed or service terminated. If a hearing is requested, the City Manager or his or her designee shall schedule a date and time for said hearing as soon as possible after the request is filed, but not later than five business days after the filing or such request for hearing. At the hearing, the person whose service connection is to be restricted or terminated and the utilities personnel may offer evidence. The City Manager or his or her designee shall make a final determination as to whether service should be restricted or terminated and under what conditions.

13.66.090 Violation--Additional remedy. As an additional remedy, the violation of any provision of this chapter by any person who has received more than one written warning pursuant to Section 13.66.070 to refrain from the same or any other violation under this chapter in one calendar year shall be deemed and is declared to be, a public nuisance and may be subject to abatement in accordance with Chapter 1.24 of the Rohnert Park Municipal Code.

SECTION 2. Repeal of Conflicting Ordinances. All former Ordinances or parts thereof conflicting or inconsistent with the provisions of this Ordinance or of the Code hereby adopted are thereby repealed.

SECTION 3. Severability. If any section, subsection, sentence, clause or phrase of this Ordinance is for any reason held to be invalid, such decision shall not affect the validity of the remaining portions of this Ordinance. The City Council hereby declares that it should have adopted the Ordinance and each section, subsection, sentence, clause or phrase thereof, irrespective of the fact that any one or more sections, subsections, sentences, clauses or phrases be declared unconstitutional.

SECTION 4. Effective Date: This ordinance shall be in full force and effective 30 days after its adoption and shall be published and posted as required by law.

SECTION 5. Pursuant to Health and Safety Code section 21065, this Ordinance is not a project subject to the California Environmental Quality Act.

This ordinance was introduced on the 12th day of October, 2004 and

DULY AND REGULARLY ADOPTED by the City Council of the City of Rohnert Park this 26th day of October, 2004 by the following vote:

AYES: **Five (5) Councilmembers Flores, Mackenzie, Spradlin, Vidak-Martinez and Mayor Nordin**

NOES: **None (0)**

ABSENT: **None (0)**

ASBSTAIN: **None (0)**

CITY OF ROHNERT PARK

Mayor Gregory A. Nordin

ATTEST:

City Clerk Judy Hauff

Approved as to Form:

Interim City Attorney Gabrielle Whelan

764388v2 80078/0012

RESOLUTION NO. 27308

RESOLUTION OF THE COUNCIL OF THE CITY OF SANTA ROSA DECLARING A WATER SHORTAGE EMERGENCY, IMPLEMENTING STAGE 1 OF THE CITY'S URBAN WATER SHORTAGE CONTINGENCY PLAN REQUESTING CUSTOMERS TO VOLUNTARILY REDUCE WATER USE BY 15%, AND AUTHORIZING UTILIZATION OF THE CATASTROPHIC RESERVE.

WHEREAS, the City of Santa Rosa is a City empowered to provide water service within certain boundaries; and

WHEREAS, the Sonoma County Water Agency (Agency) is the wholesaler of water to the City of Santa Rosa; and

WHEREAS, on February 2, 2009, the Agency held a press conference projecting that water storage may hit new historically low levels unless water rationing is ordered and significant rainfall occurs; and

WHEREAS, the Agency has not yet declared a water shortage nor reduced water allocations to the City of Santa Rosa and all municipal customers of the Agency; and

WHEREAS, the Agency has announced it anticipates requiring 30% mandatory rationing from its municipal customers within the coming weeks; and

WHEREAS, the City of Santa Rosa has the authority and responsibility to adopt water demand reduction measures within its area of service; and

WHEREAS, the City of Santa Rosa has the authority to employ the Catastrophic Reserve during a Water Shortage Emergency; and

WHEREAS, in preparation for the water shortage declaration from the Agency, Utilities Department staff is recommending implementation of Stage 1 of the City's Urban Water Shortage Contingency Plan; and

WHEREAS, on February 19, 2009, the Board of Public Utilities adopted a Resolution recommending that the Council of the City of Santa Rosa adopt a resolution declaring a water shortage emergency, directing staff to implement a program of demand management as defined by Stage 1 of the City's Urban Water Shortage Contingency Plan to realize City-wide water reduction of 15%, and authorizing staff to utilize the Catastrophic Reserve to compensate for loss of revenue due to reduced water sales.

NOW, THEREFORE, BE IT RESOLVED that the Council of the City of Santa Rosa declares a water shortage emergency and directs staff to implement a program of demand management as defined by Stage 1 of the City's Urban Water Shortage Contingency Plan to realize City-wide water reduction of 15%.

BE IT FURTHER RESOLVED that the Council authorizes staff to utilize the Catastrophic Reserve to compensate for loss of revenue due to reduced water sales.

IN COUNCIL DULY PASSED this 24th day of February, 2009.

AYES: (7) Mayor Gorin, Vice Mayor Vas Dupre, Councilmembers Bender, Sawyer, Jacobi, Wysocky and Olivares

NOES: (0)

ABSENT: (0)

ABSTAIN: (0)

ATTEST: _____
City Clerk

APPROVED: _____
Mayor

APPROVED AS TO FORM:

_____
City Attorney

COUNCIL POLICY			
Subject:	Policy Number	Effective Date	Number of Pages
WATER EFFICIENT LANDSCAPE POLICY	200-20	07/01/2007	Page 1 of 13

Introduction: The Water Efficient Landscape Policy was initially adopted by Resolution No. 21142 of the Santa Rosa City Council on December 22, 1992 in response to California's Government Code Section 65591 which requires local agencies to adopt water efficient landscape regulations. The Policy was updated to amend the Applicability, Definitions, Irrigation, Documentation for Compliance, Other Provisions and Provisions for Appeal sections and to add an Appendix to the policy and was adopted as Council Policy 200-XX by the Santa Rosa City Council on June 5, 2007 to apply to projects on or after July 1, 2007. The adopted Policy is shown below.

The Policy:

I. PURPOSE

The purpose of this policy is to ensure efficient water use by establishing standards for landscape design appropriate to Santa Rosa's climate, soils, water resources, land use and resource planning.

II. APPLICABILITY

1. This policy applies to all new projects, public and private, with landscaping that require conditional use permit or design review by the City, or a Utilities certificate on or after July 1, 2007[1], and in the following categories: office, commercial, industrial and institutional landscaping; park and greenbelt landscaping; developer-installed landscaping in multiple-family residential and in common areas of single-family residential.

2. This policy does not apply to landscaping in private areas of single-family and multiple-family residential projects, since they are subject to City Council Policy No. 200-19.

3. This policy does not apply to any landscapes irrigated by private well water. However, these projects are encouraged to use this policy as guidelines.

4. This policy does not apply to registered historical sites.

5. This policy does not apply to ecological restoration projects that do not require

1 Projects that have a completed application for a Conditional Use Permit, Building Permit, Design Review or Utilities Certificate on file prior to July 1, 2007 will be governed by the City of Santa Rosa Water Efficient Landscape Policy as adopted by City Council Resolution No. 21142 and as amended by City Council Resolution No. 26846.

permanent irrigation systems.

6. Parks, playgrounds, sports fields, golf courses, schools and cemeteries are exempt from the turf area limit of this policy. In these projects, turf will be allowed in all areas where functional need for turf is demonstrated. Every other requirement of this policy is applicable.

III. DEFINITIONS

For purposes of this Policy, the following definitions apply:

1. Drought resistant cool-season grass - Cool season grasses which can tolerate drought stress. These grasses usually require high-water-use irrigation scheduling to stay green and vital, but will survive under limited water. Examples: turf-type tall fescues e.g., Medallion and Rebel.

2. Functional need (for turf) - Turf planting which serves a functional or practical need rather than purely aesthetic purpose. Examples: athletic fields and pedestrian circulation areas.

3. High-water-use plantings - Turf, annuals, container plantings, and other plants recognized as high-water-use by the *Water Use Classification of Landscape Species* document (http://www.owue.water.ca.gov/docs/wucols00.pdf), as it currently exists or maybe amended in the future.

4. Hydrozone - A portion of a landscape having plants with similar water needs. Typically, a hydrozone is served by a valve or set of valves with the same type of irrigation hardware and schedule.

5. Irrigation circuit - A section of an irrigation system, including the piping and sprinkler heads or emitters, that is operated by a single remote control valve.

6. Low-water-use plants - "Mediterranean Region" and native trees, shrubs and groundcovers (such as rosemary), juniper, most native oaks, and other plants recognized as low-water-use by the *Water Use Classification of Landscape Species* document (http://www.owue.water.ca.gov/docs/wucols00.pdf), as it currently exists or maybe amended in the future.

7. Low Head Drainage - Water that escapes from the low irrigation heads after a valve has turned off.

8. Matched precipitation rate - All emission devices on a given irrigation valve apply water at the same rate.

9. Microclimate - A section of a landscaped site with unique climatic conditions that affect the amount of water plants within the area use. Examples of landscape mircroclimates include courtyards, tree understory areas, median islands.

10. Moderate-water-use-plant - Many ornamental trees, shrubs, and groundcovers, most fruit bearing trees, roses, and other plants recognized as moderate-water-use by the *Water Use Classification of Landscape Species* document, (http://www.owue.water.ca.gov/docs/ wucols00.pdf), as it currently exists or maybe amended in the future.

11. Non-mechanically compacted soil - Soil which has not undergone engineered compaction procedures.

12. Organic amendment - Any fully organic material added to the soil to improve soil structure, and other physical properties of the soil. Examples: composted sawdust, redwood soil conditioner, compost, peat moss.

13. Overspray - Water which is discharged from an overhead irrigation system outside the desired planting area, especially water which wets adjacent hard surfaces, e.g., sidewalks, patios, streets.

14. Porous landscape fabric - A material that allows water to flow through it to the soil surface.

15. Porous mulch - A loose material which is applied to the soil surface to reduce evaporation and retard weed growth. Examples of acceptable mulches include: wood chips, decomposed granite, straw, compost.

16. Project's landscaped area - The parcel area less building, footprints, driveways, paved walks and patios, parking areas and undeveloped open space or designated natural areas. The project's landscaped area does include all areas under irrigation, water features and hardscape other than those noted above.

17. Project water saving techniques (to mitigate run-off from slopes) - Landscape design techniques which either allows irrigation to be applied at a rate close to the infiltration rate of the soil or which captures and recycles run-off.

18. Rain shut-off device - A device which automatically shuts the irrigation system off when a measurable amount of rain occurs.

19. Reference evapotranspiration - A standard calculation of the quantity of water transpired by a reference crop and evaporated from adjacent soil surfaces as measured by the California Irrigation Management Information System (CIMIS) of weather stations.

20. Registered historical sites - Sites which are registered as historically significant through either national, state, city or county registries.

21. Runoff - Water which is not absorbed by the soil to which it is applied and runs off onto other areas. Runoff usually occurs when water is applied at a rate greater than the infiltration rate of the soil, and is especially problematic on slopes and on heavy clay soils.

22. Water feature - Ornamental or functional body of water or fountain.

IV. PLANT SELECTION, WATER FEATURES, AND USE LIMITATION

1. Turf, high-water plantings (e.g. annuals, container plants) and water features (e.g., fountains, pools) shall all be considered high-water-uses and shall be limited to not more than 40% of the project's landscaped area if non-drought resistant cool-season grass is used, and to no more than 50% of the landscaped area if drought resistant cool-season grass or warm-season grass is used.

2. Plants selected in all other landscaped areas shall be well-suited to the climate, geology and topographic conditions of the site, and shall be low-water-use once established.

3. No turf or high-water-use plants shall be allowed on slopes exceeding 10%, or 25% where other project water saving techniques can compensate for the increased runoff, and where need for such slopes is demonstrated.

4. No turf shall be allowed in areas eight feet wide or less.

5. Plants having similar water use shall be grouped together in distinct hydrozones and shall be irrigated with separate irrigation circuits.

6. Recirculating water shall be used for all water features.

V. SOIL CONDITIONING AND MULCHING

1. A minimum of one foot depth of non-mechanically compacted soil shall be available for water absorption and root growth in planted areas.

2. In areas with overhead irrigation, organic amendment shall be incorporated into the soil to a minimum depth of 6" at a minimum rate of 5 cubic yards per 1000 square feet, or per specific amendment recommendations from a soils laboratory report.

3. A minimum of a two inch layer of porous mulch shall be applied to all exposed soil surfaces of non-turf areas within the landscaped area. Non-porous material, such as plastic sheeting, shall not be placed under the mulch; porous landscape fabric is permitted.

VI. IRRIGATION

1. All planted landscaped areas shall be irrigated with automatic controllers with repeat start-time potential.

2. When the landscape contains more than one type of plant type (turf, ground cover, annual) or a variety of solar exposures, controllers shall have multiple program potential.

3. Separate irrigation circuits shall be provided for different plant types, irrigation methods, solar exposures, microclimates (e.g. understory, courtyard), slopes and soil types.

4. Pressure regulation shall be installed so that all components of the irrigation system operate at the manufacturer’s recommended optimal pressure

5. Point application methods (drip, bubbler) shall be used where overhead irrigation would result in overspray, runoff, or non-uniform application.

6. Irrigation delivery systems shall be designed in such a manner that water does not run off or overspray onto adjacent pavement, sidewalks, structures or other non-landscaped areas.

7. Sprinkler heads shall have matched precipitation rates on each irrigation circuit.

8. Rain shut-off devices shall be installed on each irrigation controller.
9. Check valves shall be installed where elevation differential may cause low head drainage.

VII. DOCUMENTATION FOR COMPLIANCE

The following documentation is to be presented to the City at each of the four steps of review defined below. This documentation is required for compliance with this policy.

STEP 1: PRELIMINARY DESIGN REVIEW

In the Preliminary Landscape Statement (See Appendix A), briefly describe the planting and design actions that are intended to meet the requirements of this policy.

STEP 2: FINAL DESIGN REVIEW

The following shall be submitted with a design review application or with a conditional use permit application when involving design review or when required to apply for a Utilities Certificate:

A. The landscape planting design plan that accurately and clearly identifies and depicts:
   - new and existing trees, shrubs, groundcovers, turf, and any other planting areas;
   - plants by botanical name and common name;
   - plant sizes and quantities;
   - property lines, new and existing building footprints, streets, driveways, sidewalks and other hardscape features;
   - pools, fountains, water features,

B. A conceptual irrigation design plan or statement which describes irrigation methods and design actions that will be employed to meet the irrigation specifications of this policy.

STEP 3: BUILDING PERMIT/PLAN CHECK

The following shall be reviewed and approved prior to a building permit being issued:

A. The planting design as submitted at step 2.
B. The irrigation plan drawn at the same scale as the planting plan that::

- Accurately and clearly identifies and depicts irrigation system point of connection;
- Accurately and clearly identifies and depicts irrigation system components, e.g. controller, pipe, remote-control valves, sprinklers and other application devices, rain shut-off device, check valves, pressure regulating devices, backflow prevention devices.
- Includes the Hydrozone Table and Hydrozone Summary Table (See Appendix B)

C. Where slopes exceed 10%, a grading plan drawn at the same scale as the planting plan that accurately and clearly identifies finished grades and spot elevations where contours exist within landscaped areas.

D. The Certificate of Conformance (See Appendix C), completed by the design professional, which substantiate compliance with all requirements of this policy.

STEP 4: COMPLETION OF INSTALLATION

Upon installation and completion of the landscape a final inspection shall be performed to verify policy compliance. The Water Conservation Program requires advance notice for all inspections. Inspections can be requested for either morning or afternoon during regular business hours. Specific times of the day cannot be scheduled. Building permit final approval shall not be completed until the landscape inspection is approved. An extension of the building permit to complete landscape and irrigation installation shall be requested and must be approved by the Chief Building Official prior to occupancy.

VIII. OTHER PROVISIONS

1. The Director of Utilities will consider and may allow the substitution of design alternatives and innovation which may equally reduce water consumption for any of these requirements.

2. The Director of Utilities will accept documentation methods, water allowance determination, and landscape and irrigation design requirements of the State of California Model Water Efficient Landscape Ordinance instead of sections 2-6 of these requirements where it can be demonstrated that the State procedure will more effectively address the design requirements of the project.

IX. PROVISIONS FOR APPEAL

The applicant or any affected person may appeal the final decision of staff regarding plan check or final inspection to the Director of Utilities, or a final decision of the Director of Utilities to the Board of Public Utilities by filing a written notice of appeal within ten City working days of the date of the decision. The decision of the Board of Public Utilities shall be final and may not be appealed to the City Council. An appeal regarding plan check must be submitted prior to the installation of the landscape.

Appendix A

CITY OF SANTA ROSA

WATER EFFICIENT LANDSCAPE POLICY

Preliminary Landscape Statement

Project Name _____

Project Location _____

Type of Project (e.g., commercial, residential) _____

_____

The *Preliminary Landscape Statement* is to be submitted at Preliminary Design Review.

Briefly describe the planting and design actions intended to meet the requirements of the Water Efficient Landscape Policy.

_____

_____

_____

_____

_____

_____

_____ _____
Signature Date

_____ _____
Project Representative Phone

_____
Address

Appendix B

CITY OF SANTA ROSA

WATER EFFICIENT LANDSCAPE POLICY

On landscape and irrigation plans, include the total planned square footage of planted areas for high water use plants (i.e.- turf, annuals and container plants); moderate water use plants (i.e. - ornamental trees, shrubs ground covers, and perennials primarily irrigated by sprinklers); and low water use plants (i.e. - drought tolerant plants irrigated primarily through drip emitters). The planting plan must include specific plant names that fit in each category. The following tables should appear on all landscape and irrigation plans:

Hydrozone Table Complete for all valves

Valve No.	Irrigation Method (Spray, drip, etc.)	Plant type (High, Moderate, Low)	GPM	Precipitation Rate (in/hr)	Area (ft^2)	% of Landscape
1						
2						
3						

Summary Hydrozone Table

Plant Type	Area (ft^2)	% of Landscape
Low water use		
Moderate water use		
High water use		
Total		

Appendix C

CITY OF SANTA ROSA

WATER EFFICIENT LANDSCAPE POLICY

Certificate of Conformance

Project Name _____

Project Location _____

Type of Project (e.g., commercial, residential) _____

_____

The *Certificate of Conformance* is to be submitted with the building permit application, together with complete planting, irrigation and, where necessary, grading plans.

Please check all boxes, unless otherwise noted, and fill in appropriate blanks.

I Plant Selection, Water Features, and Use Limitation

1. Check one:
   [ ] Turf, high-water-use plantings (e.g. high-water-use plants, container plants) and water feature (e.g.fountains, pools) cover not more than 40% of the project's landscaped area if non-drought resistant cool-season grass is used, and to no more than 50% of the landscaped area if drought resistant or warm-season grass is used.
   Type of grass used _____.
   Total high-water-use coverage _____ %.

   [ ] This project is exempt from the turf area limit of this policy because it falls into one of the following categories: park, playground, sports field, golf course, school, and cemetery. (Circle appropriate category)

2. [ ] Plants selected in all other landscaped areas are well-suited to the climate, geology and topographic conditions of the site, and shall be low-water-use once established.

3. Check one:
   [ ] No turf or high-water-use plants are used on slopes exceeding 10%.
   [ ] Turf is used on slopes up to 25% with the following special water saving

techniques used to compensate for increased run-off:
_____
_____
_____
_____

4. [ ] No turf is used in areas eight feet wide or less.

5. [ ] Plants having similar water use are grouped together in distinct hydrozones and are irrigated with separate irrigation circuits.

6. Check if water features are used:
   [ ] Recirculating water is used for all water features.

II Soil Conditioning and Mulching

1. [ ] A minimum of one foot depth of non-mechanically compacted soil is available for water absorption and root growth in planted areas.

2. Check one:
   [ ] In areas with overhead irrigation, organic amendment is specified to be incorporated into the soil to a minimum depth of 6" at a minimum rate of 5 cubic yards per 1000 square feet.
   [ ] Amendment recommendations from a soils laboratory report are specified, and this report is attached.

3. [ ] A minimum of a two inch layer of porous mulch is specified to be applied to all exposed soil surfaces of non-turf areas within the landscaped area. No non-porous material, such as plastic sheeting, will be placed under the mulch.

III Irrigation

1. [ ] All landscaped areas are irrigated with automatic systems with repeat start-time potential.

2. Check if appropriate:
   [ ] This landscape contains more than one type of plant type (turf, ground cover, annual) or a variety of solar exposures, therefore controllers with multiple programs are used.

[ ] Separate irrigation circuits are provided for different plant types, irrigation methods, solar exposures, microclimates, slopes and soil types.

[ ] Pressure regulation is provided to effect correct operating pressure for each water delivery hardware type (e.g. spray, rotor, drip, bubbler). The specific pressure regulation techniques employed are:

[ ] Point application methods (drip, bubbler) are used where overhead irrigation would result in overspray, runoff, or non-uniform application.

[ ] Irrigation delivery systems are designed in such a manner that water does not run off or overspray onto adjacent pavement, sidewalks, structures or other non-landscaped areas.

[ ] Sprinkler heads have matched precipitation rates on each valve circuit.

[ ] Rain shut-off devices are specified for each irrigation controller.

[ ] Check valves specified where elevation differential may cause low head drainage.

_____ _____

Signature Date

_____ _____

Project Design Professional Phone

_____

Address

CITY OF SONOMA

ORDINANCE NO. 02 - 2009

AN ORDINANCE AMENDING TITLE 13 OF THE SONOMA MUNICIPAL CODE BY ADDING CHAPTER 13.10 "WATER SHORTAGE AND CONSERVATION PLAN" ESTABLISHING A WATER CONSERVATION AND SHORTAGE PLAN

The City Council of the City of Sonoma does ordain as follows:

SECTION 1. Section 13.04.024, "Water Waste Prohibitions," of the Sonoma Municipal Code is hereby repealed.

SECTION 2. The Municipal Code of the City of Sonoma is hereby amended by adding Chapter 13.10 Water Shortage and Conservation Plan, to Title 13, Water and Sewage, to read as follows:

Chapter 13.10
WATER CONSERVATION AND SHORTAGE PLAN

Sections:

13.10.010	Scope.
13.10.020	Declaration of policy.
13.10.030	Definitions.
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13.10.080	Exceptions and application procedures for exceptions.
13.10.090	Violation--Enforcement.
13.10.100	Notice and Hearing
13.10.110	Violation--Additional remedy.

13.10.010 Purpose and authority.
The purpose of this Water Shortage and Conservation Plan is to conserve the water supply of the City for the greatest public benefit with particular regard to public health, fire protection and domestic use, to conserve water by reducing waste, and to achieve water use reductions in response to water shortages that occur from time to time.

Nothing in this ordinance shall preclude the City Council from passing an emergency resolution for the immediate curtailment of water use by its customers due to water supply shortages and delivery limitations caused by catastrophic events and conditions, either natural or unnatural.

13.10.020 Declaration of policy.
It is declared that, because of the conditions prevailing in the City and in the County of Sonoma, the public health, safety, and welfare requires that the water resources available to the City be

put to the maximum beneficial use to the extent to which they are capable, to promote water conservation and the efficient use of potable water furnished by the City, by eliminating intentional or unintentional water waste when a reasonable alternative solution is available, and by prohibiting use of equipment which is wasteful.

13.10.030 Definitions.
"Allotment" means the maximum quantity of water allowed for each customer over any applicable period as established in the water rationing provisions in this chapter.

"City" means the City of Sonoma acting by and through the City of Sonoma public works department as operator of the City of Sonoma water system.

"City Manager" is the city manager of the City of Sonoma

"Customer" means any person, whether within or without the geographic boundaries of the City of Sonoma, who uses water supplied by the City.

"Director" is the public works director of the City of Sonoma.

"Excess-use" means the usage of water by a water customer in excess of the water allotment provided under the water rationing provisions of this chapter, over an applicable period.

"GPD" means gallons per day.

"Municipal Code" means the Municipal Code of the City of Sonoma.

"Person" means any person, firm, partnership, association, corporation, company, organization, or governmental entity.

"Service interruption" means the temporary suspension of water supply, or reduction of pressure below that required for adequate supply, to any customer, portion of a water supply, or entire system.

"Water rationing" means procedures established to provide for the systematic distribution of critically-limited water supplies, in order to balance demand and limited available supplies, and to assure that sufficient water is available to preserve public health and safety.

13.10.040 Authorization.
The City Manager or his/her designee, is authorized and directed to implement the applicable provisions of this chapter upon determination that such implementation is necessary to protect the public health, safety, and welfare.

13.10.050 Application.
The provisions of this chapter shall apply to all persons, customers, and property served by the City.

13.10.060 Waste of Water Prohibited.
It is unlawful for a customer to permit potable water to escape down a gutter, ditch, or other surface drain and/or to fail to repair a controllable leak of water due to defective plumbing. No

customer of the City shall use or permit the use of potable water from the City for residential, commercial, institutional, industrial, agricultural, or other purpose for the non-essential uses as defined in Section 13.10.060(A).

A. Nonessential Uses. Non-essential uses are defined as follows:
   1. The washing of sidewalks, walkways, driveways, parking lots and other hard-surfaced areas by direct hosing, except as may be necessary to properly dispose of flammable or other dangerous liquids or substances, wash away spills that present a trip and fall hazard, or to prevent or eliminate materials dangerous to the public health and safety provided that the disposal of such is in conformance with chapter 13.32 Stormwater Management and Discharge Control;
   2. The escape of water through breaks or leaks within the customers plumbing or private distribution system for any substantial period of time within which such break or leak should reasonably have been discovered and corrected. It shall be presumed that a period of seventy-two (72) hours after the customer discovers such a break or leak or receives notice from the City, is a reasonable time within which to correct such break or leak or, at a minimum, to stop the flow of water from such break or leak;
   3. Irrigation in a manner or to an extent which allows excessive run off of water or unreasonable over-spray of the areas being watered. Every customer is deemed to have his/her water system under control at all times, to know the manner and extent of his/her water use and any run off, and to employ available alternatives to apply irrigation water in a reasonably efficient manner;
   4. Washing cars, boats, trailers or other vehicles and machinery directly with a hose not equipped with a shutoff nozzle;
   5. Water for non-recycling decorative water fountains; and
   6. Water for non-recirculating conveyor car wash systems.

B. Exempt Water Uses. Use of water supplied by a private well or from a reclaimed wastewater, grey water or rainwater utilization system is exempt from this chapter.

13.10.070 Water shortage stages.
When a water shortage stage has been declared by resolution of the City Council, no customer of the City shall knowingly make, cause, use, or permit the use of water from the City for residential, commercial, industrial, agricultural, governmental, or any other purpose in a manner contrary to any provision of this chapter.

A. Stage 1. Voluntary conservation – water shortage alert. The City Council may by resolution declare a Stage 1 water shortage upon recommendation by the Director that the Board of Directors for the Sonoma County Water Agency has officially declared up to 15 percent reduction in Russian River water supply delivery to the City. In order to achieve an overall system-wide reduction goal of up to15 percent of Russian River water supply deliveries, all potable water customers of the City shall be requested to:
   1. Apply irrigation water only during the evening and early morning hours to reduce evaporation losses.
   2. Inspect all irrigation systems, repair leaks, and adjust spray heads to provide optimum coverage and eliminate avoidable over-spray.
   3. For irrigation valves controlling water applied to lawns, vary the minutes of run-time consistent with fluctuations in weather.

4. Reduce minutes of run-time for each irrigation cycle if water begins to run-off to gutters and ditches before the irrigation cycle is completed.
5. Become informed about and adhere to the City's Water Waste Prohibitions as established in Section 13.10.060.
6. Utilize water conservation rebate and other incentive programs to replace high water-use plumbing fixtures and appliances with water-efficient models.
7. Utilize City information regarding using water efficiently, reading water meters, repairing ordinary leaks, and how to apply water efficiently to landscaping.

B. Stage 2. Mandatory conservation – water shortage. The City Council may by resolution declare a Stage 2 water shortage upon recommendation by the Director that the Board of Directors of the Sonoma County Water Agency has officially declared a 16 percent to 25 percent reduction in Russian River water supply delivery to the City or if Stage 1 reduction goals cannot be met without implementing Stage 2. In order to achieve an overall system-wide reduction goal of up to 25 percent of Russian River water supply deliveries, the following restrictions shall apply in addition to Stage 1 restrictions as set forth in Sections 13.10.070(A):

1. Refilling or initial filling of a swimming pool is not permitted;
2. Use of water for ornamental fountains is not permitted;
3. Non-commercial washing of privately-owned motor vehicles, trailers and boats except from a bucket and a hose equipped with a shut-off nozzle is not permitted;
4. Any use of water from a fire hydrant except for fighting fires. Use for essential construction needs may be permitted by the Director upon submittal of a permit application for construction water;
5. Use of potable water for dust control at construction sites is not permitted;
6. Residential and commercial irrigation is not permitted except on specific days and times as set forth by Resolution of the City Council;
7. Other uses deemed to be non-essential by the City Council upon recommendation of the Director that such additional measures are necessary to achieve an overall system-wide reduction of up to 25 percent in Russian River water supply deliveries.

C. Stage 3. Mandatory compliance – severe water shortage. The City Council may by resolution declare a Stage 3 water shortage upon recommendation by the Director that the Board of Directors of the Sonoma County Water Agency has officially declared a 26 percent to 40 percent reduction in Russian River water supply delivery to the City or if Stage 2 reduction goals cannot be met without implementing Stage 3. In order to achieve an overall system-wide reduction goal of up to 40 percent of Russian River water supply deliveries, the following restrictions shall apply in addition to Stage 1 and Stage 2 restrictions as set forth in Sections 13.10.070(A) and 13.10.070(B):

1. Watering of athletic fields, turf areas in public and private parks unless water usage is no more than 75 percent of year 2006 for the same period of time; or if 2006 billing data unavailable or not appropriate for use, a different baseline year may be used as approved by the Director;
2. Non-commercial washing of vehicles is not permitted;
3. Other uses deemed to be non-essential by the City Council upon recommendation of the Director that such additional measures are necessary to achieve an overall system-wide reduction of up to 40 percent in Russian River water supply deliveries.

D. Stage 4. Mandatory water rationing – critical water shortage. The City Council may by resolution declare a Stage 4 water shortage upon recommendation by the Director that the Board of Directors of the Sonoma County Water Agency has officially declared a reduction of greater than 40 percent in Russian River water supply delivery to the City or if Stage 3 reduction goals cannot be met without implementing Stage 4. In order to achieve an overall system-wide reduction goal of greater than 40 percent of Russian River water supply deliveries, water rationing will be implemented upon development of a systematic water rationing plan and subsequent acceptance of the plan by City Council. During Stage 4 water shortage, Stage 1, Stage 2 and Stage 3 restrictions as set forth in Sections 13.10.070(A), 13.10.070(B) and 13.10.070(C) shall apply.

1. A water rationing plan establishing water allotments for residential, commercial and institutional customers of the City shall be developed by the Director taking into consideration projections and estimates made by the Sonoma County Water Agency pertaining to the Russian River water supply and the City's local water supply. The water rationing plan shall include but not limited to the following analyses and evaluations:
   a. Allocation amounts for the City's customers based on the amount of available water for the City's water service area and taking into consideration essential facilities and economic and fiscal impacts of the water supply reductions;
   b. A Stage 4 water shortage rate structure for conservation "tiered" rates, drought surcharges, excess-use penalties and fees;
   c. A systematic plan for temporary service interruptions to all or part of its water system, as may be deemed appropriate to further extend limited and/or dwindling water supplies;
   d. A water billing plan that identifies the Finance Department's responsibilities for obtaining and monitoring customer data and water usage to effect the water rationing plan; and
   e. A public outreach and notification plan for implementing temporary service interruptions and water rationing.
2. No new water connections shall be permitted during a Stage 4 water shortage except as approved by the City Manager for public health and safety reasons.
3. No new water agreements to serve water shall be entered into by the City during a Stage 4 water shortage.

13.10.080 Exceptions and application procedures for exceptions.

Any customer of the City may make written application for an exception. Said application shall describe in detail why applicant believes an exception is justified.

A. The City Manager may grant exceptions for use of water otherwise prohibited by this section upon finding and determining that failure to do so would cause an emergency condition affecting the health, sanitation, fire protection or safety of the applicant or public; or, cause an unnecessary and undue hardship on applicant or the public, including but not limited to, adverse economic impacts, such as loss of production or jobs.
B. The decision of the City Manager may be appealed to the City Council by submitting a written appeal to the City Clerk within fifteen (15) calendar days of the date of the decision. Upon granting any appeal, the City Council may impose any conditions it determines to be just and proper. Exceptions granted by the City Council shall be prepared in writing and the City Council may require the exception be recorded at applicant's expense.

13.10.090 Violation--Enforcement.
The violation of each provision of this chapter, and each separate violation thereof, shall be deemed a separate offense, and shall be enforced as an infraction punishable by a fine in the amount provided by chapter 1.12 General Penalty of the Code. The City may, after written notification to customer and a reasonable time to correct the violation as solely determined by the City, take some or all of the following actions. Fees and charges for the activities below shall be established by resolution of the City Council.

A. Written notice to the customer of the water waste violation including a specified period of time to correct the violation.
B. Personal contact with the customer at the address of the water service. If personal contact is unsuccessful, written notice of the violation including a date that the violation is to be corrected may be left on the premises, with a copy of the notice sent by certified mail to the customer.
C. The City Council may authorize the installation of a flow-restricting device on the service line and require the property owner and/or resident to reimburse the City for its costs in installing the flow restricting device.
D. The City Council may levy a water waste fee to the customer, said fee established by separate ordinance.
E. After notice and a hearing provided in accordance with section 13.10.100 below, the City Council may authorize termination of water service, if said action is deemed by the City Attorney to be allowable under statutory requirements at the time, and the charge for same shall be billed to the customer. Except in cases of extreme emergency as solely determined by the City Manager, service shall not be reinstated until verified by the City Manager that the violation has been corrected and all charges and fees have been paid.

13.10.100 Notice and hearing.
Before the City either installs a water flow-restricting device or terminates water service, a hearing shall be scheduled before the City Council with notice provided to the property owner and the resident of the property of the time, date and place of the hearing. Such notice shall be provided at least ten days prior to the hearing date. At the hearing, the City Council shall hear testimony from all interested persons and shall make a determination as to whether a water flow-restricting device should be installed or water service terminated. If the City Council determines that a water-flow restricting device should be installed, the City Council shall establish a date by which the City will install such device and the City Council shall further require the property owner and/or resident to reimburse the City its costs in installing the flow-restricting device. If the property owner and/or resident does not pay these installation costs after being billed for such costs by the City, the City Manager may utilize the procedures contained in chapter 1.12 General Penalty of the Municipal Code to recoup the City's installation costs.

13.10.110 Violation--Additional remedy.
As an additional remedy, the violation of any provision of this chapter shall be deemed, and is declared to be, a public nuisance and may be abated in accordance with chapter 1.12 General Penalty of the Municipal Code.

SECTION 3. Repeal of Conflicting ordinances. All former ordinances or parts thereof conflicting or inconsistent with the provisions of this ordinance or of the Code hereby adopted are thereby repealed.

SECTION 4. Severability. If any section, subsection, sentence, clause, or phrase of this Ordinance is for any reason held invalid , such decision shall not affect the validity of the remaining portions of this Ordinance. The City Council hereby declares that it should have adopted this ordinance and each section, subsection, sentence, clause, or phrase thereof irrespective of the fact that any one or more of sections, subsections, sentences, clauses or phrases be declared unconstitutional.

SECTION 5. Effective Date. This ordinance shall be in full force and effective 30 days after its adoption and shall be published and posted as required by law.

SECTION 6. Pursuant to Health and safety code section 21065, this ordinance is not a project subject to the California Environmental Quality act.

PASSED, APPROVED AND ADOPTED by the City Council of the City of Sonoma this 4th day of March 2009.

Ken Brown, Mayor

ATTEST:

Gay Rainsbarger, City Clerk

State of California)
County of Sonoma)
City of Sonoma)

I, Gay Rainsbarger, City Clerk of the City of Sonoma, do hereby certify that the foregoing ordinance was adopted on March 4, 2009 by the following vote:

AYES: Sebastiani, Gallian, Barbose, Sanders, Brown
NOES: None
ABSENT: None

Gay Rainsbarger, City Clerk

City of Sonoma
2009 Water Shortage Response Plan

Revised: May 14, 2009

Background

Dry weather conditions in the current and past two water years have caused a significant decline in storage levels in Lake Pillsbury and Lake Mendocino. Sonoma County Water Agency (Water Agency) staff predicts that storage in Lake Mendocino will again decline to a historic low at the beginning of the fall Chinook migration. The Water Agency's goal is to have 30,000 acre-feet of storage in Lake Mendocino at the beginning of the fall migration season. To meet storage goals, an additional 16,000+ acre-feet must be saved from storage releases from Lake Mendocino that would be made to achieve minimum in-stream flows.

In order to minimize flows from Lake Mendocino during the spring and summer months, deliveries to water contractors will need to come from storage in Lake Sonoma via conveyance through Dry Creek. While there is adequate water supply in Lake Sonoma to meet water contractors' demands, low flow restrictions through Dry Creek will limit deliveries to water contractors. In response, in February 2009 the Water Agency informally announced that a 15 to 30 percent reduction in water deliveries may be needed to keep more water in Lake Mendocino. On April 6, 2009 the State Water Resources Control Board issued an order for a reduction of diversions from the Russian River of 25% from the baseline year of 2004. The City of Sonoma is therefore required to reduce its overall water use by 25%.

Actions Needed to Address a 25 percent Delivery Reduction

The Sonoma County Water Agency's water contractors prepared an objection to the State Board's diversion reduction order. The objection requested that the 25% delivery reduction be reduced to 20%. However, currently, the 25% water reduction goal remains in effect. The City has begun to step up its water conservation efforts and local supply production in order to meet water reduction goals currently in effect during this water year. The actions to be implemented are described below.

1) The City has adopted a Water Shortage and Conservation Ordinance (Ordinance No. 02-2009) that provides for various stages of water shortages and the resulting levels of conservation and rationing that would be needed in order to meet water reduction goals;
2) The City Council has passed resolution No. 14-2009 April 15, 2009 which declares Stage 2 Mandatory Water Conservation through October 2, 2009; and

3) The City Council has passed Resolution No. 15-2009 on April 15, 2009 which establishes permitted days of residential and commercial irrigation. Landscape irrigation of residential and commercial water customers is only permitted Tuesday, Thursday, Saturday and Sunday between the hours of 7:00 p.m. and 7:00 a.m. of the following day.

4) City staff will continue to monitor the water shortage condition and the Water Agency's delivery projections and will revise the level of conservation needed to meet the change in delivery projections; and

5) The City will be supplementing its Russian River water supply with the use of its local groundwater supply, to the maximum extent feasible.

Water Conservation Plan

Authorization

Under the proposed Water Shortage and Conservation Ordinance, Section 13.10.070(A) of the Ordinance, the City Council is authorized to Implement Stage 2, Mandatory Conservation. Until the Ordinance takes effect (30 days after adoption), Council approved Resolution No. 21-2007 which authorized the declaration of Voluntary Water Conservation measures to continue to be in effect.

Goals and Objectives

The following measures will be implemented by City staff in order to achieve an overall system-wide reduction goal of up to 25 percent.

1. Work cooperatively with the Sonoma County Water Agency staff and other water contractors to provide for a "regional" and consistent water conservation message to all customers.

2. Implement Stage 2 Restrictions as follows:
    - Refilling or initial filling of a swimming pool is not permitted;
    - Use of water for ornamental fountains is not permitted;
    - Non-commercial washing of privately-owned motor vehicles, trailers and boats except from a bucket and a hose equipped with a shut-off nozzle is not permitted;
    - Any use of water from a fire hydrant except for fighting fires. Use for essential construction needs may be permitted by the Director upon submittal of a permit application for construction water;
    - Use of potable water for dust control at construction sites is not permitted;

- Residential and commercial irrigation is not permitted except on specific days and times as set forth by Resolution of the City Council;
- Other uses deemed to be non-essential by the City Council upon recommendation of the Director that such additional measures are necessary to achieve an overall system-wide reduction of up to 25 percent in Russian River water supply deliveries.

3. Implement a public outreach plan that consists of the following measures:

    - Mailing of Top Ten (regional) water conservation tips to water customers
    - Flyers to water customers through mailings and public events and markets
    - Provide bill inserts for water conservation
    - Add text in utility bill to promote water conservation
    - Provide booths and activities at water conservation events
    - Target letters to large water customers (top 100)
    - Newspaper advertisement and articles (Sun, Index Tribune and Press Democrat
    - Newsletter announcements (the "Water Source")
    - Radio and television public service announcements
    - City Manager water shortage updates at Council meetings
    - Bulletin Board advertisement (City Hall/Carnegie Building/Whole Foods and other local businesses), as appropriate
    - Posting of water conservation signs at all public facilities
    - "Water served upon request" table placards at restaurants
    - Towel and linen requests to conserve cards for hotels
    - Letters to businesses through the Economic Development Board

4. Implement water conservation measures for City facilities that include the following:

    - Reduce irrigation in City parks by 30 percent
    - Shut off irrigation to public parkway strips with the exception of areas within the Plaza
    - No outdoor washing of vehicle fleets that can be taken to a commercial car wash that recycles the wash water
    - Post signs at all bathrooms and kitchens requesting voluntary water conservation
    - Shut off drinking fountains and post voluntary water conservation signs
    - No hydrant flushing
    - Flushing of water lines to be conducted only as needed for water quality purposes

5. Renewed advertisement of the following existing water conservation programs:

    - "Cash for grass"
    - Toilet and plumbing retrofits
    - High efficiency washer rebates
    - Pre-rinse spray valves
    - Low-flow hose nozzles
    - Water-wise gardening CD
    - Water survey for indoor and outdoor usage
    - Irrigation audits
    - Water budgets for dedicated irrigation meters
    - "Smart" controllers
    - Irrigation efficient rebates
    - Toilet leak detection tablets
    - Low-water use landscape brochures
    - Other programs as they become approved

6. Enforcement that consists of public education notices as follows:

    - Public Works crew will post a door hanger requesting water conservation when water waste is observed during normal work routines (such as meter reading, driving to job sites, etc.)
    - If observed that water waste continues after a reasonable amount of time and after written notices and personal contact have been made with the customer, penalties may be enforced including fines and/or a flow-restricting device may be installed. These enforcement actions will be conducted according to the provisions of Chapter 1.12 of the City Code.

7. City staff will analyze the cost/benefit of billing monthly and present to Council for consideration.

8. City staff will coordinate with the Water Agency in continuously monitoring the level of water reductions achieved.

Local Groundwater Supply Plan

Goals and Objectives

Maximize the use of local groundwater supply in accordance with the City's Urban Water Management Plan and as provided for in Section 3.5 of the Restructured Water Supply Agreement with the Sonoma County Water Agency. Implementing the following guidelines will assist the Water Agency in meeting the goal of maintaining Lake Mendocino storage levels in Fall 2009.

1. Conduct pump tests for the City's four online active well sites to establish the maximum sustainable yields for each site.

2. Utilize the four online municipal well sites for maximum pumpage to meet water demands from June 2009 through October 2009 but not exceed the maximum sustainable yield.

3. "Tune up" the pumps at the City's wells to ensure maximum pumping capabilities.

4. Public Works staff will monitor the groundwater pumpage at each well site to ensure the maximum projected annual amount is maximized, to the extent feasible.

CITY OF SONOMA

ORDINANCE NO. 02 - 2009

AN ORDINANCE AMENDING TITLE 13 OF THE SONOMA MUNICIPAL CODE BY ADDING CHAPTER 13.10 "WATER SHORTAGE AND CONSERVATION PLAN" ESTABLISHING A WATER CONSERVATION AND SHORTAGE PLAN

The City Council of the City of Sonoma does ordain as follows:

SECTION 1. Section 13.04.024, "Water Waste Prohibitions," of the Sonoma Municipal Code is hereby repealed.

SECTION 2. The Municipal Code of the City of Sonoma is hereby amended by adding Chapter 13.10 Water Shortage and Conservation Plan, to Title 13, Water and Sewage, to read as follows:

Chapter 13.10
WATER CONSERVATION AND SHORTAGE PLAN

Sections:

13.10.010	Scope.
13.10.020	Declaration of policy.
13.10.030	Definitions.
13.10.040	Authorization.
13.10.050	Application.
13.10.060	Water waste prohibitions.
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13.10.080	Exceptions and application procedures for exceptions.
13.10.090	Violation–Enforcement.
13.10.100	Notice and Hearing
13.10.110	Violation–Additional remedy.

13.10.010 Purpose and authority.
The purpose of this Water Shortage and Conservation Plan is to conserve the water supply of the City for the greatest public benefit with particular regard to public health, fire protection and domestic use, to conserve water by reducing waste, and to achieve water use reductions in response to water shortages that occur from time to time.

Nothing in this ordinance shall preclude the City Council from passing an emergency resolution for the immediate curtailment of water use by its customers due to water supply shortages and delivery limitations caused by catastrophic events and conditions, either natural or unnatural.

13.10.020 Declaration of policy.
It is declared that, because of the conditions prevailing in the City and in the County of Sonoma, the public health, safety, and walfare requires that the water resources available to the City be

put to the maximum beneficial use to the extent to which they are capable, to promote water conservation and the efficient use of potable water furnished by the City, by eliminating intentional or unintentional water waste when a reasonable alternative solution is available, and by prohibiting use of equipment which is wasteful.

13.10.030 Definitions.
"Allotment" means the maximum quantity of water allowed for each customer over any applicable period as established in the water rationing provisions in this chapter.

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"City Manager" is the city manager of the City of Sonoma

"Customer" means any person, whether within or without the geographic boundaries of the City of Sonoma, who uses water supplied by the City.

"Director" is the public works director of the City of Sonoma.

"Excess-use" means the usage of water by a water customer in excess of the water allotment provided under the water rationing provisions of this chapter, over an applicable period.

"GPD" means gallons per day.

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13.10.040 Authorization.
The City Manager or his/her designee, is authorized and directed to implement the applicable provisions of this chapter upon determination that such implementation is necessary to protect the public health, safety, and welfare.

13.10.050 Application.
The provisions of this chapter shall apply to all persons, customers, and property served by the City.

13.10.060 Waste of Water Prohibited.
It is unlawful for a customer to permit potable water to escape down a gutter, ditch, or other surface drain and/or to fail to repair a controllable leak of water due to defective plumbing. No

customer of the City shall use or permit the use of potable water from the City for residential, commercial, institutional, industrial, agricultural, or other purpose for the non-essential uses as defined in Section 13.10.060(A).

A. Nonessential Uses. Non-essential uses are defined as follows:
   1. The washing of sidewalks, walkways, driveways, parking lots and other hard-surfaced areas by direct hosing, except as may be necessary to properly dispose of flammable or other dangerous liquids or substances, wash away spills that present a trip and fall hazard, or to prevent or eliminate materials dangerous to the public health and safety provided that the disposal of such is in conformance with chapter 13.32 Stormwater Management and Discharge Control;
   2. The escape of water through breaks or leaks within the customers plumbing or private distribution system for any substantial period of time within which such break or leak should reasonably have been discovered and corrected. It shall be presumed that a period of seventy-two (72) hours after the customer discovers such a break or leak or receives notice from the City, is a reasonable time within which to correct such break or leak or, at a minimum, to stop the flow of water from such break or leak;
   3. Irrigation in a manner or to an extent which allows excessive run off of water or unreasonable over-spray of the areas being watered. Every customer is deemed to have his/her water system under control at all times, to know the manner and extent of his/her water use and any run off, and to employ available alternatives to apply irrigation water in a reasonably efficient manner;
   4. Washing cars, boats, trailers or other vehicles and machinery directly with a hose not equipped with a shutoff nozzle;
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B. Exempt Water Uses. Use of water supplied by a private well or from a reclaimed wastewater, grey water or rainwater utilization system is exempt from this chapter.

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   1. Apply irrigation water only during the evening and early morning hours to reduce evaporation losses.
   2. Inspect all irrigation systems, repair leaks, and adjust spray heads to provide optimum coverage and eliminate avoidable over-spray.
   3. For irrigation valves controlling water applied to lawns, vary the minutes of run-time consistent with fluctuations in weather.

4. Reduce minutes of run-time for each irrigation cycle if water begins to run-off to gutters and ditches before the irrigation cycle is completed.
5. Become informed about and adhere to the City's Water Waste Prohibitions as established in Section 13.10.060.
6. Utilize water conservation rebate and other incentive programs to replace high water-use plumbing fixtures and appliances with water-efficient models.
7. Utilize City information regarding using water efficiently, reading water meters, repairing ordinary leaks, and how to apply water efficiently to landscaping.

B. Stage 2. Mandatory conservation – water shortage. The City Council may by resolution declare a Stage 2 water shortage upon recommendation by the Director that the Board of Directors of the Sonoma County Water Agency has officially declared a 16 percent to 25 percent reduction in Russian River water supply delivery to the City or if Stage 1 reduction goals cannot be met without implementing Stage 2. In order to achieve an overall system-wide reduction goal of up to 25 percent of Russian River water supply deliveries, the following restrictions shall apply in addition to Stage 1 restrictions as set forth in Sections 13.10.070(A):

1. Refilling or initial filling of a swimming pool is not permitted;
2. Use of water for ornamental fountains is not permitted;
3. Non-commercial washing of privately-owned motor vehicles, trailers and boats except from a bucket and a hose equipped with a shut-off nozzle is not permitted;
4. Any use of water from a fire hydrant except for fighting fires. Use for essential construction needs may be permitted by the Director upon submittal of a permit application for construction water;
5. Use of potable water for dust control at construction sites is not permitted;
6. Residential and commercial irrigation is not permitted except on specific days and times as set forth by Resolution of the City Council;
7. Other uses deemed to be non-essential by the City Council upon recommendation of the Director that such additional measures are necessary to achieve an overall system-wide reduction of up to 25 percent in Russian River water supply deliveries.

C. Stage 3. Mandatory compliance – severe water shortage. The City Council may by resolution declare a Stage 3 water shortage upon recommendation by the Director that the Board of Directors of the Sonoma County Water Agency has officially declared a 26 percent to 40 percent reduction in Russian River water supply delivery to the City or if Stage 2 reduction goals cannot be met without implementing Stage 3. In order to achieve an overall system-wide reduction goal of up to 40 percent of Russian River water supply deliveries, the following restrictions shall apply in addition to Stage 1 and Stage 2 restrictions as set forth in Sections 13.10.070(A) and 13.10.070(B):

1. Watering of athletic fields, turf areas in public and private parks unless water usage is no more than 75 percent of year 2006 for the same period of time; or if 2006 billing data unavailable or not appropriate for use, a different baseline year may be used as approved by the Director;
2. Non-commercial washing of vehicles is not permitted;
3. Other uses deemed to be non-essential by the City Council upon recommendation of the Director that such additional measures are necessary to achieve an overall system-wide reduction of up to 40 percent in Russian River water supply deliveries.

D. Stage 4. Mandatory water rationing – critical water shortage. The City Council may by resolution declare a Stage 4 water shortage upon recommendation by the Director that the Board of Directors of the Sonoma County Water Agency has officially declared a reduction of greater than 40 percent in Russian River water supply delivery to the City or if Stage 3 reduction goals cannot be met without implementing Stage 4. In order to achieve an overall system-wide reduction goal of greater than 40 percent of Russian River water supply deliveries, water rationing will be implemented upon development of a systematic water rationing plan and subsequent acceptance of the plan by City Council. During Stage 4 water shortage, Stage 1, Stage 2 and Stage 3 restrictions as set forth in Sections 13.10.070(A), 13.10.070(B) and 13.10.070(C) shall apply.

1. A water rationing plan establishing water allotments for residential, commercial and institutional customers of the City shall be developed by the Director taking into consideration projections and estimates made by the Sonoma County Water Agency pertaining to the Russian River water supply and the City's local water supply. The water rationing plan shall include but not limited to the following analyses and evaluations:
   a. Allocation amounts for the City's customers based on the amount of available water for the City's water service area and taking into consideration essential facilities and economic and fiscal impacts of the water supply reductions;
   b. A Stage 4 water shortage rate structure for conservation "tiered" rates, drought surcharges, excess-use penalties and fees;
   c. A systematic plan for temporary service interruptions to all or part of its water system, as may be deemed appropriate to further extend limited and/or dwindling water supplies;
   d. A water billing plan that identifies the Finance Department's responsibilities for obtaining and monitoring customer data and water usage to effect the water rationing plan; and
   e. A public outreach and notification plan for implementing temporary service interruptions and water rationing.
2. No new water connections shall be permitted during a Stage 4 water shortage except as approved by the City Manager for public health and safety reasons.
3. No new water agreements to serve water shall be entered into by the City during a Stage 4 water shortage.

13.10.080 Exceptions and application procedures for exceptions.

Any customer of the City may make written application for an exception. Said application shall describe in detail why applicant believes an exception is justified.

A. The City Manager may grant exceptions for use of water otherwise prohibited by this section upon finding and determining that failure to do so would cause an emergency condition affecting the health, sanitation, fire protection or safety of the applicant or public; or, cause an unnecessary and undue hardship on applicant or the public, including but not limited to, adverse economic impacts, such as loss of production or jobs.

B. The decision of the City Manager may be appealed to the City Council by submitting a written appeal to the City Clerk within fifteen (15) calendar days of the date of the decision. Upon granting any appeal, the City Council may impose any conditions it determines to be just and proper. Exceptions granted by the City Council shall be prepared in writing and the City Council may require the exception be recorded at applicant's expense.

13.10.090 Violation–Enforcement.
The violation of each provision of this chapter, and each seperate violation thereof, shall be deemed a separate offense, and shall be enforced as an infraction punishable by a fine in the amount provided by chapter 1.12 General Penalty of the Code. The City may, after written notification to customer and a reasonable time to correct the violation as solely determined by the City, take some or all of the following actions. Fees and charges for the activities below shall be established by resolution of the City Council.

A. Written notice to the customer of the water waste violation including a specified period of time to correct the violation.
B. Personal contact with the customer at the address of the water service. If personal contact is unsuccessful, written notice of the violation including a date that the violation is to be corrected may be left on the premises, with a copy of the notice sent by certified mail to the customer.
C. The City Council may authorize the installation of a flow-restricting device on the service line and require the property owner and/or resident to reimburse the City for its costs in installing the flow restricting device.
D. The City Council may levy a water waste fee to the customer, said fee established by separate ordinance.
E. After notice and a hearing provided in accordance with section 13.10.100 below, the City Council may authorize termination of water service, if said action is deemed by the City Attorney to be allowable under statutory requirements at the time, and the charge for same shall be billed to the customer. Except in cases of extreme emergency as solely determined by the City Manager, service shall not be reinsteted until verified by the City Manager that the violation has been corrected and all charges and fees have been paid.

13.10.100 Notice and hearing.
Before the City either installs a water flow-restricting device or terminates water service, a hearing shall be scheduled before the City Council with notice provided to the property owner and the resident of the property of the time, date and place of the hearing. Such notice shall be provided at least ten days prior to the hearing date. At the hearing, the City Council shall hear testimony from all interested persons and shall make a determination as to whether a water flow-restricting device should be installed or water service terminated. If the City Council determines that a water-flow restricting device should be installed, the City Council shall establish a date by which the City will install such device and the City Council shall further require the property owner and/or resident to reimburse the City its costs in installing the flow-restricting device. If the property owner and/or resident does not pay these installation costs after being billed for such costs by the City, the City Manager may utilize the procedures contained in chapter 1.12 General Penalty of the Municipal Code to recoup the City's installation costs.

13.10.110 Violation–Additional remedy.
As an additional remedy, the violation of any provision of this chapter shall be deemed, and is declared to be, a public nuisance and may be abated in accordance with chapter 1.12 General Penalty of the Municipal Code.

SECTION 3. Repeal of Conflicting ordinances. All former ordinances or parts thereof conflicting or inconsistent with the provisions of this ordinance or of the Code hereby adopted are thereby repealed.

SECTION 4. Severability. If any section, subsection, sentence, clause, or phrase of this Ordinance is for any reason held invalid , such decision shall not affect the validity of the remaining portions of this Ordinance. The City Council hereby declares that it should have adopted this ordinance and each section, subsection, sentence, clause, or phrase thereof irrespective of the fact that any one or more of sections, subsections, sentences, clauses or phrases be declared unconstitutional.

SECTION 5. Effective Date. This ordinance shall be in full force and effective 30 days after its adoption end shall be published and posted as required by law.

SECTION 6. Pursuant to Health and safety code section 21065, this ordinance is not a project subject to the California Environmental Quality act.

PASSED, APPROVED AND ADOPTED by the City Council of the City of Sonoma this 4th day of March 2009.

Ken Brown, Mayor

ATTEST:

Gay Rainsbarger, City Clerk

State of California)
County of Sonoma)
City of Sonoma)

I, Gay Rainsbarger, City Clerk of the City of Sonoma, do hereby certify that the foregoing ordinance was adopted on March 4, 2009 by the following vote:

AYES: Sebastiani, Gallian, Barbose, Sanders, Brown
NOES: None
ABSENT: None

Gay Rainsbarger, City Clerk

CITY OF SONOMA

RESOLUTION NO. __ - 2009

RESOLUTION OF THE CITY OF SONOMA DECLARING STAGE 2, MANDATORY WATER CONSERVATION THROUGH OCTOBER 2, 2009

WHEREAS, the Sonoma County Water Agency (SCWA) filed a petition with the State of California Water Resources Control Board (SWRCB) requesting approval of a Temporary Urgency Change to its Russian River diversions permits pursuant to California Water Code section 1435; and

WHEREAS, the SCWA petition is to allow temporary reductions to the Russian River instream flow requirements to prevent depletion of storage in Lake Mendocino which would, among other impacts, severely impact threatened or endangered Russian River fish species; and

WHEREAS, the SWRCB approved the Temporary Urgency Change petition by Order WR 2009-0027-DWR (Order) which is in effect from April 6, 2009 through October 2, 2009; and

WHEREAS, the Order provides for minimum Russian River instream flow and requires that the SCWA make a 25 percent reduction in diversions from the Russian River to its customers and water contractors; and

WHEREAS, the City of Sonoma, as a water contractor subject to the 25 percent delivery reduction, will need to achieve an overall system-wide reduction goal of 25 percent; and

WHEREAS, Section 13.10.070 provides for the declaration of various water stages by Council to address reductions in the City water supply upon recommendation of the Director of Public Works of the action needed; and

WHEREAS, the Director of Public Works recommends that a Stage 2, Mandatory Water Conservation, be implemented to achieve the 25 percent reduction goal.

NOW, THEREFORE, BE IT RESOLVED that the City of Sonoma City Council hereby declares a Stage 2, Mandatory Water Conservation and this Declaration shall be in effect until October 2, 2009.

ADOPTED this _____ day of _____ 2009 by the following vote:

AYES:
NOES:
ABSENT:

_____
Ken Brown, Mayor

ATTEST:

_____
Gay Rainsbarger, City Clerk

CITY OF SONOMA

RESOLUTION NO. __ - 2009

RESOLUTION OF THE CITY OF SONOMA ESTABLISHING PERMITTED DAYS OF RESIDENTIAL AND COMMERCIAL IRRIGATION

WHEREAS, Council approved Resolution No. ___-2009 declaring a Stage 2, Mandatory Water Conservation; and

WHEREAS, as provided for under Section 13.10.070(B)(6) of the Municipal Code, residential and commercial irrigation is not permitted except on specific days and times as set forth by resolution of the City Council.

NOW, THEREFORE, BE IT RESOLVED that landscape irrigation of residential and commercial water customers is not permitted except on the days and times as follows:

Tuesday	7:00 p.m. – 7:00 a.m.
Thursday	7:00 p.m. – 7:00 a.m.
Saturday/Sunday	7:00 p.m. – 7:00 a.m.

BE IT FURTHER RESOLVED that Hand-watering of landscape, as opposed to automatic irrigation, is exempt from this exclusion, provided, Section 13.10.060, Waste of Water Prohibited, is followed by the customer.

ADOPTED this _____ day of _____ 2009 by the following vote:

AYES:
NOES:
ABSENT:

_____
Ken Brown, Mayor

ATTEST:

_____
Gay Rainsbarger, City Clerk

Information & Resources For Your Business:

WATER CONSERVATION

Reductions in Water Supply Lead to Mandatory Conservation Rules

In response to a 25% reduction in Russian River water supplies implemented by the Sonoma County Water Agency, the City of Sonoma has implemented a Stage 2 Mandatory Water Conservation Program. The objective of the conservation regulations is to **achieve a citywide reduction in water usage of 25%**, measured against a "base year" of 2004, by implementing a series of requirements for both business and residential customers.

Under Stage 2 Water Conservation requirements, **landscape irrigation is prohibited except on Tuesdays, Thursdays, Saturdays and Sundays from 7 p.m. through 7 a.m. the following day**. Other rules under Stage 2 Mandatory Conservation that affect businesses include prohibitions against:

- Irrigation that allows water to run off due to excessive watering, overspray, or irrigating when raining
- Washing of sidewalks, walkways, driveways, parking lots and other hard-surfaced areas
- Use of water for ornamental fountains
- Washing of vehicles unless using a bucket and hose equipped with a shut-off nozzle, or using a commercial carwash that recycles water.

In addition, both businesses and residents are strongly encouraged to continue to implement further conservation measures on a voluntary basis in order to achieve the 25% citywide reduction goal. For businesses, one of the best ways to identify ways to conserve is to **obtain a free, on-site, no-obligation water assessment**. The assessment will provide a conservation plan tailored to your business and identify potential rebates and ongoing cost savings. To learn more about getting a water assessment for your business, contact the Sonoma County Water Agency, (707) 547-1968. For more info abont Stage 2 Water Conservation requirements, contact the City's Water Conservation Coordinator at 933-2247.

Restrictions on Turf Irrigation at Commercial Properties

Further restrictions have been put in placed by the State Water Resources Control Board (SWRCB), which has issued an order prohibiting the irrigation of commercial and governmental ornamental turf through October 2, 2009. Ornamental turf is interpreted by the Sonoma County Water Agency as turf that is not used regularly by a significant number of people, including turf at office and other commercial buildings, business parks, and median strips. The prohibition does not apply to turf irrigated by recycled water or by private wells. An exemption is possible for commercial customers that establish and implement a water budget with a 25% reduction. City of Sonoma Public Works staff will work with affected commercial customers on a one-on-one basis to assist them in compliance.

If you are considering landscape modifications for your business, a valuable local resource is Qualified Water Efficient Landscapers (QWEL). These Sonoma and Marin area landscape professionals are making a positive impact on reducing landscape water demand by becoming more water efficient in landscape design, maintenance, and operation. QWEL provides 20 hours of educational foundation based on principals of proper plant selection for the local climate, irrigation system design and maintenance, and irrigation system programming and operation. For a list of QWEL certified professionals, visit **qweltraining.com.**

Rebates Are Available

"Cash For Grass" turf replacement rebates are available in both the City of Sonoma and the Valley of the Moon Water District service areas, subject to available funding. In the City of Sonoma, commercial customers are eligible for a total rebate of up to $3,000. A pre- and post-inspection is required. For more information, call (707) 547-1968.

The **Landscape Equipment Rebate** program offered by the City of Sonoma is designed to encourage businesses to improve the efficiency of their existing irrigation systems. Rebates range from 50% (for irrigation controllers, matched precipitation rate sprinkler heads, and sub-meters) to 75% (for drip irrigation equipment, pressure regulation devices, and valves) or even 100% (for rain shut-off devices). The first step is a free water use assessment; call the Sonoma County Water Agency, (707) 547-1968 or the Sonoma County Business Environmental Alliance at (707) 565-6455.

Rebates are available to commercial sewer customers through Sonoma County Sanitation for a variety of **water efficiency improvements**, including smart irrigation controllers, high efficiency toilets and urinals, high efficiency clothes washers, connectionless food steamers, water efficient ice machines, pressurized water brooms, dry vacuum pumps, medical equipment steam sterilizers, and more. For details, visit **sonomacountywater.org/scsrebates** or call (707) 547-1968.

Costs associated with implementing permanently attached water efficiency upgrades are also eligible for financing through the Sonoma County Energy Independence program. Combined with the available rebates, this program can allow your business to significantly improve your water efficiency with very little upfront cost. Visit **sonomacountyenergy.org** for more information.

Lodging Industry Programs

Lodging properties are encouraged to implement an "opt in" linen exchange program, whereby guest room sheets and towels are only replaced upon request, rather than automatically changed each day. The Sonoma Valley Economic Development Partnership provides linen exchange cards for use in guest rooms at no charge. Lodging properties that have implemented this program report a high level of guest participation and significant savings in costs for both water and energy. For more information, visit **SonomaValley4Biz.com**.

In addition, a "Dear Guest" letter from the Mayor of Sonoma has been made available to all lodging businesses in Sonoma, emphasizing the importance of water conservation in keeping Sonoma Valley a sustainable community and including suggestions for water-saving behaviors while visiting.

Questions? Contact the City's Water Conservation Coordinator at 933-2247.

City of Sonoma
Department of Public Works
No. 1 The Plaza
Sonoma California 95476-6690
Phone (707) 938-3332 Fax (707) 938-3240

May 22, 2009

Dry water supply conditions exist in Sonoma

NOTICE TO CONTRACTORS HOLDING HYDRANT METERS
In Response to Mandatory Water Reduction

On April 15, 2009, the Sonoma City Council declared a water shortage emergency in response to a reduction in the City's water supply caused by a dry 2008/2009 winter season. Because of our reduced supply conditions, City Council enacted Stage 2 of our Water Shortage and Conservation Ordinance to accomplish a city-wide 25% reduction in water use, effective immediately and through October.

You have received this letter because you have a hydrant meter with which you have used potable water for construction and other purposes. During this water shortage, contractors within the City of Sonoma will no longer be allowed to use potable water for dust control or other construction related purposes. You may use properly treated recycled water for those purposes.

You are required to return your hydrant meter to the Building Department by June 12, 2009, 5:00 p.m. or risk forfeiture of your deposit

As an alternative that you may wish to consider, the Sonoma Valley CSD Wastewater Treatment Plant located at 22675 Eighth Street East, Sonoma, sells tertiary treated wastewater for allowed recycled water uses. Contractors can fill their tanks from a treatment plant hydrant between 8:00 a.m. – 4:00 p.m., 7 days a week. The current cost is $25 per 1,000 gallons. For further information, please contact Mr. Hody Wilson at 975-5199.

Appeals for an exception to this hydrant meter requirement may be made by sending a letter addressed to the City Manager at the following address: City of Sonoma, No. 1 The Plaza, Sonoma, CA 95476. Your letter should describe in detail why the applicant believes an exception is justified. Written appeals must be received by the City Manager no later than June 12, 2009, or you may risk forfeiture of your deposit..

Thank you for your cooperation in responding to this water shortage emergency.

Contact us:

- To report water waste at 938-3332 or email us at water@vom.com
- For more information, contact our water conservation coordinator at 933-2247.

See Top Ten water conservation tips on the back of this Notice

City of Sonoma
Department of Public Works
No. 1 The Plaza
Sonoma California 95476-6690
Phone (707) 938-3332 Fax (707) 938-3240

May 28, 2009

Dry water supply conditions exist in Sonoma

NOTICE TO OUR CUSTOMERS FOR Mandatory Water Reduction

On April 15, 2009, the Sonoma City Council declared a water shortage emergency in response to a reduction in the City's water supply caused by a dry 2008/2009 winter season. Because of our reduced supply conditions, City Council enacted Stage 2 of our Water Shortage and Conservation Ordinance to accomplish a city-wide 25% reduction in water use. Effective immediately and through October, a mandatory reduction in water use from your previous year's usage is in effect for each Residential and Commercial water customer of Sonoma. We recognize that some customers have taken steps to reduce their usage and have installed water conservation hardware and implemented conservation practices in their daily routines. The 25% mandatory reduction in city-wide water use can most effectively be achieved by reducing water applied to your landscaped areas. For the summer of 2009, a brown lawn will be the new "green" symbol of water conservation in Sonoma.

During this Stage 2 shortage, landscape irrigation will be allowed **only** on the following days and times:

Allowed Days	Allowed Hours
Tuesdays	7:00 pm through 7:00 am the next day
Thursdays	7:00 pm through 7:00 am the next day
Saturdays	7:00 pm through 7:00 am the next day
Sundays	7:00 pm through 7:00 am the next day

During this Stage 2 shortage, the following prohibitions are in effect:

- Irrigation that allows water to run off due to excessive watering, overspray or irrigating when raining
- Washing of sidewalks, walkways, driveways, parking lots and other hard-surfaced areas
- Refilling or initial filling of a swimming pool
- Use of water for ornamental fountains
- Washing of vehicles, trailers and boats unless a bucket and hose equipped with a shut-off nozzle are used or taken to a commercial carwash that recycles water

We will keep you updated with further notifications through our local newspapers, customer letters and our City website (www.sonomacity.org).

Thank you for your cooperation in responding to this water shortage emergency.

Contact us:

- To report water waste at 938-3332 or email us at water@vom.com
- For more information, contact our water conservation coordinator at 933-2247.

See Top Ten water conservation tips on the back of this notice

City of Sonoma
Department of Public Works
No. 1 The Plaza
Sonoma California 95476-6690
Phone (707) 938-3332 Fax (707) 938-3240

June 3, 2009

Dry water supply conditions exist in Sonoma

NOTICE TO OUR CUSTOMERS FOR Mandatory Water Reduction

On April 15, 2009, the Sonoma City Council declared a water shortage emergency in response to a reduction in the City's water supply caused by a dry 2008/2009 winter season. Because of our reduced supply conditions, City Council enacted Stage 2 of our Water Shortage and Conservation Ordinance to accomplish a city-wide 25% reduction in water use. This mandatory water reduction is effective immediately and through October.

Your property is on the list of top 100 highest water users in the City of Sonoma. To save water during this water shortage, please fix water leaks and consider replacing on-site water using appliances, such as clothes washers or dishwashers, with high-efficiency models. You can also install ultra-low flow toilets, faucet aerators and low-flow shower heads in your facility if you have not already done so. Faucet aerators and low-flow shower heads are available free of charge from the City.

In addition to increasing the efficiency of your indoor water use, the City asks that you cut your irrigation time **by 25% or more**. During this Stage 2 shortage, landscape irrigation will be allowed **only** on the following days and times:

Allowed Days	Allowed Hours
Tuesdays	7:00 pm through 7:00 am the next day
Thursdays	7:00 pm through 7:00 am the next day
Saturdays	7:00 pm through 7:00 am the next day
Sundays	7:00 pm through 7:00 am the next day

During this Stage 2 shortage, the following prohibitions are in effect:

- Irrigation that allows water to run off due to excessive watering, overspray or irrigating when raining
- Washing of sidewalks, walkways, driveways, parking lots and other hard-surfaced areas
- Refilling or initial filling of a swimming pool
- Use of water for ornamental fountains
- Washing of vehicles, trailers and boats unless a bucket and hose equipped with a shut-off nozzle are used or taken to a commercial carwash that recycles water

Thank you for your cooperation in responding to this water shortage emergency. To report water waste, please call 938-3332 or email us at water@vom.com. For more information regarding water conservation, contact our water conservation coordinator at 933-2247. You may also log onto the City's website at www.sonomacity.org for water conservation program information.

See Top Ten water conservation tips on the back of this notice

City of Sonoma
Department of Public Works
No. 1 The Plaza
Sonoma California 95476-6690
Phone (707) 938-3332 Fax (707) 938-3240

June 5, 2009

Dry water supply conditions exist in Sonoma

NOTICE TO OUR IRRIGATION CUSTOMERS FOR Mandatory Water Reduction

On April 15, 2009, the Sonoma City Council declared a water shortage emergency in response to a reduction in the City's water supply caused by a dry 2008/2009 winter season. Because of our reduced supply conditions, City Council enacted Stage 2 of our Water Shortage and Conservation Ordinance to accomplish a city-wide 25% reduction in water use. This mandatory water reduction is effective immediately and through October.

You are receiving this Notice because your property has a dedicated irrigation meter. To save water during this water shortage, the City asks that you **cut your irrigation time by 25% or more**. For the summer of 2009, a brown lawn will be the new "green" symbol of water conservation in Sonoma.

During this Stage 2 shortage, landscape irrigation will be allowed **only** on the following days and times:

Allowed Days	Allowed Hours
Tuesdays	7:00 pm through 7:00 am the next day
Thursdays	7:00 pm through 7:00 am the next day
Saturdays	7:00 pm through 7:00 am the next day
Sundays	7:00 pm through 7:00 am the next day

During this Stage 2 shortage, the following prohibitions are in effect:

- Irrigation that allows water to run off due to excessive watering, overspray or irrigating when raining
- Washing of sidewalks, walkways, driveways, parking lots and other hard-surfaced areas
- Refilling or initial filling of a swimming pool
- Use of water for ornamental fountains
- Washing of vehicles, trailers and boats unless a bucket and hose equipped with a shut-off nozzle are used or taken to a commercial carwash that recycles water

Thank you for your cooperation in responding to this water shortage emergency. To report water waste, please call 938-3332 or email us at water@vom.com. For more information regarding water conservation, contact our water conservation coordinator at 933-2247.

See Top Ten water conservation tips on the back of this notice

Follow these Top Ten Water Conservation Tips to achieve an immediate 25% reduction in water use.

TOP TEN WATER CONSERVATION TIPS

1. Reduce outdoor irrigation run times by 25% or more.
2. Eliminate all landscape irrigation run-off.
3. Find and repair leaks now.
4. Inspect and tune-up irrigation system monthly.
5. Use a broom, not a hose, to clean driveway, deck or patio.
6. Use a bucket and a hose with an automatic shut-off nozzle when you wash the car, or take the car to a carwash that recycles.
7. Cover pools and hot-tubs to reduce evaporation.
8. Use front-load, high efficiency washing machines.
9. Run the dishwasher and clothes washer with full loads only.
10. Install low-flow showerheads, faucet aerators and ultra-low flow toilets.

CITY OF SONOMA

RESOLUTION NO. 14 - 2009

RESOLUTION OF THE CITY OF SONOMA DECLARING STAGE 2, MANDATORY WATER CONSERVATION THROUGH OCTOBER 2, 2009

WHEREAS, the Sonoma County Water Agency (SCWA) filed a petition with the State of California Water Resources Control Board (SWRCB) requesting approval of a Temporary Urgency Change to its Russian River diversions permits pursuant to California Water Code section 1435; and

WHEREAS, the SCWA petition is to allow temporary reductions to the Russian River instream flow requirements to prevent depletion of storage in Lake Mendocino which would, among other impacts, severely impact threatened or endangered Russian River fish species; and

WHEREAS, the SWRCB approved the Temporary Urgency Change petition by Order WR 2009-0027-DWR (Order) which is in effect from April 6, 2009 through October 2, 2009; and

WHEREAS, the Order provides for minimum Russian River instream flow and requires that the SCWA make a 25 percent reduction in diversions from the Russian River to its customers and water contractors; and

WHEREAS, the City of Sonoma, as a water contractor subject to the 25 percent delivery reduction, will need to achieve an overall system-wide reduction goal of 25 percent; and

WHEREAS, Section 13.10.070 provides for the declaration of various water stages by Council to address reductions in the City water supply upon recommendation of the Director of Public Works of the action needed; and

WHEREAS, the Director of Public Works recommends that a Stage 2, Mandatory Water Conservation, be implemented to achieve the 25 percent reduction goal.

NOW, THEREFORE, BE IT RESOLVED that the City of Sonoma City Council hereby declares a Stage 2, Mandatory Water Conservation and this Declaration shall be in effect until October 2, 2009.

ADOPTED this 15th day of April 2009 by the following vote:

AYES:	Gallian, Barbose, Sanders, Brown
NOES:	None
ABSENT:	Sebastiani

_____
Ken Brown, Mayor

ATTEST:

_____
Gay Rainsbarger, City Clerk

CITY OF SONOMA

RESOLUTION NO. 15 - 2009

RESOLUTION OF THE CITY OF SONOMA ESTABLISHING PERMITTED DAYS OF RESIDENTIAL AND COMMERCIAL IRRIGATION

WHEREAS, Council approved Resolution No. 14-2009 declaring a Stage 2, Mandatory Water Conservation; and

WHEREAS, as provided for under Section 13.10.070(B)(6) of the Municipal Code, residential and commercial irrigation is not permitted except on specific days and times as set forth by resolution of the City Council.

NOW, THEREFORE, BE IT RESOLVED that landscape irrigation of residential and commercial water customers is not permitted except on the days and times as follows:

Tuesday	7:00 p.m. – 7:00 a.m.
Thursday	7:00 p.m. – 7:00 a.m.
Saturday/Sunday	7:00 p.m. – 7:00 a.m.

BE IT FURTHER RESOLVED that Hand-watering of landscape, as opposed to automatic irrigation, is exempt from this exclusion, provided, Section 13.10.060, Waste of Water Prohibited, is followed by the customer.

ADOPTED this 15th day of April 2009 by the following vote:

AYES:	Gallian, Barbose, Sanders, Brown
NOES:	None
ABSENT:	Sebastiani

_____
Ken Brown, Mayor

ATTEST:

_____
Gay Rainsbarger, City Clerk

MENDOCINO COUNTY BOARD OF SUPERVISORS
ONLINE AGENDA SUMMARY

BOARD AGENDA # 12a

-Arrangements for public hearings and timed presentations must be made with the Clerk of the Board in advance of public/media noticing
-Agenda Summaries must be submitted no later than *noon* Monday, 15 days prior to the meeting date (along with electronic submittals)
-Send 14 complete sets (original, single-sided+13 copies) – Items must be signed-off by appropriate departments and/or County Counsel
-Transmittal of electronic Agenda Summaries and associated records must be emailed to: bosagenda@co.mendocino.ca.us
-Electronic Agenda Transmission Checklist: ☒ Agenda Summary ☒ Records ☐ If applicable, list other online information below
-Executed records will be returned to the department within one week. Arrangements for expedited processing must be made in advance

TO: Board of Supervisors **DATE:** June 25, 2009

FROM: Jeanine B. Nadel, County Counsel **MEETING DATE:** July 14, 2009

DEPT RESOURCE/CONTACT:

Tom Mitchell, CEO	PHONE: 463-4441	Present ☒	On Call ☐
Roland Sanford, MCWA	PHONE: 463-4589	Present ☒	On Call ☐
Jeanine B. Nadel, County Counsel	PHONE: 463-4446	Present ☒	On Call ☐

Consent Agenda ☐ Regular Agenda ☒ Noticed Public Hearing ☐ Time Allocated for Item: 15 min.

■ **AGENDA TITLE:** URGENCY ORDINANCE ADDING CHAPTER 7.10 TO THE MENDOCINO COUNTY CODE ENTITLED "EMERGENCY WATER CONSERVATION"

■ **PREVIOUS BOARD/BOARD COMMITTEE ACTIONS:** March 24, 2009: Drought Emergency adopted by the Board of Supervisors

■ **SUMMARY OF REQUEST:** Introduction and adoption of Chapter 7.10 to be added to the Mendocino County Code to establish the necessary rules and regulations on matters related to the local drought emergency adopted by the Board of Supervisors on March 24, 2009 and continuing to date. Cooperation is needed from all Lake Mendocino water users to achieve the State Water Resources Control Board's 50 percent water conservation goal for the Mendocino County portion of the Russian River drainage.

This ordinance should be passed as an urgency ordinance for the immediate preservation of the public peace, health and safety.

■ **SUPPLEMENTAL INFORMATION AVAILABLE ONLINE AT:**
■ **ADDITIONAL INFORMATION ON FILE WITH THE CLERK OF THE BOARD** (CHECKED BY COB IF APPLICABLE): ☐

FISCAL IMPACT:

Source of Funding	Current F/Y Cost	Annual Recurring Cost	Budgeted in Current F/Y
N/A			Yes ☐ No ☒

■ **SUPERVISORIAL DISTRICT:** 1☐ 2☐ 3☐ 4☐ 5☐ All☒ ■ **VOTE REQUIREMENT:** Majority☒ 4/5ths☐

■ **RECOMMENDED ACTION/MOTION:** Introduce and adopt Ordinance adding Chapter 7.10 to the Mendocino County Code; authorize Chair to sign the same.

Send County Counsel, CEO, Sheriff & Water Agency one copy of the adopted ordinance.

■ **ALTERNATIVES:** Do not adopt.

■ **CEO REVIEW (NAME):** Hunter Alexander **PHONE:** 463-4441

RECOMMENDATION: Agree ☒ Disagree ☐ No Opinion ☐ Alternate ☐ Staff Report Attached ☐

BOARD ACTION (DATE: 7-14-09**):** ☑ Approved ☐ Referred to _____ ☐ Other _____

RECORDS EXECUTED: ☐ Agreement: _____ ☐ Resolution: _____ ☑ Ordinance: 4224 ☐ Other _____

Revised-01/09

SUMMARY

ORDINANCE ADDING CHAPTER 7.10 TO THE MENDOCINO COUNTY CODE ENTITLED "EMERGENCY WATER CONSERVATION"

This ordinance adds Chapter 7.10 to the Mendocino County Code to introduce and immediately adopt the ordinance to establish the necessary rules and regulations on matters related to the local drought emergency adopted by the Board of Supervisors on March 24, 2009 and continuing to date. Cooperation is needed from all Lake Mendocino water users to achieve the State Water Resources Control Board's 50 percent water conservation goal for the Mendocino County portion of the Russian River drainage. This ordinance should be passed as an urgency ordinance for the immediate preservation of the public peace, health and safety.

ORDINANCE NO. 4224

URGENCY ORDINANCE ADDING CHAPTER 7.10 TO THE MENDOCINO COUNTY CODE ENTITLED "EMERGENCY WATER CONSERVATION"

The Board of Supervisors of the County of Mendocino ordains as follows:

Chapter 7.10 of the Mendocino County Code shall read as follows:

"Chapter 7.10 EMERGENCY WATER CONSERVATION

Section 7.10.010. Purpose

The declared purpose of this Chapter is to adopt the necessary rules and regulations on matters related to the local drought emergency adopted by the Board of Supervisors on March 24, 2009 and continuing to date. Such rules are designed to protect life and property affected by the emergency. Cooperation of all Lake Mendocino water users is necessary to achieve the State Water Resources Control Board's 50 percent water conservation goal for the Mendocino County portion of the Russian River drainage. Immediate action is necessary to avoid depleting Lake Mendocino storage and to, in turn, avoid significant health and safety risks, and catastrophic economic losses to Mendocino County's residents. Based on the findings set forth below, this ordinance is passed as an urgency ordinance for the immediate preservation of the public peace, health, and safety.

Section 7.10.020 Findings.

1. Mendocino County is now in its third consecutive year of drought.

2. Lake Mendocino storage remains at unprecedentedly low levels and water delivery limitations have become worse in this third year of drought, creating emergency conditions in Mendocino County.

3. On March 24, 2009, the Mendocino County Board of Supervisors adopted Resolution Number 09-069 declaring a local emergency in Mendocino County due to drought conditions. The Declaration will continue until such time as the Board of Supervisors declares otherwise.

4. Pursuant to Government Code § 8630 et seq., and Mendocino County Code Chapter 7.04, the Director of Emergency Services and the Board of Supervisors may promulgate orders and regulations necessary to preserve the public order and safety.

5. On April 6, 2009, the State Water Resources Control Board issued Order WR 2009-0027-DWR reducing minimum instream flow requirements downstream of Lake Mendocino and implementing 25 percent and 50 percent Russian River water conservation goals in Sonoma and Mendocino counties, respectively. The order was effective as of April 1, 2009.

6. In response to State Water Resources Control Board Order WR 2009-0027-DWR, the Mendocino County Russian River Flood Control and

Water Conservation Improvement District (District) notified its customers in a letter dated April 15, 2009 that their 2009 water allocations from the District would be reduced by 50 percent.

7. On May 28, 2009, the State Water Resources Control Board issued Order WR 2009-0034-EXEC reaffirming the water conservation objectives set forth in State Water Resources Control Board Order WR 2009-0027-DWR.

8. Despite the enactment of State Water Resources Control Board Order WR 2009-0034-EXEC, Lake Mendocino is projected to reach perilously low storage levels by the fall of 2009.

9. On December 11, 2007, the Redwood Valley County Water District Board of Directors declared a Water Shortage Emergency due to lack of adequate rainfall, and that lack of adequate rainfall has continued through the winter of 2008-2009.

10. On April 15, 2009, the City of Ukiah City Council declared a Local Emergency under the State Emergency Services Act and a Stage I Water Shortage Emergency under Section 3602 of the Ukiah City Code.

11. On April 16, 2009, the Redwood Valley County Water District Board of Directors declared that the December 11, 2007 emergency was still in effect, and that it would be necessary to increase the level of conservation to Tier 4 of Redwood Valley County Water District's Ordinance number 1, with 50 percent mandatory conservation effective May 15, 2009.

12. On May 26, 2009, the Millview County Water District Board of Directors adopted Resolution 09-03 declaring a Water Supply Emergency within the boundaries of the Millview County Water District and advanced the water conservation level to stage two, limiting consumption to residential customers to 5,250 gallons per month and requiring a 25% reduction to all commercial/ industrial users.

13. The drought conditions impacting Lake Mendocino water storage are exacerbated by the 2004 Potter Valley Federal Energy Regulatory Commission Decision restricting water diversions from the Eel River to the Russian River by an average of 35 percent, as well as Water Right Decision 1610, which governs stream flow releases from Lake Mendocino and mandates unnecessarily high stream flow releases that the National Marine Fisheries Service has concluded greatly limit the quantity and quality of juvenile salmon and steelhead habitat in the Russian River.

14. The Mendocino County recently endured one of its worst fire seasons in history and the continuing drought conditions increase the risk of devastating fires and reduced water supplies for fire suppression.

15. The adverse environmental, economic, and social impacts of the drought pose an imminent threat of disaster and threaten to cause widespread harm to people, businesses, property, communities, wildlife, and recreation in Mendocino County.

16. The Mendocino County Board of Supervisors has requested assistance from the State of California, from all relevant State agencies, including but not limited to, the Office of Emergency Services, the Department of Water Resources, the State Water Resources Control Board, the Department of General Services, the Department of Public Health, and the Department of Food and Agriculture, with such assistance to include, but not be limited to, the provision of technical and financial assistance, surplus equipment, and regulatory relief to assist in mitigating or averting the impacts of the drought emergency by increasing water supply and availability, reducing mandated water releases, facilitating water transfers and emergency intertie connections, and all other necessary and appropriate actions to mitigate or relieve the drought emergency.

17. The Mendocino County Board of Supervisors also requested that a Federal declaration of emergency be declared for Mendocino County and further requests that Federal assistance be made available from all relevant Federal agencies, including, but not limited to the Department of Agriculture, the Department of the Interior and the Federal Drought Action Team.

Section 7.10.030 Conservation Requirement.

All Mendocino County users of the Lake Mendocino water supply, which is defined as "water held in storage for eventual release or directly diverted from Lake Mendocino", shall reduce their water usage by 50 percent as compared to at least one of the following:

a) The maximum allowable annual diversion amount set forth in a valid Appropriative water right permit or license held by the water user and issued by the State Water Resources Control Board.

b) The maximum annual water allocation set forth in a valid water supply contract between the water user and the Mendocino County Russian River Flood Control and Water Conservation Improvement District.

c) The corresponding average water usage for the time period beginning on July 15, 2004 and extending through October 2, 2004, or in instances where no applicable water usage data are available for 2004, the corresponding five-year average water usage for the 80-day time period beginning on July 15 and extending through October 2.

d) Any alternative measure approved by the Mendocino County Water Agency.

All users shall also be required to comply with all rules and regulations regarding water usage that have been adopted by each agency, city, or district.

Section 7.10.040 Reporting Requirements.

All water agencies, cities, districts, and other persons or entities who are not serviced by an agency, city, or district who divert water subject to this chapter shall, on a monthly basis, provide written documentation to the Mendocino County Water Agency that the above requirement is being met. This does not apply to those individual water customers who are serviced by an agency, city, or district.

Section 7.10. 050 Penalty.

The violation of any provisions of any section of this ordinance, including, but not limited to, the reporting requirements set forth in section 7.10.040, shall be treated as a misdemeanor.

Section 7.10.060 Review.

This ordinance shall be reviewed for modification or repealed at the time the Declaration of Emergency has been discontinued by the Board of Supervisors.

Section 7.10.070 Severability.

The provisions of this ordinance are separate and severable. If any provision of this ordinance is for any reason held by a court to be unconstitutional or invalid, the Board declares that it would have passed this ordinance irrespective of the invalidity of the provision held to be unconstitutional or invalid. Such unconstitutionality or invalidity shall therefore not affect the remaining provisions of this ordinance, or the validity of its application to other persons or circumstances."

PASSED AND ADOPTED by the Board of Supervisors of the County of Mendocino, State of California, on this 14th day of July, 2009, by the following roll call vote:

AYES:	Supervisors Brown, McCowen, Smith and Colfax
NOES:	Supervisor Pinches
ABSENT:	None

WHEREUPON, the Chairman declared the Ordinance passed and adopted And **SO ORDERED**.

Chair, Board of Supervisors

ATTEST: KRISTI FURMAN
Clerk of Said Board

By: _____
Deputy

APPROVED AS TO FORM:

JEANINE B. NADEL, County Counsel

By: _____

I hereby certify that according to the provisions of Government Code Sections 25103, delivery of this document has been made.

KRISTI FURMAN
Clerk of the Board

By: _____
DEPUTY

Summary
North Marin Water District
Emergency Water Conservation Ordinance Number 22
(Novato Service Area Only)

On May 19, 2009, the North Marin Water District Board of Directors held a public hearing and approved Ordinance 22 enacting water use restrictions summarized below.

Water Waste and Non-Essential Use Prohibitions

Phase 1: Effective March 1, 2009 until Ordinance is Rescinded by Board

- Gutter flooding (i.e. unreasonable irrigation overspray or irrigation run-off onto pavement).
- Failure to repair a controllable leak of water within a reasonable time.
- Using water for non-recycling decorative fountains or single-pass cooling systems.
- Washing down exterior paved areas.
- Refilling a swimming pool drained after March 1, 2009.
- Washing privately-owned motor vehicles, trailers and boats except from a bucket and hose equipped with an automatic shut-off nozzle.
- Landscape watering beyond the hours of 10:00 PM and 6:00 AM of the next day - hand-watering from a hose with an automatic shut-off nozzle or drip irrigation system will be allowed.
- New or enlarged water service connections to the District's system.

Phase 2: Additional Non-Essential Use Prohibitions Effective June 1, 2009 to comply with State Water Resources Control Board Order WR 2009-0027 until October 6, 2009 or until such declaration is rescinded:

- Use of water from a fire hydrant except for fighting fires, human consumption, essential construction needs or use in connection with animals.
- Watering of any lawn, garden, landscape area except if customer maintains an overall 25% reduction in water use compared to the 2004 year's use in the same billing period, or if the landscape is irrigated with drip or by hand with a container or hose with automatic shut off nozzle. *Customers using less than 200 gallons per day are permitted to water their landscapes without the required 25% reduction if compliant with Section 5 - Waste of Water Prohibited.*
- Initial filling of a swimming pool for which building permit was issued after March 1, 2009.
- Use of potable water supply for dust control at construction sites.
- Use by a vehicle washing facility in excess of 75% of the amount used by it during corresponding billing period in the prior year.
- Any non-residential use in excess of 75% of the amount used by the customer during the corresponding billing period in prior year.

Violation Procedure

1) Customers found to be in violation of North Marin Water District Ordinance 22 will receive a written warning describing the violation and order that it be corrected, cured and abated

immediately or within such specified time that is determined to be reasonable. If said order is not complied with, service may be disconnected.

2) If customer's water service is disconnected for said violation, a reconnection fee of $100 shall be paid.
3) If the violation is not corrected after the first disconnection of water service and reconnection fee has been paid, the water service may be disconnected again with a reconnection fee of $200. Any water service that is disconnected twice shall be reconnected with a flow-restricting device.
4) If a swimming pool has been filled with water furnished by the District after March 1, 2009 service shall be disconnected and a reconnection fee of $800 shall be paid.

Variance Procedure

Applications for variance for any non-essential use prohibitions of Ordinance 22, Section 6 may be made to the General Manager. The General Manager may grant a variance if reasonably necessary.

Questions or Comments

All customer questions and comments regarding the emergency water conservation ordinance should be referred to the Water Conservation Hotline (415) 897-4133 ext. 8711

NORTH MARIN WATER DISTRICT

EMERGENCY WATER CONSERVATION ORDINANCE

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EMERGENCY WATER CONSERVATION ORDINANCE

ORDINANCE NO. 22

BE IT ORDAINED by the Board of Directors of North Marin Water District that the provisions of Ordinance 21 of said District shall be changed to read as shown below:

Section 1. Declaration of a Water Shortage Emergency

This Board of Directors does hereby find and declare as follows:

(a) On February 17, 2009, a public hearing was held on the matter of whether this Board of Directors should declare a water shortage emergency because dry year conditions exists within the water service area of this District which is served by Stafford Lake and the North Marin Aqueduct which delivers water from Sonoma County Water Agency's (SCWA) Russian River supply.

(b) Notice of said hearing was published in the Marin Independent Journal, a newspaper of general circulation printed and published within said water service area of the District.

(c) At said hearing all persons present were given an opportunity to be heard and all persons desiring to be heard were heard.

(d) Said hearing was called, noticed and held in all respects as required by law.

(e) This Board heard and has considered each protest against the declaration and all evidence presented at said hearing.

(f) A water shortage emergency condition exists and prevails within the portion of the territory of this District served by Stafford Lake and the North Marin Aqueduct. Said portion of this District is hereinafter referred to as the Novato area and consists in all the territory of this District except the portions hereof in the western part of Marin County denominated Annexations 2, 3, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15 and 16 generally known as Point Reyes Station, Inverness Park, Bear Valley, Olema, Paradise Ranch Estates, Oceana Marin, and territories on the east shore of Tomales Bay. Said water shortage exists by reason of the fact that low water storage conditions exists in Lake Mendocino on the Russian River and the State Water Resources Control Board (SWRCB) Order WR 2009-0027 approved a temporary change in SWRCB Decision 1610 to reduce required instream flow releases to the Russian River from Lake Mendocino and reduce authorized diversions from the Russian River by SCWA for delivery to its customers including North Marin Water District. Said water shortage will limit the

water supply availability from the SCWA such that the ordinary demands and requirements of the water consumers in the Novato area cannot be met and satisfied without depleting the water supply of the district to the extent that there would be insufficient water for human consumption, sanitation, and fire protection in the Novato area.

Section 2. Purpose and Authority

The purpose of this ordinance is to conserve the water supply of the District for the greatest public benefit with particular regard to public health, fire protection and domestic use, to conserve water by reducing waste, and to the extent necessary by reason of drought and the existing water shortage emergency condition to reduce water use fairly and equitably. This ordinance is adopted pursuant to Water Code section 350 et seq. and sections 31026 - 31029. The General Manager is granted authority to adjust measures identified in Sections 4, 5 and 6 of this ordinance to be consistent with Emergency Water Conservation measures of other local agencies which receive Russian River water from SCWA or to achieve a higher level of conservation if listed water use reduction goals are not met.

Section 3. Effect of Ordinance

This ordinance shall become effective immediately, shall be effective only in the Novato service area, shall supersede and control over any other ordinance or regulation of the District in conflict herewith, and shall remain in effect until the Board of Directors declares that the water shortage emergency has ended. The effective period shall herein be referred to as “suspension period”.

Section 4. Suspension of New Connections to the District's Water System

(a) From and including March 1, 2009 until the Board of Directors by resolution declares that the water shortage has ended, which period is hereinafter referred to as the suspension period, no new or enlarged connection shall be made to the District's water system except the following:

(1) connection pursuant to the terms of connection agreements which prior to February 18, 2009, had been executed or had been authorized by the Board of Directors to be executed;

(2) connection of fire hydrants;

(3) connection of property previously supplied with water from a well which runs dry;

(4) connection of property for which the Applicant agrees to defer landscape installation until after the suspension period.

(b) During the suspension period applications for water service will be processed only if the Applicant acknowledges in writing that such processing shall be at the risk and expense of the Applicant and that if the application is approved in accordance with the District's regulations, such approval shall confer no right upon the Applicant or anyone else until the suspension period has expired, and that the Applicant releases the District from all claims of damage arising out of or in any manner connected with the suspension of connections.

(c) Upon the expiration of the suspension period, the District will make connections to its water system in accordance with its regulations and the terms of connection agreements for all said applications approved during the suspension period.

(d) Nothing herein shall prohibit or restrict any modification, relocation or replacement of a connection to the District's system if the General Manager determines that the demand upon the District's water supply will not be increased thereby.

Section 5. Waste of Water Prohibited

No water furnished by the District shall be wasted. Waste of water includes, but is not limited to, the following:

(a) permitting water to escape down a gutter, ditch or other surface drain;

(b) failure to repair a controllable leak of water;

(c) failure to put to reasonable beneficial use any water withdrawn from the District's system;

(d) all items listed in Regulation 15, Section b., Waste of Water Prohibited.

Section 6. Prohibition of Non-Essential Use of Water

(a) No water furnished by the District shall be used for any purpose declared to be non-essential by this ordinance.

Phase 1 - Introductory Phase (15% Reduction)

(b) The following uses are declared to be non-essential from and after March 1, 2009:

(1) washing sidewalks, driveways, parking areas, tennis courts, patios, decks or other exterior paved areas except by the Novato Fire Protection District or other public agency for the purpose of public safety;

(2) refilling a swimming pool drained after March 1, 2009;

(3) non-commercial washing of privately-owned motor vehicles, trailers and boats except

from a bucket and except that a hose equipped with an automatic shut-off nozzle may be used for a quick rinse.

(4) Request restaurants to serve water only upon request.

(5) Watering of any lawn, garden, landscaped area, tree, shrub or other plant except from a handheld hose equipped with an automatic shut-off nozzle or container or drip irrigation system except customers of the District may use a sprinkler or sprinkler system to apply water furnished by the District to irrigate any lawn, garden, landscaped area, trees or shrubs provided said application is attended, properly controlled, performed in a non-wasteful manner and confined to the hours between 10 p.m. and 6:00 a.m. of the next day. The term sprinkler shall be defined to include soaker hoses or lines. The District reserves the right to check the water use of any customer and if such use exceeds 85% of the use by the same customer or account for the corresponding period in previous year or if sprinkled water is used in a wasteful manner, the General Manager may prohibit sprinkling by that customer.

Phase 2 - Moderate Mandatory Conservation (25% reduction)

(c) The following additional uses are declared to be non-essential effective June 1, 2009, to comply with the SWRCB WR 2009-0027 until October 6, 2009 or until such declaration is rescinded:

(1) any use of water from a fire hydrant except for fighting fires, human consumption, essential construction needs or use in connection with animals;

(2) watering of any lawn, garden, landscaped area, tree, shrub or other plant except from a handheld hose equipped with an automatic shut-off nozzle or container or drip irrigation system except overhead sprinkler irrigation can be used if customer maintains an overall 25% reduction in water use compared to the 2004 year's use in the same billing period. (Customers using less than 200 gallons per day are permitted to water their landscapes without a required 25% reduction if compliant with Section 5. Waste of Water Prohibited);

(3) initial filling of any swimming pool for which application for a building permit was made after March 1, 2009;

(4) watering any portion of a golf course except for tees and greens except as provided in Section 2 herein or where private wells or recycled water supply is used;

(5) use of potable water supply for dust control at construction sites;

(6) any non-residential use in excess of 75% of the amount used by the customer during the corresponding billing period in the year 2004.

Section 7. Variances

Applications for a variance from the provisions of Section 6 of this ordinance may be made to the General Manager. The General Manager may grant a variance to permit a use of water otherwise prohibited by Section 6 if the General Manager determines that the variance is reasonably necessary. Any decision of the General Manager under this section may be appealed to the Board of Directors.

Section 8. Violations

(a) If and when the District becomes aware of any violation of any provision of Section 5 or 6 of this ordinance, a written notice shall be placed on the property where the violation occurred and/or mailed to the person who is regularly billed for the service where the violation occurs and to any other person known to the District who is responsible for the violation or its correction. Said notice shall describe the violation and order that it be corrected, cured and abated immediately or within such specified time as the General Manager or District staff determines is reasonable under the circumstances. If said order is not complied with, the District may forthwith disconnect the service where the violation occurs.

(b) a fee of $100 shall be paid for the reconnection of any service disconnected pursuant to subsection (a) during the suspension period.

(c) No service which is disconnected a second time because of a violation of Section 5 or 6 of this ordinance during the suspension period, shall be reconnected unless a device supplied by the District which will restrict the flow of water to said service is installed. Furthermore, the fee for reconnection of such a service during the suspension period shall be $200 in lieu of the fee required by subsection (b) hereof.

(d) In the event the District determines that water furnished by the District has been used to fill a swimming pool in violation of Section 5 or 6 hereof, service shall be disconnected and shall be reconnected pursuant to Section 8 (b) or Section 8 (c) hereof, as applicable, except that the reconnection fee shall be $800 for each offense.

Section 9. Signs on Lands Supplied from Private Wells or Recycled Water

The owner or occupant of any land within the Novato water service area that is supplied with water from a private well or with recycled water shall post and maintain in a conspicuous place thereon a sign furnished by the District giving public notice of such supply.

* * * * *

I hereby certify that the foregoing is a true and complete copy of an ordinance duly and regularly adopted by the Board of Directors of North Marin Water District at a regular meeting thereof held on May 19, 2009 by the following vote:

AYES:	Directors Baker, Fraites, Petterle, Rodoni, Schoonover
NOES:	None
ABSENT:	None
ABSTAIN:	None

Renee Roberts, District Secretary
North Marin Water District

(SEAL)

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Resolution 09-14

A RESOLUTION OF THE SWEETWATER SPRINGS WATER DISTRICT
Approving the Sweetwater Springs Water District Water Conservation Program

WHEREAS, the California State Water Resources Board issued Board Order WR 2009-0027-DWR (the "Order") on April 6, 2009, which approves a Temporary Urgency Change in Sonoma County Water Agency (SCWA) Permits to Russian River water users. The Order directs SCWA to "submit a plan to the State Water Resources Control Board to obtain the cooperation and participation of agricultural and municipal Russian River water users to reach a water conservation goal of 25 percent in Sonoma County" through October 2, 2009; and

WHEREAS, the reservoirs in the Russian River system and the flows in the River are low and projections indicate that conditions will deteriorate further later in the summer and fall of 2009; and

WHEREAS, it is in the District's and SCWA's interest that a cooperative effort be developed to address the water shortage situation in the Russian River system; and

WHEREAS, the District adopted the 2005 Urban Water Conservation Plan (the "Plan") by Resolution 08-01 on February 7, 2008, which includes a water shortage contingency element: and

WHEREAS, the Plan's voluntary and mandatory rationing stages may be triggered by a water supply shortage; and

WHEREAS, the Order issued by the California State Water Resources Board indicates a water supply shortage exists thereby triggering the need for enhanced water conservation practices by all users of the Russian River; and

WHEREAS, the Plan provides for voluntary water conservation practices when the conservation target is below 25%; and

WHEREAS, this level of voluntary conservation by District customers may be achieved by adjustment to their interior or exterior water use, but still requires concerted effort by District staff; and

WHEREAS, attached as Exhibit A is a list of the programs and activities that will be undertaken by the District to assist its customers in achieving water savings of up to 15% compared to 2008 water use under the voluntary conservation program. This level of conservation is equivalent to a 25% reduction based on District 2004 water usage; and

WHEREAS, the conservation activities recommended by the District Program are important in all seasons and all years, regardless of State Board Orders and seasonal shortages.

NOW, THEREFORE BE IT RESOLVED that the Board of Directors of the Sweetwater Springs Water District approves the District's Water Conservation Program, as described in Exhibit A and directs staff to begin implementation the programs and activities listed therein.

This Resolution was adopted this June 4, 2009, on roll call by the following vote:

Wanda Smith : _____
Victoria Wikle : _____
Jim Quigley: _____
Sukey Wilder: _____
Gaylord Schaap: _____

_____
Victoria Wikle
President of the Board

ATTEST:

_____
Julie A. Kenny
Clerk of the Board

Exhibit A
Resolution 09-14
Sweetwater Springs Water District Water Conservation Program
June 4, 2009

Reduction Target for the District is up to 25% reduction based on the 2004 water use and production for the months of May through September. For the District, as a whole, this equates to a 15% reduction compared to 2008 water use and production during the same summer months. This is not a rationing target or goal for individuals – some customers have little room for additional water use reduction, others can do much more.

District participation is based on the State Board Order directing the Sonoma County Water Agency (SCWA) to "submit a plan to the State Water Resources Control Board to obtain the cooperation and participation of agricultural and municipal Russian River water users to reach a water conservation goal of 25 percent in Sonoma County" from May 1, 2009 to October 2, 2009, in response to SCWA's Temporary Urgency Change request for Decision 1610. The base year for the 25% reduction calculation is 2004.

The approach/strategy is voluntary conservation whereby District customers are encouraged and offered resources to use water wisely, and to search for and fix leaks on their property. The District will continue with its capital projects aimed at reducing system losses, pay attention to water wasting in the District, fix surfacing leaks as quickly as possible, and look for other opportunities to reduce system losses.

Program Elements:

- Public Education/Information, such as
    - Work with SCWA and other water providers in the region for coordinated message
    - Information on website
    - Mailer in May
    - Home Water Audits – self and assisted:
        - Instructions on meter reading.
        - Check for leaks inside and outside.
        - Evaluate all water uses in facility or home.
    - Office Display with handouts – rebates, low flow showerheads, faucet aerators
    - Provide information on rebates, incentive programs, and water conservation strategies for residents/businesses.
    - Media Spots – press releases, PSA's done on a regional basis
    - Connect with Statewide effort
- Waste of Water Prohibited, staff will be alerted to be on the lookout for wastage of water and contact customers, as appropriate.
- Rate incentives – rates scheduled to go into effect July 3 have increased financial incentive to reduce water use (higher incline to tiered rates).
- Capital Improvement Program – CIP IV-A is replacing water distribution mains as part of program to reduce system losses. CIP IV-A, Project 2 is starting May 11 and should help reduce losses this summer. CIP IV-A, Project 1 should be completed in mid May and also will reduce system losses.
- District staff fix reported and found leaks on a priority basis.

ORDINANCE NO. 1007

AN ORDINANCE OF THE VALLEY OF THE MOON WATER DISTRICT INSTITUTING WATER WASTE PROHIBITIONS

SECTION 1. The Valley of the Moon Water District does hereby ordains as follows:

The Regulations of the Valley of the Moon Water District hereby amended by adding Section 12 to read as follows:

"Section 12 - Water Waste Prohibitions

A. Purpose. The purpose of this Section is to promote water conservation and the efficient use of potable water furnished by the Valley of the Moon Water District by eliminating intentional or unintentional water waste when a reasonable alternative solution is available, and by prohibiting use of equipment which is wasteful.

B. Nonessential Uses. No customer of the Valley of the Moon Water District shall use or permit the use of potable water from the Valley of the Moon Water District for residential, commercial, institutional, industrial, agricultural, or other purpose for the following nonessential uses:

1. The washing of sidewalks, walkways, driveways, parking lots and other hard-surfaced areas by direct hosing, except as may be necessary to properly dispose of flammable or other dangerous liquids or substances, wash away spills that present a trip and fall hazard, or to prevent or eliminate materials dangerous to the public health and safety;

2. The escape of water through breaks or leaks within the customer's plumbing or private distribution system for any substantial period of time within which such break or leak should reasonably have been discovered and corrected. It shall be presumed that a period of seventy-two (72) hours after the customer discovers such a break or leak or receives notice from the Valley of the Moon Water District, is a reasonable time within which to correct such break or leak or, at a minimum, to stop the flow of water from such break or leak;

3. Irrigation in a manner or to an extent which allows excessive run off of water or unreasonable over-spray of the areas being watered. Every customer is deemed to have his water system under control at all times, to know the manner and extent of his water use and any run off, and to employ available alternatives to apply irrigation water in a reasonably efficient manner;

4. Washing cars, boats, trailers or other vehicles and machinery directly with a hose not equipped with a shutoff nozzle;

5. Water for non-recycling decorative water fountains;

6. Water for single pass evaporative cooling systems for air conditioning in all connections installed after June 6, 2000 unless required for health or safety reasons;

7. Water for new non-recirculating conveyor car wash systems; and

8. Water for new non-recirculating industrial clothes wash systems.

C. Exempt Water Uses. All water use associated with the operation and maintenance of fire suppression equipment or employed by the Valley of the Moon Water District for water quality flushing and sanitation purposes shall be exempt from the provisions of this section. Use of water supplied by a private well or from a reclaimed wastewater, gray water or rainwater utilization system is also exempt.

D. Variances. Any customer of the Valley of the Moon Water District may make written application for a variance. Said application shall describe in detail why applicant believes a variance is justified.

1. The General Manager of the District may grant variances for use of water otherwise prohibited by this section upon finding and determining that failure to do so would cause an emergency condition affecting the health, sanitation, fire protection or safety of the applicant or public; or, cause an unnecessary and undue hardship on applicant or public, including but not limited to, adverse economic impacts, such as loss of production or jobs.

2. The decision of the General Manager of the District may be appealed to the Board of Directors by submitting a written appeal to the District within fifteen (15) calendar days of the date of the decision. Upon granting any appeal, the Board of Directors may impose any conditions it determines to be just and proper. Variances granted by the Board of Directors shall be prepared in writing and the Board of Directors may require the variance be recorded at applicant's expense.

E. Enforcement and Fees. Depending on the extent of the water waste the District may, after written notification to customer and a reasonable time to correct the violation as solely determined by the District, take some or all of the following actions. Penalties, fees and charges noted below shall be established by resolution of the District. The penalties listed in Sections E3, E4 and E5 below will be applied only in acute emergencies as determined and publicly announced by the General Manager, or after the Board has declared a Stage 2 or equivalent water shortage condition.

General Manager, or after the Board has declared a Stage 2 or equivalent water shortage condition.

1. Written notice to the customer of the water waste violation including a specified period of time to correct the violation.

2. Personal contact with the customer at the address of the water service. If personal contact is unsuccessful, written notice of the violation including a date that the violation is to be corrected may be left on the premises, with a copy of the notice sent by certified mail to the customer.

3. The District may install a flow-restricting device on the service line.

4. The District may levy a water waste fee to the customer.

5. The District may cause termination of water service and the charge for same shall be billed to the customer. Except in cases of extreme emergency as solely determined by the General Manager of the District, service shall not be reinstated until verified by the District that the violation has been corrected and all charges and fees have been paid.

SECTION II. SEVERABILITY

If any section, subsection, sentence, clause, phrase, or word of this ordinance is for any reason held to be invalid, the validity of the remaining portion of this ordinance shall not be affected.

SECTION III. FINDINGS

A. This Ordinance is enacted in accordance with California Water Code section 375, *et seq.* and for the purpose of insuring that all water furnished by the District is put to reasonable beneficial use, to prevent the waste of water, and to promote efficient use and conservation of water.

B. The District determines that this ordinance is a Class 7 categorical exemption under section 15307 of the California Environmental Quality Act, which exempts actions by regulatory agencies for protection of natural resources.

SECTION IV. EFFECTIVE DATE

This ordinance shall become effective upon its adoption.

SECTION V. PUBLICATION

Within ten (10) days after its adoption, this resolution shall be published pursuant to Section 6061 of the Government Code in full in a newspaper of general circulation that is printed,

published, and circulated in the District. If there is no such newspaper the resolution shall be posted within ten (10) days after its adoption in three public places within the District.

On the Motion of Director Whinery and second by Director Kenny, the Ordinance was PASSED, APPROVED AND ADOPTED this 6th day of June, 2000, by vote as follows:

President Willer	Aye	Director Sutsos	Aye
Vice President Whinery	Aye	Director Kenny	Aye
Director Pedroncelli	Aye		

AYES: 5 NOES: 0 ABSTAIN: 0 ABSENT 0

BY: David C. Willer
David Willer, President of the Board

I HEREBY CERTIFY that the foregoing Resolution was duly adopted at a regular meeting of the Board of Directors of the Valley of the Moon Water District, held on the 6th day of June, 2000, of which meeting all Directors were duly notified and at which meeting a quorum was present at all times and acting.

By: Judith Ponts
Judith Ponts, Board Secretary

Approved:
Attorney

User/Ordinances/ord1007

ORDINANCE NO. 1009
ORDINANCE OF THE BOARD OF DIRECTORS OF THE VALLEY OF THE MOON WATER DISTRICT ESTABLISHING WATER CONSERVATION MEASURES.

WHEREAS, the Valley of the Moon Water District (District) is a County Water District, duly organized and existing under the provisions of the County Water District Law (California Water Code section 30000 *et seq.*), and is empowered to provide water service to customers within certain boundaries; and

WHEREAS, the Sonoma County Water Agency (Water Agency) is the wholesaler of water to the District; and

WHEREAS, on February 2, 2009, the Water Agency held a press conference to announce that water storage in Lake Sonoma and Lake Mendocino is projected to reach low levels unless significant rainfall occurs; and

WHEREAS, the Water Agency has indicated that it may have to reduce deliveries to its water contractors, including the District, this summer; and

WHEREAS, the District has the authority and responsibility to adopt water demand reduction measures within its area of service.

NOW, THEREFORE, BE IT ORDAINED BY THE BOARD OF DIRECTORS OF THE VALLEY OF THE MOON WATER DISTRICT THAT all water customers of the Valley of the Moon Water District are hereby directed to implement the following water conservation measures:

1. Use water efficiently and reduce less essential uses of water with the goal of achieving an overall system-wide 15% reduction in water use.
2. Implement the following irrigation practices with the goal of reducing system-wide water use for irrigation by 20%. Customers who use non-District source of water for irrigation are also encouraged to conserve water to the extent possible.
    a. Irrigate between 12:00 a.m. and 6:00 a.m. to reduce water loss from evaporation.
    b. Inspect all irrigation systems, repair leaks, and adjust irrigation spray heads to provide optimum coverage and eliminate avoidable over-spray.
    c. For irrigation valves controlling water applied to lawns, vary the run-time consistent with fluctuations in weather.
    d. Reduce run-time for each irrigation cycle if water begins to run-off to gutters and ditches before the irrigation cycle is completed.
3. Become conversant with and strictly adhere to the Valley of the Moon Water District's Water Waste Prohibition Ordinance No. 1007.

4. Utilize water conservation incentives, rebates and give-a-way programs to replace plumbing fixtures and appliances with water efficient models.
5. Take advantage of the free information available from the Valley of the Moon Water District on how to use water efficiently, read water meter, repair ordinary leaks, and implement water efficient landscapes.
6. Run dishwashers and clothes washers with full loads only
7. Use a broom, not water, to clean sidewalks, driveways, decks or patios.
8. Use a hose with an automatic shut-off nozzle when washing vehicles, or take vehicles to a carwash that recycles water.
9. Prevent and report water waste.

BE IT FURTHER ORDAINED that the General Manager is hereby authorized and directed to publish and post this Ordinance in accordance with the Statute, to take such steps as he shall deem necessary to implement the overall demand reduction needed, and to report back to this Board on the status of the water supply available to the District and the results of demand reduction by the District's customers, and shall make such recommendations for further actions of this Board as may be necessary and appropriate.

THIS ORDINANCE PASSED AND ADOPTED THIS 3rd DAY OF MARCH, 2009, by the following votes:

Director Prushko Aye

Director Townsend Aye

Director Bandur Aye

Director Bramfitt Aye

Director Kenny Aye

By Ronald W. Prushko
President

By Shari Walk
Deputy Secretary

AYES 5 NOES 0 ABSENT 0 ABSTAIN 0

I HEREBY CERTIFY that the foregoing Resolution was duly adopted at a regular meeting of the Board of Directors of Valley of the Moon Water District held on the 3rd day of March, 2009, of which meeting all Directors were notified and at which meeting a quorum was present at all times and acting.

By Shari Walk
Deputy Secretary

RESOLUTION NO. 2493-09

A RESOLUTION OF THE TOWN COUNCIL OF THE TOWN OF WINDSOR DECLARING A STAGE 2 WATER SHORTAGE CONDITION AND DIRECTING IMPLEMENTATION OF MANDATORY WATER DEMAND REDUCTION MEASURES

WHEREAS, the Town of Windsor is a retail water purveyor and Sonoma County Water Agency contractor; and

WHEREAS, on April 7, 2009, the Sonoma County Water Agency announced that the State, in response to the Agency's request for reduced Russian River flows, has issued an order for a 25 percent reduction in Russian River diversions to its contractors from April 6th to October 2, 2009; and

WHEREAS, in response to public comments on the State Order, the State reissued the Order on May 28, 2009, and

WHEREAS, the State Order lists the Agency's water rights permits under which the Town pumps water at its Russian River Well Field as those being subject to the 25 percent reduction in diversions, and

WHEREAS, in response to the State's Order for both a 25 percent reduction in diversions and a 25 percent increase in conservation and in accordance with the water shortage emergency ordinance (codified into the Municipal Code as Section 12-3-800), the Windsor Council may, by resolution declare a Mandatory Stage 2 Water Shortage Emergency condition.

NOW, THEREFORE, BE IT RESOLVED that the Town Council of the Town of Windsor does hereby find, determine and declare, in accordance with Section 1 (j) of the Town's Water Shortage Ordinance, a Stage 2 Water Shortage Emergency condition exists within the territory of the Town and all water service areas served by the Town and directs the implementation of all water demand reduction measures specified in the Town's Water Shortage Emergency Ordinance for a Stage 2 Water Shortage Emergency condition, and

FURTHERMORE BE IT RESOLVED that the Town Council of the Town of Windsor does hereby find, determine and declare, in accordance with Section 1 (j) of the Town's Water Shortage Ordinance, the overall mandatory rationing requirement shall be 25 percent below usage for the corresponding period of calendar year 2004, a mandatory residential rationing requirement of 30 percent below usage for the corresponding period of calendar year 2004, and a mandatory irrigation rationing requirement of 50 percent below usage for the corresponding period of calendar year 2004, and

FURTHERMORE BE IT RESOLVED that in order for the residential customers to meet the 30 percent reduction goal, residential irrigation is limited to three days per week, with residents east of Highway 101 irrigating Tuesdays, Thursdays, and Saturdays, and residents west of Highway 101 irrigating Wednesdays, Fridays, and Sundays, and residents will not irrigate on Mondays.

PASSED, APPROVED AND ADOPTED this 1st day of July 2009, by the following vote:

AYES:	**COUNCILMEMBERS FUDGE, SALMON, SCHOLAR AND MAYOR GOBLE**
NOES:	**NONE**
ABSTAIN:	**NONE**
ABSENT:	**COUNCILMEMBER ALLEN**

ROBIN R. GOBLE, MAYOR

ATTEST:

MARIA DE LA O, TOWN CLERK

Appendix C – Sonoma County Water Agency Public Outreach

	Source	Event	Date
Paid Ads			
Print Publications			**February 2 - October 12, 2009**
	The Press Democrat	Community Pulse	2/2/09-9/12/09
	The Press Democrat	Community Pulse	2/2/09-9/12/09
	La Voz	Save Our Water Campaign 2009	2/2/09-9/12/09
	Petaluma Argus Courier	Save Our Water Campaign 2009	2/2/09-9/12/09
	Rohnert Park Community Voice	Save Our Water Campaign 2009	2/2/09-9/12/09
	The Press Democrat	Save Our Water Campaign 2009	2/2/09-9/12/09
	Sonoma County Farm Bureau News	Save Our Water Campaign 2009	2/2/09-9/12/09
	Sonoma County WineGrape Comm.	Save Our Water Campaign 2009	2/2/09-9/12/09
Radio			
	Office of the Governor: Radio Address	Save Our Water Campaign 2009	2/2/09-9/12/09
	BobFM	Save Our Water Campaign 2009	2/2/09-9/12/09
	Exitos	Save Our Water Campaign 2009	2/2/09-9/12/09
	KRCB	Save Our Water Campaign 2009	2/2/09-9/12/09

	Source	**Event**	**Date**
	KRUSH	Save Our Water Campaign 2009	2/2/09-9/12/09
	KRVR	Save Our Water Campaign 2009	2/2/09-9/12/09
	KSRO	Save Our Water Campaign 2009	2/2/09-9/12/09
	KZST	Save Our Water Campaign 2009	2/2/09-9/12/09
	KXTS	Save Our Water Campaign 2009	2/2/09-9/12/09
Television			
	NBC Bay Area - Water Matters Show	Save Our Water Campaign 2009	7/02/09-9-12-09
Billboards			
	Regional Transit Billboards	Save Our Water Campaign 2009	2/2/09-9/12/09
	Santa Rosa Plaza Billboards	Save Our Water Campaign 2009	6/2/09-9/12/09
	Displays on 10 Sonoma County buses	Save Our Water Campaign 2009	5/2/09-9/12/09
Internet			
	Pressdemocrat.com	Save Our Water Campaign 2009	2/2/09-9/12/09
	Sonomacountywater.org	Save Our Water Campaign 2009	2/2/09-9/12/09
	Contractor websites	Save Our Water Campaign 2009	2/2/09-9/12/09
	Water Matters - NBC	Save Our Water Campaign 2009	7/2/09-9/12/09
	Save Our Water	Save Our Water Campaign 2009	7/2/09-9/12/09
	Twitter	Save Our Water Campaign 2009	2/2/09-9/12/09
	Facebook	Save Our Water Campaign 2009	2/2/09-9/12/09

	Source	**Event**	**Date**
Theaters	Movie theaters - Santa Rosa/Windsor	Save Our Water Campaign 2009	2/2/09-9/12/09
Earned Media	**Press releases, Media advisories, Radio**	**Press conferences, Opinion editorials**	
	Agency Press Release	Water shortage projection	2/2/2009
	Agency Press Release	Recent Rainfall Increases Storage Levels, Conservation Continues	2/24/2009
	Agency Press Release	"Normal" Water Year Declared by SCWA Water Permits	3/4/2009
	Agency Press Release	Surplus Water Users Receive Notification of Temp. Term. Of Service	3/26/2009
	Agency Press Release	Russian River Flows to be Reduced	4/7/2009
	Agency Press Release	Public Workshop Focuses on Sonoma County's Water Supply	4/8/2009
	Agency Press Release	State Water Board Orders Ban on Turf Irrigation	4/10/2009
	Agency Press Release	Sonoma County Sanitation Water Efficiency Program Launched	4/18/2009
	Agency Press Release	Vineyard Irrigation/Cooling Water Conservation Demonstration Breaks Ground	4/19/2009
	Agency Press Release	Rain is Falling, Turn off Your Sprinklers	5/2/2009
	Agency Press Release	Water Awareness Month Kicks Off	5/5/2009
	Agency Press Release	State Water Resources Control Board Confirms	6/1/2009
		25 Percent Reduction in Water Diversions	
	Agency Press Release	"Save Our Water" Campaign Kicks Off	6/8/2009

	Source	**Event**	**Date**
	Agency Press Release	Low Water Storage Notifications Made,	6/11/2009
		Help Beat the Heat	
	Agency Press Release	Free High Efficiency Fixtures and	8/18/2009
	Agency Press Release	Direct Installation Program Approved	
	Newspaper articles	Press Democrat, Wall Street Journal Wine Spectrum San Francisco Chronicle Windsor Times, Healdsburg Tribune, West County Gazette Russian River Monthly, Petaluma Argus Courier Sonoma Index Tribune, North Bay Business Journal San Francisco Business Journal, Ukiah Daily Journal Bohemian	2/2/09-9/12/09
	Television reports	All major Bay Area stations	2/2/09-9/12/09
	Radio reports	All major Bay Area stations	2/2/09-9/12/09
Special Events	**Quantity distributed**		
	1000+	Sonoma County Fair Water Conservation/Water Education booth	7/1/2009

	Source	Event	Date
	50	Public Hearing Temporary Urgency Change in Agency's Water Rights Permits, Ukiah	3/16/2009
	30	Public Hearing Temporary Urgency Change in Agency's Water Rights Permits, Healdsburg	3/17/2009
	15	Public Hearing Temporary Urgency Change in Agency's Water Rights Permits, Guerneville	3/18/2009
Speakers Bureau			
	40	Sonoma County Master Gardeners	2/2/09-9/15/09
	120	Sons in Retirement Meeting	2/2/09-9/15/09
		Water Advisory Committee meetings	
	22	Creekwood Pines HOA Board Meeting	2/2/09-9/15/09
		Executive Council of Homeowners Wine Country Resource Panel	2/2/09-9/15/09
	25	Sonoma Valley Groundwater Advisory Board	2/2/09-9/15/09
Program Coordination			
	20	Mendocino Splash Day	6/10/2007
	225	SoCo Economic Briefing Breakfast: Sonoma's County's Advantage in a Slowing Economy	5/31/2007
	100	Healdsburg Farmer Day	5/26/2007
	5,000	Water Wise Gardening for Sonoma and Marin	5/5/2007

	Source	**Event**	**Date**
		Counties compact disc	
	Business Environmental Alliance	BEA Water Conservation Checklist for Your Business	5/1/2007
	web	BEA About the Business Water Project	5/1/2007
	web	BEA Sonoma SURE! Conservation Tips	5/1/2007
	1,000	Shower timers bi-lingual	5/1/2007
	25	Qualified Water Efficient Landscaper Training	3/1/2007
	225	BEA 6th Annual Business Breakfast	2/22/2007

Appendix D – Sanitation District Flier

SONOMA COUNTY WATER AGENCY

FREE* DIRECT-INSTALL PLUMBING PROGRAM

For residential, multi-family, commercial, industrial, & institutional sanitation customers

Call one of the Participating Plumbing Contractors listed below to determine eligibility and for program details.

The program includes:

- Replacement of at least one high-flush toilet (3.5 gallons per flush or more) with a high-efficiency toilet (1.1 gpf or less) from our List of Qualifying Toilet Models or
- Replacement of at least one urinal (1.0 gallons per flush or more) with a high efficiency urinal (0.125 gpf or less) from our List of Qualifying Urinal Models

In addition, the program offers free:

- Replacement of all high-flow faucet aerators to high-efficiency models (1.5 gallons per minute or less) and
- Replacement of all high-flow showerheads with high-efficiency models (2.0 gpm or less).

Participating Plumbing Contractors	Airport/Larkfield/Wikiup Sanitation Zone	Geyserville Sanitation Zone	Occidental County Sanitation District	Penngrove Sanitation Zone	Russian River County Sanitation District	Sea Ranch Sanitation Zone	Sonoma Valley County Sanitation District
All Source Plumbing – (714) 309-7160	✓	✓	✓	✓	✓	✓	✓
ARC Plumbing – (707) 579-4086	✓	✓	✓	✓	✓		✓
Boden Plumbing – (707) 996-8683 (commercial and multi-family only)							✓
ER Plumbing – (707) 938-1121				✓			✓
Pipedreams Plumbing – (707) 523-1315	✓	✓	✓	✓	✓		✓
Southwest Environmental, Inc. – (800) 307-5700	✓	✓	✓	✓	✓	✓	✓
Tom's Plumbing – (707) 884-3818						✓	

More plumbers may be participating - visit our website to obtain the current list.

* **Please Note:** Participating Plumbing Contractors are authorized to provide and install High-Efficiency Toilets. If you already have disabled access toilets, they will be replaced with disabled access toilets. However, the program cannot cover upgrades from standard toilets to disabled access toilets or any additional upgrades outside of the program scope.

www.sonomacountywater.org/direct-install

Questions or concerns? Call Brian Lee, Water Conservation Specialist, at (707) 547-1918.

Updated October 15, 2009

High-Efficiency Fixture Direct-Install Program

Frequently Asked Questions

Is this really a free program?

Yes, the majority of the time. The program covers the cost of both the toilet and installation. However, it does not cover the cost of repairs or upgrades to existing conditions such as repairing floor damage from dry rot or retrofits for ADA compliance. The Participating Plumbers may offer additional services or upgrades for a fee.

Who can participate?

Any home or business connected to a participating sanitation district or zone may participate provided that the existing toilet(s) meets replacement criteria of being manufactured before 1993 and were designed to flush more than 1.6 gallons per flush. If you are unsure if your toilets qualify, the Participating Plumbers will be able to determine eligibility. The participating sanitation districts are Occidental County Sanitation District, Russian River County Sanitation District, and Sonoma Valley County Sanitation District. The participating sanitation zones are Airport/Larkfield/Wikiup, Geyserville, Penngrove, and Sea Ranch Sanitation Zones.

What is included in the program?

The High-Efficiency Fixture Direct Install Program includes a qualifying, high-efficiency toilet (or urinal), toilet seat, wax ring, bolt kit, recycling of the old toilet, and labor for installation. If replacement is necessary, an angle stop with water supply line, flange and/or riser will be included and installed. The Participating Plumber will also check your other water using fixtures and replace your showerheads and aerators with free, water-efficient models.

Are all of the Participating Plumbers the same?

No, any plumber can sign up and agree to participate. You should select a plumber from the Participating Plumbers List the same way you would normally select a plumber – by shopping around and obtaining multiple bids or estimates.

Do all of the plumbers install the same toilets?

No, each Participating Plumber may provide and install any high-efficiency toilet from our List of Qualifying Toilet Models which can be found on our website at *www.sonomacountywater.org/direct-install*. Shop around and work with your selected Participating Plumber to get the toilets you prefer.

How many toilets or urinals will be changed?

All toilets and urinals at the property will be retrofitted with new, qualifying high-efficiency fixtures. Our goal is to replace 100% of the old, water wasting toilets and urinals.

Can I install my own toilet instead?

Yes, you can select your own toilets from our List of Qualifying Toilet Models and install them yourself (or hire any plumber) by participating in our rebate program. You can get up to $150 back for each qualifying high-efficiency toilet. See program information for complete details at *www.sonomacountywater.org/sanitation-rebates*. (Rebates are not available for Sea Ranch Sanitation Zone.)

I got a rebate for my toilets in the past. Can I still participate?

No, unless you did not change all of your toilets. This program is for replacing older, pre-1993 toilets that are designed to flush at more than 1.6 gallons per flush. If you have received a rebate in the past, your toilets are already efficient.

Why is the sanitation district paying for this?

Rather than expanding treatment plant capacity, the zones and districts are reducing the amount of wastewater that flows to the treatment plant by helping you save water. A new high-efficiency toilet can use as much as 63% less water per flush without any sacrifice in performance. It's a win-win solution!

Appendix C-1

Russian River Estuary Outlet Channel Adaptive Management Plan

RUSSIAN RIVER ESTUARY OUTLET CHANNEL
ADAPTIVE MANAGEMENT PLAN YEAR 1

Prepared for

Sonoma County Water Agency

Prepared by

Philip Williams & Associates, Ltd.

with

Bodega Marine Laboratory, University of California at Davis

July 30, 2009

PWA REF. # 1958.01

Services provided pursuant to this Agreement are intended solely for the use and benefit of the Sonoma County Water Agency.

No other person or entity shall be entitled to rely on the services, opinions, recommendations, plans or specifications provided pursuant to this agreement without the express written consent of Philip Williams & Associates, Ltd., 550 Kearny Street, Suite 900, San Francisco, CA 94108.

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1. INTRODUCTION

Sonoma County Water Agency (the Agency), with the assistance of PWA, has developed a proposed management plan for the Russian River Estuary mouth in response to a recent Biological Opinion (BO) from the National Marine Fisheries Service (NMFS) designed to improve salmonid rearing habitat in the estuary (NMFS, 2008). The proposed plan revises the existing Russian River Estuary outlet channel management plan.

The management plan documented in this report is for the first year (Year 1) of management following issuance of the BO. The BO recognizes several phases of outlet channel management over fifteen years with additional management options specified for each phase. The outlet channel is part of an adaptive process for management actions to enhance salmonid habitat. If earlier phases are successful in meeting the performance criteria, subsequent phases will not be needed. The Year 1 management plan, to be implemented in 2009, is part of the first phase of outlet channel management (Phase 1) specified in the BO.

The approach of the Year 1 plan is to meet the objective of the Reasonable and Prudent Alternative (RPA), Alterations to Estuary Management, to the greatest extent feasible while staying within the constraints of existing regulatory permits and minimizing the impact to aesthetic and recreational resources of the site. It is the Agency's intent to apply for modified permits that allow additional flexibility to manage the outlet channel to meet the goals of the BO for Year 2 onward. It is recognized that the measures developed in the Year 1 management plan, when implemented, may not fully meet the objective established by the RPA. The concept of this approach was developed in coordination with NMFS.

The goal of the management plan is to reduce marine influence on the Russian River Estuary (Figure 1) during the management period, May 15th through October 15th. The management actions are intended to limit tidal exchange between the ocean and the estuary. Instead of the existing tidal estuary, the BO proposes a perched lagoon with water levels above tidal elevations. With tidal inflows limited, river inflow to the lagoon may enhance the extent of freshwater habitat for the benefit of salmonid rearing. Maintaining the lagoon water levels in a perched state that is also below flood stage requires an outlet channel to convey water from the estuary to the ocean over the beach berm.

The adaptive implementation of this outlet channel is the focus of this management plan. This adaptive management plan, as documented in this report, is initiated with planning that includes: (1) defining project performance criteria, (2) developing a conceptual model of relevant physical processes, and (3) conducting technical analysis to quantify target outlet channel conditions. The resulting operations and management plan derived from these planning steps is also documented in this report. The adaptive management strategy will continue by actual implementation of this plan, then monitoring and evaluating the outlet channel response to refine the plan for subsequent years.

2. CONCLUSIONS AND RECOMMENDATIONS

Conclusions about the physical processes affecting outlet channel behavior and recommendations for Year 1 management are summarized below.

2.1 CONCLUSIONS: PHYSICAL PROCESSES AFFECTING OUTLET CHANNEL BEHAVIOR

1. The location of the outlet channel, at the interface of the Russian River estuary and the surf zone of the Pacific Ocean, is a dynamic system influenced by river discharge, ocean waves, and sand transport. As such, the outlet channel will be subject to variable forcing at hourly, tidal, and monthly timescales. In order for the outlet channel mouth to preserve its function in this active transport zone, the net sediment transport must be small, even though the gross sediment transport is large. To sustainably meet its performance criteria, the outlet channel must be resilient in the face of this variable forcing. This resiliency is difficult to predict.
2. Under current management of the Russian River watershed and estuary, there are no known occurrences of target outlet channel conditions occurring during the proposed management season of May 15 to October 15 for the ten year period of record (1999 to 2008) for which water levels and channel photographs are available. Instead, as a result of natural processes and existing artificial breaching practice, the connection between the estuary and the ocean has been observed in one of two states: bi-directional tidal exchange (88% of the time during the management period) or fully closed with no exchange (12% of the time).
3. Conditions similar to target outlet channel performance criteria were observed outside the management period five times between 1999 and 2008. However, these events appeared to be extended transitions to fully tidal conditions rather than stable conditions. Estuary water levels steadily declined throughout all events and the estuary typically returned to tidal exchange within 48 hours.
4. To meet the performance criteria, the outlet channel geometry must simultaneously meet two key constraints: convey sufficient discharge from the estuary to the ocean to preserve constant water levels in the estuary and preserve channel function by avoiding closure or breaching. These two constraints can be in conflict, since both conveyance capacity and the potential for breaching increase with flow rates but closure is more likely for lower flow rates.
5. The target outlet channel is subject to two failure modes: (1) closure caused by deposition, leading to estuary water levels to rise and possibly cause flooding, and (2) breaching caused by scour, leading to tidal exchange and marine conditions in the estuary. Of the two failure modes, breaching is more detrimental to the goal of improving salmonid habitat because it immediately exposes the estuary to tidal water levels and saline inflow. Once breaching occurs, the estuary may persist in a breached state for weeks or months before the target outlet channel can re-form. The immediate

impact of closure is only increasing estuary water levels, which allows time for management action to prevent habitat loss.

6. Based on engineering calculations, the channel bed slope must be essentially flat (slope on the order of 0.0001) and water depths less than 2 ft, preferably 0.5 to 1 ft, to reduce the likelihood of channel scour at likely May to October flows.
7. Based on the results of hydrologic modeling, it may be difficult to convey sufficient discharge to maintain estuary water levels while simultaneously keeping the bed shear stress in the outlet channel below the threshold for scour. Even with the anticipated reduced 2009 instream flows, the predicted local bed shear stress during the management period fluctuates above and below the critical bed shear stress threshold.
8. River discharge at Jenner is a significant source of uncertainty for hydraulic conditions in the outlet channel. Discharge measurements are made at the USGS Guerneville gaging station (11467000), 21 miles upstream from the Russian River's mouth, and changes in flow (losses/gains) are known to occur between the Guerneville station and the mouth. A water balance model for the estuary indicates that losses between the Guerneville gaging station and the mouth vary from 10% to 53% and averaged 37%. Limited USGS measurements suggest lower losses.

2.2 RECOMMENDATIONS: YEAR 1 MANAGEMENT ACTIONS

1. Initial management actions should be conservative to minimize the risk of breaching, even if this means increased likelihood of closure. Practically, this means an initial preference for smaller, but perhaps more frequent, management actions that are corrections to the existing channel configuration. Based on experience from these initial efforts, larger and less frequent actions may be undertaken.
2. Once the estuary closes, take early actions to widen the channel and increase conveyance so that when reconnecting the channel, the estuary water levels are no more than 0.5 to 1 ft above the constructed channel bed elevation. This approach reduces the potential for scour. It may also result in lower lagoon water levels, particularly early in the season.
3. The Year 1 target outlet channel will be approximately 100 feet wide, 0.5 to 2 ft deep, and occupy a planform alignment within the area occupied by the channel under current management practice. A wider, shallower channel will be more resilient, less likely to scour.
4. Channel excavation activities should be completed (i.e. the temporary sand barrier removed) coincident with high tides in the ocean. This will reduce the scour potential associated with the initial outflow at the time of breaching.
5. Because of uncertainty about the system and its response to outlet channel management, the adaptive management approach specified in the BO and being pursued by the Agency is critical. A year-end evaluation to assess actual channel performance and revised management for subsequent years is also recommended.

3. PERFORMANCE CRITERIA

The principal estuarine habitat goal stipulated in the Reasonable and Prudent Alternative (RPA), Alterations to Estuary Management, in the BO is to reduce marine influence in the estuary from May 15 to October 15. According to the BO, marine influence includes tidal water level oscillations and saline water. Marine conditions diminish habitat quality for salmonid rearing by reducing the habitat extent, elevating salinity above optimal levels for salmonids juveniles and their invertebrate prey, and flushing juveniles into the ocean.

The performance criteria for outlet channel management are intended to assist in meeting the estuarine habitat objective of the RPA specified in the BO. This section presents performance criteria for Phase 1 of outlet channel management, and minor modifications to these criteria for Year 1 management.

Performance criteria for water quality and ecological values in the lagoon are addressed separately and are not included in this document. In addition, management of the outlet channel for steelhead habitat may impact on other species that use the estuary such as seals and birds. The Agency is addressing these impacts through a separate process.

3.1 PHASE 1

Phase 1 of outlet channel management has the following performance criteria for the May 15 to October 15 management period:

1. **Estuary water levels**. The estuary water level management target is "[a]n average daily water surface elevation of at least 7 feet [NGVD] from May 15 to October 15" (BO, p. 249). Higher estuary water levels, but not exceeding flood stage of 9 ft NGVD, would be preferred by NMFS. However, water levels greater than 4 ft NGVD are expected to accompany reduced marine influence and would be likely to improve habitat.
2. **Sand channel**. The outlet channel will be a temporary feature, created only by excavating and placing beach sand. No new structures or mechanical devices, temporary or permanent, will be a part of the outlet channel implementation.
3. **Minimize artificial breaching**. Though the overall goal is to create a freshwater estuary, and therefore avoid artificial breaching, in light of natural variability of river discharge and nearshore wave conditions, several years of experience managing the estuary may be required to develop operational procedures which minimize the need for artificial breaching. As such, NMFS estimates "that SCWA will need to artificially breach the lagoon using methods that do not create a perched lagoon twice per year between May 15 and October 15 during the first three years covered by this opinion, and once per year between May 15 and October 15 during years 4-15 covered by this opinion" (BO, p. 302).

4. **Economic feasibility**. Operations and maintenance requirements will not place undue burden on the Agency in terms of cost, particularly as it relates to frequency or duration of maintenance activities.
5. **Public Safety**. The outlet channel management plan will not diminish public safety as it pertains to floodplain property owners, visitors and employees of the State Beach, and the Agency maintenance staff.

To meet the criterion for estuary water level (#1 above), the estuary will function as a perched lagoon with "water surface elevation above mean high tide … where freshwater flows out to the ocean over the sandbar at the lagoon's mouth" (BO, p. 92). This implies uni-directional flow in the outlet channel, from the estuary to the ocean, to minimize marine influence, and minimal sediment transport within the outlet channel to prevent the channel bed from scouring and transforming into a tidal channel.

Note that each time the lagoon breaches, the lagoon is subject to undesirable water quality conditions not just during the breached period, but also for some period of time following the breach. "NMFS anticipates 3-4 weeks of adverse water quality conditions after the sandbar closes at the mouth of the estuary" (BO p. 302). Thus the management plan seeks to minimize natural, as well as artificial breaching events.

The management plan should anticipate a permanent reduction in instream minimum flow requirements between the Dry Creek confluence and the mouth starting in 2010. Minimum flows will be reduced from current State Water Resources Control Board Water Right Decision 1610 levels of 125 ft^3/s to 80-85 ft^3/s [1]. The expected reduction in minimum river flows will provide more favorable conditions for channel management to avoid breaching.

For channel location, the BO suggests the use of "a lagoon outlet channel cut diagonally to the northwest. … Alternative methods may include … use of a channel cut to the south if prolonged south west swells occur" (BO p. 250).

3.2 YEAR 1

As discussed above (Section 1), the approach of the Year 1 plan is to meet the objective of the RPA to the greatest extent feasible while staying within the constraints of existing regulatory permits. It is recognized that the measures developed in the Year 1 management plan, when implemented, may not fully meet the objective established by the RPA as summarized in Section 3.1 above. The concept of this approach was developed in coordination with NMFS.

The management plan assumes that under existing regulatory permits the Agency may excavate up to 1000 cubic yards of sand per excavation event (as specified in the permits) to create a

[1] The proposed instream flow requirement is 70 ft^3/s, but "SCWA maintains a 10 to 15 ft^3/s buffer to avoid non-compliance of the minimum standard" (BO, p. 245).

channel 25 to 100 ft wide. The channel width range is consistent with historic widths observed within the management covered by existing permits (Behrens, 2008).

For Year 1, performance objectives for lagoon water levels will be more tolerant of lower water levels (i.e., average water levels may be less than 7 ft NGVD). This approach reduces the risk of uncontrolled breaching within existing permit constraints. The outlet channel may function less frequently as a unidirectional channel. The objective will be to reduce tidal flows to the extent feasible, including creating muted tidal conditions in the lagoon. Lastly, artificial breaching may be required more frequently during Year 1. With this management plan, SCWA seeks to minimize or avoid such breaches during the management period, but recognizes that they may be needed to avoid flooding of adjacent properties.

Because of a multi-year drought, the Agency has petitioned the State Water Resources Control Board to temporarily reduce the minimum instream flow requirements in 2009 to 35 ft^3/s for the reach between the Dry Creek confluence and the mouth. The low river flows expected during the Year 1 management season provide more favorable conditions for channel management within existing permit constraints.

4. CONCEPTUAL MODEL

The conceptual model of the outlet channel articulates the project's working assumptions about process linkages between channel features, external conditions (e.g. river flow and ocean processes), and channel performance. These working assumptions are uncertain, and may not capture all relevant processes. However, by making these assumptions explicit, they can be documented, discussed, and tested, all of which are necessary steps in the adaptive management process. Observations of the actual outlet channel response will then enable refinement of the conceptual model. In addition, because the conceptual model is expressed in a relatively non-technical manner, it provides an avenue for public outreach and education about the outlet channel. The conceptual model is not a hydrodynamic, sediment transport model but rather uses empirical observations and geomorphic interpretations to identify likely responses to key forcing parameters, given antecedent conditions and management actions.

Development of a conceptual model for the outlet channel focuses on the essential physical processes and linkages, as well as the management parameters of the channel. Although this approach leaves out some processes which may slightly alter the channel's performance, it prevents the conceptual model from becoming so complex that it becomes unwieldy. In addition to limiting the conceptual model's scope to only the essential processes, the model also excludes impacts of the outlet channel on water quality and ecological aspects of the estuary. To further enhance model clarity, the conceptual model is presented graphically with a schematic that reflects the layout of the physical system. One caveat to simplification is that the static, schematic diagrams clearly do not encapsulate the full complexity of this dynamic system.

The conceptual model first describes target conditions for the outlet channel, in accordance with the performance criteria in Section 3. Then the model identifies the morphological processes which may lead to the two failure modes for the outlet channel: closure and breaching. Closure refers to sand transport induced by ocean waves that deposits sufficient volume of sand in the outlet channel mouth that it blocks the outlet channel. Closure prevents discharge through the outlet channel, leading to increasing estuary water levels and the threat of flooding. Breaching refers to the flows enlarging the outlet channel to the point that it becomes a tidal inlet subject to bi-directional flow. It is important to note that these "failure modes" are conditions associated with natural tidal inlets and river mouths, but are considered problems at the Russian River Mouth because modified forcing parameters have affected the timing and frequency such that native species are adversely affected (see the BO), as well as conflicts with other man-made constraints. One of the key questions in this management plan is whether the inherently dynamic system can be "trained" to drain gradually without breaching and then closing repeatedly.

There are additional aspects of the site which may impact the outlet channel, but whose impacts are thought to be secondary or not well defined. Therefore, they are not included in the conceptual model at this time. If implementation of the outlet channel suggests these aspects are important, they will be incorporated into a revised conceptual model. These aspects include large

rocks and/or bed rock within the beach berm, jetty impacts on seepage, and decadal changes to beach width. Specifically, the jetty at the river mouth and the fill across the tombolo to the south of the site may have affected littoral processes and mouth dynamics, but are not addressed in this study.

This conceptual model is based on existing literature, knowledge of similar estuaries, professional judgment, and discussion with project stakeholders (the Agency, NMFS, California Department of Fish and Game, and California State Parks). An initial version of this model was presented to a meeting of project stakeholders on March 23, 2009. Based on feedback from that meeting and the technical analyses detailed below, the conceptual model was revised and included in this management plan.

4.1 TARGET OUTLET CHANNEL CONDITIONS

The conceptual model for target outlet conditions is shown in Figure 2. Ideally, the outlet channel conveys water from the estuary to the ocean so that estuary can be maintained in a non-tidal state during the management period. A key performance criterion of this non-tidal state is that the water levels in the estuary (h_l) fall within the range of 4 to 9 ft NGVD, with elevations above 7 ft NGVD preferred. The estuary water level will not be managed directly, e.g. by pumping. Instead, it will be managed indirectly by management actions dictated by the BO, the operation and maintenance of the outlet channel and the reduction of instream flow requirement.

The estuary water level is determined by the balance between inflowing river discharge (Q_r) and three outflows: outlet channel discharge (Q_c), evaporation (Q_e), and seepage through beach berm (Q_s). For estuary water levels to remain within the target range, the inflow and outflows must sum to zero when averaged over a period of several days. As indicated by the width of the arrows depicting these flows in Figure 2, the river inflow and the outlet channel discharge are the two largest flows; evaporation and seepage are minor factors in the water balance. As such, the outlet channel discharge capacity needs to nearly match the river discharge. If the discharge is too low, the estuary water level will rise to flood stage and artificial breaching will be necessary. If the discharge is too high, the channel will scour and deepen, allowing tidal flows to enter through the channel. The outlet channel discharge is determined in part by its width, bed elevation, slope, and planform alignment. These parameters can be managed to a certain degree, but are likely to evolve in response to the natural variability of the discharge and wave forcing, and the effects of tide range. The river inflow is another management parameter, however, since its value is determined as part of a separate water supply determination and permitting process, its manipulation is not considered here.

Although sediment transport will be minimal within the outlet channel under target conditions, the channel's mouth will perpetually be an active transport zone. This portion of the channel, at its interface with the ocean, will be an active transport zone for two reasons. First, it lies within

the surf zone and breaking waves move up and down its face in response to the tides and variations in wave direction, magnitude, and period. Second, this wave action creates a slope on the order of 10:1, which is sufficiently steep that flows of nearly any magnitude from the outlet channel will accelerate to above the scour velocity threshold. In order for the outlet channel to persist with this active transport zone at its mouth, this zone will have to experience minimal net sediment transport. In other words, tidal fluctuations in water level and variability in wave intensity will cause the locations of scour and deposition to shift at hourly timescales, but averaging across several tidal cycles, any sand lost by scour will be balanced by an equivalent amount of deposition. This active transport zone also plays a significant role in lateral migration of the existing channel mouth. This process is discussed in Section 4.4 on planform alignment.

Preserving these target conditions, particularly the discharge conveyance capacity, requires that the outlet channel maintain its cross-sectional flow area. This flow area can decrease or increase, leading to the two failure modes of the outlet channel, closure and breaching. These two failure modes are discussed in the sections below.

4.2 CHANNEL FAILURE: CLOSURE

The processes which lead to outlet channel closure are likely to originate from elevated total water levels in the ocean (z_{wave}), as shown on the right side of Figure 3. Elevated ocean water levels will move the active transport zone into the outlet channel, increasing deposition at elevations above that of the outlet channel's bed, z_{out}. Once deposition rates exceed any capacity of the outlet channel discharge to scour sediment, a berm will build at the mouth of the outlet channel, causing it to close. This process is thought to occur over one to several high tides, corresponding to one to several days. During the management season, total water level is the combination of two ocean processes, the tides and ocean waves. As offshore waves interact with the coastline and nearshore, they are transformed such that the significant elevation on the beach is a function of the wave direction, magnitude, period and runup. While the tides fluctuate with a predictable schedule, ocean waves vary according to the unpredictable weather and wind patterns over the ocean. Therefore, the total water level can be best characterized as frequency distribution that is based on observed tide and wave data.

If the outlet channel closes and flow through the channel stops, the estuary water level will increase since the continuing river inflow cannot be exported through evaporation and seepage alone. Although seepage rates are likely to increase as a result of increasing water levels, it is assumed that seepage rates will remain significantly below river inflow. As the water level rises, it will again overflow the beach berm when it reaches the minimum elevation of the berm crest. Early in the management season, the flow may overtop the berm below flood stage of 9 ft NGVD. However, as the berm crest elevation rises over the course of the management period, the water levels can rise above flood stage. If more moderate management actions do not stop this rising water level, a full artificial breach, as is currently practiced, will be necessary to prevent flooding.

4.3 CHANNEL FAILURE: BREACHING

The breach failure considered as part of the conceptual model and shown in Figure 4 is breaching that occurs when the outlet channel is operating according to the target conditions described above. Breaching is likely to result from two processes, high discharge which scours the channel bed or seepage-induced bed mobilization. Natural or artificial breaching after a closure event are not considered because it is assumed that management actions would be enacted to return the outlet channel to target conditions prior to a breach. Additionally, breaching by wave overtopping or strong river discharge are not considered because these processes are associated with winter storm events, which are rare during the management period.

Because the outlet channel is an unconsolidated bed composed of relatively small particles, it is susceptible to scour by the discharge flowing through the outlet channel. Sand scoured from the channel will be lost to the ocean and there is not a significant upstream source to replace scoured sand. Extensive scour will enlarge the channel to the point of breaching and tidal inflows. To prevent scour, flow conditions within the outlet channel (u_c) must be below the threshold for scouring sand (u_{crit}). This threshold is a function of the sand grain size, which has been observed to be coarse sand, narrowly distributed around 1 mm at the Russian River mouth (EDS, 2009a). Whether the flow velocity is below the threshold depends on hydraulic conveyance through the management parameters of the outlet channel's width, length, and bed slope.

As noted in the description of target channel conditions, the beach face slope is set by wave action in the surf zone and is sufficiently steep that flow velocity exceeds threshold for sand movement for all expected discharge rates. Under target conditions, the sand scoured by this process will be replaced by wave action on high tides, yielding no net change in the channel mouth morphology. However, if the scour is larger than deposition on the beach face, the active scour zone may move landward, into the outlet channel. This upstream movement is similar to nick point migration or head-cutting observed in streams and rivers. It is also the process observed by the Agency's maintenance staff when the beach berm is artificially breached under current practice. The breaching typically happens very quickly, before wave-induced sand transport can close off the breach in subsequent higher tides.

A second possible mechanism of breaching is seepage-induced sand mobilization, represented in Figure 4 as a wider arrow associated with Q_s. If seepage rates are sufficiently large, the movement of water through the sand can mobilize sand particles where the seepage flow daylights at the ground surface. Piping of groundwater along preferred pathways, which may exist within or adjacent to the jetty, might encourage this process by increasing flow rates through portions of the beach. Although seepage failure has not been observed at the Russian River estuary, it has been observed at other estuaries including Crissy Field (Battalio et al 2006) and others (Kraus et al 2002). Seepage failure may simultaneously accompany other breach

mechanisms and hence be difficult to identify on its own. Or, seepage failure may require a larger head difference between the estuary and the ocean than what occurs at the Russian River mouth because of artificial breaching to prevent flooding.

In contrast to closure which can be managed with further intervention, breaching can immediately and negatively impacts the habitat objectives by allowing the marine influences of tidal water levels and saline water to enter the estuary. For this reason, breaching is more detrimental to habitat goals than closure.

4.4 PLANFORM ALIGNMENT

Because of the presence of hard barriers in the form of the southern jetty and the northern cliffs, the outlet channel is expected to occupy an alignment within the same region that the current tidal inlet occupies, as show in Figure 1. At this initial stage in the adaptive management process, the conceptual model for the outlet channel's planform alignment is indeterminate as to a target alignment most likely to facilitate outlet channel sustainability. Therefore, observations and interpretations of the existing channel are presented in this section to provide an indication of factors acting on the proposed outlet channel. Once the outlet channel is implemented and monitored, a more definitive conceptual model for target alignment will be developed.

The exiting channel's initial alignment after a closure is typically straight and set by one of three factors, depending on the breaching mechanisms. When breached by high river discharge, the channel aligns itself to the northwest, primarily in response to the direction of the river flow during these events. When the channel naturally breaches itself at water levels below flood stage, it will overflow the berm at the minimum elevation in the berm crest. For example, in April 2009, this low point was toward the north since this was where the antecedent inlet had lowered the berm crest elevation. The Agency has attempted artificial breaching in several locations; under current practice, the initial alignment is perpendicular to the beach and just to the north of the large rock ("Haystack Rock") at the northwest corner of the estuary (Agency staff, personal communication).

Once breached, the existing channel typically changes alignment because the mouth migrates laterally in response to wave and littoral transport processes (Behrens et al., 2009). Lateral migration by the mouth while the upstream channel lags behind creates a sinuous channel. The direction and magnitude of wave energy and the resultant littoral sand transport are thought to determine the migration direction and extent. For the case of a tidal inlet, the mouth moves in the direction of the littoral transport (Dean and Dalrymple, 2002). However, observations by NMFS suggest that the direction of migration may be reversed for outlet channel such that the mouth moves against the direction of littoral transport (J. McKeon, personal communication). Observations by Behrens et al. (2009) show that the existing tidal mouth typically moves both northward and southward during the management period. Their analysis correlates large changes

in mouth location with rapid changes in significant wave height, indicating that the wave processes control the migration process. The bi-directional migration of the mouth suggests that wave energy also changes directions. This is further supported by the resulting shape of the channel, which can develop multiple channel bends in response to the mouth reversing directions. The temporal and spatial distribution of wave energy along the mouth is not well documented. Studies using trace elements and sand budgets along this stretch of coast indicate reversing directions of littoral transport because of varying periods of convergence and divergence of wave energy (DeGraca, 1976). The predominant direction may be sensitive to the relative contributions of northwest wind waves versus southerly swell. For instance, Behrens et al. (2009) show that mouth migration patterns are significantly different during El Niño years with the channel remaining in at the northern end of its range for the entire summer. They speculate that the decrease in northerly wind waves during El Niño events may explain this phenomenon. Another potential cause for this pattern is the more southerly approach angle of incident swell waves during El Nino years, as suggested by Allen and Komar (2006).

An additional factor which may affect the mouth location is the landward migration of the offshore bar. This bar, which is created by sand eroded off the beach during winter storms, moves landward with the low steepness summer waves. If this bar, which runs parallel to the shore, moves sufficiently close to the channel mouth, it may force the mouth to either side.

5. EMPIRICAL ASSESSMENT OF HISTORIC INLET CONDITIONS

The Russian River inlet is highly variable in form, position, and capacity for tidal conveyance. Analyses of field data and an extensive photographic record of daily conditions show that this variability is largely influenced by tides as well as seasonal changes in wave and river conditions (Rice, 1974; Behrens, 2008). Management actions also influence the timing and duration of closure events (Goodwin and Cuffe, 1994).

When the estuary is open to the ocean, the inlet can take one of the following forms:

- A river-dominated channel with minimal influence from tides and waves. This occurs during short-lived river flood events between December and April.
- A channel controlled by a mix of river flow, tides, and wave action. This is the most common inlet state, with waves tending to deposit sand in the inlet and estuary-to-ocean flows due to tide and river being active in removing sand from the inlet. Estuary tidal range is a fraction of the ocean tidal range, ranging from zero to over 70%, varying in response to sediment infilling and scouring of the inlet channel. Here we give special attention to "marginally tidal inlets", where tidal conveyance is less than 10%.
- A one-way overflow channel with water draining from a perched estuary, i.e., the sand barrier is built across the mouth of the estuary, but the estuary water level is high enough to overflow. Waves have limited control over such an "overflow inlet", and tidal influence is nonexistent. River flow rate controls estuary water level and overflow volume, which determines the susceptibility to breaching.

This section provides an overview of inlet states observed during the years 1999 to 2008, with an emphasis on the dates corresponding to the proposed management period of May 15 to October 15. The purpose of this assessment is to use existing data to identify relationships between forcing due to river, tides and waves and the response of the estuary mouth ("inlet") – and to explore the frequency of the latter two conditions described above.

5.1 FREQUENCY AND FATE OF RUSSIAN RIVER INLET STATES

The possible occurrence of an "overflow" channel at the mouth of the Russian River estuary was investigated by comparing water level records from the Jenner gage with tidal data from the NOAA Point Reyes station. The focus was to analyze events when the inlet was open for at least 24 hours with water levels remaining above tidal influence and slowly varying. Attention was also given to events when the inlet allowed minimal amounts of tidal interaction. Dates for which the inlet was at least partially open were disaggregated into a series of categories based on the ratio of the estuary tide range observed at the Jenner gage to ocean tide range (defined here as "tidal conveyance") – see Table 1. Estuary tide is driven by ocean tide, but estuary tide range is reduced either due to the elevation of the channel base that precludes complete draining of the estuary to low tide levels or due to the channel size being too small for enough water to be

transported between estuary and ocean. The estuary-ocean tidal ratio is thus an indicator of mouth state, with smaller values representing an increasingly choked mouth (near to closure or overflow state).

Table 1 Frequency of observed inlet states from May 15-October 15 for years 1999-2008.

Inlet state		Number of days observed	Proportion of period
Tidal conveyance[1]	0-5%	10	0.8%
	6-10%	4	0.3%
	10-29%	82	5.4%
	30-49%	315	20.9%
	50-69%	590	39.2%
	≥ 70%	142	9.4%
Full inlet closure		161	10.7%
Overflow channel, stable or decreasing water level(≥ 24 hours)		0	0.0%
Device error		199	13.2%

[1]Defined as the ratio of estuary tide range to ocean tide range.

The 161 days when the estuary was closed consisted of 26 separate closure events. Of these, 19 were artificially breached and the remaining 7 were natural breaches. Although the low number of natural breach events prevents any statistically significant comparisons with river or wave data, it is worth noting that flows over 400 ft^3/s resulted in natural breaches within 1-2 days of closure. Including all closures, there was a correlation between Guerneville flow and closure duration, with lower flows leading to longer closure periods.

Although there were no instances of overflow conditions during the proposed management period, there were five relevant events that occurred just outside of this period during the years 1999-2008. All events had decreasing water levels, reflecting down-cutting of the barrier, although the rate of down-cutting was slow enough to prevent tidal interaction for at least 24 hours. Two of these events occurred during October, one in November, and two in May. Three of the events were associated with closure events and most lasted for less than 48 hours. An exception was a five-day event that occurred 6-11 May 2008. In this case, the inlet was breached artificially, and the Agency immediately noted that the channel had become elongated, beginning near "Haystack Rock", nearly 450 feet north of the jetty, and terminating at the jetty. This is uncommon, as post-breach channels are almost always short and wide (Behrens, 2008). The sudden elongation of the channel is likely associated with onshore bar migration.

During tidal periods, tidal conveyance was less than 10% on only 14 days during the management period from 1999-2008. These states were generally a precursor to closure events – all dates for which tidal conveyance was below 10% resulted in closure and the muted tidal state typically lasted for only one or two days. They were most commonly observed during short periods when

an artificial breach failed to keep the inlet open for more than 1 or 2 days, or during periods of low flow when the inlet was narrow and elongated. Note that there is a diminishing propensity for the inlet to be in a muted tidal state when it is close less than 30% of the full tide range. This indicates that being in between fully open or fully closed is not a condition supported by natural processes at this site.

5.2 WAVE AND RIVER CHARACTERISTICS

Wind waves and river outflow characteristics strongly influence the behavior of the inlet. These forcings exhibit seasonal patterns and other trends that correlate with different inlet states. Details of these relationships are presented below.

5.2.1 Seasonal patterns

Wave data were obtained from the CDIP Point Reyes buoy and a transformation matrix accounting for shoaling and refraction (e.g. http://cdip.ucsd.edu/) was used to transfer deepwater conditions to conditions at a location at 10-meter depth near the inlet. This method provides a first-order estimate of nearshore wave conditions that is necessary as there is a significant difference between deepwater/offshore waves and those nearshore. Wave energy is greatest in winter, declining through spring, to a minimum in July-August. However, late spring storms and/or early fall storms can occasionally produce waves exceeding 10 feet in the vicinity of the inlet during the management period. As discussed in Rice (1974) and Behrens et al. (2009), predominant swell waves from the northwest are often the cause of prolonged inlet migration or closure during late spring.

Data on river flow at Guerneville show a rapid decline from a maximum at the beginning of the management period (mid-May) to a minimum in August (Table 2). Flows in July through September are low, between 80 and 225 ft^3/s for the years 1999 to 2008.

5.2.2 Conditions during different inlet states

Wave and flow conditions were compared with specific inlet states, as shown in Table 2.

Marginally tidal inlet: There is a relation between tidal conveyance and nearshore waves (H_s is significant wave height). Marginal tidal conveyance (< 10%) occurs during larger waves (H_s of 2.5 to 3.25 feet), consistent with the idea that these are transitory states associated with inlet closure and one needs waves big enough to overcome tidal (plus river) flows. These wave conditions may be lower during periods of weaker river flow. Further, if this marginally tidal mouth condition persisted, it could do so for any weaker wave conditions (which would not close the mouth).

Closed inlet: Estuary water level increase during closure events was analyzed to understand how close these conditions were to a steady-state overflow scenario. In all cases, water levels rose at rates of 0.1 ft/day or faster (Table 2). However, accounting for estuary area, the slower water

level rise suggests that it may be possible to achieve a steady state with limited flow over the berm if river flows are of order 100 ft^3/s or weaker. Flows marginally over 100 ft^3/s may be possible, depending on the limit on overflow rate without eroding the sand barrier.

Overflow inlet: All of the five observed overflow events had flows higher than 100 ft^3/s, but only one persisted for more than a couple of days. Further, all of these events exhibited unusual conditions. The October 1999, November 1999 and first May 2008 event occurred during a sequence in which high waves began to induce closure, but a sudden increase in river flow prevented full closure and eroded the channel down to its original state. It appears that overflow conditions only occurred because the initial transition towards closure allowed estuary water levels to temporarily exceed high tide levels. The event in October 2006 occurred after a natural breach of a four-day closure, so the lower flows observed in this case are expected. Finally, the most persistent event in May 2008 was associated with an unusually long channel, which is important in that frictional losses may have encouraged the prolonged high water elevation in the estuary. As noted above, this event was likely due to seasonal onshore bar migration.

Table 2 Comparison of average wave and average river conditions for various ranges of tidal conveyance and water level increase in the estuary. Overflow conditions are analyzed for five events observed outside of the proposed management period.

Inlet state		Guerneville flow, ft^3/s	Nearshore H_s, ft
Open inlet with given tidal conveyence:	<10%	323	3.2
	10-29%	261	2.5
	30-49%	219	2.1
	50-69%	276	2.0
	≥70%	328	1.8
Closed inlet; estuary stage rising at given rates:	0.1-0.29 ft/day	146	2.7
	0.3-0.49 ft/day	175	2.6
	0.5-0.7 ft/day	185	3.4
	≥0.7 ft/day	211	4.1
Overflow channel (outside management period)	Oct 28, 1999	291	15.7
	Nov 4-5, 1999	247	5.9
	Oct 26, 2006	155	2.2
	May 1-2, 2008	323	6.6
	May 6-11, 2008	283	1.3

5.2.3 Analysis of wave runup

The mouth of the estuary is typically closed by waves depositing sediment in the inlet channel during slack highwater tides, but waves can only do so if wave runup can reach the height of the inlet channel base. Thus, wave runup exceedance curves were generated for each of the management months to assess the likelihood of the (overflow) channel being closed by wave action. De-shoaled deepwater equivalent wave heights were combined with daily higher-high

tide water levels to estimate runup height following Stockdon et al. (2006), and assuming a constant beach-face slope. The height exceeded by 2% of the waves under given monthly wave conditions is shown in Figure 5. Runup is highest in October, with heights of 11ft being exceeded on 1 in 10 days. For May, June and September, runup exceeds 10ft on 1 in 10 days, and this drops to 9ft for July and August. This is consistent with the seasonal cycle of large swell events, due to winter storms in the north Pacific, which may occur in October, and occasional swell events due to storms in the tropical or south Pacific during summer. The locally generated waves due to northerly winds in summer are of shorter period and lower height. These data suggest that wave-induced closure of an overflow channel will be a greater concern at the beginning and end of the May-October management period.

5.3 CHANNEL PLANFORM GEOMETRY

Inlet morphological behavior has been studied by Behrens (2008) for the years 1999-2008 through an analysis of inlet width, length and position estimates derived from photographic records. Data collection methods and error estimates are described in Behrens et al (2009). Inlet planform geometry and closure risk are summarized for different mouth states (Table 3).

Table 3 Inlet planform geometry for overflow conditions and various ranges of tidal muting (May 15 to October 15, 1999-2006). Overflow conditions are analyzed despite the fact that they occurred outside of this timeframe.

Inlet state		Inlet width[1], ft	Inlet length[1], ft	Most common configuration	Closure risk[2]
Open inlet with given tidal conveyance:	<10%	25 ± 1.8	530 ± 37.1	≥2 channel bends	81.3%
	10-29%	51 ± 3.6	358 ± 25.1	1-2 channel bends	35.3%
	30-49%	71 ± 5.0	282 ± 19.7	1 channel bend	28.6%
	50-69%	86 ± 6.0	236 ± 16.5	1 channel bend	13.7%
	≥ 70%	92 ± 6.4	221 ± 15.5	Straight	3.5%
Overflow channel (outside management period)	Oct 28, 1999	60 ± 4.2	140 ± 9.8	Straight	--
	Nov 4-5, 1999	20 ± 1.4	360 ± 25.2	Deflected by jetty	--
	Oct 26, 2006	25 ± 1.8	110 ± 7.7	Straight	--
	May 1-2, 2008	65 ± 4.6	100 ± 7.0	Straight	--
	May 6-11, 2008	20 ± 1.4	480 ± 33.6	Deflected by jetty	--

[1] Ranges are based on error estimates from Behrens *et al* (2009).
[2] Defined as the number of observations that were followed by closure within two weeks, divided by the total number of observations.

The data for overflow channel geometry indicate that the limited number of overflow events exhibited a range of shapes. The geometry of the only persistent case (6-11 May 2008) suggests that frictional loss plays an important role in attenuating channel velocity and the resulting downcutting.

However, there is a tradeoff for the frictional losses associated with sinuous channels. For a marginally tidal inlet the channel is long and narrow, with a couple of bends – and there is a very high risk of closure. There is no apparent relation between inlet position (not shown in this table) and tidal conveyance. However, marginally tidal inlets and overflow inlets were observed only at the northern or southern extreme of the inlet's migration range. Inlet width and length are known to vary in concert with river flow during the wetter months of the year and with tidal range during the drier months (Behrens et al., 2009). In general, low-flow conditions (low tides or river flow) appear to encourage inlet elongation and narrowing. Inlet width, length, and the number of channel bends all influence the tidal signal by determining frictional losses in the channel.

5.4 NOTES ON OTHER ESTUARIES

Overflow inlets have been observed in numerous estuaries along the coasts of California, Oregon, Chile and South Africa (and probably other areas with comparable climate and topography) (personal communication, John Largier). These are unpublished observations. Specifically, an overflow inlet is typically observed to persist for 1 to 3 months each year at the mouth of Salmon Creek (10 miles south of the Russian River) and at the mouth of the Gualala River, discussed below. Further, small central coast estuaries exhibit overflow states during spring and summer, e.g., Scott Creek and Waddell Creek. Systems photographed along the Chilean, South African and Oregon coasts are of similar size in terms of river flow and lagoon area. The absence of observations of overflow conditions in larger estuaries, similar to the size of the Russian River, suggests that there is a limit to the flow energy that can be accommodated by flow over a sand barrier of finite width (and thus high slope).

5.4.1 Gualala River

The mouth of the Gualala River is located 31 miles northwest of Jenner. Both its tidal prism and annual river flow are significantly lower than those of the Russian River. Despite this, the sites have several similarities, most notably their similarly sized beaches bordered by headlands. During a typical year, the inlet is closed for the entire summer and is opened by the first major storm of the winter (ECORP, 2005). The inlet requires consistent rainfall to remain open, and it is common for closures to occur within several weeks after each major storm event. As rainfall decreases during the spring, the inlet undergoes repeated cycles involving a closure event, a period of gradual estuary stage increase leading to a natural breach, and finally, several days to several weeks of minimal tidal conveyance and/or overflow conditions culminating in a new closure event. These cycles appear to continue until evaporative and seepage losses counterbalance inflows into the estuary, preventing the stage increase required to cause a natural breach event.

5.4.2 Carmel River

California State Parks adaptively manages the beach berm which creates a lagoon at the mouth of the Carmel River (CA Dept. of Parks and Recreation, 2008). The goal of this management is

similar to the goal stated in the Russian River BO (NMFS, 2008): to enhance the freshwater salmonid rearing habitat during summer months. Sometime in April, May, or June, once the Carmel River discharge into the estuary drops below 20-25 ft^3/s, bulldozers are used to increase the height of the beach berm. This elevated berm blocks ocean tides and saline water from entering the estuary, thereby creating a perched lagoon. When forming the elevated beach berm, an outlet channel is also created so that if lagoon water levels exceed 10 feet NGVD, the outlet channel will drain water from the lagoon into the ocean. The outlet channel only conveys water if the discharge to the lagoon does not taper off from 25-20 ft^3/s to 10 ft^3/s as rapidly as expected. Once river discharge falls below approximately 10 ft^3/s, evaporation and seepage export enough water from the lagoon that lagoon water levels no longer increase.

The Carmel Lagoon outlet channel differs from the proposed Russian River outlet channel with respect to several key features, as summarized in Table 4. Overall, the Russian River outlet channel is likely to be more difficult to manage than the Carmel River outlet channel because of its higher required conveyance, longer operational period, and lack of natural grade control.

Table 4 Comparison between Russian River and Carmel River outlet channel features

Outlet channel feature	Russian River, Year 1	Carmel River Lagoon
Conveyance capacity	50 ft^3/s	10 ft^3/s
Operational period	5 months (May-Oct)	1 month
Grade control	none	natural rock outcrops

6. CHANNEL CONFIGURATION ANALYSIS

As discussed in the conceptual model for target conditions, the outlet channel geometry must simultaneously meet two key constraints: convey sufficient discharge from the estuary to the ocean to preserve constant water levels in the estuary and preserve channel function by avoiding closure or breaching. Note that these two constraints can be in conflict since both conveyance capacity and the potential for breaching increase with flow rates but closure is more likely for lower flow rates. The technical analyses described in this section inform the range of target channel conditions by quantifying the relationship between outlet channel dimensions, bed scour potential, and hydraulic conditions. The ocean-driven processes associated with closure, the wave runup elevation and planform alignment, are discussed above in Section 4. Preventing breaching, a necessary condition for reducing marine influence on the estuary is the focus of this section.

Since the outlet channel will be located within a bed of unconsolidated beach sand, a key management objective is creating a channel which can sustain its cross section geometry instead of scouring. Breaching can occur if the discharge through the outlet channel is sufficiently forceful to scour the channel bed. To reduce the possibility of scour, threshold design principles (NRCS, 2007) are used to examine channel configurations most likely to avoid scour while meeting the other constraints of the system.

Channel design using a threshold methodology consists of the following steps:

- *Estimate the critical shear stress threshold.* This is a function of the site's bed particle composition, which can be characterized by grain size.
- *Predict hydraulic conditions for the proposed channel.* Use engineering calculations of steady flow and a one-dimensional hydraulic model of time-varying flow to estimate the velocity and shear stress for a proposed set of channel geometry, flow, and bed roughness.
- *Compare threshold and predicted bed shear stress.* The estimates from the two previous steps are compared with a factor of safety to account for variations in hydraulic conditions about the mean and uncertainty in parameter estimation.
- *Sensitivity analysis and uncertainty.* Evaluate the sensitivity of threshold and predicted bed shear stress to input parameters as well as the factors contributing to overall uncertainty.

6.1 CRITICAL SHEAR STRESS

The critical shear stress is defined as the applied bed shear stress at which sediment motion occurs. The critical threshold represents a balance between the force exerted by the flow on the bed and the resisting gravitational force of individual sediment particles. Flows above the critical shear stress will transport sediment while flows below the critical shear stress will result in no

motion. The critical shear stress is dependent on characteristics of the sediment such as sediment density and particle size.

Sediment samples at the Russian River mouth were collected in March 2009 to inform the assessment of critical shear stress within the outlet channel. Ten sediment samples taken along the proposed outlet channel alignment were analyzed to determine the characteristic grain size distribution. On average, 78% of the sediment had a grain diameter between 0.6-2.0 mm (coarse sand), 18% was greater than 2.0 mm (granular), and 4% was between 0.2-0.6 mm (medium sand) (EDS, 2009a). Visual observations of grain size by PWA near the mouth indicated a typical diameter between 0.8-1.25 mm (coarse sand).

Based on this assessment of typical beach grain size, PWA estimated the critical shear stress using methods outlined in Soulsby (1997) and Fischenich (2001). For the typical range of observed grain size from 0.8-1.25 mm, a critical shear stress of 0.4-0.7 Pa (0.008-0.015 lb/ft^2) was determined for sand particles in the vicinity of the proposed outlet channel (Attachment A-1).

6.2 PREDICTED HYDRAULIC CONDITIONS

6.2.1 Steady mean flow conditions

PWA conducted a preliminary assessment of outlet channel hydraulics under steady typical summer flow conditions as a screening tool to characterize the range of possible channel geometry parameters (bed elevation, channel slope, width, and length). Simple hydraulic equations for open channel flow were used to estimate the in-channel velocity and bed shear stress.

PWA evaluated different combinations of river discharge, bed roughness, channel slope, and flow depth to evaluate channel performance. For a given discharge the hydraulic equations can be solved to determine the values of slope, width, and depth that satisfy the critical shear stress threshold for sediment motion. Once one of these three parameters is selected, the other two are fixed to meet a given shear stress threshold (NRCS, 2007). Multiple combinations of channel slope and width are capable of conveying the design flow at or below the critical shear stress threshold.

Figure 6 shows an example stability curve for the outlet channel design. A stability curve is a tool used by designers to evaluate channel stability under a range of feasible slope-width combinations. Any combination of slope and width that falls on the stability curve will be stable for the prescribed discharge. Combinations of width and slope that plot above the stability curve will result in erosion and scour of the channel. Combinations of width and slope that plot on or below the stability curve will be stable (or depositional). For a given width, the depth of flow can be determined from the corresponding depth-width curve (Figure 6). For example, a 100-ft wide channel will be stable for channel slopes less than approximately 0.000125 and will flow at a depth of approximately 11 inches. The stability curve shows that as slope increases, channel

width must also increase to keep channel velocities below the critical threshold for transport. Channel width and depth are inversely related for points on the stability curve, resulting in either a narrow channel with relatively deep flow or a wide channel with relatively shallow flow.

6.2.2 Calculation of estuary inflows

PWA developed and calibrated a water balance model based on observed lagoon water levels at Jenner, CA. The purpose of the water balance model is to estimate the reduction in river discharge between Guerneville, a monitoring station approximately 15 miles upstream of the Austin Creek confluence that marks the start of the Russian River estuary. The losses in discharge are believed to be due to diversions, interaction with the adjacent aquifer, and groundwater pumping, although no detailed information is available. The reduction factor serves as the calibration variable for the water balance model. For all cases, predicted estuary water levels during closure periods do not match observations unless lagoon inflows are reduced relative to the Guerneville discharge.

Model Setup

During a closure event, the rate of water level increase is a direct function of the net flows into and out of the lagoon (Goodwin and Cuffe 1993):

$$\frac{\Delta V}{\Delta t} = A\frac{\Delta h}{\Delta t} = \alpha Q_R - A i_{evap} - Q_s$$

where:

$\triangle V$	=	lagoon inflow during closure (ft^3)
$\triangle t$	=	duration of closure (days)
A	=	surface area of the lagoon (ft^2)
$\triangle h$	=	change in water level in the lagoon (ft)
Q_R	=	river discharge at Guerneville (ft^3/day)
α	=	discharge reduction factor for groundwater losses
i_{evap}	=	rate of evaporation from the lagoon (ft/day)
Q_S	=	rate of seepage loss through the barrier beach (ft^3/day)

All terms in the water balance equation can be measured or approximated to allow calculation of α, the discharge reduction factor, for each closure event. The components and data sources of the water balance model are described below:

- Estuary water level and inlet state ($\triangle h$) – Jenner water level time series, (SCWA, 2000-2007). The inlet was assumed to be closed (no flow) during the calibration, based on periods when the estuary water levels were non-tidal and increasing estuary water levels.
- Guerneville discharge (Q_R) – USGS gaging station 11467000 (Russian River near Guerneville, CA at Hacienda Bridge) (http://waterdata.usgs.gov).

- Evaporation (i_{evap}) – estimated based on climatological evaporation rates for CIMIS evapo-transpiration reference Zone 1 (California coast) (*www.cimis.water.ca.gov*, Attachment A-3).
- Berm seepage (Q_S) – estimated using Darcy's Law based on water level difference between lagoon and ocean (Attachment A-4).
- Lagoon stage-storage curve (A) – determined from 2008 sidescan survey and LiDAR digital elevation model (EDS 2009b).

The volume of water entering the closed lagoon as a result of waves overtopping the beach berm is assumed negligible and not included in the water balance model. This assumption is based on wave conditions and wave event duration during the May through October management period. Wave conditions during the management period are associated with beach berm building, not with extensive overtopping and berm erosion more prevalent during winter storm events. In addition, the duration of wave events are typically shorter than the duration of closure ($\triangle t$), and therefore overtopping, if present, would likely coincide with the start of the closure, not the later portion of the closure from which change in water level ($\triangle h$) observations were used in the water balance model. As an initial check on the assumption of negligible overtopping volume, the potential increase in lagoon water level was calculated for overtopping events only likely to occur during extreme winter storms. FEMA coastal flood guidelines (Jones et al., 2005) suggest 1 ft^3/s per foot of beach berm as the upper range for overtopping rate during extreme events. Applying this rate to the beach berm length and estuary area at the Russian River estuary, the lagoon water level would rise less than 0.5 ft. Since this amount of water level increase is an upper bound not likely to occur during the management period and since even this upper bound is considerably less than the change in water level values ($\triangle h$) applied in the water balance model, the negligible wave overtopping assumption is reasonable. If more detailed wave and berm dimension data are collected at the site, more detailed wave overtopping volumes during the management period can be estimated.

Model Calibration

The observed rate of water level increase ($\triangle h/\triangle t$) in the lagoon during 18 closure events was calculated from the Jenner gage data. Rates of water level increase ranged from 0.4 ft/day to 3 ft/day and averaged 1 ft/day. The required inflow ($\triangle V/\triangle t$) to yield the observed rates was calculated based on an assumed lagoon surface area (A) at closure of approximately 400 acres. From the observed average discharge at Guerneville (Q_R) over each closure period, a discharge reduction factor, α, was calculated for estuary inflow during each of the closure events. The percent reduction ranged from 10% to 53% and averaged 37% (Attachment A-5). The largest reductions in discharge typically occurred in summer and were less in the spring and fall.

The reduction factors were averaged over each month from May-October to approximate a seasonal trend. The resulting calibration curve (Attachment A-5) was used to reduce the Guerneville discharge in the unsteady hydraulic modeling discussed in Section 6.2.3 to predict downstream flow rates into the lagoon based on upstream discharge measurements.

Comparison with Discharge Measurements

A limited set of USGS discharge measurements provides another estimate of estuary inflow relative to the continuous discharge measurements at Guerneville. These discharge measurements, collected at four stations[2] in the 14 miles below Guerneville, typically fall within 10% of the Guerneville average daily discharge. This suggests that the water balance model may over-predict the reduction in flow losses between Guerneville and the estuary. Since the results of the water balance are used to estimate estuary inflow in the unsteady hydraulic model (see Section 6.2.3 below), the estuary inflow values in the unsteady hydraulic model may under estimate actual estuary inflow. Presently, the existing data are insufficient to explain the discrepancy between the water balance model and the discharge measurements. Higher rates of seepage through the beach berm are one possible explanation. Monitoring to resolve this discrepancy is recommended in Section 7.7. The USGS data was evaluated late in development of the Outlet Channel Adaptive Management Plan. Though consideration of higher estuary inflows is not carried through all aspects of the analysis presented in this report, the implications of potentially higher inflows are discussed in the model sensitivity analysis and outlet channel management sections of this report.

6.2.3 Hydraulic modeling of unsteady mean flow conditions

Using the calibrated water balance model results described in Section 6.2.2, PWA developed a hydraulic model to evaluate the performance of the outlet channel for various hydrologic scenarios. This modeling is a refinement of the steady mean flow calculations described in Section 6.2.1 because it quantifies estuary discharge, explicit channel geometry, and temporal changes in hydraulic parameters. Sources and sinks accounted for in the model include river discharge, groundwater losses, berm seepage, evaporation, and outlet channel discharge (described in more detail in Section 6.2.2 and Figure 7). Flow in the outlet channel is represented by one-dimensional channel hydraulics as a function of estuarine water levels, channel dimensions, channel slope, and bed roughness. Initial channel dimensions were based on the results of the preliminary analysis described in Section 6.2.1. Model channel geometry was revised iteratively based on subsequent hydraulic analyses and discussions with the Agency and NMFS. The model simulates estuary water levels and outlet channel flow for the period spanning proposed outlet channel operations, from May 15 to October 15.

Discharge Boundary Condition

PWA analyzed historic discharge data at Guerneville to select a "typical" water year for the hydraulic model boundary condition. A time series of monthly discharge was obtained from USGS for the time period from 1970 to 2008 and compared to the median monthly discharge for the duration of record to select a typical water year. For each month, the difference between the month's discharge and the median monthly discharge was computed. The sum of the differences

[2] Data available from USGS National Water Information System (http://waterdata.usgs.gov/nwis), Russian River station names (site number): Duncan Mills (11467210), Monte Rio (382757123003801), Vacation Beach (11467006), and Rio Nido (383012122574501).

(for May-Oct only) was used to rank each year relative to median conditions. Based on this ranking, the 2000 water year was selected as the most typical year.

The year 2000 discharge time series was used to generate a synthetic discharge time series to approximate anticipated 2009 conditions. A measured time series is preferable to using the median daily discharge because it retains some of the short-term variability in the observed flow rates. A synthetic discharge time series for anticipated 2009 conditions was derived from the typical discharge time series by scaling the Guerneville discharge to an average summertime flow of 70 ft^3/s. This reduction ratio of approximately 40% is based on the anticipated 2009 emergency instream flow requirements versus historic instream flows. In addition to averaging 70 ft^3/s, short-term variability ranges from about 50-100 ft^3/s during the May to October management period. The resulting discharge time series at Guerneville is shown in Figure 7a for the simulation period.

The anticipated 2009 discharge time series at Guerneville was further reduced using the calibration curve developed in Section 6.2.2 to account for downstream losses between the gaging station and the lagoon. The resulting estuary inflow time series is shown in Figure 7a. Predicted 2009 inflows to the lagoon vary from approximately 30-50 ft^3/s and average approximately 40 ft^3/s during the summer months. This is consistent with the reduced instream flow requirements obtained by the Agency for 2009 operations (Section 3.2).

Model Setup

The configuration for the unsteady HEC-RAS hydraulic model is very similar to the water balance model described in Section 6.2.2. The unsteady model includes the lagoon, outlet channel, and beach face, and simulations span the duration of the operational period, from May 15-October 15. The outlet channel was parameterized as a prismatic rectangular channel with a width of 100 ft and length of 300 ft. Bed roughness (Manning's n) was set to 0.02. The channel bed was set at 5 ft NGVD and transitions to a 1V:70H slope on the beach face. The actual beach face slope is believed to be closer to 1V:10H; however, a milder slope was required for model stability. Sensitivity runs with a steeper beach face slope indicated negligible influence on velocities in the upstream portion of the outlet channel. A downstream water level boundary condition was prescribed for the ocean; however, since the outlet channel bed elevation is above the limit of tidal influence (approximately 4.5 ft NGVD), there was no impact on outlet channel hydraulics.

Results

Model runs were conducted for the operational period from May 15-October 15 for the proposed outlet channel geometry described above. Time series of lagoon water level, channel velocity, and bed shear stress were extracted to evaluate channel performance. Bed shear stress and lagoon water level results for the hydraulic modeling are shown in Figure 8a and Figure 8b, respectively. The bed shear stress values shown in Figure 8a are mean model predicictions times 1.5 to account for transverse variations in bed shear stress not captured by the one-dimensional model

(Fischenich , 2001). The results for the proposed channel geometry and the anticipated 2009 hydrology are shown as the "Baseline" curve. The expected range of critical shear stress (0.4-0.7 Pa) is shown in Figure 8a for reference. After the initial higher flow period during the spring and early summer, both shear stress and lagoon water level are relatively constant throughout the summer and fall (July-October). This corresponds to flow rates at Guerneville below a threshold discharge of approximately 90 ft^3/s. Bed shear stress fluctuates near the critical shear stress during this period, suggesting some potential for sediment motion and scouring of the channel. Lagoon water levels are relatively constant around 5.5 ft NGVD, resulting in a typical flow depth of approximately 0.5 ft in the channel. Channel velocities are approximately 0.7-0.8 ft/s.

6.3 SENSITIVITY ANALYSIS AND UNCERTAINTY

PWA conducted sensitivity and uncertainty model runs for important variables and parameters to assess the impact on channel performance. Parameters tested were: (1) discharge reduction coefficient, (2) bed roughness (Manning's n), and (3) critical shear stress.

Discharge reduction coefficient

The model calibration procedure for discharge losses from the USGS gaging station at Guerneville to the Russian River lagoon is described in Section 6.2.2. Comparison of observed and predicted rates of water level increase during closure events demonstrated losses of 10-50% relative to the measured upstream discharge. The baseline simulation presented in Section 6.2.3 used a calibrated seasonally-varying coefficient to reduce flow rates into the lagoon, typically resulting in a reduction of 30-50% over the management period. To test channel performance during higher than expected summertime flows (due to lower groundwater losses, diversions, etc), a sensitivity run with a constant reduction factor of 20% was conducted. As discussed above (Section 6.2.2), limited USGS discharge measurements suggest a reduction factor of no more than 10%.

Bed Roughness (Manning's n)

Manning's n is a coefficient that characterizes the surface roughness of the channel bed. For sandy channels, roughness is primarily a function of grain size. Various parameterizations exist for estimating bed roughness (Bray 1979; Bruschin 1985; Julien 2002; Limerinos 1970; Strickler 1923, USGS 1984), yielding Manning's n values of 0.017-0.026 for a grain size of 1 mm (Attachment A-2). A Manning's n of 0.02 was selected for the baseline simulation presented in Section 6.2.3. To test the sensitivity of the results on bed roughness, a sensitivity run with a roughness of 0.025 (25% higher) was conducted.

Critical Shear Stress

Uncertainty in the critical shear stress for beach sand at the Russian River mouth is primarily due to the fact that the beach is comprised of a distribution of particles of varying diameter (see Section 6.1), as opposed to a uniform grain size. Grain size analyses indicate a narrow distribution of approximately 0.8-1.25 mm diameter sand, for which the critical shear stress

ranges from 0.4-0.7 Pa. The critical shear stress for the typical grain size of 1 mm is 0.5 Pa. This uncertainty band is shown in Figure 8a to illustrate the uncertainty in the critical shear stress threshold relative to the modeled bed shear stress.

Results

The results of the roughness and discharge reduction coefficient ("Losses") sensitivity model runs are shown in Figure 8a for bed shear stress and Figure 8 b for lagoon water level. Higher than anticipated bed roughness results in a less hydraulically efficient channel that elevates lagoon water levels and channel depths by a small amount (<0.1 ft) during the summer months (July 15-October 15). Average bed shear stress during the same period increased by approximately 25% from 0.60 Pa for the baseline simulation to 0.76 Pa. Higher than anticipated flows (20% diversion scenario) had a similar, but more significant, impact on bed shear stress and water level. Average water levels and channel depth increased by approximately 0.13 ft relative to the baseline simulation. Average bed shear stress increased by approximately 60% to an average value of 0.95 Pa for the summer months, well above the expected critical shear stress threshold. If flow losses between Guerneville and the estuary are even less than 20%, as suggested by the USGS discharge data, bed shear stress would be even higher for a channel constrained to a width of 100 ft.

The results of the sensitivity simulations suggest that while the outlet channel appears to operate in a marginally stable state for the anticipated conditions, variability in sediment grain size, bed roughness, and lagoon inflow could result in channel scour (widening or deepening) or breaching. If necessary, a wider channel could be excavated (or could develop naturally) to reduce bed shear stress below the critical threshold. It should also be noted that the simulations for 2009 anticipated hydrology assume lagoon inflow based on proposed reductions to minimum in stream flow requirements for the summer of 2009. In future years, discharge to the lagoon may be higher than modeled and a wider outlet channel may be required to convey flows below the critical threshold for sand transport.

7. PROPOSED OUTLET CHANNEL ADAPTIVE MANAGEMENT FOR YEAR 1

This section provides new recommended channel management practices related to the BO requirements. Existing management practices for notification of agencies, public safety, operator safety, operational responsibility, and other practices not related to meeting the BO objectives are not affected and are not discussed here. These existing practices are documented in the Standard Operational Procedures: Russian River Mouth Opening (SCWA, 2002).

The strategy for outlet channel management is an incremental approach that seeks to minimize the risk of uncontrolled breaching. This strategy includes the following:

- favoring smaller, more frequent modifications over larger, less frequent, modification with less certain outcome
- tolerating more frequent channel closure to avoid the channel breaching to fully tidal conditions
- initially managing estuary water levels at the lower end of the 4-9 ft NGVD range to reduce the scour potential associated with larger water surface differences between the lagoon and ocean

Once experience is gained from implementing the channel and observing its response, it may be possible to make larger changes during each incremental modification. These larger changes will decrease the duration and frequency of management activity, thereby reducing the disturbance impact over time. Management practices will be incrementally modified over the course of the management period (May 15th to October 15th) in effort to improve performance in meeting the goals of the BO.

To provide context for the proposed management plan, the first section below describes previous breaching practices for the inlet. Subsequent sections describe the target channel dimensions and supporting operations details.

7.1 PREVIOUS BREACHING PRACTICES

Breaching has historically been performed in accordance with the *Russian River Estuary Study 1992-1993* (PWA, 1993) in effort to minimize flooding of low lying shoreline properties in the Estuary. The beach berm was artificially breached by the Agency when the water surface elevation in the estuary is between 4.5 and 7.0 feet as read at the Jenner gage. Breaching was performed by creating a deep cut in the closed beach berm approximately 100 feet long by 25 feet wide and 6 feet deep by moving up to 1,000 yd^3 of sand. Based on experience and beach topography at the time of the breach, the planform alignment of the breach was selected to maximize the success of the breaches. Breaching activities were typically conducted on outgoing tides to maximize the elevation head difference between the estuary water surface and the ocean. After the last portion of the beach berm was removed, water would begin flowing out the channel at high velocities, scouring and enlarging the channel to widths of 50 to 100 feet. As the channel

evolved and meandered, it reached lengths in excess of 400 ft. After breaching, the estuary would be subject to saline water inflow throughout incoming tides.

7.2 INITIATION OF EXCAVATION

Initial channel excavation will be performed when the outlet channel first closes following May 15th, the beginning of the management period. It is important to initiate excavation shortly after closure, to prevent lagoon water levels from rising too high above the elevation of the beach berm before the outlet channel can be constructed.

Should the outlet channel close in the weeks immediately preceding the management period, the Agency may initiate excavation to increase the likelihood of entering the management period with the target channel configuration in place. If the channel remains open for some period after May 15th or is breached later in the management season, then begins to show signs of closure (reduced tidal range), the Agency may consider grading to assist channel closure.

The constructed outlet channel may also close during the management season, such as following a large wave event. In such circumstances, it will be necessary to regrade the channel before the lagoon water level rises too high above the new (higher) beach berm elevation.

7.3 TARGET CHANNEL DIMENSIONS

7.3.1 Bed Elevation

The bed will be excavated 0.5 to 1 foot below the lagoon water level along its entire length, to achieve target channel depths (discussed below) upon initiation of flow. At the start of the management season, lagoon water levels and the channel bed are likely to be lower in elevation, since the system will have recently transitioned from intertidal to closed. As the management season progresses, sand is expected to move onto the beach berm, raising the viable bed elevation for the outlet channel. As the channel bed builds higher, it will support higher lagoon water levels while maintaining channel depth within the target range. Frequent maintenance will likely be required early in the management season to maintain an open outlet channel as the beach berm elevation builds. Eventually, the outlet channel may be above the typical wave runup elevation, the elevation at which waves may induce channel closure, and close less frequently. The Phase 1 performance criteria are to develop an outlet channel that supports a stable, perched lagoon with water surface elevations at approximately 7 ft NGVD for several months (Section 3.1). Stable conditions imply that river inflow into the lagoon would be approximately the same as outflow through the outlet channel and that net sand deposition or erosion does not impair the outlet channel's function. However, this goal may not be achievable in Year 1 because additional constraints in place during this first year call for modified performance criteria.

Channel bed elevations are expected to be in the range of 3 to7 ft NGVD, with corresponding lagoon water levels of 4 to 8 ft, using a typical flow depth of one foot. At the start of the

management season, the minimum beach elevation will be at or just above the tide range when the berm closes, probably between 3 ft and 5 ft NGVD. This minimum beach elevation will be the elevation of the channel bed. The median wave runup elevation during the management period is approximately 6 ft NGVD (Section 5.2.3 and Figure 5). However, intermittent large wave events increase the wave runup to elevations above 9 ft NGVD, during which time closure is more likely. Conceptually, the desired channel bed elevation range is limited on the high end by flooding and on the low end by wave runup (which can close the channel). For example, the upper end of the channel bed elevation, 7 ft NGVD, can be thought of as limited by the flood stage elevation (9 ft NGVD) minus the typical design channel depth (1 ft) and a factor of safety (1 ft). Developing a better feel for these parameters is one objective of the adaptive management plan.

The bed slope should be nearly flat within the outlet channel to minimize the likelihood of scouring the bed. This may be difficult to maintain. In particular, incision within the "flat" channel bottom may occur.

7.3.2 Depth

The target range of water depths, 0.5-2 ft, is constrained on the upper end by the maximum depth at which the channel is likely to be stable (not scour). The lower end of the range is constrained by the width; shallower depths would require impractically large channel widths to provide sufficient cross-sectional area to convey flow. Shallower water depths represent a greater factor of safety with regard to preventing bed scour since bed friction retards flow speed more strongly for shallower depths.

7.3.3 Width

The width of the channel is estimated to vary within 25-100 ft for consistency with the existing management permits. Initial management will start with excavating a channel approximately 100 ft wide to provide maximum feasible capacity to convey discharge without scouring the channel. If experience demonstrates that this wider channel has excess conveyance capacity, subsequent modifications may consist of narrower channel widths. On the other hand, if actual estuary inflows are larger than predicted (see Section 6.2.2), then a wider channel may be required to convey sufficient discharge to prevent rising lagoon water levels while simultaneously avoiding scour in the outlet channel. Because of permitting constraints, a channel wider than 100 ft cannot be implemented in Year 1 (Section 3.2).

7.3.4 Length

The channel length is estimated to vary within 100-400 ft, consistent with historic channel lengths observed within the management period (Behrens, 2008). Length will be a function of the channel's planform alignment.

7.4 CHANNEL LOCATION/PLANFORM ALIGNMENT

The initial approach will be to construct the channel in the same general location and alignment as the preexisting channel (i.e., the location just prior to closure). Excavation will simply widen and connect the channel in place. As the channel migrates during the management season, the location of new excavation may follow this migration. If the channel closes, alternative channel alignments may be implemented to test the relationship of mouth location on channel stability. Various channel locations within the extent of the existing alignment (Figure 1) may be pursued to take advantage of site features such as areas of reduced wave energy and rocks imbedded in the beach.

7.5 EXCAVATION TIMING RELATIVE TO THE TIDAL CYCLE

Under the proposed management plan, channel modifications will be initiated during low tide so that after several hours of work, the channel will be completed near high tide. As per existing practices, a temporary barrier will be left between the ocean and lagoon during excavation. When the last material is excavated, then the temporary barrier will be removed at or near high tide. This will minimize the difference in water levels between the estuary and ocean, reducing the potential for the re-connected channel to scour into a fully tidal inlet.

7.6 EXCAVATION FREQUENCY AND VOLUMES

Creating and maintaining the outlet channel will probably employ one or two pieces of heavy machinery (e.g. excavator or bulldozer) to move sand on the beach. At the start of the management period (late spring or early summer), when configuring the outlet channel for the first time that year, conditions may require operating machinery daily or near daily from some initial period. The precise number of excavations would depend on uncontrollable variables such as seasonal ocean wave conditions (e.g. wave heights and lengths), river inflows, and the success of previous excavations (e.g. the success of selected channel widths and meander patterns) in forming an outlet channel that effectively maintains lagoon water surface elevations. As technical staff and maintenance crews gain more experience with implementing the outlet channel and observing its response, maintenance during the remainder of the management season is anticipated to be less frequent. In consideration of the natural beach environment and public access, effort will be made to minimize the amount and frequency of mechanical intervention.

The quantity of sand moved will depend on antecedent beach topography. To stay consistent with current management practices, excavation volumes will not exceed 1,000 yd^3. Any sand excavated from the channel will be placed on the adjacent beach in such a way as to minimize changes to beach topography outside the outlet channel.

7.7 MONITORING

Monitoring of the outlet channel should be implemented to facilitate an understanding of the channel's behavior and guide adaptive changes to this initial management plan. The monitoring would quantify changes in the beach and channel elevation, lengths, and widths, as well as flow velocities and observations of the bed structure (to identify bed forms and depth-dependent grain size distribution indicative of armoring) in the channel. Because monitoring requires human presence on beach, potentially disturbing the seal population, the monitoring frequency represents a balance between management of the outlet channel and minimizing disruption of wildlife.

A list of recommended monitoring tasks for Year 1 is provided below in Table 5.

Table 5 Monitoring tasks associated with outlet channel management

Task	Description	Field Activities	Frequency
Recommended			
Operations log	Record of outlet channel management actions and ambient conditions.	Operations staff to generate written record of operations (excavation method, extent, and location) and ambient conditions (weather, ocean state, estuary water level)	Daily to monthly (Depends on operational activity)
Outlet channel location and state	An automated video or still camera station to capture the outlet channel's location and state.	Field staff to install and service a camera, power supply, and possibly communication system on hillside adjacent to estuary.	Hourly imaging (automated); Weekly servicing
Outlet channel discharge measurements	Collected within the outlet channel to verify the channel's conveyance.	Field staff to complete cross sectional flow velocity surveys using flow meter attached to a wading rod with electronic data logger.	Every 2 weeks
Outlet channel bed structure	Observe the bed for bed forms and depth-dependent grain size distribution indicative of armoring. Sediment sampler used.	Field staff to collect sediment sample from the surface of the channel bed.	Monthly
Outlet channel topography	Collect outlet channel elevation and width	Field staff to survey outlet channel features using a total station and prism mounted on a survey rod.	Monthly
Beach topography	Collect beach elevation	Field staff operating a reflectorless total station from adjacent hillside.	Monthly
Estuary discharge measurements	Integrate cross sectional velocity data in estuary at various locations from mouth to Duncans Mills.	A boat with field staff, collecting cross sectional data from mouth to Duncans Mills.	Weekly

7.8 UNCERTAINTY AND LIMITATIONS

The proposed operations are based on the analyses documented in this report and on our professional judgment. Uncertainties about the actual estuary inflow, berm seepage, and outlet channel performance remain. As described in Section 6.2.2, the two methods for estimating estuary inflow, the water balance model and limited discharge measurements, predict disparate estuary inflows. The seepage through the beach berm is based only on inferred, not observed, estimates of hydraulic conductivity. The outlet channel, particularly its downstream end, will be located in a highly dynamic environment that is influenced by changing river flow, tidal water levels and waves. Since the outlet channel will not include any hard structures, all of these sources of hydrologic forces can readily alter the channel's configuration, which may make it difficult to achieve and maintain the channel's successful function.

Adaptive management once the channel is implemented will further enhance management practice. Actual feasibility with regards to the full range of dynamic conditions has not been determined. Risks associated with outlet channel failure have not been quantified. In addition to the channel's performance criteria, there are also water quality and ecological performance criteria for the perched lagoon. These additional criteria have not been evaluated as part of the outlet channel management plan.

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10. FIGURES

Source: Sonoma County Orthophotography (April-May, 2000)

0 250 500 1,000 Feet

figure 1

Russian River Estuary Outlet Channel Management Plan

Russian River Estuary Site Location

PWA Ref# - 1958.01

PWA

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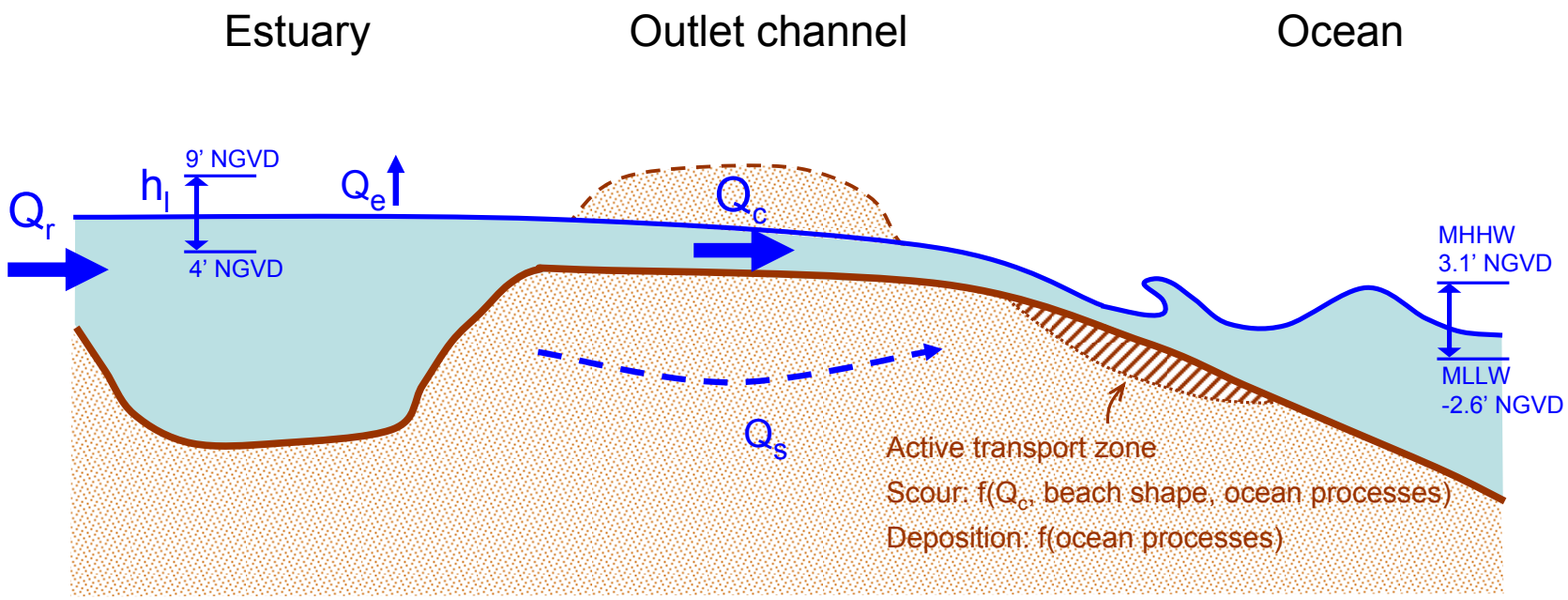


Parameters

h_l=lagoon water level

Q_r=river discharge

Q_c=outlet channel discharge

Q_s=seepage discharge

Q_e=evaporation from lagoon

Processes

- $Q_r = Q_c + Q_e + Q_s$ (averaged over days)
- No sediment transport within outlet channel
- Active sediment transport outside outlet channel

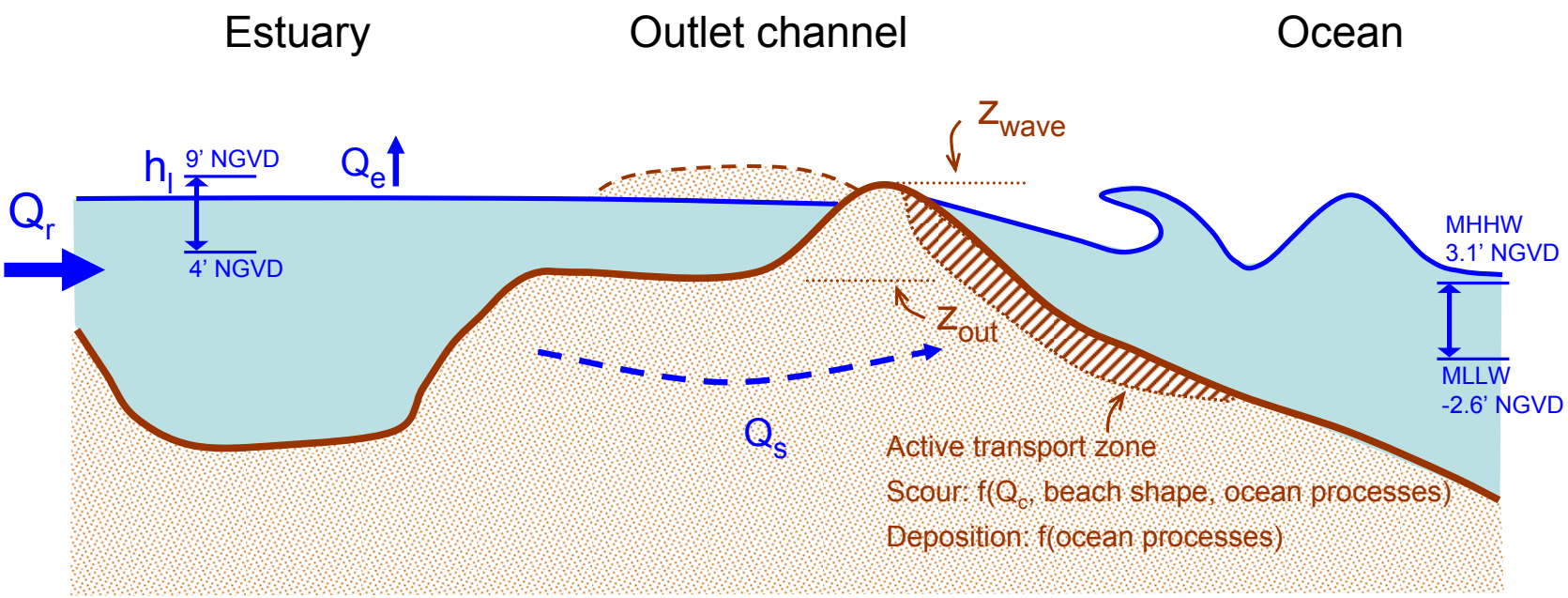
figure **2**

Russian River Estuary Outlet Channel Management Plan

Conceptual model – Target conditions

PWA Ref# 1958.01

PWA



Parameters

z_{out}=target channel bed elevation

z_{wave}=wave runup elevation; f(wave conditions, ocean water level, channel location)

Processes

- $z_{wave} \geq z_{out}$
- wave-induced sediment transport closes outlet channel
- $Q_c \rightarrow 0$
- h_l increasing

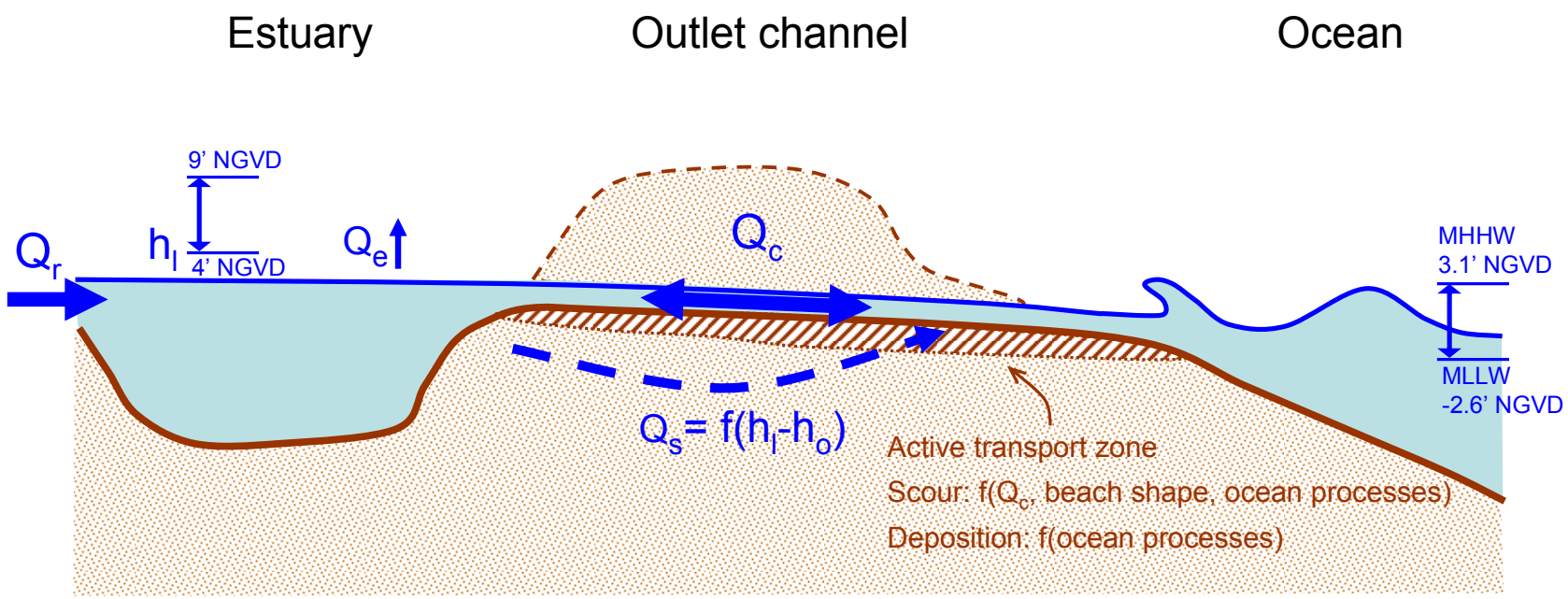
figure ***3***

Russian River Estuary Outlet Channel Management Plan

Conceptual model – Closure

PWA Ref# 1958.01

PWA



Parameters

u_c= f(channel slope, length, and width; Q_r; ocean water level)
(can be managed to greater or lesser degree)

u_{crit} is f(grain size)

Processes

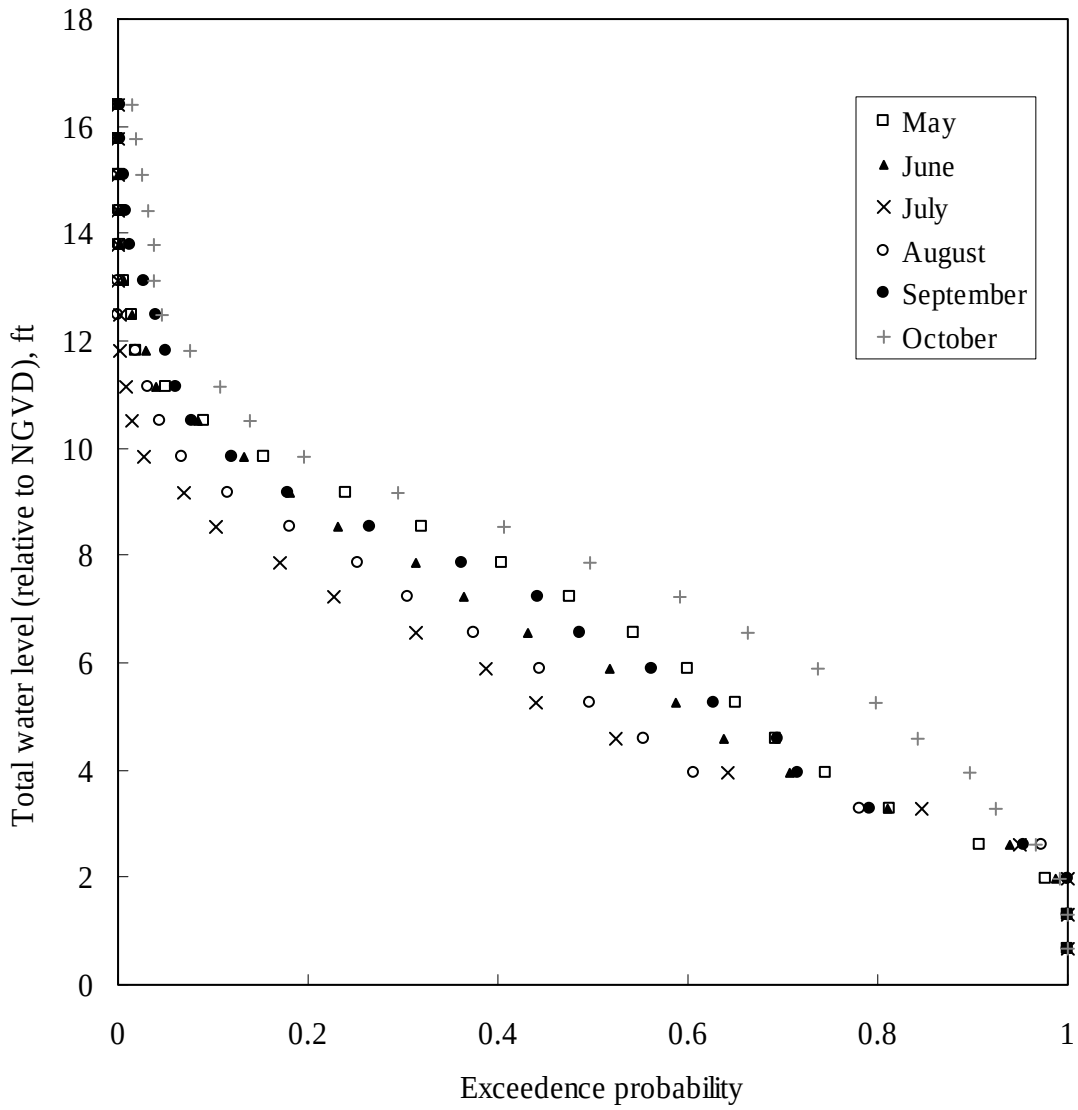
- $u_c > u_{crit}$; high velocities scour channel
- Q_s increases; high seepage creates groundwater piping and erosion
- sediment transport within outlet channel

figure ***4***
Russian River Estuary Outlet Channel Management Plan

Conceptual model – Breaching

PWA Ref# 1958.01

PWA



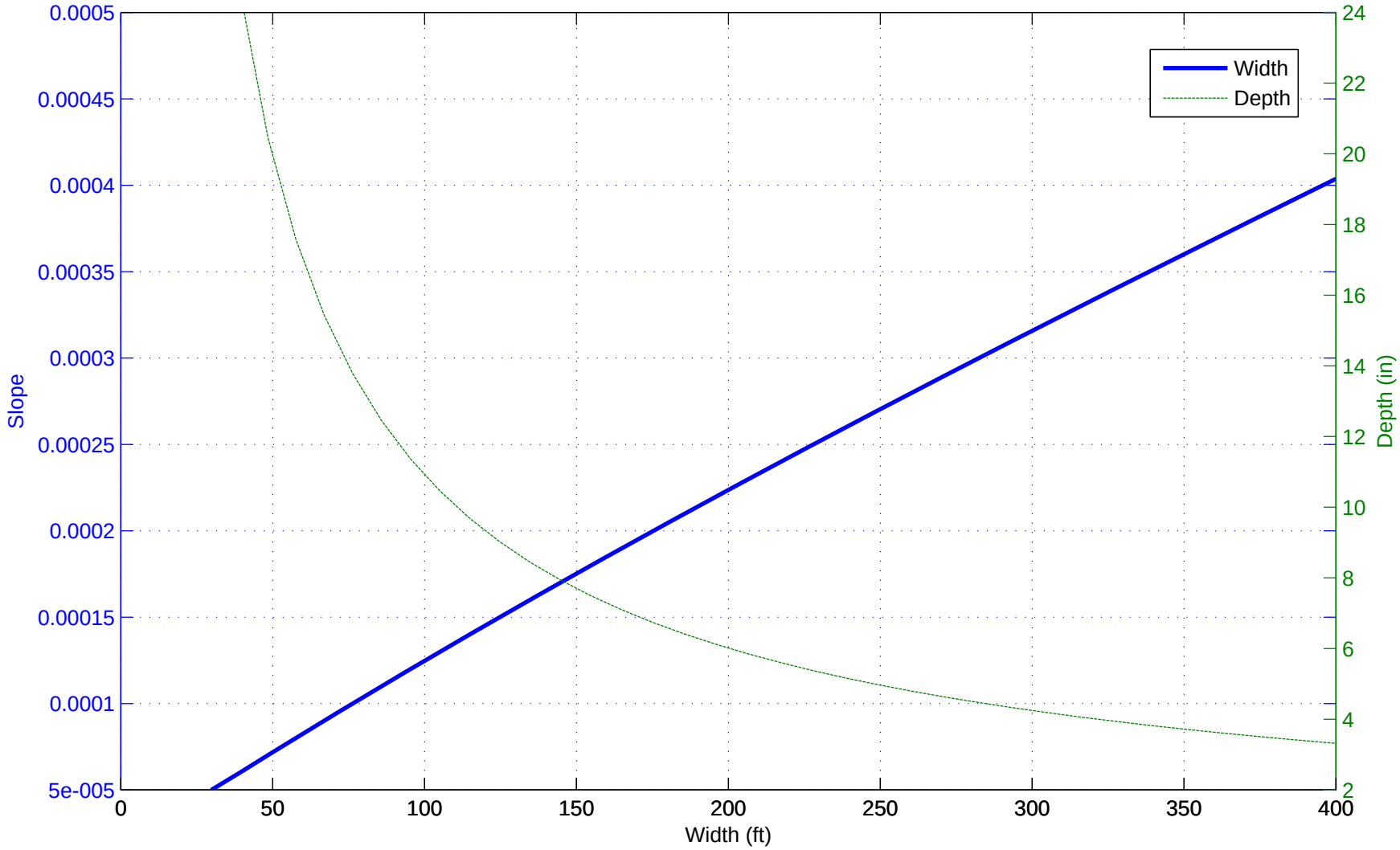
Source: D. Behrens (unpublished). Wave data from CDIP Point Reyes buoy.
Note: Total water level calculated as sum of daily higher high tide and wave runup elevation. Wave runup calculated from Stockdon et al (2006) using estimated de-shoaled deepwater equivalent wave heights.

figure **5**
Russian River Outlet Channel Management Plan

Total Water Level Exceedance, May-Oct

PWA Ref# 1958.01

PWA



Source: Stability curve for local bed shear stress of 0.5 Pa, flowrate of 70 cfs, and Manning's roughness of 0.02.

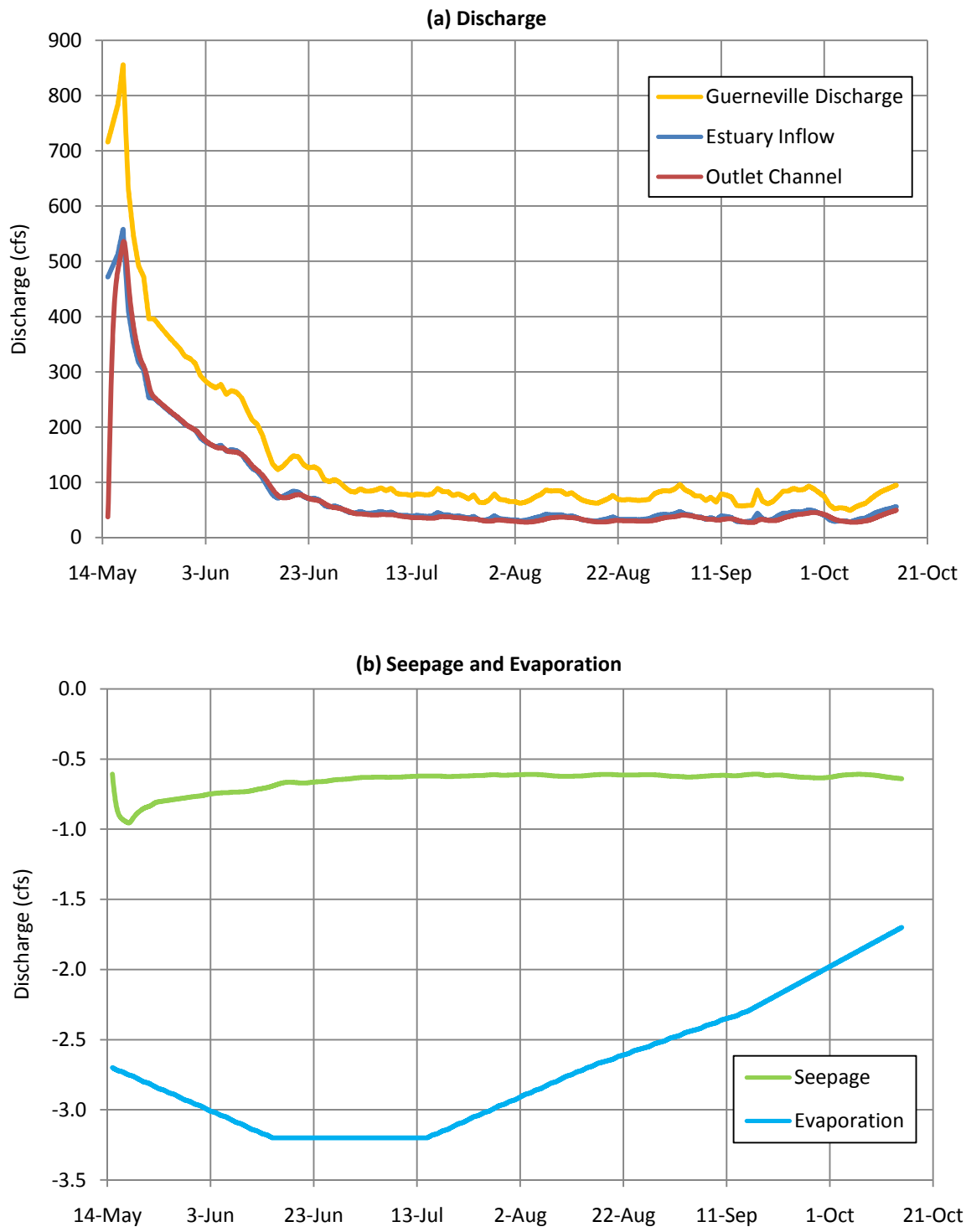
Figure 6
Russian River Estuary Outlet Channel Management Plan

Slope vs. Width Stability Plot

PWA Ref# 1958.01

PWA

j:\1958.01RREAMPOutletChannel\Task 4 Prelim geometry\matlab\solve_geometry.m



Source: Discharge times series based on observations at USGS gaging station at Hacienda Bridge, Guerneville, CA (#11467000). Evaporation rates calculated from monthly climatological rates for CIMIS evapotranspiration zone 1 (California coast).

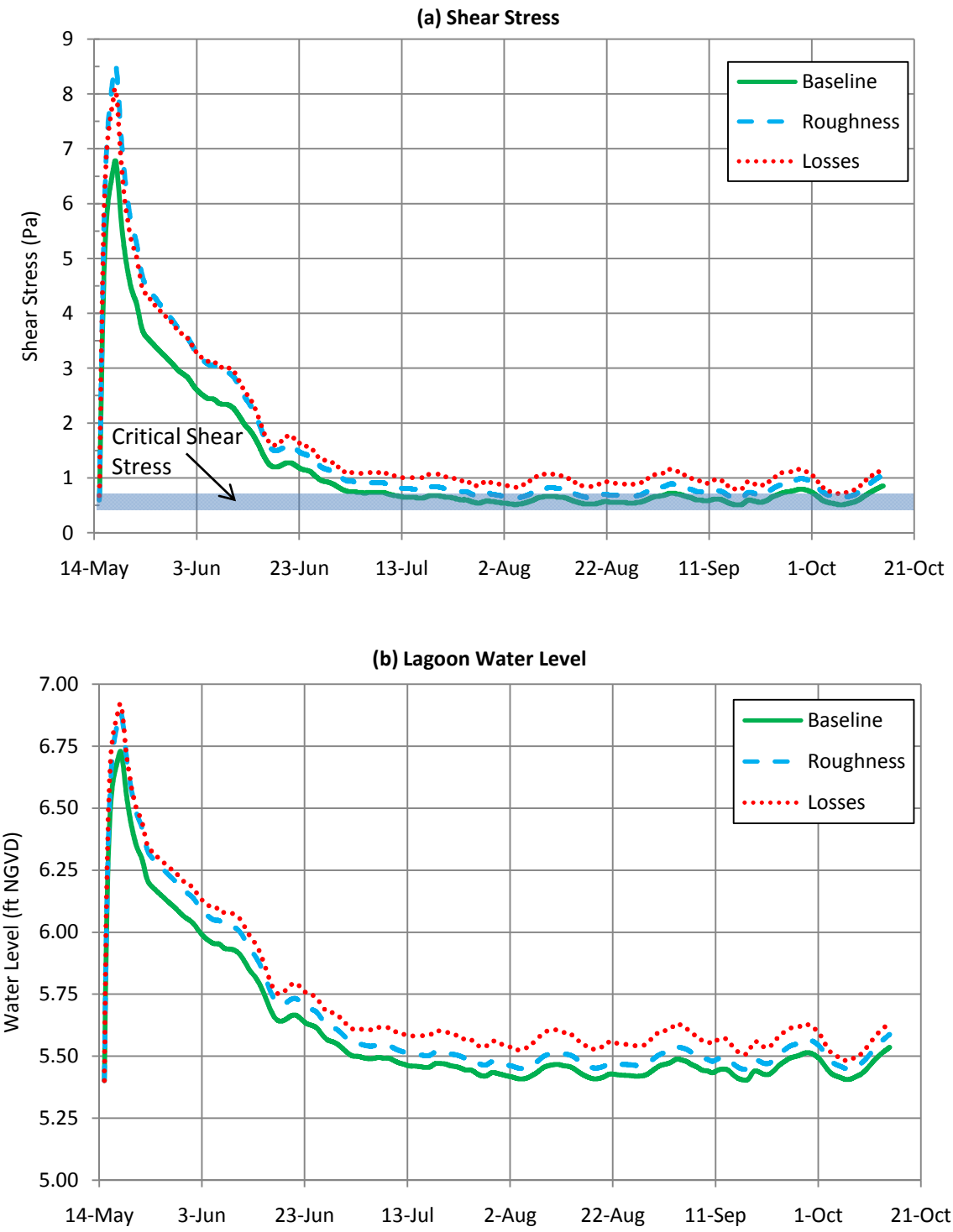
figure **7**

Russian River Estuary Outlet Channel Management Plan

Hydraulic Model Discharge - 2009 Anticipated Hydrology

PWA Ref#: 1958.01

PWA



Notes: Baseline channel geometry: width=100 ft, length=300 ft, bed=5 ft NGVD, n = 0.02. Sensitivity results shown for roughness scneario (n=0.025) and losses scenario (20% uniform reduction in discharge from Guerneville to lagoon).
Source: HEC-RAS hydraulic model results for outlet channel.

figure **8**

Russian River Estuary Outlet Channel Management Plan

Hydraulic Model Results - 2009 Anticipated Hydrology

PWA Ref#: 1958.01

PWA

1958.01_2009_Anticipated_Operations.xls

ATTACHMENT A: SUPPORTING WORKSHEETS FOR CHANNEL CONFIGURATION ANALYSIS

Worksheets

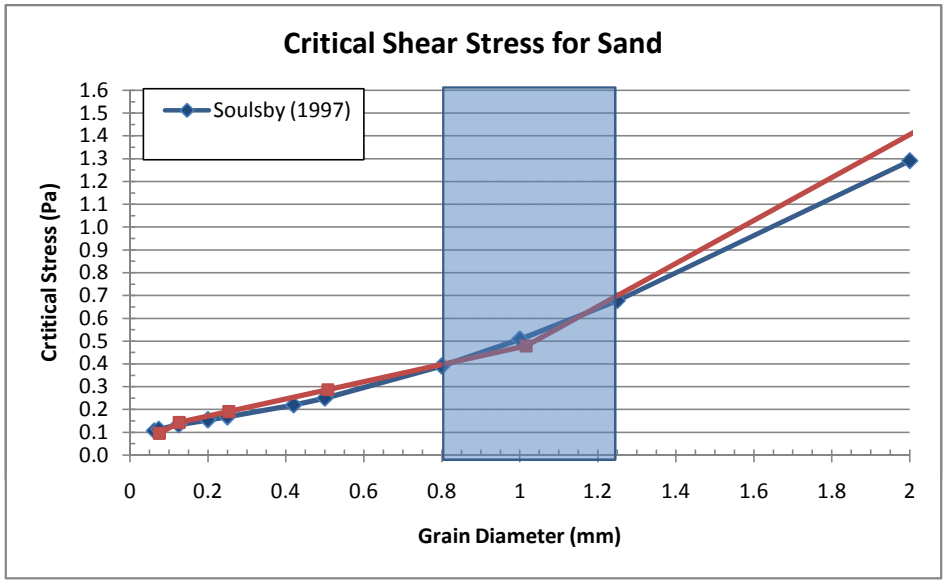
A-1. Critical shear stress for incipient motion of sane particles
A-2. Manning's n
A-3. Evaporation
A-4. Berm seepage
A-5. Mouth closure
A-6. Russian River discharge

A-1. Critical shear stress for incipient motion of sand particles

1958.01 Russian River Estuary Outlet Channel
J. Vandever (PWA)
4/1/2009

Variables		
p	1000	kg/m^3
g	9.81	m/s^2
s	2.65	(quartz)
v	1.0E-06	m^2/s

D (mm)	D*	Theta_crit	tau_crit (Pa)	Grain Size
0.0625	1.58	0.105	0.11	Very Fine Sand
0.074	1.87	0.094	0.11	
0.125	3.16	0.066	0.13	Fine Sand
0.20	5.06	0.048	0.15	
0.25	6.32	0.041	0.17	Medium Sand
0.42	10.62	0.032	0.22	
0.5	12.65	0.031	0.25	Coarse Sand
0.8	20.24	0.030	0.39	
1.0	25.30	0.031	0.51	Very Coarse Sand
1.25	31.62	0.033	0.68	
2.0	50.59	0.040	1.29	Granular



Notes: units Pa = N/m^2, assumes density of freshwater, quartz grained sand
Method based on Soulsby (1997) Dynamics of Marine Sand:

$$D_* = \left[\frac{g(s-1)}{\nu^2}\right]^{1/3} D$$

$$\theta_c = \frac{0.3}{1+1.2D_*} + 0.055\left[1-\exp(-0.020D_*)\right]$$

$$\tau_c = \rho(s-1)gd\theta_c$$

Note: does not account for gravitational effects on sloping bed

A-2. Manning's n worksheet

1958.01 Russian River Estuary Outlet Channel
J. Vandever (PWA)
4/1/2009

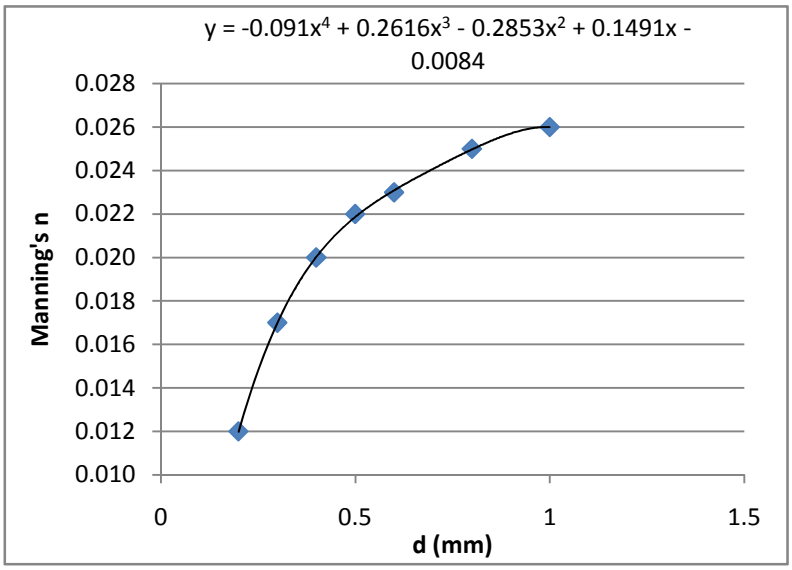
d_{50}	1	mm	0.003281 ft
D	0.84	ft	
Rh	0.83	ft	
S	0.00008	ft/ft	

Equation	n	Notes
Strickler (1923)*	0.018	*valid d range unknown
Limerinos (1970)*	0.021	
Bray (1979)*	0.017	
Bruschin (1985)*	0.018	
Julien (2002)*	0.024	
USGS (WSP2339)	0.026	for 0.2<d<1.0 mm
Average	**0.021**	
Average w/o USGS	**0.020**	

USGS

d (mm)	n
0.2	0.012
0.3	0.017
0.4	0.020
0.5	0.022
0.6	0.023
0.8	0.025
1.0	0.026
2.0	0.035

Polynomial fit to USGS data (d=2.0 mm not included):



A-3. Evaporation Worksheet

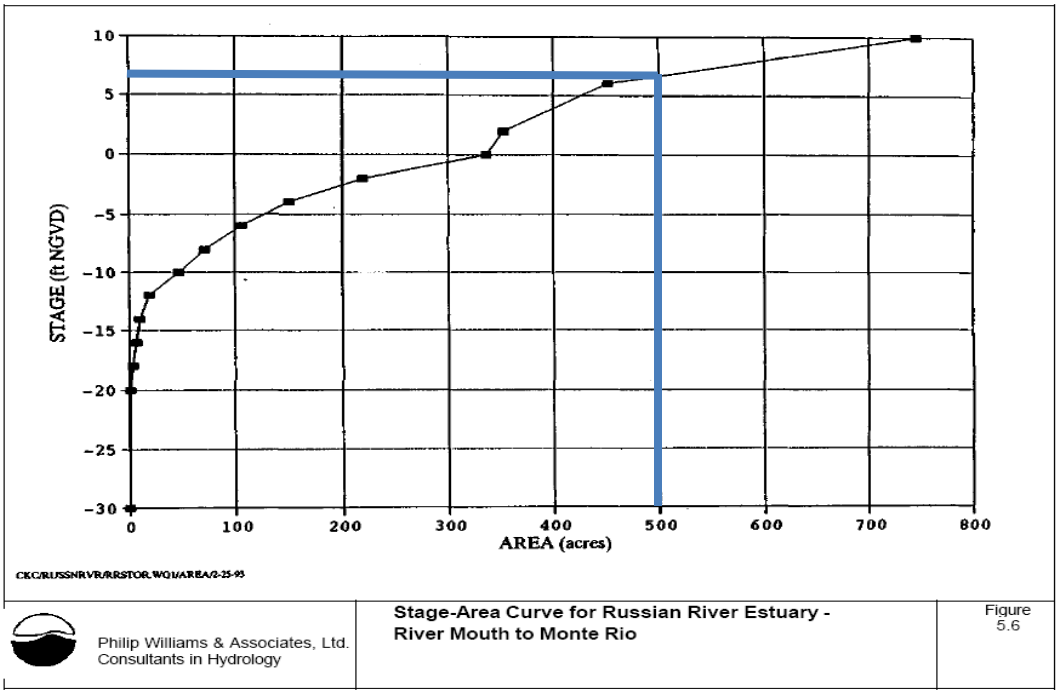
1958.01 Russian River Estuary Outlet Canal
J. Vandever (PWA)
15-Apr-09

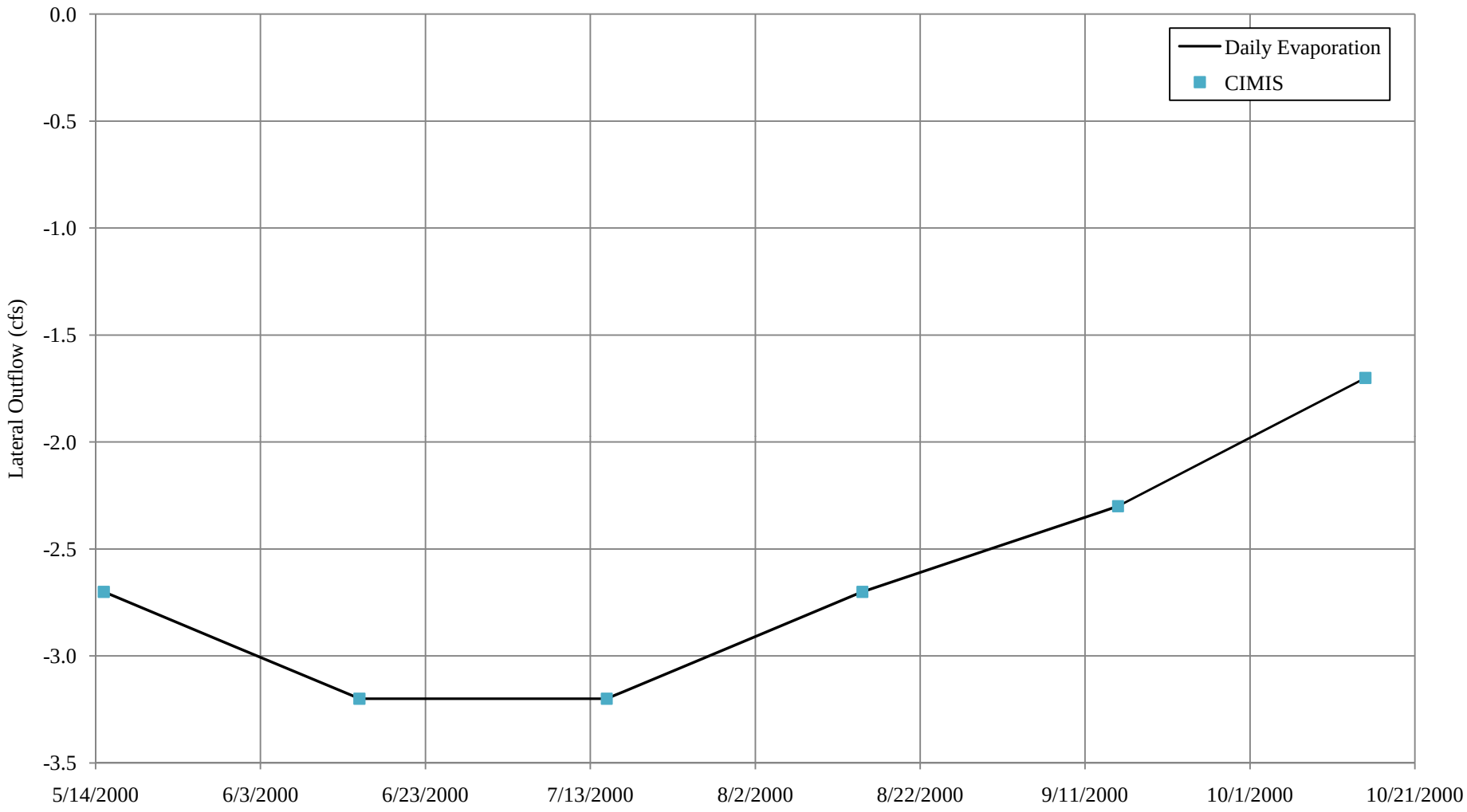
CIMIS Reference Evapotranspiration (Eto) Zones
http://www.cimis.water.ca.gov/cimis/images/etomap.jpg

Russian River Estuary is located on California coast in Zone 1
(Coastal plains and heavy fog. Lowest Eto in California, characterized by dense fog)

	in/month	days	in/day	mm/day	cfs
Jan	0.93	31	0.03	0.76	0.6
Feb	1.40	28	0.05	1.27	1.1
Mar	2.48	31	0.08	2.03	1.7
Apr	3.30	30	0.11	2.79	2.3
May	4.03	31	0.13	3.30	2.7
Jun	4.50	30	0.15	3.81	3.2
Jul	4.65	31	0.15	3.81	3.2
Aug	4.03	31	0.13	3.30	2.7
Sep	3.30	30	0.11	2.79	2.3
Oct	2.48	31	0.08	2.03	1.7
Nov	1.20	30	0.04	1.02	0.8
Dec	0.62	31	0.02	0.51	0.4

RRE Surface Area 500 acres
21,780,000 sq ft





Notes: Daily evaporation rates for Russian River lagoon interpolated from CIMIS average monthly evapotranspiration statistics for Zone 1 (Coastal plains and heavy fog). Calculations assume lagoon surface area of 500 acres.

Appendix ***A-3***

Russian River Estuary Outlet Channel Management Plan

HEC-RAS model evaporation boundary condition

PWA Ref #: 1958.01

PWA

A-4. Berm Seepage and Hydraulic Conductivity

1958.01 Russian River Estuary Outlet Canal
J. Vandever (PWA)
16-Apr-09

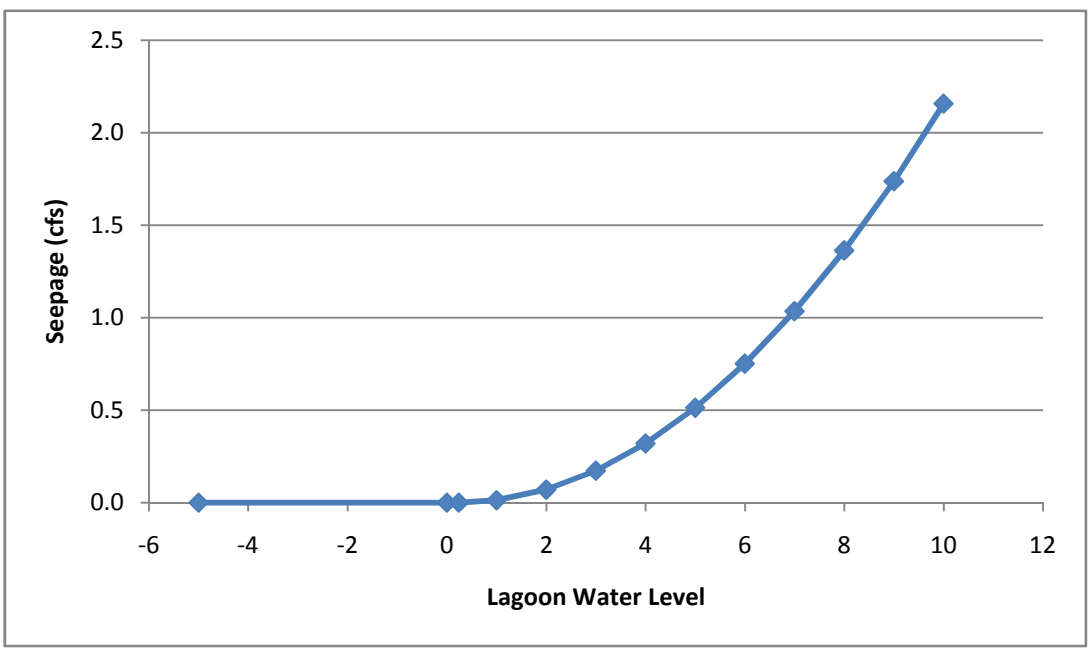
HEC-RAS Diversion Rating Curve

Lagoon WL (ft)	dh (ft)	q (cfs)	
-5	0	0.00	
0	0	0.00	
0.24	0	0.00	(MTL)
1	0.76	0.01	
2	1.76	0.07	
3	2.76	0.17	
4	3.76	0.32	
5	4.76	0.51	
6	5.76	0.75	
7	6.76	1.03	
8	7.76	1.36	
9	8.76	1.74	
10	9.76	2.16	(Flood Stage)
11	10.76	2.62	
12	11.76	3.13	

Darcy's Law

$$q = k\frac{\Delta h}{W}A = k\frac{\Delta h}{W}(\Delta h \cdot L)$$

W	250	ft
L	2500	ft
z_ocean	0.24	ft NGVD (MTL)
k	0.0023	ft/s



A-4. Berm Seepage and Hydraulic Conductivity

1958.01 Russian River Estuary Outlet Canal
J. Vandever (PWA)
7-Apr-09

Bouwer, H. 1978. Groundwater Hydrology. McGraw-Hill, Inc. 480 p.

	Hydraulic Conductivity (m/day)		Hydraulic Conductivity (cm/s)		
	Low	**High**	**Low**	**High**	**Mid**
Fine Sand	1	5	0.001	0.006	0.003
Medium Sand	5	20	0.006	0.023	0.014
Coarse Sand	20	100	0.023	0.116	0.069
Gravel	100	1000	0.116	1.157	0.637
Sand and Gravel	5	100	0.006	0.116	0.061

A-5. Mouth Closure Calibration Worksheet

1958.01 Russian River Estuary Outlet Canal
J. Vandever (PWA)
17-Apr-09

Russian River mouth closure calibrations - HEC-RAS model Years Examined: 2000, 2001, 2003, 2004, 2005, 2007

Accounts for losses between Hacienda Bridge (Guerneville, CA) and the lagoon and the interaction with the aquifer adjacent to the estuary.

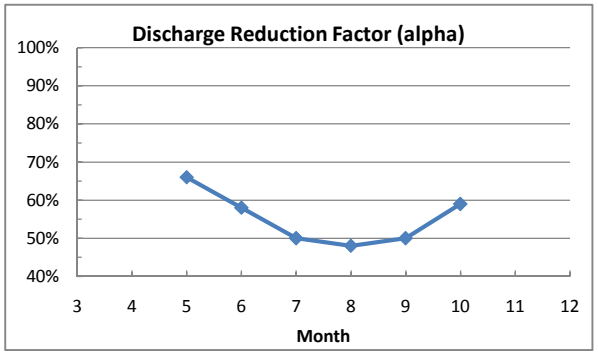
No detailed information available for the aquifer groundwater elevations or extraction rates by wells. The loss term is a calibrated variable in the model.

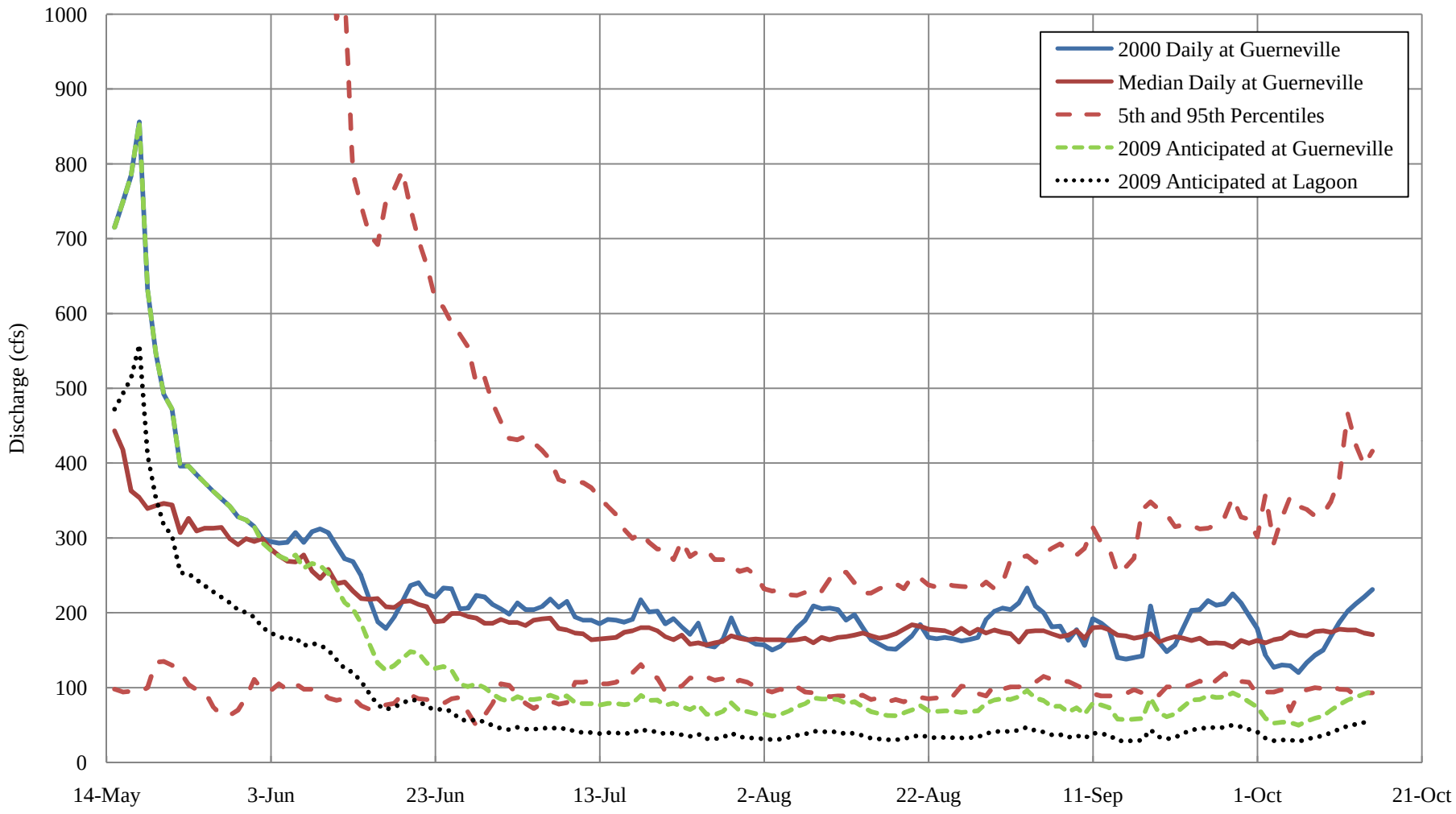
Lagoon Surface Area	400	ac
	17,424,000	sq ft
Evaporation and Seepage Losses	4	cfs

Calibration	Date		Water Level (ft NGVD)		dh	dt	dh/dt (ft/day)	dV/dt (cfs)	USGS Discharge (cfs)	% Reduction	alpha
Closure Event ID	Start	End	Start	End							
06May2000	5/6/2000 18:00	5/9/2000 6:00	3.10	8.40	5.30	2.50	2.12	432	580	26%	74%
24May2000	5/24/2000 8:00	5/25/2000 18:00	3.84	5.76	1.92	1.42	1.36	278	385	28%	72%
16June2000	6/16/2000 13:00	6/21/2000 6:00	4.79	6.90	2.11	4.71	0.45	94	200	53%	47%
25Aug2000	8/25/2000 0:00	9/5/2000 8:00	2.56	7.62	5.06	11.33	0.45	94	195	52%	48%
03Oct2000	10/3/2000 0:00	10/11/2000 12:00	2.85	6.53	3.68	8.50	0.43	91	140	35%	65%
15May2001	5/15/2001 23:00	5/21/2001 21:00	2.14	5.51	3.37	5.92	0.57	119	200	41%	59%
07Apr2007	4/7/2007 13:00	4/11/2007 0:00	1.17	7.68	6.51	3.46	1.88	384	480	20%	80%
13Apr2007	4/13/2007 21:30	4/17/2007 14:30	1.97	7.68	5.71	3.71	1.54	315	465	32%	68%
24Apr2007	4/24/2007 17:00	4/26/2007 14:00	1.51	7.57	6.06	1.88	3.23	656	725	10%	90%
13Oct2007	10/13/2007 2:30	10/22/2007 11:30	2.51	9.15	6.64	9.38	0.71	147	255	42%	58%
9June2003	6/9/2003 17:30	6/12/2003 1:00	2.77	6.47	3.70	2.31	1.60	322	475	32%	68%
9Oct2003	10/9/2003 23:11	10/14/2003 20:40	4.00	6.21	2.21	4.90	0.45	91	170	46%	54%
05Nov2004	11/5/2004 11:00	11/12/2004 4:00	2.40	8.93	6.53	6.71	0.97	196	300	35%	65%
26July2004	7/26/2004 15:41	8/5/2004 0:00	2.27	5.90	3.63	9.35	0.39	78	140	44%	56%
2May2004	5/2/2004 15:40	5/6/2004 19:35	3.44	8.39	4.95	4.16	1.19	240	420	43%	57%
16Apr2004	4/16/2004 9:09	4/18/2004 7:40	4.78	7.98	3.20	1.94	1.65	333	570	42%	58%
3Oct2005	10/3/2005 23:00	10/17/2005 6:30	2.40	8.30	5.90	13.31	0.44	89	170	47%	53%
17Sep2005	9/17/2005 2:00	9/21/2005 13:30	3.37	5.69	2.31	4.48	0.52	104	175	40%	60%

Note: Start and end times represent times used for water level calibration and do not correspond to exact timing of closures and breaches.

Month	Month	% Loss	N	HEC-RAS Multiplier
April	4	26%	4	
May	5	34%	4	66%
June	6	42%	2	58%
July	7	44%	1	50%
Aug	8	52%	1	48%
Sep	9	40%	1	50%
Oct	10	43%	4	59%
Nov	11	35%	1	
			18	





Notes: Median daily discharge calculated from 1970-2008.
Source: USGS gage 11467000 (Russian River near Guerneville, CA). 2009 anticipated discharge at Guerneville calculated from 2000 discharge by scaling factor to obtain typical summertime flowrates of 70 cfs. 2009 anticipated lagoon inflow calculated based on calibrated seasonal losses from Guerneville to lagoon.

Attchmnt A-6

Russian River Estuary Outlet Channel Management Plan

Daily Russian River Discharge

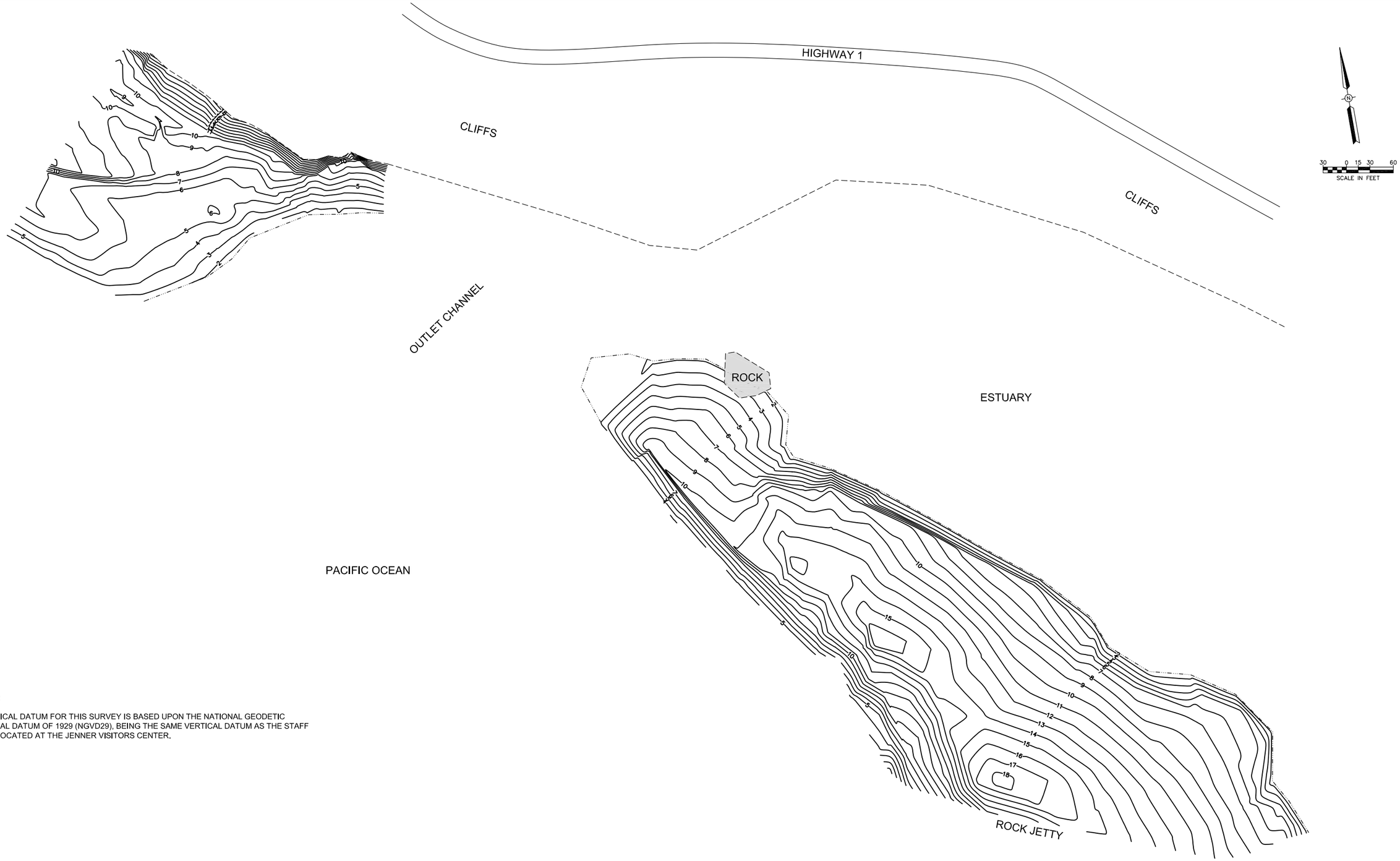
PWA Ref #: 1958.01

PWA

J:\1958.01RREAMPOutletChannel\Task 5 Hydrologic modeling\Data\Streamflow\USGS_11467000_WaterYear_2000.xls

Appendix C-2

Beach topographic maps



NOTES:

1. VERTICAL DATUM FOR THIS SURVEY IS BASED UPON THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD29), BEING THE SAME VERTICAL DATUM AS THE STAFF GAGE LOCATED AT THE JENNER VISITORS CENTER.

NO.	DATE		BY

SONOMA COUNTY WATER AGENCY

SCALE: AS NOTED
DATE : AS NOTED
DRAWN : EKM
CHECKED : JRM

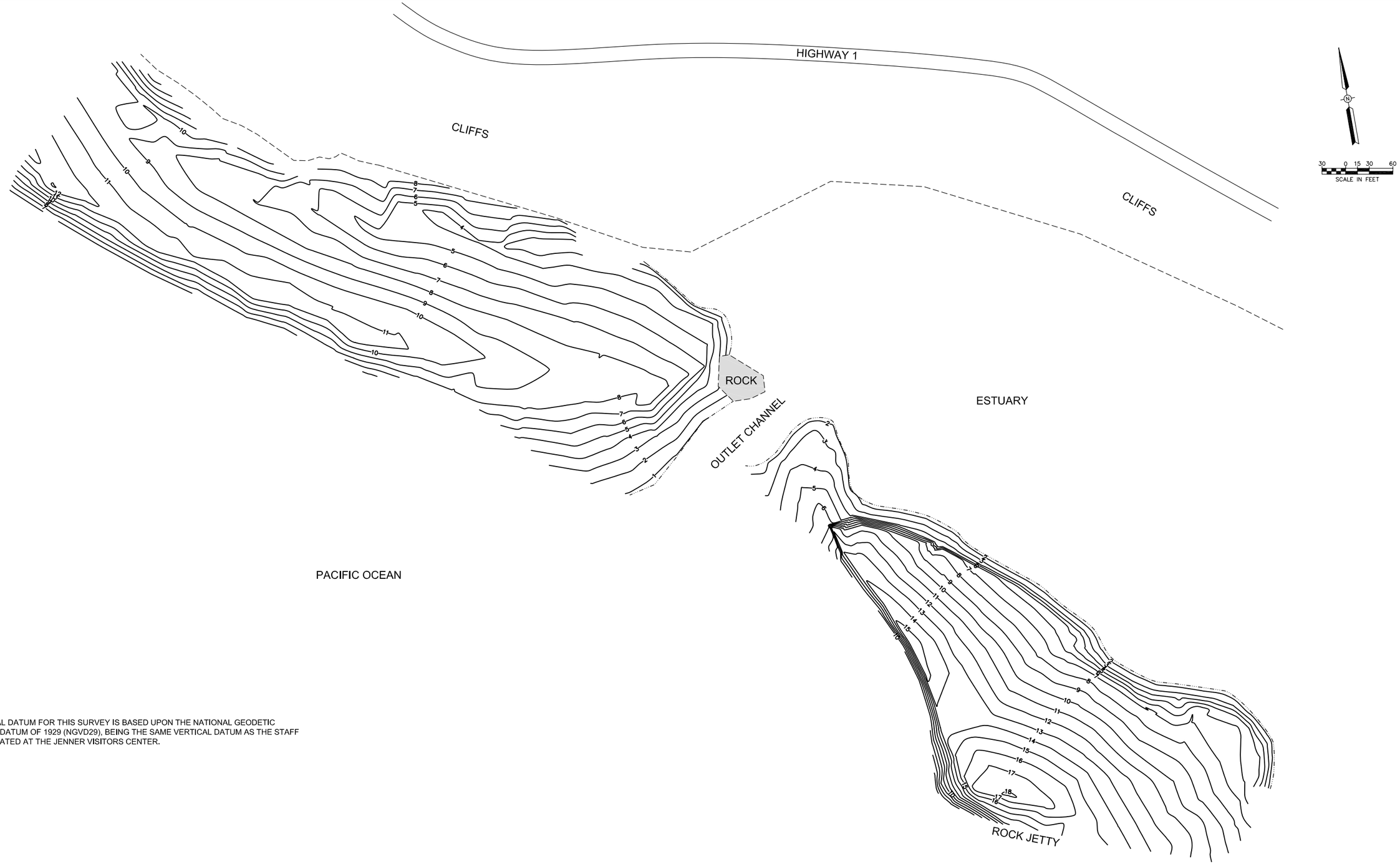
APPROVED DEPUTY CHIEF ENGR:
SUBMITTED
DESIGNED

RUSSIAN RIVER INSTREAM FLOW RESTORATION (RRIFR) PROGRAM

MONTHLY SURVEY OF BEACH TOPOGRAPHY AND OUTLET CHANNEL: JUNE 4, 2009

FILE NAME:
CONTRACT NO. XXX
DRAWING NUMBER
SHEET NO. 1 OF 1

\\SD-Data\Survey\Land Projects\RRIFR-EstuaryManagementAndMonitoring_PN7339\dwg\SandBarMonitoring.dwg



NOTES:

1. VERTICAL DATUM FOR THIS SURVEY IS BASED UPON THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD29), BEING THE SAME VERTICAL DATUM AS THE STAFF GAGE LOCATED AT THE JENNER VISITORS CENTER.

NO.	DATE		BY

SONOMA COUNTY WATER AGENCY

SCALE: AS NOTED
DATE : AS NOTED
DRAWN : EKM
CHECKED : JRM

APPROVED DEPUTY CHIEF ENGR:
SUBMITTED
DESIGNED

RUSSIAN RIVER INSTREAM FLOW RESTORATION (RRIFR) PROGRAM

MONTHLY SURVEY OF BEACH TOPOGRAPHY AND OUTLET CHANNEL: JUNE 30, 2009

FILE NAME:
CONTRACT NO. XXX

DRAWING NUMBER

SHEET NO. 1 OF 1

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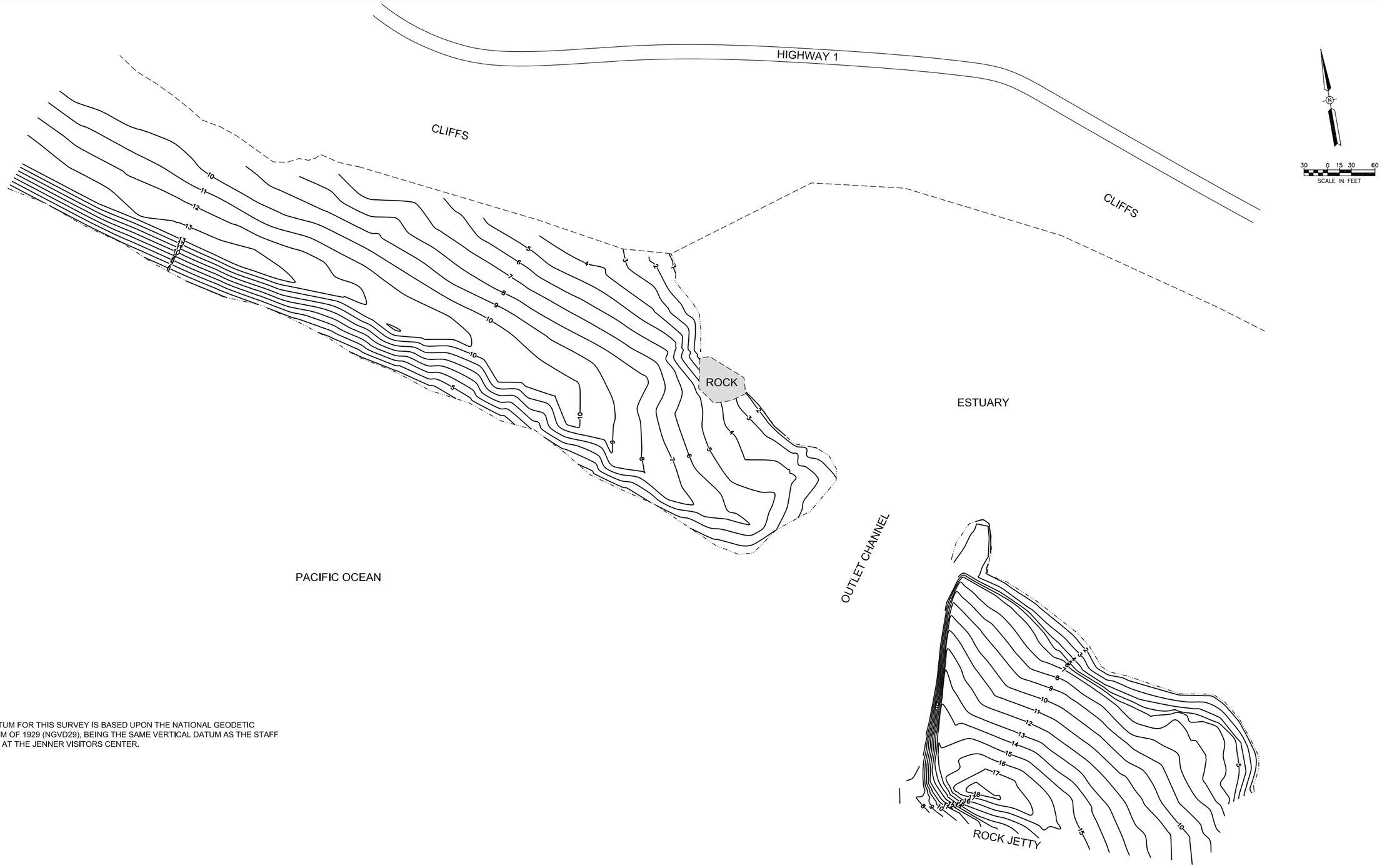

NOTES:

1. VERTICAL DATUM FOR THIS SURVEY IS BASED UPON THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD29), BEING THE SAME VERTICAL DATUM AS THE STAFF GAGE LOCATED AT THE JENNER VISITORS CENTER.

NO.	DATE		BY

SONOMA COUNTY WATER AGENCY

SCALE: AS NOTED
DATE : AS NOTED
DRAWN : EKM
CHECKED : JRM

APPROVED DEPUTY CHIEF ENGR:
SUBMITTED
DESIGNED

RUSSIAN RIVER INSTREAM FLOW RESTORATION (RRIFR) PROGRAM

MONTHLY SURVEY OF BEACH TOPOGRAPHY AND OUTLET CHANNEL: AUGUST 3, 2009

FILE NAME:
CONTRACT NO. XXX
DRAWING NUMBER
SHEET NO. 1 OF 1

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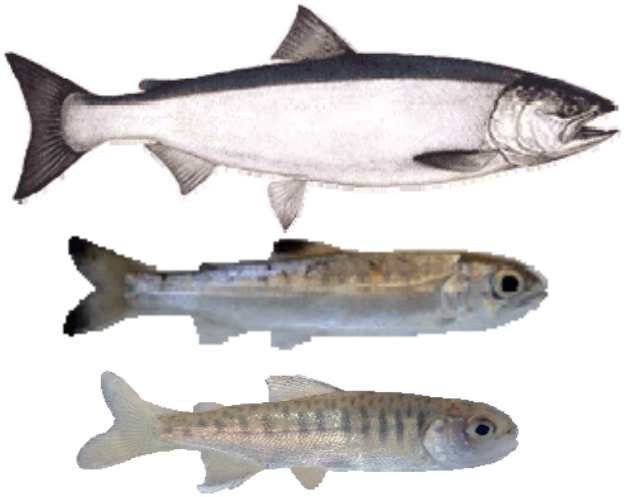
Appendix D-1

Interfluve current conditions report



Final

Current Conditions Inventory Report

Dry Creek: Warm Springs Dam to Russian River

Sonoma County, CA

Prepared for:

Sonoma County Water Agency
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December 2, 2010

EXECUTIVE SUMMARY

Introduction

The Dry Creek Habitat Restoration Feasibility Study is being conducted to explore options for habitat enhancement in Dry Creek, a major tributary to the Russian River in Sonoma County, California. The habitat enhancement work is proposed by Sonoma County Water Agency (SCWA) as one component of the larger Russian River Instream Flow and Restoration (RRIFR) effort that addresses river management in relationship to agency operations. In particular, key goals identified for habitat restoration in Dry Creek include development of rearing and refugia habitat for Central California Coast (CCC) coho salmon (*Onchorhynchus kisutch*) and CCC steelhead trout (*O. mykiss*). Coho salmon and steelhead trout are listed under the Endangered Species Act as *endangered* and *threatened*, respectively. Habitat enhancement in Dry Creek is seen as a significant opportunity for recovery of coho and steelhead in the region due to the relative abundance of cool water in the late summer months which is atypical of streams in the region. Late summer rearing conditions are considered a critical bottleneck for species recovery. Minimum habitat restoration goals for Dry Creek are discussed later in this document and detailed more specifically in the Final Biological Opinion for Water Supply, Flood Control and Channel Maintenance Activities (RRBO: NMFS 2008).

The feasibility study follows a two-phase approach. Phase 1 includes inventory and assessment of current conditions in the study reach between Warm Springs Dam and the confluence with the Russian River (hereafter referred to as 'lower Dry Creek'). Phase 2 will include detailed feasibility assessment and conceptual design of habitat enhancement opportunities identified during the current conditions inventory. This document summarizes Phase 1 of the study.

Watershed Context

The Dry Creek watershed is located in the interior coast range of northern Sonoma and southern Mendocino counties, approximately 30 miles from the Pacific Ocean and 60 miles north of San Francisco Bay. Warm Springs Dam is located on Dry Creek at river mile 13.9, at the confluence of Dry and Warm Springs Creeks. The Dry Creek watershed lies within a region of Mediterranean climate, characterized by warm, dry summers and cool wet winters.

The characteristic pattern of the natural flow regime for Dry Creek prior to operation of the dam (before 1984) was seasonal with the creek running nearly dry each year in the summer and early fall. Flow rates under natural conditions increased three orders of magnitude during the winter. After operation of the dam commenced in 1984, the flow regime changed to a perennial stream with much less variation in flow rates between summer and winter. Summers have consistent base flow while winter peak flows are reduced relative to natural flow conditions.

The present condition of lower Dry Creek expresses the legacy of management in the basin, which extends back to the settlement of the valley starting in the 1850s. Gravel mining began in the Russian River near Healdsburg about 1900, and continued in various locations within the mainstem until the late 1960s, and then shifted to the Russian River terraces below Healdsburg. The Potter Valley project was constructed in the early 1900s, which supplemented flow in the Russian River with water from the Eel River in northern California. Gravel mining also occurred along lower Dry Creek from the 1950s to the 1970s near the Mill Street bridge (approximately 2 miles above the creek mouth). In conjunction with the construction of Healdsburg (1952) and Coyote (1959) Dams on the Russian River which served to reduce downstream supplies of gravel, gravel mining and other activities resulted in a significant lowering of the base level for Dry Creek, which resulted in significant degradation in the main channel of lower Dry Creek, and subsequently in the tributaries (Army Corps of Engineers 1987).

Current Geomorphology of Dry Creek

The current geomorphology of lower Dry Creek is a result of the interaction of local geology, watershed characteristics, hydrology, and vegetative characteristics; the legacy of channel evolution and response to land management changes; and the ongoing influence of flow management. Lower Dry Creek is an incised, perennial, alluvial gravel bed stream that has responded to significant human induced hydrologic and geomorphic change over the past 150 years. At the time of this report, the study reach is primarily composed of pool-riffle and plane-bed morphology (Montgomery and Buffington 1997) with an average channel gradient of 0.18%. The channel corridor is generally narrow relative to the active channel width, and relatively uniform in width over most of the study reach, with periodic wider reaches.

Widespread, systemic incision occurred historically in response to base-level lowering and other factors. Assessments completed in close proximity to the time of dam closure concluded that systemic degradation of lower Dry Creek had generally ceased by the time the dam came online (Harvey and Schumm 1985). The primary determinant of current geomorphic conditions is the influence of the dam, expressed through modified sediment supply, altered hydrology and the growth of riparian vegetation. Dam construction ceased delivery of bed material from the upper 60% of the watershed. The hydrologic regime has been converted from a seasonal runoff-based regime to a regime that combines moderate winter floods, year-round flows, and sustained, relatively high baseflow conditions. The change in hydrology has also resulted in increased growth of riparian trees that influence bank erosion rates.

The reduction in bedload supply is most noticeable in the reach between the dam and the confluence of Dutcher (RM 11.8) and Pena (RM 11) Creeks. The reduction in bed material supply is moderated by successive tributaries entering lower Dry Creek. The most significant of these in terms of bed material supply include Dutcher Creek (RM 11.8), Pena Creek (RM 11), Crane Creek (RM 6.3) and Mill Creek (RM 0.6). The reach between Pena Creek and Westside Bridge (RM 11 to RM 2) did not appear to be actively incising or aggrading, though there are selected areas of active channel adjustment. The

reach between Westside Bridge and the confluence appeared to be the most alluvial reach, in which the channel position and shape are most readily shaped by fluvial forces

Regulation has resulted in elevated summer baseflow conditions that when combined with the Mediterranean climate produces near ideal conditions for growth of riparian trees and shrubs. Regulation has also resulted in severe curtailment of major floods, which limits disturbance and removal of newly recruited and established vegetation. This combination of effects has resulted in extensive vegetative colonization of formerly active bar surfaces. Colonization of the bar surfaces serves to limit lateral migration of the active channel within the channel corridor, and has the effect of sequestering a reservoir of gravel within the system.

Vegetative colonization of bar surfaces has also lead to an active channel that is efficient at moving gravel supplied to the stream despite the reduced flood flow hydrology. Mature vegetation and dense understory growth hydraulically roughen over bank areas and concentrate high flow velocities in the channel during high flow events. However, based on field observations, the combination of reduced bed material supply and reduced flood magnitudes and frequencies do not appear to have resulted in incremental systemic degradation or aggradation. It appears that vertical degradation was essentially complete before dam closure. Degradation is also kept in check by features which control the bed grade spaced periodically over the reach, such as bedrock exposures and grade control structures.

Fish Habitat in Dry Creek

The goals of the current habitat inventory were to census aquatic habitat for coho salmon and steelhead trout in Dry Creek downstream of the Warm Springs Dam, to provide context for the development of fish habitat enhancement alternatives, and to establish a basic pre-treatment baseline against which to measure the effects of future fish habitat enhancement projects. Habitat conditions were documented at the summer steady-state operational discharge of approximately 100 cfs.

Dry Creek historically supported populations of coho and steelhead, although it only provided marginal salmon habitat when compared to other Russian River tributaries closer to the coast (Hopkirk and Northen 1980). Coho and steelhead are present in Dry Creek year-round. Adult coho and steelhead enter Dry Creek to spawn in the late fall and winter. Eggs deposited in gravel nests called redds incubate through the winter and early spring, and fry emerge in springtime. Juvenile coho and steelhead rear in Dry Creek for a minimum of one year before emigrating to the sea the following late winter or spring. Furthermore, it should be noted that Dry Creek currently supports a robust population of Chinook salmon (*O. tshawytscha*). Future habitat enhancement efforts will consider interactions with this important population.

The current inventory found that Dry Creek is composed of 26% riffles, 23% pools, 7% scour pools, 44% flatwaters and less than 1% cascades based on the relative frequency of mainstem habitats. Pool depths generally decreased in the downstream direction, with a

greater proportion of scour pools in the middle to upstream end of the survey area. Overall, there was far more flatwater than riffle habitat (44% of mainstem habitats by frequency versus 26% for riffles). Although Dry Creek is composed of 26% riffles by frequency, riffles represent only 12% of mainstem habitats by length. A total of 44 alcoves and 27 side channels were measured, with a relatively greater number of off-channel habitats in the lower half of the study reach. The percent cover ranged from 27% associated with pools to 14% associated with riffles.

Pebble counts were conducted at riffles in all surveyed reaches. The substrate sizes in these riffles meet coho and steelhead spawning requirements. The predominant substrate in riffles, flatwaters and pools was gravel. In side channel pools, dominant substrate was most often fine sediment, gravel, or sand.

Instream woody debris (small, medium and large) totaled an average of 183 pieces of wood per mile in lower Dry Creek, with variability from reach to reach, including 63 pieces per mile in Reach 14 to 362 pieces per mile in Reach 10. We also classified wood as living or dead. 46% of all the pieces counted were living, with 44% of the *large* pieces living, and 46% of the *small* and *medium* pieces living. Recent publications highlight the geomorphic and ecological importance of living wood in Northern Californian stream systems.

A moderate amount of cover provided by overhanging terrestrial vegetation (within 6” of the water surface) was found by the 2009 habitat inventory. Average cover in pools (27%) was higher than in flatwaters (22%), and cover was greater in flatwaters than in riffles (14%). Off-channel habitats generally had much higher cover than main channel units. Additionally, the present inventory found complexity values to be high, but moderate to low shelter ratings. Overall, edge habitat was present in 41% of all habitat units. Although we did not specifically measure bank erosion, eroding banks were observed in Reach 1 and in Reach 7. There were a large number of bank stabilization efforts observed in the creek, including riprap, cars, creosote-preserved wood fences, steel I-beams, and chain-link fence.

Fish Habitat Enhancement in Dry Creek

The recommended Reasonable and Prudent Alternative contained in the Biological Opinion on Russian River basin reservoir and river management requires enhancement of six miles of lower Dry Creek to provide near ideal summer rearing conditions for coho and steelhead at the proposed steady state operational discharge (approximately 100 cfs), with an emphasis on coho.

The RRBO offers specific criteria with respect to desired rearing habitat characteristics. These include pool abundance (33% to 67%) and frequency (pool: riffle ratio between 1:2 and 2:1), pool depth (2 ft to 4 ft), pool velocity (<0.2 ft/s), structure and cover (ample large woody debris), and pool size (500 ft^2 to 2700 ft^2). The RRBO also stresses the availability of off-channel habitats in low velocity areas with substantial cover. Finally, the enhancement techniques should consider ‘log or rock weirs, deflectors, log jams,

constructed alcoves, side channels, backwaters, and dam pools that have successfully increased the quantity and quality of summer and winter rearing habitat for coho and steelhead' (NMFS 2008).

Based on the current fish habitat inventory which was completed at the approximate steady state discharge, the study reach contains 23% pools, 7% scour pools, 26% riffles, and 44% flatwaters by frequency of main channel habitats. Average maximum and residual pool depths were 5.2 and 3.6 feet respectively. The overall quantity of pool habitat falls below the desired range, and the pools may lack sufficient cover and structure. Furthermore, a preliminary analysis indicates that pool velocities ranged from 0.2 to 1.3 ft/s with an average of 0.6 ft/s, generally higher than the 0.2 ft/s target pool velocity listed in the RRBO. By frequency, riffles comprise 26% of main channel habitats, however only comprise 12% of main channel habitats by length. A limited amount of alcove habitat was identified. Based on these results and additional discussion with stakeholders, a suite of proposed enhancements will be developed in successive phases of the project. The proposed enhancements are likely to include combinations of mainstem pool and riffle enhancement, off-channel backwater and alcove enhancement and creation, side-channel enhancement and creation, and enhancement and stabilization of streambanks.

System- and project-scale feasibility will be assessed in the next phase of the study. However, areas of interest for potential enhancement were noted during the geomorphic and habitat inventory fieldwork in August-September 2009. Areas for potential enhancement of pools, riffles and streambanks are numerous along the study reach. Therefore, more effort was focused on identifying locations to enhance and create off-channel alcove and backwater, and side-channel habitat. These types of habitats have been proven to be particularly productive for rearing of coho salmon. While opportunities for these habitat types exist in lower Dry Creek, potential challenges are posed by Dry Creek's narrow, incised reaches, with limited lateral areas within close elevation range of the active channel. Additional constraints on enhancement vary over the length of the study reach, and include local factors such as sediment supply, elevation relative to active channel, local grade control features, and the backwater influence of the Russian River.

Phase 2 of the study will assess the feasibility of habitat enhancement in the areas of interest. Based on the results of the feasibility assessment, a list of project opportunities for which feasibility has been established will be developed. Conceptual designs will be developed for the sites deemed feasible.

ACKNOWLEDGEMENTS

The following contributed significantly to the current conditions inventory and are acknowledged for their respective efforts:

Sonoma County Water Agency Staff
Dry Creek Advisory Group Members
Dry Creek Property Owners
California Department of Fish and Game Staff
National Marine Fisheries Service Staff
U.S. Army Corps of Engineers Staff

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1 INTRODUCTION

The Dry Creek Habitat Restoration Feasibility Study is being conducted to explore options for habitat enhancement in Dry Creek, a major tributary to the Russian River in Sonoma County, California (Figure 1). The habitat enhancement work is proposed by Sonoma County Water Agency (SCWA) as one component of the larger Russian River Instream Flow and Restoration (RRIFR) effort that addresses river management in relationship to agency operations. In particular, key goals identified for habitat restoration in Dry Creek include development of rearing and refugia habitat for Central California Coast (CCC) coho salmon (*Onchorhynchus kisutch*) and CCC steelhead trout (*O. mykiss*). Coho salmon and steelhead trout are listed under the Endangered Species Act as *endangered* and *threatened*, respectively. Habitat enhancement in Dry Creek is seen as a significant opportunity for recovery of coho and steelhead in the region due to the relative abundance of cool water in the late summer months which is atypical of streams in the region. Late summer rearing conditions are considered a critical bottleneck for species recovery. Minimum habitat restoration goals for Dry Creek are discussed later in this document and detailed more specifically in the Final Biological Opinion for Water Supply, Flood Control and Channel Maintenance Activities for the Russian River Watershed (NMFS 2008).

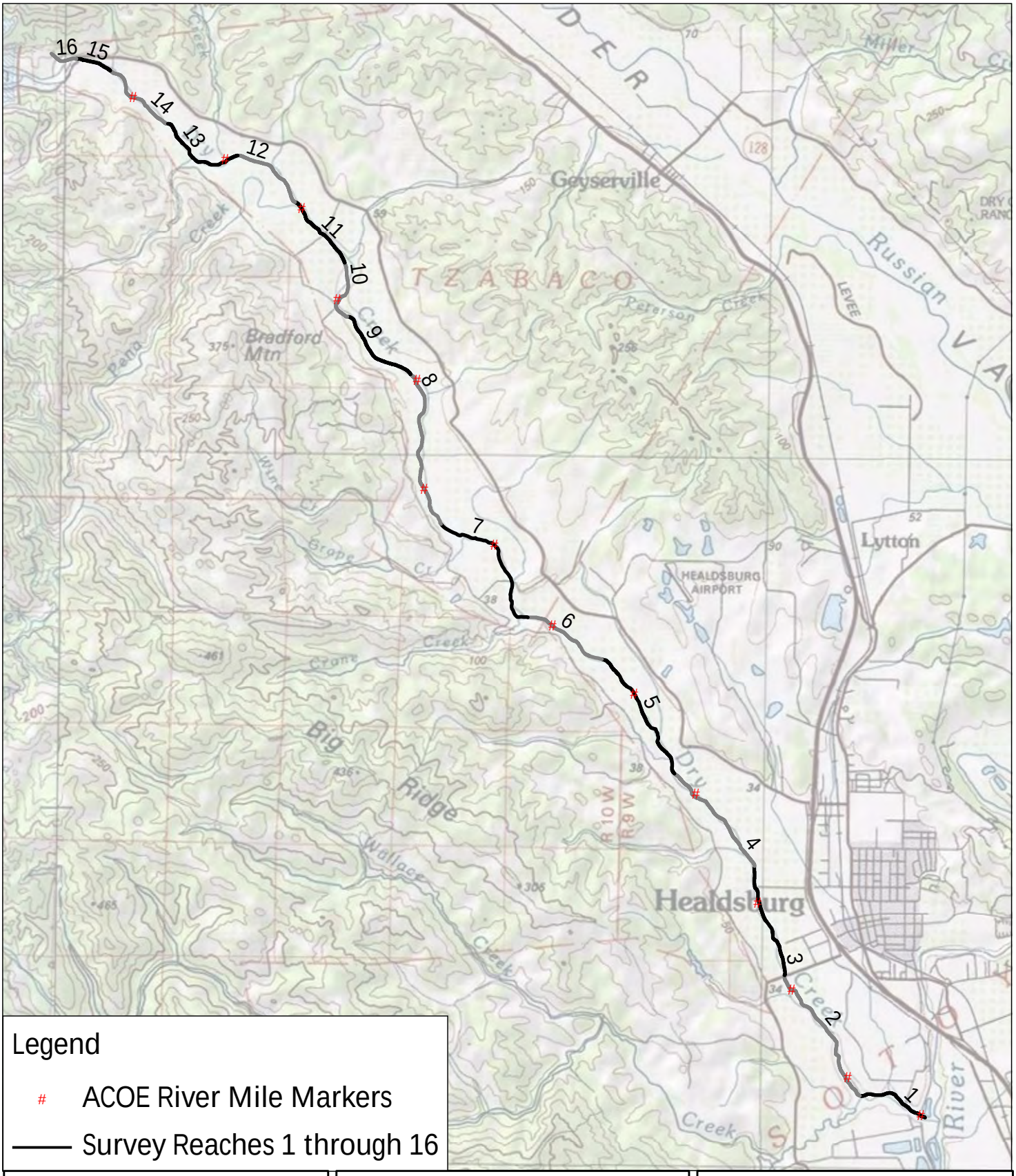
2 SCOPE OF WORK

The feasibility study follows a two-phase approach. Phase 1 includes inventory and assessment of current conditions along Dry Creek between Warm Springs Dam and the confluence with the Russian River (hereafter referred to as 'lower Dry Creek'). Phase 2 will include detailed feasibility assessment and conceptual design of habitat enhancement opportunities identified during the current conditions inventory.

The present document reports the results of the current conditions inventory. The effort included the following primary tasks:

1. Review of existing data regarding Dry Creek hydrology, geomorphology and habitat conditions.
2. Analysis of Dry Creek basin hydrology.
3. Reconnaissance and analysis of geomorphic conditions in lower Dry Creek.
4. Inventory and analysis of fish habitat present in lower Dry Creek.
5. Identification of potential enhancement sites along lower Dry Creek for further review in the detailed feasibility stage.

The following sections report the results of Phase 1.



0 3,000 6,000 Feet

0 0.5 1 Miles

DRY CREEK
Current Conditions Inventory
Figure 1: Study Reach

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3 DRY CREEK WATERSHED CONTEXT

The following paragraphs provide regional and watershed context for the inventory and analysis reported in the subsequent report sections.

3.1 Regional Setting

The Dry Creek watershed is located in the interior coast range of northern Sonoma and southern Mendocino counties, approximately 30 miles from the Pacific Ocean and 60 miles north of San Francisco Bay. Dry Creek is a fourth-order tributary that drains 217 square miles of rugged terrain in the southwestern portion of the Russian River Basin in a generally northwest to southeast direction, with a watershed which is approximately 32 miles long and 7 miles wide (Simons and Li 1980). Elevations range from 70 feet near the mouth to nearly 3000 feet near the headwaters, with half of the watershed above 1,100 feet in elevation. In terms of annual runoff contribution and drainage area, Dry Creek is the first and the second largest tributary of the Russian River, respectively (Army Corps of Engineers 1984). Downstream of the Dry Creek confluence at Healdsburg (river mile 30.6), the Russian River flows westerly to the Pacific Ocean at Jenner, California.

Warm Springs Dam (WSD; Photograph 1) is located on Dry Creek at river mile 13.9, at the confluence of Dry and Warm Springs Creeks. The 130 square mile watershed located above the dam is characterized by steep, mountainous terrain with basin slopes ranging from 30% to 80% and channel gradient ranging from 8 to 200 feet per mile (0.2 to 3.8%; Army Corps of Engineers 1987a). Downstream of the dam, lower Dry Creek is a gravel bed river that flows through a flat agricultural valley 0.5 to 1 mile wide with approximate average gradient of 0.2%. Principal tributaries entering Dry Creek below WSD include Pena Creek (drainage area 22.3 sq. mi.) and Mill Creek (drainage area 22 sq. mi.). Agricultural production in the lower Dry Creek valley was based on orchard fruit through the 1970s. Grapes are the primary agricultural crop today.

Photograph 1: Warm Springs Dam.

3.2 Geology

3.2.1 Lithology

Review of available geologic mapping and literature sources indicate that the Dry Creek drainage occupies a structurally controlled valley that generally lies on the boundary between sedimentary units of the Great Valley Complex (Healdsburg terrane) to the east and various fault bounded lenses of the Coast Range ophiolite and metamorphic rock units of the Franciscan Complex to the west (Blake, Graymer, and Stamski, 2002). However, sandstone, siltstone, and shale units belonging to the Great Valley Complex are also mapped along the western margin of the valley adjacent to river reaches 6 and 7 and the lower portion of reach 8, in what appears to be a large, west-southwest plunging, synclinal fold. The contact between the sedimentary rock of the Great Valley Complex and the volcanic and intrusive rocks of the Coast Range ophiolite is obscured beneath Quaternary alluvium of the lower Dry Creek floodplain (Figure 2).

Quaternary sedimentary rock units, including siltstone, sandstone, and conglomerates of the Pliocene-Pleistocene Glen Ellen Formation, as well as Pleistocene alluvial and marine terrace deposits, have been mapped along the eastern margin of the Dry Creek valley. The youngest sediments found within the valley are stream channel and floodplain deposits associated with Dry Creek and include up to three terrace deposits, the oldest of which appears to be approximately 1,000 years old (Harvey and Schumm, 1985).

Table 1 summarizes the potential rock types that may underlie the bed of lower Dry Creek based on proximity to various geologic units mapped along the western flank of the valley.

Table 1: Potential rock types that may underlie Dry Creek.

River Reach	Adjacent Bedrock Type	Geologic Unit Affiliation
2	metagraywacke sandstone	Franciscan Complex
3, 4	graywacke sandstone, greenstone, and chert	Franciscan Complex
5	graywacke sandstone, greenstone	Franciscan Complex
5	basalt, diabase, gabbro, diorite, and serpentinite	Coast Range ophiolite
5, 6, 7, 8	sandstone, siltstone, and shale	Great Valley Complex
8	basalt	Coast Range ophiolite
9, 13	diabase, gabbro, and diorite	Coast Range ophiolite
14	diabase, gabbro, diorite, and serpentinite	Coast Range ophiolite
14, 15	graywacke sandstone	Great Valley Complex

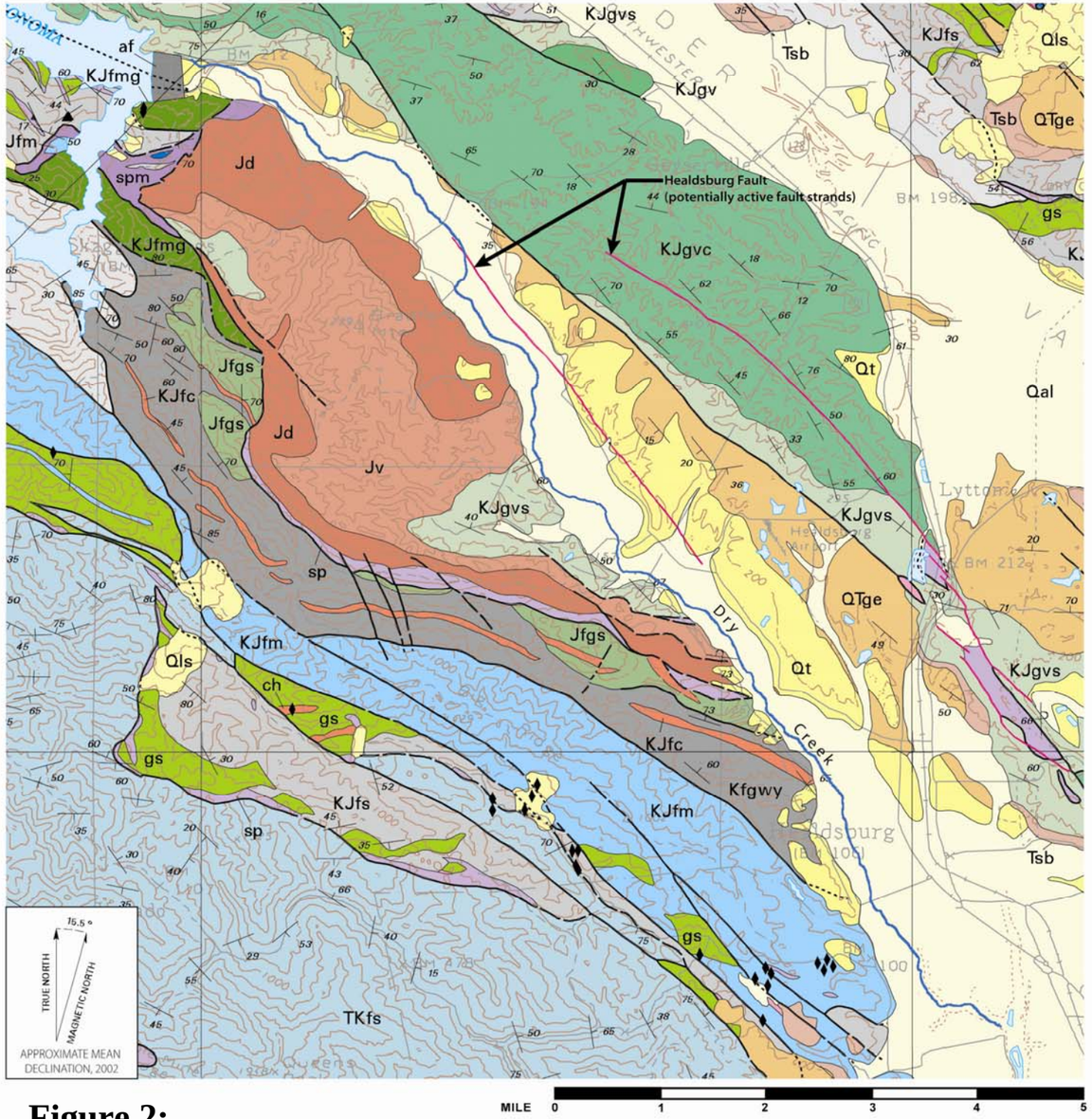


Figure 2:
Geologic Map of the Lower Dry Creek Valley and Surrounding Areas, Sonoma County, California

Exerpted and Modified from:
Geologic Map and Map Database of Western Sonoma, Nothernmost Marin, and Southernmost Mendocino Counties, California
by
M.C. Blake, Jr., R.W. Graymer, and R.E. Stamski
2002

LIST OF MAP UNITS

SURFICIAL DEPOSITS

- Qal — Alluvial fan and fluvial deposits (Quaternary)
- Qt — Alluvial and marine terrace deposits (Pleistocene)
- QTge — Glen Ellen Formation (Pleistocene(?) and Pliocene)
- Qls — Landslide deposits (Quaternary)

BEDROCK UNITS

Sonoma Volcanics (Pliocene and Miocene)

- Tsb — Basalt

Franciscan Complex

- TKfs — Sandstone (late Eocene to Late Cretaceous, Turonian)
- Kfgwy — Sandstone (Late and Early Cretaceous, Cenomanian and (or) late Albian)
- KJfc — Chert (Cretaceous and Jurassic)
- KJfs — Graywacke and mélange (Cretaceous and Jurassic)
- fsr — Mélange
  - gs — Greenstone block
  - ch — Chert block
  - gwy — Graywacke block
  - m — High-grade metamorphic rock block
  - sp — Serpentinite block
- Jfgs — Greenstone (Jurassic)
- KJfm — Metagraywacke (Cretaceous and Jurassic)
- KJfmg — Metabasalt (Cretaceous and Jurassic)

Great Valley complex

- KJgv — Sandstone, shale, and conglomerate (Early Cretaceous and Late Jurassic)
- KJgvs — Sandstone, siltstone, and shale
- KJgvc — Conglomerate

Coast Range Ophiolite (Late and Middle Jurassic)

- Jv — Mafic and intermediate volcanic rocks
- Jd — Mafic and intermediate intrusive rocks
- sp — Serpentinite
- spm — Serpentinite matrix mélange

MAP SYMBOLS

- **Contact**-- Depositional or intrusive contact or large mélange block edge; dashed where approximately located; dotted where concealed
- **Fault**-- Dashed where approximately located; small dashes where inferred; dotted where concealed; queried where location is uncertain; magenta denotes Quaternary active fault
- 35 — Strike and dip of bedding
- High-grade block, mappped locally
- Low-grade block, mapped locally

Harvey and Schumm (1985) note that outcrops of bedrock are almost entirely found where the present channel of Dry Creek is located near the western flank of the valley. The only exception to this occurs near Warm Springs Dam, where Dry Creek abuts the northeastern flank of the valley along exposed outcrops of Great Valley Complex sandstones. However, the contact between the sedimentary rock of the Great Valley Complex and the volcanic and intrusive rocks of the Coast Range ophiolite is thought to be a depositional contact, but obscured beneath Quaternary alluvium of the lower Dry Creek floodplain (Blake, Graymer, and Stamski, 2002). Thus, the bedrock foundation underlying almost any location along lower Dry Creek could potentially be sedimentary rock associated with the Great Valley Complex.

A key component of the geomorphic analysis completed by Harvey and Schumm included an assessment of bedrock exposed at Grape Creek. At this location, they noted the presence of two depositional units (a cemented sand and gravel unit and a very tight, consolidated unit of laminated silts and clays) which lay directly on an erosional unconformity above exposed sedimentary bedrock. Their descriptions of these depositional units are very similar to hydrogeologic descriptions of the Glen Ellen Formation within the Santa Rosa Valley groundwater basin (California Department of Water Resources, 2003). Harvey and Schumm noted that these depositional units are approximately 8 to 10 feet thick and rest on top of a 4- to 5-foot-thick bed of boulders and cobbles which appear to have been derived from the erosion of the underlying bedrock.

Based on their observations at Grape Creek, Harvey and Schumm identified similar cemented depositional units at several other points along the 1985 channel profile of lower Dry Creek (reaches 5 through 8; Figure 1), and inferred that bedrock was approximately 8 to 10 feet below the channel bed. However, Harvey and Schumm noted that the resistant bedrock and/or the cemented sediments were exclusively located on the western side of the valley and considered any estimation of the suballuvial location of bedrock to be highly speculative eastward of these bedrock and resistant alluvial controls.

3.2.2 Structure

Regional geologic mapping, digital imagery available for Google Earth™ through the United States Geological Survey (USGS) Quaternary fault and fold database (http://earthquakes.usgs.gov/regional/qfaults), and the regional fault evaluation report (Bryant, 1982) show several strands of the Healdsburg fault within and immediately adjacent to the Dry Creek drainage. Seismically, the Healdsburg fault comprises a 1 to 2 kilometer wide system of northwest trending, right-lateral strike-slip fault strands. These strands appear to be a northwest extension of the Rodgers Creek fault and define part of a complex seismic stepover with the Maacama fault to the north (McLaughlin and Sarna-Wojcicki, 2003). Both the Rodgers Creek and Maacama fault systems are zoned as active[1] under the State of California Alquist-Priolo (AP) Earthquake Fault Zoning Act (CDMG, 1997).

Although not currently zoned as active under the AP Act, workers mapping in the surrounding region considered some traces of the Healdsburg fault to be "recently active"

[1] Active faults are defined as those exhibiting either surface ruptures, topographic features created by faulting, surface displacements of Holocene (younger than about 11,000 years old) deposits, tectonic creep along fault lines, and/or close proximity to linear concentrations or trends of earthquake epicenters.

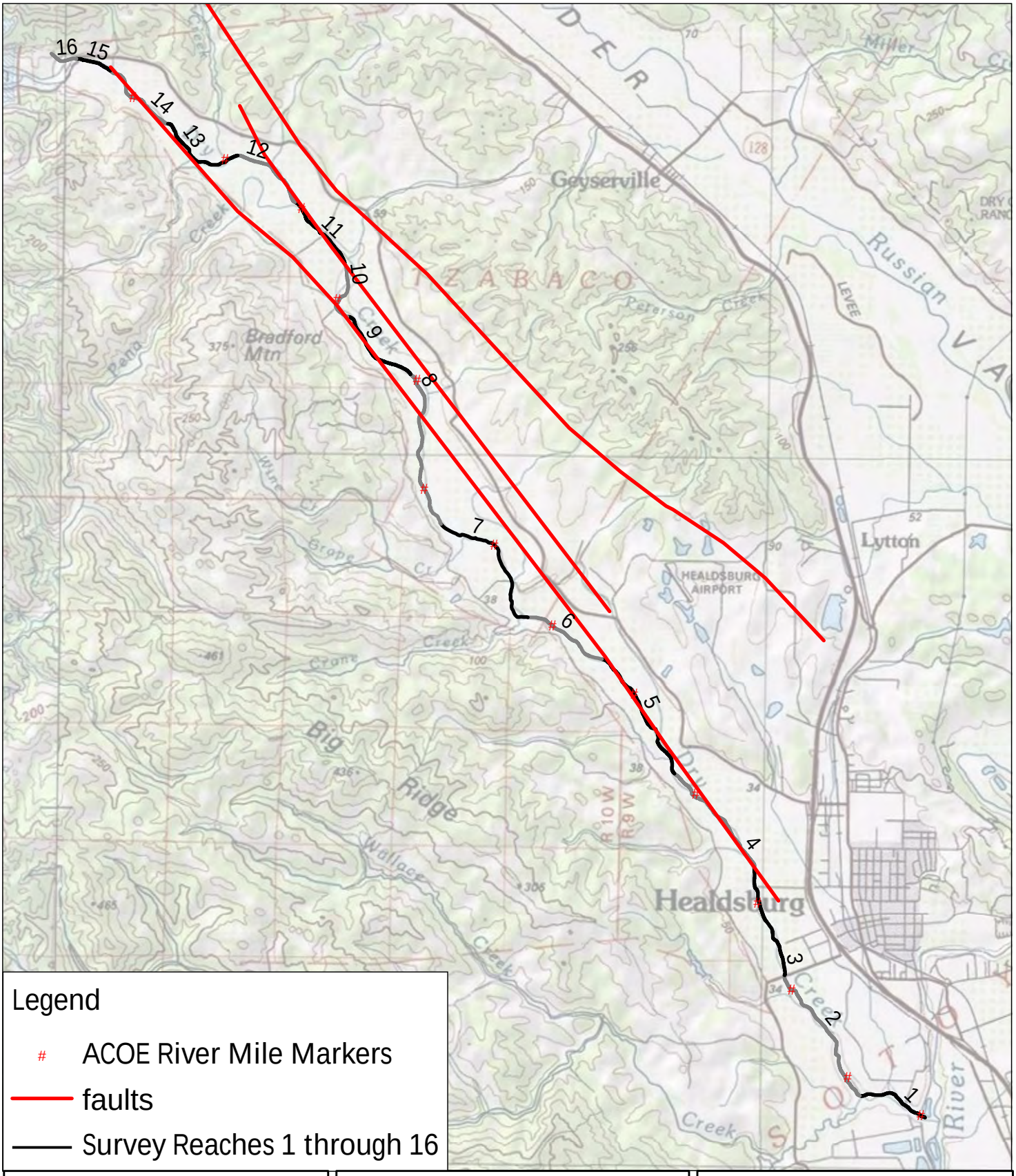
(Huffman and Armstrong, 1980) or "Quaternary active" (Blake, Graymer, and Stamski, 2002). Based on available paleoseismic studies for the region and the structural relationship of the Healdsburg fault with the active Rodgers Creek and Maacama fault systems, these mapped fault strands should be considered potentially active[2].

3.2.3 Air Photo Analysis

Stereo-paired aerial photographs of the northern portion of lower Dry Creek, from river reach 7 to reach 16, and surrounding areas, were analyzed for the presence of prominent topographic lineaments and geologic structural trends that might adversely impact possible habitat enhancement improvements. The aerial photographs reviewed are 1:12,000 scale, black and white stereo-paired prints taken by Pacific Aerial Surveys in April 2000. A list of photographs reviewed is included in the references. In addition, digital satellite imagery available from Google Earth™ was reviewed to assess the current alignment of lower Dry Creek with respect to mapped Quaternary fault traces available from the USGS Quaternary fault and fold database.

Stereoscopic analysis of the aerial photos and digital imagery suggests that one or more reaches of Dry Creek may be structurally controlled along traces of the Healdsburg fault or other lineaments that we infer may be associated with the fault. Across the site, several sections of lower Dry Creek exhibit unusually low sinuosity for a stream in a dominantly alluvial drainage. These low sinuosity reaches are either coincident with and/or parallel to mapped strands of the Healdsburg fault (Figure 3). In particular, portions of reaches 10 through 12 are located on or along the projected trace of a mapped fault strand. Along the southwestern margin of the drainage, low sinuosity portions of reaches 3-5, 8-9, and 13-15 are all generally aligned along a linear trend that parallels mapped strands of the Healdsburg fault.

[2] Potentially active faults displace geologic deposits of Pleistocene age (about 2 million to 11,000 years old).



0 3,100 6,200 Feet

0 0.5 1 Miles

DRY CREEK
Current Conditions Inventory
Figure 3: Fault Lineaments

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3.3 Climate

The Dry Creek watershed lies within a region of Mediterranean climate, characterized by warm, dry summers and cool wet winters. Average monthly temperatures range from 47 deg. F in December to 70.5 deg. F in July (Figure 4). Mean annual precipitation ranges from 41.3 inches (Healdsburg) to 45.4 inches (Warm Springs Dam) in the vicinity of the study area, to greater than 60 inches in the coastal mountains that form the western boundary of the watershed (Table 2). Over 90% of the precipitation falls between the months of October and April, with approximately 70% occurring between November and February (Table 1; Western Regional Climate Center 2009). Snowfall is uncommon except in the highest elevations of the Coast Range.

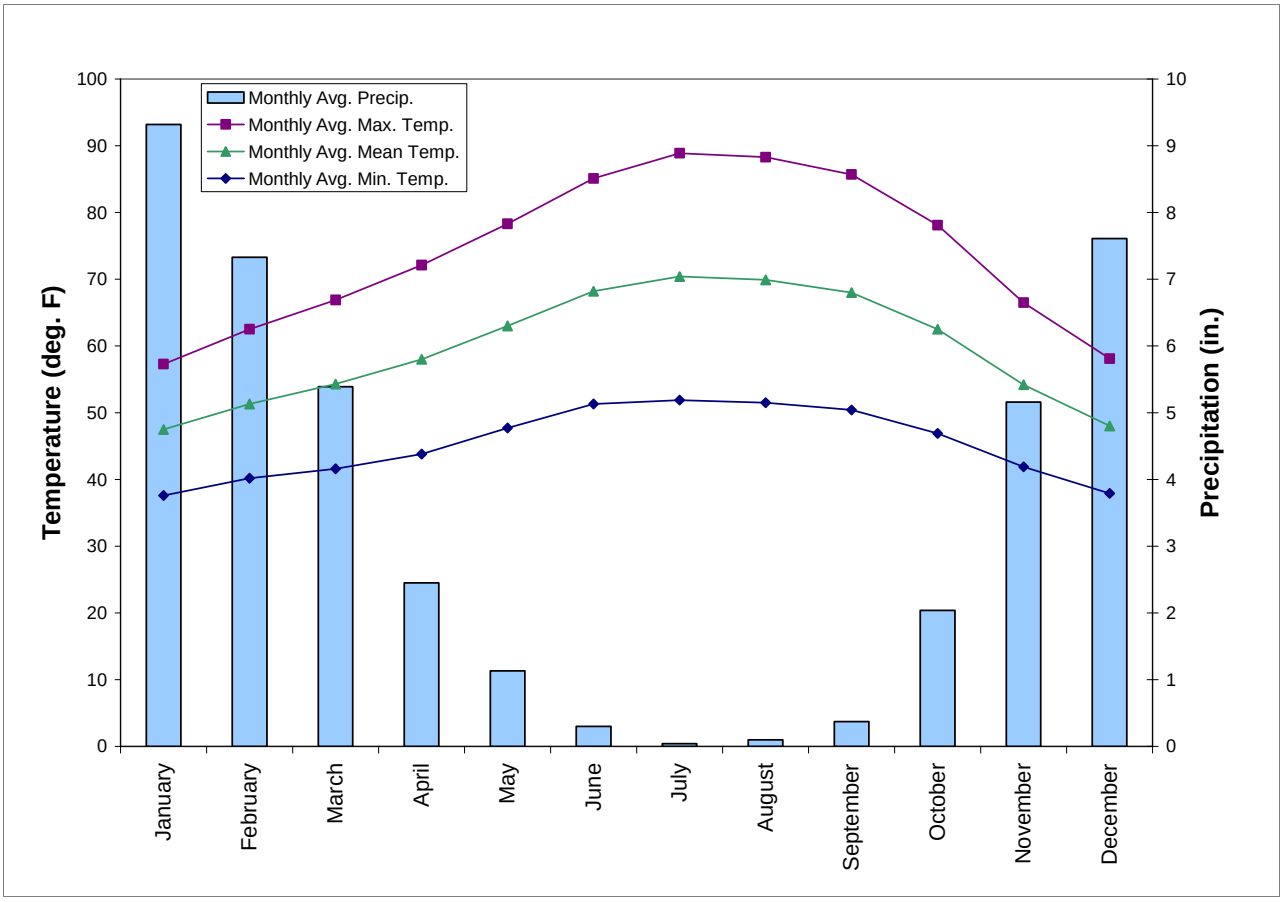


Figure 4: Mean monthly temperature and precipitation at Healdsburg (Station 043875) for the period 1893-2009.

Significant runoff events historically occurred in conjunction with Pacific frontal storms, normally the result of the southerly migration of the Aleutian low pressure system. Rainfall of significant proportions is produced by the combined effect of orographic and frontal convergence lifting mechanisms. Dominant winds associated with major storms are normally from the southwest (Army Corps of Engineers 1984).

Table 2: Average, minimum and maximum mean temperature and precipitation at Healdsburg (Station 043875) for the period 1893-2009.

	Average Temperature			Average Precipitation				
	Max.	Min.	Mean	Mean	High	Year	Low	Year
	F	F	F	in.	in.		in.	
Annual	74	45.2	59.6	41.3	96.3	1983	13.7	1976
Winter	59.3	38.6	48.9	24.3	49.4	1969	5.3	1976
Spring	72.4	44.4	58.4	9.0	27.5	1983	0.8	2008
Summer	87.4	51.6	69.5	0.4	3.7	1954	0.0	1893
Fall	76.8	46.4	61.6	7.6	26.7	1973	0.0	1929
January	57.3	37.6	47.5	9.3	33.7	1909	0.4	1976
February	62.5	40.2	51.3	7.3	25.4	1998	0.1	1953
March	66.9	41.6	54.3	5.4	21.1	1907	0.1	1988
April	72.1	43.8	58	2.5	12.9	1948	0.0	1907
May	78.3	47.7	63	1.1	9.5	2005	0.0	1903
June	85.1	51.3	68.2	0.3	2.2	1967	0.0	1893
July	88.9	51.9	70.4	0.0	1.7	1974	0.0	1893
August	88.3	51.5	69.9	0.1	3.2	1954	0.0	1893
September	85.7	50.4	68	0.4	4.5	1959	0.0	1902
October	78.1	46.9	62.5	2.0	10.8	1962	0.0	1905
November	66.5	41.9	54.2	5.2	21.2	1973	0.0	1929
December	58.1	37.9	48	7.6	25.2	2002	0.0	1989

3.4 Dry Creek Watershed Management

The present condition of lower Dry Creek expresses the legacy of management in the basin, which extends back to the settlement of the valley starting in the 1850s. Between 1850 and 1870, approximately 40 percent (approximately 50 sq. mi.) of the forested watershed area was cleared and converted to grazing land. This land use change had the effect of modifying runoff characteristics and sediment production, which led to an initial period of aggradation and subsequent degradation of lower Dry Creek between 1850 and 1900 (Army Corps of Engineers, 1987). At the time of European settlement, lower Dry Creek regularly spilled over its banks onto the historic floodplain, which is the area utilized for agricultural production today. In conjunction with conversion of the former floodplain for agricultural production in the lower reaches of Dry Creek, additional clearing, drainage and manipulation of tributary streams occurred.

Gravel mining began in the Russian River near Healdsburg about 1900, and continued in various locations within the mainstem until the late 1960s, and then shifted to the Russian River terraces below Healdsburg. Gravel mining also occurred along lower Dry Creek from the 1950s to the 1970s near the Mill Street bridge (approximately 2 miles above the creek mouth). The Potter Valley project was constructed in the early 1900s, which supplemented flows in the Russian River with water from the Eel River in northern California. In conjunction with the construction of Healdsburg (1952) and Coyote (1959) Dams on the

Russian River, gravel mining and other activities resulted in a significant lowering of the base level for Dry Creek, which resulting in significant degradation in the main channel of Dry Creek, and subsequently in the tributaries (Army Corps of Engineers 1987). In response to the degradation, significant numbers of bed and bank stabilization measures were installed by landowners and public entities along Dry Creek and its tributaries. This included installation of three grade control structures between river miles 3 and 4 by the Army Corps of Engineers in the early 1980s (Harvey and Schumm 1985). Historic evolution of Dry Creek is discussed further in subsequent sections in this document.

First investigated in the early 1940s, construction of Warm Springs Dam on Dry Creek at approximate river mile 13.9 was authorized under the Flood Control Act of 1962. The construction phase of the project commenced in 1967, with construction of the dam itself commencing in 1970. The dam embankment and outlet works were completed in 1982, and achieved full pool in 1983. With multiple objectives including flood control, water storage and recreation, Warm Springs Dam is a 319 ft tall, 3000 ft long earthen dam with a storage capacity at gross pool of 381,000 acre-feet. This equates to approximately 230% of the mean annual runoff of Dry Creek over the period 1916-1980 (Army Corps of Engineers 1984). Construction of the dam stopped the supply of bed material from the upper watershed and operations reduce the magnitude of all floods with at least a 2-yr return interval by more than 70% (Simons and Li 1980). Although peak flows are reduced, base flows have increased to provide continuous flow throughout the year along this traditionally seasonal stream (ACOE, 1987).

3.5 Lower Dry Creek Reach Delineation

The length of Dry Creek that is the subject of this study extends from WSD to the confluence of Dry Creek with the Russian River, a total stream length of approximately 13.9 miles (lower Dry Creek). Lower Dry Creek was delineated into reaches using existing data to facilitate organization of study field efforts and analyses. The initial delineation was subsequently verified in the field to result in a final delineation of 16 reaches. Reach 16, the trapezoidal channel in the tailwater below the spillway of WSD and upstream of Bord Bridge, was not investigated in the field. The remainder of this document will refer to reaches 1 through 15 where field efforts were focused.

3.5.1 Methods

The reach delineation generally followed the protocol for stream segment identification developed by the State of Washington's Timber, Fish and Wildlife Program (Pleus and Shuett-Hames 1998). In this protocol, the primary factors leading to delineation include geomorphic parameters (relative drainage area, channel gradient and channel confinement) and non-fluvial features (e.g. structures such as bridges). This effort resulted in a preliminary delineation which was field verified during the habitat and geomorphic inventory fieldwork (discussed in subsequent sections of this document), with adjustments made as appropriate.

Relative drainage area was assessed in terms of major tributary junctions, identified based on the Strahler method of stream order determination. A 1:100,000 hydrography GIS layer obtained from the Russian River Interactive Information System (RRIIS) was used as the basis for stream order determination for Dry Creek and the tributaries. At Warm Springs

Dam, Dry Creek was determined to be a 4th order stream. Per the protocol, 2nd or higher order tributaries were then considered as significant tributaries in the reach delineation.

Channel gradient was assessed by sampling 10-m USGS digital elevation (DEM) data along the digitized alignment of Dry Creek at 200 foot intervals (the only terrain data available at the time of delineation). Per the protocol, the channel gradient results were then binned into six categories: 1) <1%, 2) 1-2%, 3) 2-4%, 4) 4-8%, 5) 8-20%, and 6) >20%. The significant majority of gradient values (88%) fell into the <1% bin, with average gradient value of 0.22 %.

Channel confinement was assessed based on the 2004 aerial photography (the most recent high resolution aerial photography available at the time of delineation) and contours (0.25 m contour interval) generated from the 10-m DEM data using GIS. Channel confinement was determined by the ratio of the active channel width of the stream to the width of the attendant floodprone surface. Confinement was determined at 200 foot intervals and binned into three categories: 1) less confined (floodprone width ≥ 4 channel widths), 2) moderately confined (floodprone width ≥2 and <4 channel widths, and 3) confined (floodprone width <2 channel widths). Confinement values most typically fell into the moderately confined category, followed by a balance of confined and unconfined sections. Because Dry Creek is an incised stream, the floodprone surface was contained within the incised channel corridor.

Non-fluvial features were determined from aerial photographs, a GIS road layer, and a GIS surface diversion layer. No diversions were found that were greater than 5 cfs, thus these were eliminated from consideration in the reach delineation. Four road alignments cross lower Dry Creek. The geomorphic and non-fluvial factors were then combined sequentially to delineate the 16 reaches using lumping and splitting rules per the protocol. Delineated reaches were then reviewed in the field to result in the reach delineation reported below.

3.5.2 Results

The delineation includes 16 reaches, for an average length of approximately 0.9 miles. The delineated reaches are reported in Table 3 and are shown on Figure 1.

Table 3: Reach delineation results for lower Dry Creek.

Reach	DS end (RM)	DS end (landmark)	US end (RM)	US end (landmark)	Length (ft)
1	0.0	Dry Creek Mouth	0.7	Mill Creek	3550
2	0.7	Mill Creek	2.0	Westside Road	7000
3	2.0	Westside Road	3.0	Fault lineament 1150' DS Sill 1	5450
4	3.0	Fault lineament 1150' DS Sill 1	4.1	1600' US Sill 3, US end check dam impoundment	5880
5	4.1	1600' US Sill 3, US end check dam impoundment	5.4	Fault lineament, 150' DS Kelley Ck	6640
6	5.4	Fault lineament, 150' DS Kelley Ck	6.2	Bedrock outcrop, 475' DS Crane Ck	4150
7	6.2	Bedrock outcrop, 475' DS Crane Ck	7.5	Bedrock outcrop, 950' US Grape Ck	6940
8	7.5	Bedrock outcrop, 950' US Grape Ck	9.0	Change in relative confinement	7700
9	9.0	Change in relative confinement	9.8	Change in relative confinement, and fault lineament	4220
10	9.8	Change in relative confinement, and fault lineament	10.3	Tributary location	3040
11	10.3	Tributary location	11.0	Pena Ck	3755
12	11.0	Pena Ck	11.7	Gradient shift, 700' DS Dutcher Ck	3700
13	11.7	Gradient shift, 700' DS Dutcher Ck	12.6	Steep riffle	4345
14	12.6	Steep riffle	13.3	Schoolhouse Creek confluence	3930
15	13.3	Schoolhouse Creek confluence	13.7	Bord Bridge	1680
16	13.7	Bord Bridge	13.9	Dam Outlet	1340

4 DRY CREEK HYDROLOGY

Hydrologic analyses were conducted to understand the past and current hydrologic conditions of lower Dry Creek. Current hydrologic conditions in the project reach are regulated by the dam which became operational in 1984. Prior to dam construction and operation, Dry Creek had a natural flow regime typical of Mediterranean streams characterized by rapidly developing peak floods of relatively short duration occurring in conjunction with significant winter precipitation events, and very low summer period base flow. During significant flood events, flow may have increased of 2-3 orders of magnitude over a short timeframe. The hydrologic analyses were also conducted to provide guidance on appropriate design flows for development of habitat restoration concepts for lower Dry Creek. The following sections provide a summary of the available stream gage data and the methods and results of the hydrologic analyses.

4.1 Summary of available data

A number of sub-watersheds and their associated tributaries contribute flow to lower Dry Creek. Table 4 provides drainage areas and river mile locations of WSD, U.S. Geological Survey (USGS) gaging stations, bridges, and inflow of sub-watersheds (and their associated tributaries) along lower Dry Creek from the outlet of WSD to the confluence of the Russian River.

Each gaging station provides daily mean discharge data and annual peak discharge data for their respective periods of record (Table 5). Two of the five gages were primarily used for the current hydrologic analyses discussed in this section. The two gages are: (1) below Warm Springs Dam (USGS No. 11465000) and (2) Yoakim Bridge (USGS No. 11465200). The gage below Warm Springs Dam was chosen because it reflects flow out of the dam without influences from other downstream tributaries. The gage at Yoakim Bridge was chosen because of its long-term data record providing over 20 years of data, both prior to and following construction of the dam. This gage includes flow from the Dutcher Creek and Pena Creek sub-watersheds and reflects their contributions as shown in Figure 5.

The discontinued gages above the dam were not used for the hydrologic analyses because of their location. The gage at the mouth of Dry Creek was not chosen for the hydrologic analyses because it is within the zone of backwater influence of the Russian River during the winter months, and reports discharge values during low flow periods only.

Table 4: Drainage areas and river miles along lower Dry Creek from Warm Springs Dam to the confluence with the Russian River.

USGS Stations, Bridges, Sub-Watersheds (and Associated Tributaries)	Tributary Drainage Area (square miles)[1]	Sub-Watershed Drainage Area (sq. miles)[1]	Dry Creek Drainage Area (sq. miles)[1]	River Mile
Outlet of Warm Springs Dam – USGS Gage No. 11465000	-	-	130.0	13.9
Dutcher Creek Sub-Watershed		8.8	138.8	
Schoolhouse Creek	0.6			
Fall Creek	2.0			
Dutcher Creek	3.0			
Local Drainage	3.2			
Pena Creek Sub-Watershed		22.9	161.7	11.0
Vince's Creek	0.9			
Pena Creek	22.0			
Yoakim Bridge – USGS Gage No. 11465200			162.0	10.7
Lambert Bridge Sub-Watershed		13.7	175.7	6.6
Canyon Road Creek	2.1			
Grape Creek	3.3			
Local Drainage	8.3			
Pine Ridge Canyon Creek Sub-Watershed		10.3	186.0	
Crane Creek	2.4			
Kelly Creek	1.6			
Pine Ridge Canyon	1.2			
Local Drainage	5.1			
Westside Bridge				2.0
Confluence Sub-Watershed		31.0	217.0	0.0
Mill Creek	22.0			
Local Drainage	9.0			

[1] *Source:* Dry Creek Sediment Engineering Investigation, Sediment Transport Studies. U.S. Army Corp of Engineers, Sacramento District. May 1987.

Table 5: Summary of USGS gaging station locations and available observed discharge values.

Station Description	USGS No.	Location	Available Observed Discharge Values
Upstream of reservoir near Yorkville, CA	11464400	38°47’21’’ 123°09’16’’ NAD27	10/01/73 – 09/30/83
In reservoir near Cloverdale, CA	11464500	38°44’59’’ 123°05’28’’ NAD27	10/01/41 – 09/30/80
Below Warm Springs Dam near Geyserville, CA	11465000	38°43’11’’ 122°59’58’’ NAD27	10/1/39 – 09/30/42; and 10/01/81 – present
Yoakim Bridge below Pena Creek near Geyserville, CA	11465200	38°41’55’’ 122°57’25’’ NAD27	10/01/59 – present
Mouth of Dry Creek at the confluence with the Russian River near Healdsburg, CA	11465350	38°35’15’’ 122°51’40’’ NAD27	10/01/81 - present

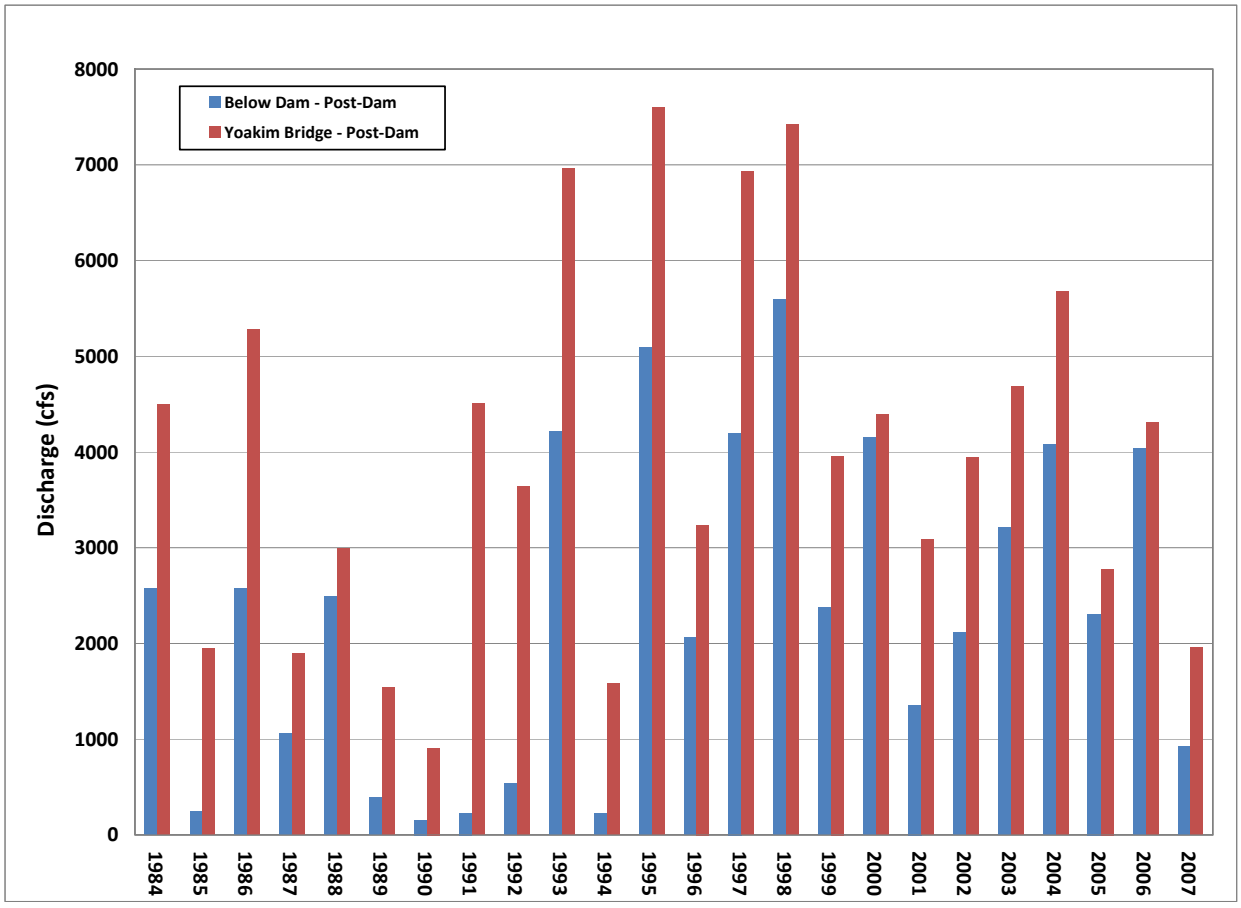


Figure 5: Comparison of post-dam peak discharge values below the dam and at Yoakim Bridge (WYs 1984-2007).

4.2 Methods

4.2.1 Flood Frequency Analysis

Peak flow hydrologic statistics (i.e., flood flows) were reviewed for the project reach. These statistics were developed using peak flow data at the gaging stations below Warm Springs Dam (USGS No. 11465000) and at Yoakim Bridge (USGS No. 11465200). The peak flow data were obtained from the USGS National Water Information System website.

The peak flow data were first estimated using the log-Pearson Type III distribution with a weighted regional skew coefficient which provided statistics for the 1.01, 2, 3, 10, 25, 50, 100, and 200-year return-interval hydrologic events. The statistics were used to plot flood frequency curves for pre- and post-dam hydrology. The post-dam flood frequency estimates produced a poor fit with the observed data due to the regulation of flows by the dam and were not used further in the analysis.

Observed peak discharge data for the gages below the dam and at Yoakim Bridge were compared with post-dam flood frequency return period estimates provided in the effective Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS; FEMA 2006) and in the Warm Springs Dam and Lake Sonoma Water Control Manual (Army Corps of Engineers 1984).

The FEMA FIS provides peak discharges for the 10, 50, 100, and 500-year return period floods at two locations that were generally compared with observed data at the two USGS gaging stations. The locations for the estimates in the FEMA document are: (1) upstream of the confluence with Dutcher Creek (Warm Springs Dam outflow), and (2) upstream of the confluence with Pena Creek. Data from the gage below the dam was compared with the FEMA estimates upstream of the confluence with Dutcher Creek. The USGS gaging station at Yoakim Bridge is downstream of Pena Creek; therefore, peak discharge data cannot be directly compared with the FEMA estimates for the location upstream of the confluence with Pena Creek. The two were generally compared, noting that the gage data includes the flow from Pena Creek while the FEMA estimates do not.

The Water Control Manual provides peak discharge estimates for the 2, 5, 10, 25, 50, 100, 200 and 500-year return interval hydrologic events for pre-dam conditions at Yoakim Bridge and post-dam conditions below Warm Springs Dam. These peak discharge estimates were combined with the FEMA estimates and compared with the two USGS gaging stations.

4.2.2 Flow Duration Analysis

Flow duration statistics for Dry Creek were developed using daily average flow data from the USGS gaging station below the Warm Springs Dam (USGS No. 11465000) and at Yoakim Bridge (USGS No. 11465200). The daily average flow data were obtained from the USGS National Water Information System website. Flow duration curves were developed by ranking daily average flows for the respective periods. Flow duration curves were developed for Yoakim Bridge pre-dam (1960-1983) and post-dam (1984-2008). In addition, a post-dam flow duration curve was developed for the gage below the dam (1984-2007).

4.2.3 Analysis of Flow Regulation

In order to assess the degree of hydrologic alteration caused by the dam, the long-term time series for the Yoakim Bridge gage station was evaluated using the Indicators of Hydrologic Alterations (IHA) methodology (Richter et al. 1996, Richter et al. 1997, Richter et al. 1998) and software (Nature Conservancy, 2009). In their 2003 analysis, Olden and Poff found that the suite of indices resulting from the IHA method adequately characterize the principal components of flow regimes (Olden and Poff, 2003). When pre-dam and post-dam periods are analyzed, the subsequent hydrologic alteration due to the dam's operations can be evaluated (Richter et al. 1996, Richter et al. 1997).

4.3 Results

The characteristic pattern of the natural flow regime for Dry Creek prior to operation of the dam (before 1984) was seasonal with the creek running nearly dry each year in the summer and early fall (Figure 6). Flow rates under natural conditions increased three orders of magnitude during the winter. After operation of the dam commenced in 1984, the flow regime changed to a perennial stream with much less variation in flow rates between summer and winter. Summers have consistent base flow while winter peak flows are reduced relative to natural flow conditions. The following sections describe the results of the flood frequency, flow duration, and IHA analyses. Each of these analyses provides insight into the hydrologic conditions of lower Dry Creek pre- and post-dam.

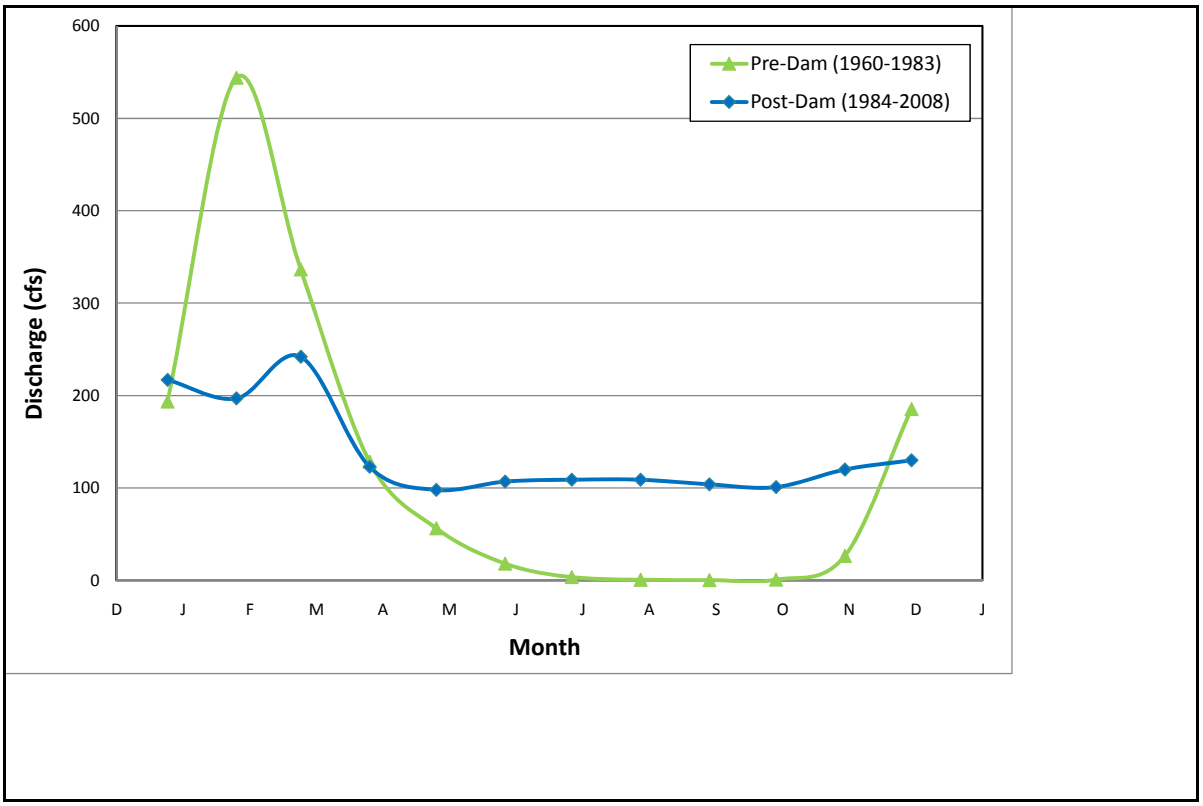


Figure 6: Comparison of monthly median discharges for pre- and post-dam periods at Yoakim Bridge (USGS No. 11465200).

4.3.1 Flood frequency

Pre- and post-dam peak discharge estimates obtained from the FEMA document and the ACOE Water Control Manual document are provided in Table 6.

Table 6: Peak discharge estimates at gages considered in this study.

	Below Dam (USGS No. 11465000)		**Upstream of the Confluence of Pena Creek**	**Yoakim Bridge (USGS No. 11465200)**
	Post-Dam		**Post-Dam**	**Pre-Dam**
Flow Event	**FEMA**	**ACOE**	**FEMA[1]**	**ACOE**
2-year	-	4000	-	23000
5-year	-	4500	-	25000
10-year	6000	6000	6200	30000
25-year	-	6000	-	35000
50-year	6000	6000	6500	38000
100-year	6000	6000	6900	40000
200-year	-	6000	-	45000
500-year	7400	7400	8800	48000

[1] Post-dam peak flow estimates from the FEMA document are from upstream of the confluence with Pena Creek. The Yoakim Bridge gage station is downstream of the confluence of Pena Creek.

Peak discharge estimates below the dam were consistent between the FEMA and ACOE documents. The post-dam peak discharge estimates upstream of the confluence with Pena Creek are higher than estimates below the dam due to flow contributions from the Dutcher Creek sub-watershed. The pre-dam peak discharge estimates at Yoakim Bridge are an order of magnitude higher than post-dam estimates.

Figure 7 shows a comparison of observed peak discharge data (1984-2008) and peak discharge estimates for the post-dam period. The peak discharge estimates below the dam (orange triangles) can be directly compared with gage data below the dam (red squares). The peak discharge estimates upstream of Pena Creek (pink squares) can be generally compared with gage data at Yoakim Bridge (blue diamonds) although the flood frequency estimates do not account for flow from Pena Creek which is measured at Yoakim Bridge. For comparison, the peak discharge estimates at Yoakim Bridge (magenta) for the pre-dam period are also shown.

The observed post-dam peak discharges below the dam have not exceeded the estimated peak discharges for period of operation. Peak discharges at Yoakim Bridge approached the estimated peak discharge values upstream of Pena Creek in 1993, 1995, 1997, and 1998, although the estimated values were not exceeded during the period of operation. This is a conservative comparison since corresponding peak discharge estimates at Yoakim Bridge

would be greater than the estimates shown due to the incremental contribution of flow from Pena Creek.

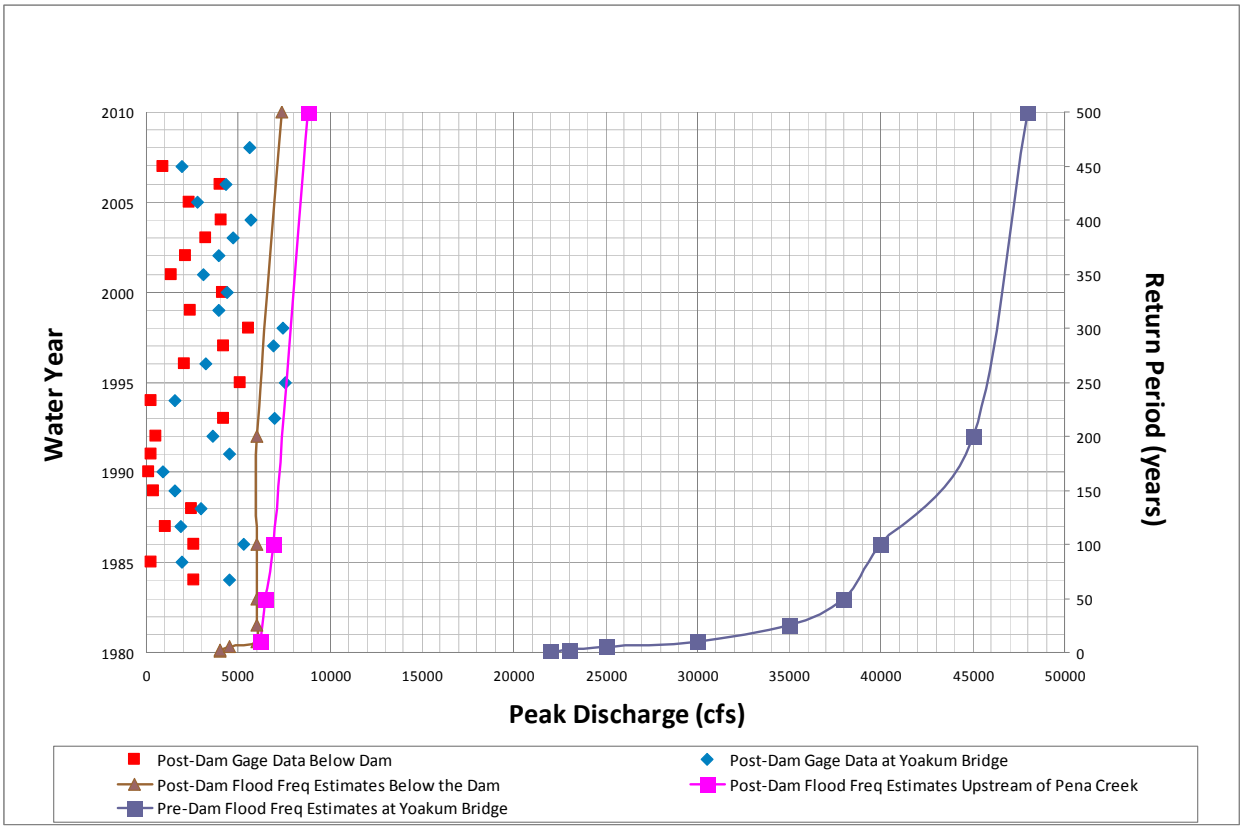


Figure 7: Comparison of pre- and post-dam peak discharge rating curves and measured (actual) peak discharge data for the post-dam period at the gaging stations located below the dam and at Yoakim Bridge. The observed data (points) are plotted against water year (left axis), while the peak discharge estimates (lines) are plotted against return period (right axis).

Figure 8 shows the frequency of occurrence for annual peak flows of varying magnitude over the pre- and post-dam periods. At the dam and the Yoakim Bridge gages for the post-dam periods, the median annual peak floods were 2345 cfs and 3960 cfs, respectively. This compares with a median annual peak flood of 16600 cfs for the pre-dam period at Yoakim Bridge.

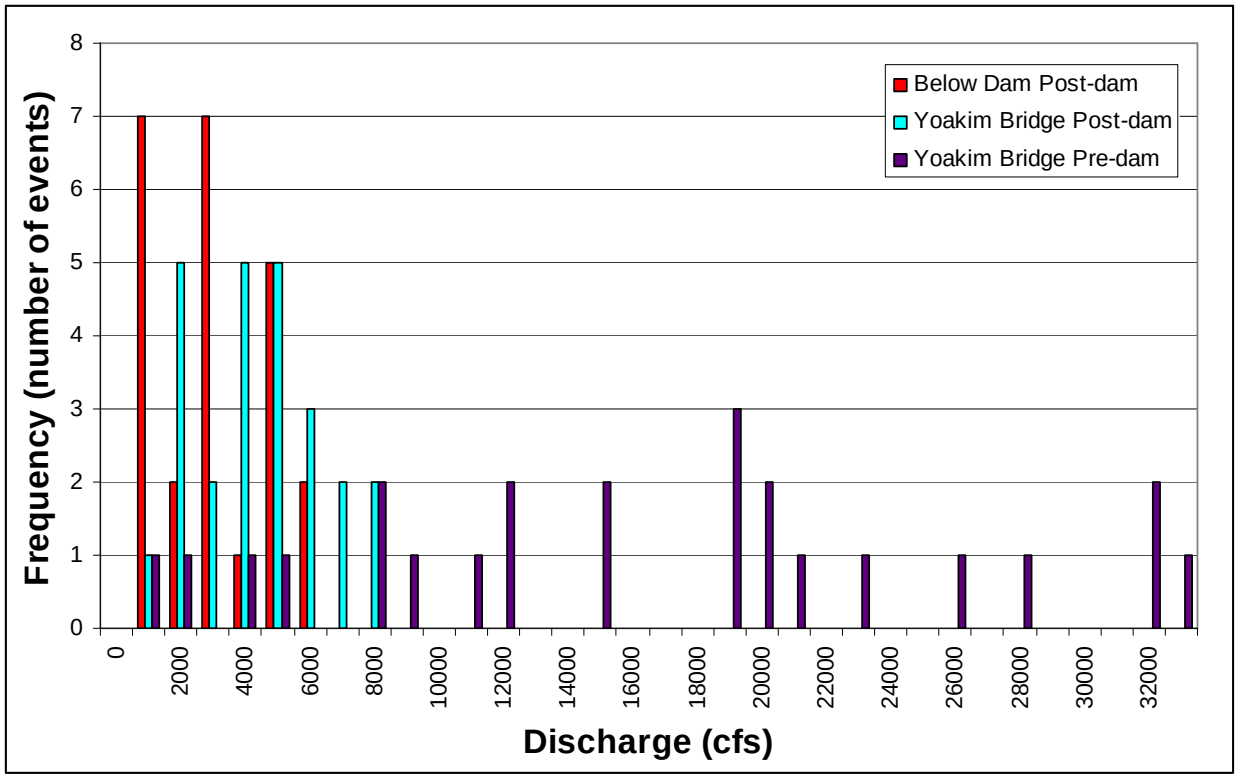


Figure 8: Histogram showing relative frequency of annual peak flows of varying discharge for the pre-dam and post-dam period.

4.3.2 Flow duration

Three flow duration curves were developed using daily flow records from the USGS gaging stations below the dam and at Yoakim Bridge: (1) post-dam, below the dam (1984-2007), (2) post-dam, at Yoakim Bridge (1984-2008), and (3) pre-dam, at Yoakim Bridge (1960-1983). Table 7 provides relevant flow-duration statistics and Figure 9 presents flow-duration curves based on this analysis.

The magnitude and frequency of extreme high and low flows have shifted with regulation by Warm Springs Dam. Table 7 shows that there were significantly more low flow days prior to construction of the dam. Flow exceeded 9.9 cfs only 62.44% of the time during the pre-dam period, while post-dam flow (for both gages) typically exceeds 9.9 cfs 100% of the time. Pre-dam flows included 20 days in the 10000 – 19999 cfs range at Yoakim Bridge, compared to zero days in the post-dam period.

Post-dam flow duration curves for the two gages are similar with a majority of the flows in the 100 cfs range (80% of flows between 70 and 200 cfs below the dam) and no dry periods (Figure 9). The 50% excedence (median) flows at the dam outlet and at Yoakim Bridge for the post-dam period are 105 cfs and 110 cfs, respectively. In contrast, the pre-dam flow duration curve at Yoakim Bridge shows a greater range of flows over the period of record. Prior to regulation, Dry Creek had zero flow in the channel 9% of the time, and more significant and frequent high flows during the period of record from 1960 to 1984, with 50% excedence flow for the Yoakim Bridge gage of 29 cfs.

Table 7: Flow duration statistics using daily discharge data for the two USGS gaging stations evaluated in this report.

Discharge Range (cfs)	Below Dam		Yoakim Bridge			
	Post-Dam		Post-Dam		Pre-Dam	
	Number of Days	% of Time Discharge Range is Exceeded	Number of Days	% of Time Discharge Range is Exceeded	Number of Days	% of Time Discharge Range is Exceeded
0 – 9.9	1	100	0	100	3327	62
10 – 99	3419	61	2690	71	2444	35
100 – 999	4979	4	5877	6	2296	9
1000 – 9999	367	0	565	0	771	0.2
10000 – 19999	0	0	0	0	20	0
Total Days in Record	8766		9132		8858	

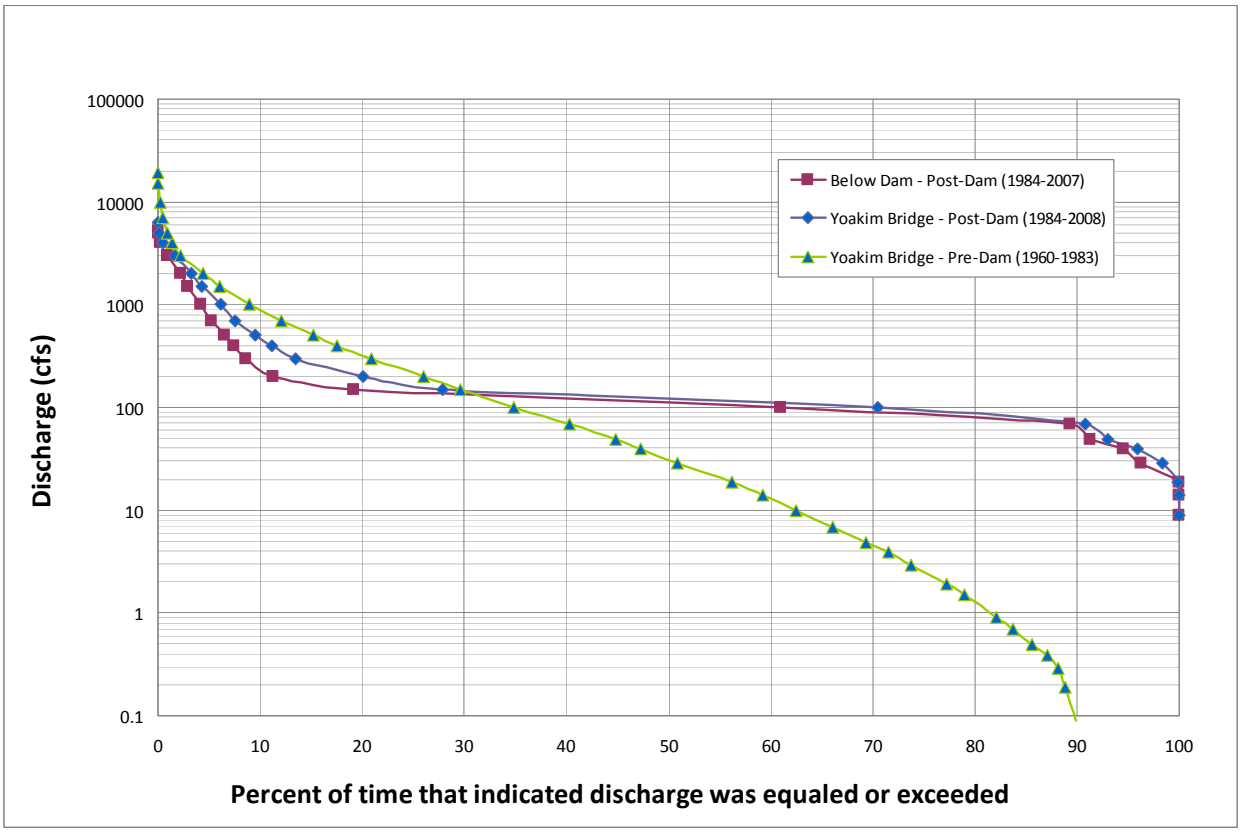


Figure 9: Flow duration curves for Dry Creek at the USGS gage station below the dam (post-dam) and at Yoakim Bridge (pre- and post-dam).

4.3.3 Regulation by Warm Springs Dam

Indicators of Hydrologic Alterations (IHA) analyses were conducted on the pre- and post-dam data at Yoakim Bridge to determine the effects of regulation on hydrology in lower Dry Creek. Selected results of the analysis are provided in Figure 6, Figure 10, and Figure 11.

Figure 6 located at the beginning of Section 4.3 shows a comparison of pre- and post-dam monthly median discharge values at Yoakim Bridge. This demonstrates the significant reduction of high flows during winter, increased minimum flows during summer and early fall, and increased constancy of flows over the year. These results suggest that the physical and ecological processes most dependant on high and low flow magnitude and duration are likely most influenced by Warm Springs Dam operation.

Figure 10 provides comparisons of mean, high-flow and low-flow conditions between pre- and post-dam periods. In particular, it shows the 1-day maximum daily mean discharge values are an order of magnitude greater for the pre-dam period. This demonstrates the significant reduction of high flows that results from regulation. When compared to the pre-dam results, the relatively small difference between the post-dam 1-day and 7-day maximum mean daily discharge results demonstrates the manner in which the dam attenuates peak flows by releasing relatively lower discharges over a more sustained period. Mean annual flow decreases slightly in the post-dam period.

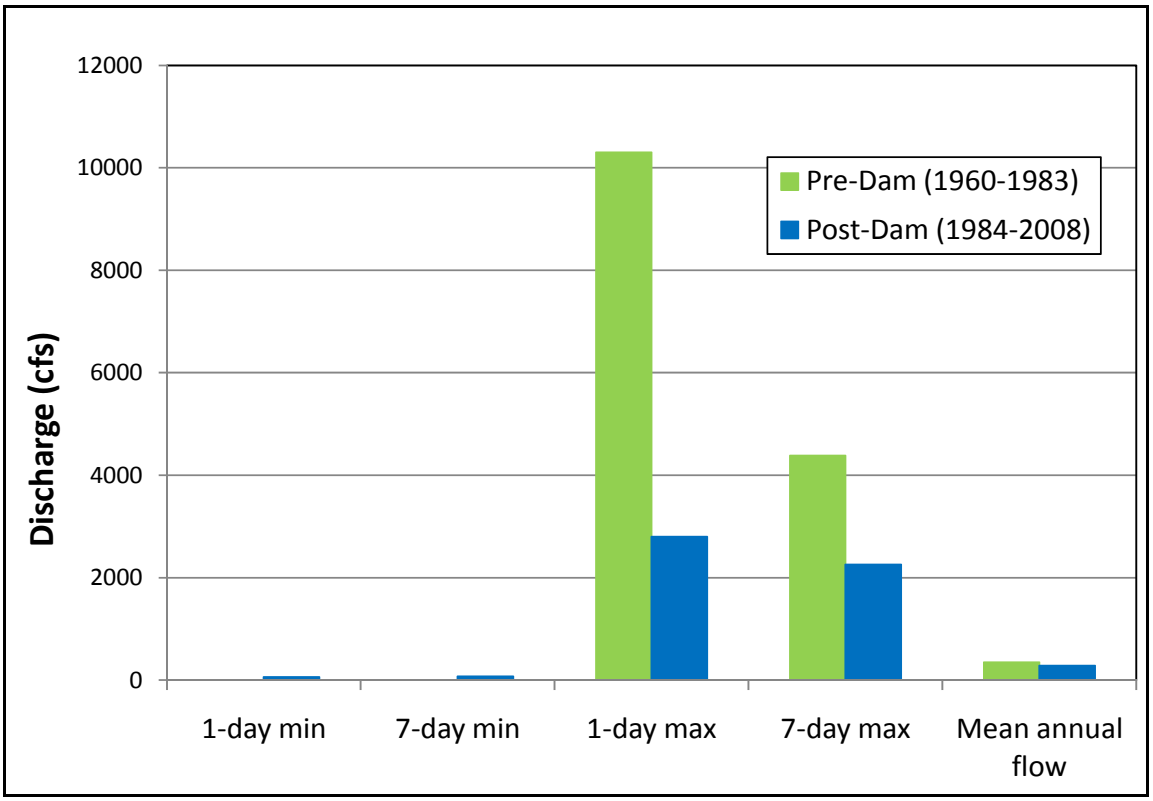


Figure 10: Magnitude and duration of annual extreme water conditions and mean annual flow for Dry Creek at Yoakim Bridge pre- and post-dam.

The alteration of low flow characteristics is examined in Figure 11 which shows an average of one low flow pulse (i.e., flow less than the 25th percentile) lasting a median of 68.5 days during pre-dam conditions, compared to an absence of low flow pulses during the regulated period. This demonstrates the extent to which low flows are supported by dam operation. In addition, the relatively greater rise and fall rates, and equivalent numbers of high flow pulses (i.e., flow greater than the 75th percentile) suggest a more dynamic hydrograph prior to regulation, and an absence of significant ramping during the regulated period, consistent with the facility objectives of flood control and minimal power production.

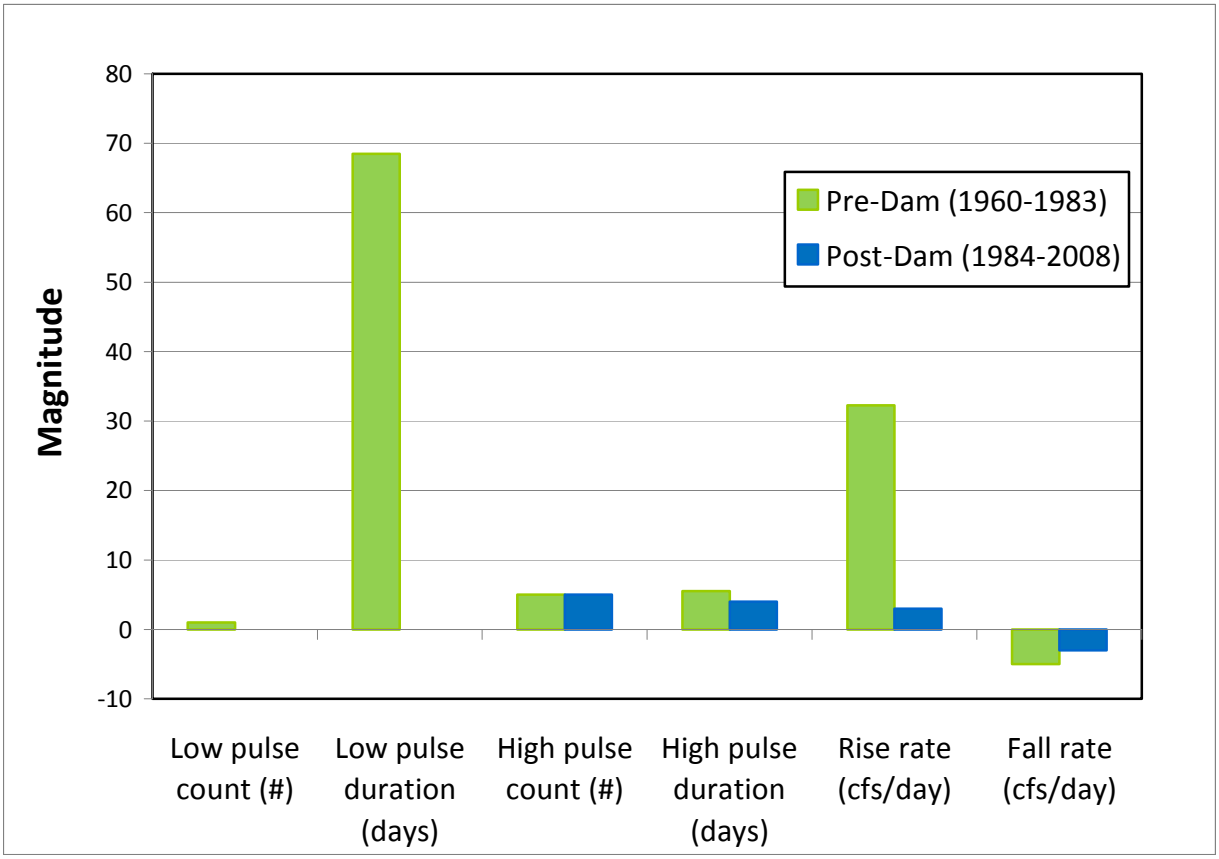


Figure 11: High and Low Flow Pulses and rates of change in discharge for Pre- and Post-Dam Dry Creek at Yoakim Bridge.

5 GEOMORPHOLOGY OF DRY CREEK

5.1 Summary of Prior Studies and Data

The geomorphology of lower Dry Creek has been the subject of several studies, with most of these occurring in conjunction with the planning and construction of Warm Springs Dam. Cleveland and Kelley (1977) conducted an early study on observed bank stability problems along lower Dry Creek. Geomorphic changes in response to land use, gravel mining, and dam operations were assessed initially by Simons and Li (1980), and later and more comprehensively by Harvey and Schumm (1984, 1985, 1987) in a series of field studies in the early to mid-1980s. As a complement to the geomorphic analyses, the Army Corps of Engineers (ACOE) conducted sediment transport modeling studies to determine the effects of the dam on bed material transport and channel evolution (Thomas et al. 1984, ACOE 1987a). Separately, McBride and Strahan (1984a, b) investigated the interaction of geomorphology, vegetative recruitment and flood hydrology with the establishment of pioneering riparian vegetation. ACOE planned and constructed a series of channel improvements (1981, 1988) in response to observed and perceived channel stability problems along lower Dry Creek. Most recently, Gordon and Meentemeyer (2006) utilized the historical aerial photographic record to assess the effects of dam operation and land use changes on channel morphology and riparian vegetation.

Harvey and Schumm (1985, 1987) mapped eleven distinct alluvial surface profiles below the dam based on aerial photo interpretation and repeat cross section surveys by the Corps of Engineers. These profiles included two relic terraces, six thalweg profiles ranging in date from 1964 to 1984, a bar surface profile active in 1984, and a bedrock profile (Figure 12). Least squares regression of these profiles resulted in consistent estimated profile gradients ranging from 0.188 to 0.197 percent, demonstrating a progression of essentially parallel channel profiles through time as the channel responding to base level lowering (Table 8). Based on these profiles, they developed an evolutionary history of lower Dry Creek spanning the period 1850 – 1984 (Figure 12 and Figure 13).

Table 8: Slopes of terrace and channel profiles and mean channel width, depth and width-depth ratio at bankfull stage. Units for slope and mean width/depth are m/m. Units for mean width and mean depth are m. Parentheses indicate standard deviation. Reprinted from Harvey and Schumm (1987).

Profile	Slope	Mean Width (std. dev.) (m)	Mean Depth (std. dev.) (m)	Mean Width/Depth Ratio (std. dev.) (m)	No. of Observations
Terrace II	0.00191	---	---	---	22
Terrace I	0.00188	---	---	---	9
1940 thalweg	0.00180	9.8 (2.7)	3.6 (0.5)	2.8 (1.0)	18
1964 thalweg	0.00188	80.5 (21.9)	4.0 (0.8)	21.6 (8.0)	23
1974 thalweg	0.00194	91.4 (30.5)	4.8 (1.3)	21.1 (9.2)	23
1976 thalweg	0.00196	94.8 (33.2)	5.1 (1.4)	19.8 (8.5)	23
1980 thalweg	0.00194	97.2 (35.1)	5.5 (1.2)	18.5 (7.7)	23
1981 thalweg	0.00195	97.8 (36.0)	5.5 (1.3)	18.6 (8.5)	23
1984 thalweg	0.00194	101.8 (36.0)	5.8 (1.3)	19.0 (10.2)	23

Terrace II was interpreted to represent the floodplain surface at the time of European settlement around 1850. Upon moving to the valley, settlers cleared a significant portion (approximately 40% by 1870) of the forested area of the watershed for grazing and agricultural production. This caused increased runoff and sediment production and resulted in approximately 3 feet of deposition of sands and gravels on top of the pre-settlement floodplain (Terrace II). By 1900, sediment delivery had decreased and the channel had incised and evolved to a new state of equilibrium with mean bed level approximately 12 feet below Terrace II (Figure 13). At this stage of evolution, the active floodplain was the surface that had been the pre-settlement channel bed and would later become Terrace I. Small amounts of gravel mining and record annual runoff prior to 1940 resulted in additional degradation Gravel mining on the Russian River and in the lower reaches of Dry Creek escalated in the 1950s and 1960s, reducing the base level at the downstream end of Dry Creek by approximately 10 ft. This base level change caused extensive channel instability, incision and degradation, to the extent that Dry Creek was found to be the highest sediment yielding tributary to the Russian River at that time (Ritter and Brown 1971). A series of large storms and unusually high runoff coincided with severe fires in the watershed during this period, precipitating rapid response to base level change (Simons and Li 1980). Consistent with trends seen in other degrading streams, repeat surveys of the channel showed an alternating pattern of vertical incision and lateral erosion as the creek attempted to re-establish channel gradient and length that was in equilibrium with the changed downstream base level and input of flow and sediment (Figure 13; Table 8; Harvey and Schumm 1985, 1987; Swanson 2009).

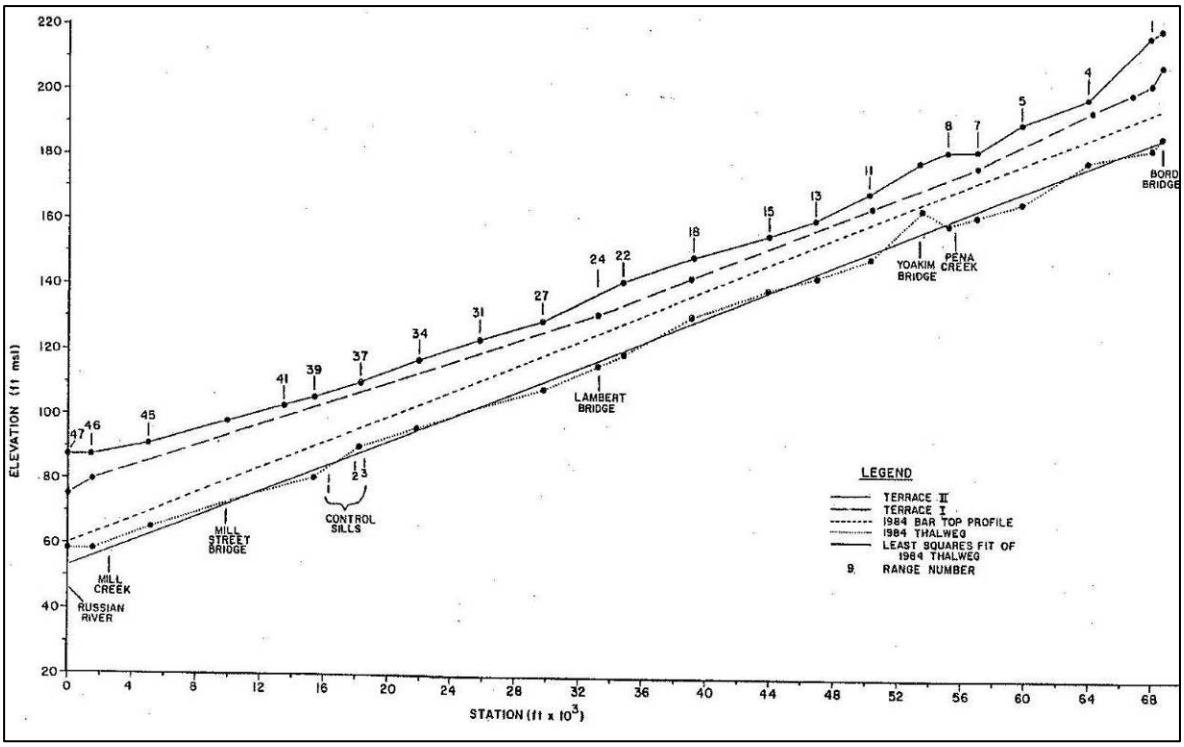


Figure 12: Longitudinal profiles of terrace II, terrace I, 1984 active bar tops, 1984 bed, and least squares regression of 1984 bed of Dry Creek. Reprinted from Harvey and Schumm (1985).

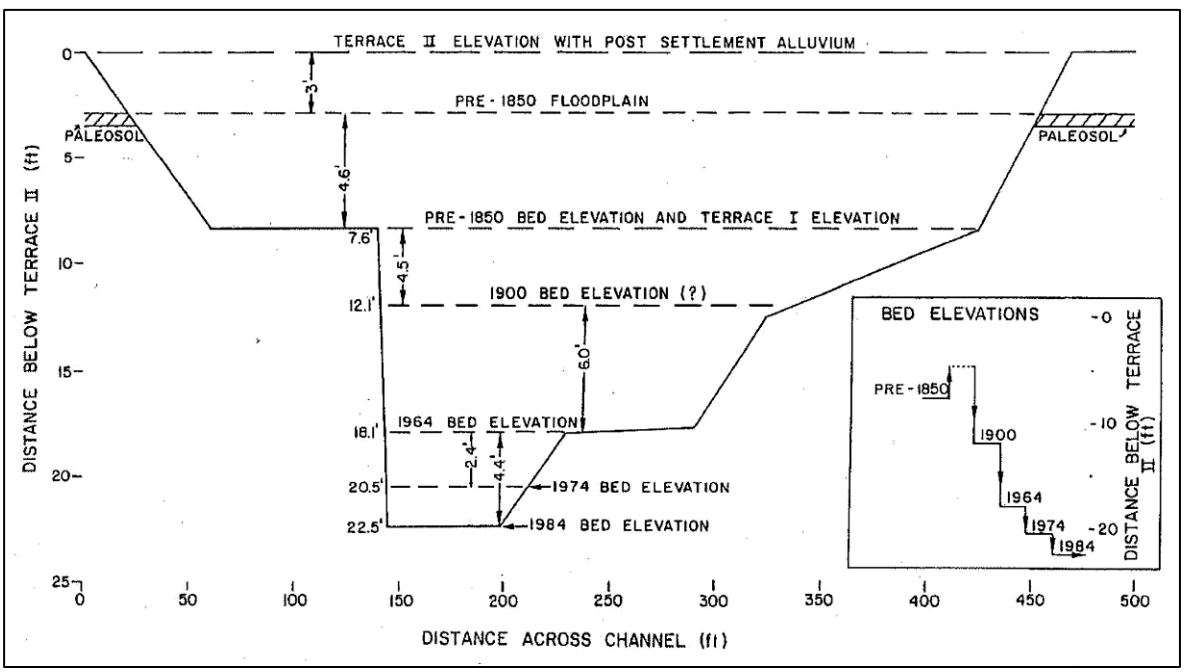


Figure 13: Schematic cross section of Dry Creek showing the chronological evolution of the channel from pre-1850 to 1984. Elevations are mean values for the individual surfaces. Inset is a diagrammatic representation of the bed elevations for Dry Creek through time.

The rate of channel degradation slowed by the late 1970s. Based on comparison of the minimum thalweg elevations at the repeat cross sections, Harvey and Schumm (1985) reported that degradation had ceased by 1974 as far upstream as Yoakim Bridge (RM 10.7). An outcrop of Franciscan Formation was exposed in the bed of the channel in 1974 at Lambert Bridge, which is located 6.6 RM upstream of the mouth (Simons and Li, 1980). Harvey and Schumm report further degradation of the bed of the channel between 1974 and 1981 in the reach upstream of Yoakim Bridge, but no significant change in bed elevation between 1981 and 1984. Harvey and Schumm (1985) further report observation of a new floodplain (tops of bar surfaces) which had formed approximately 4.5 feet above the bed within the incised channel of lower Dry Creek by 1984. Formation of a new floodplain within the incised channel is consistent with the arrival of a new quasi equilibrium condition (Figure 14). The tops of the bar surfaces in 1984 corresponded with the level of the 1964 thalweg (Harvey and Schumm 1987).

Construction and operation of Warm Springs Dam significantly reduces peak discharges and ceased delivery of bedload from the upper 130 sq. mi. of the watershed. The potential responses of the Dry Creek channel to dam closure and operation included: 1) continued channel degradation, and 2) reduction in channel cross-sectional area (Williams and Wolman 1984). Harvey and Schumm (1985, 1987) concluded that channel degradation was unlikely to continue as a result of dam operations. They found that the channel had already armored by 1984 in the first two miles below the dam. In addition, three grouted rock grade-control structures were placed in the mainstem of lower Dry Creek between river miles 3 and 4 in 1981. Further upstream, a bedrock exposure of the Franciscan Formation was providing grade control upstream of the Lambert Bridge (6.4 miles from the mouth) and exposed consolidated sands and gravels overlying bedrock outcrops provided additional resistance to erosion at 7.2 and 11.3 miles upstream from the mouth of Dry Creek. Finally, because base level drop was beginning to affect the tributaries, large amounts of sediment were being delivered to Dry Creek, beginning with Dutcher and Pena Creeks, located 3 river miles below the dam (Harvey and Schumm 1985, 1987).

Results from the sediment transport studies (Thomas et al. 1984, ACOE 1987a) corroborate Harvey and Schumm's findings (1985, 1987), suggesting that significant future degradation or aggradation along lower Dry Creek would be limited. However, because of the drop in base level along lower Dry Creek, the gradient at the mouths of the tributaries were predicted to increase, resulting in higher flow velocities and greater erosion within the tributaries themselves. Although this increased erosion was thought to provide the necessary gravel to prevent further degradation on lower Dry Creek as mentioned above, the ACOE (1987a) recommended that grade control structures be placed near the mouths of these tributaries to minimize headcutting. Grade control structures were installed in the mouths of several tributaries in the 1980s, including Pena Creek.

Landowner observations (Rued 2009) suggest that local incision within the active 'bankfull' channel continued through the early 1990s. This was attributed to extensive colonization of bar surfaces by woody vegetation (white alder, willow) under the post-dam flow regulation regime, which effectively roughened and stabilized sediments on these surfaces and focused proportionally greater flood discharges within the un-vegetated area of the channel.

Harvey and Schumm (1987) concluded that reduction in channel size through sedimentary processes due to the reduction in peak discharges was unlikely due to the significant deepening and widening that had previously occurred in response to base level change, and the development of a new quasi-equilibrium floodplain within the oversized channel. They did acknowledge the potential for vegetative encroachment onto the new floodplain surfaces due to conversion of the creek from an ephemeral to a perennial system, and reduction in the magnitude and frequency of disturbance flows.

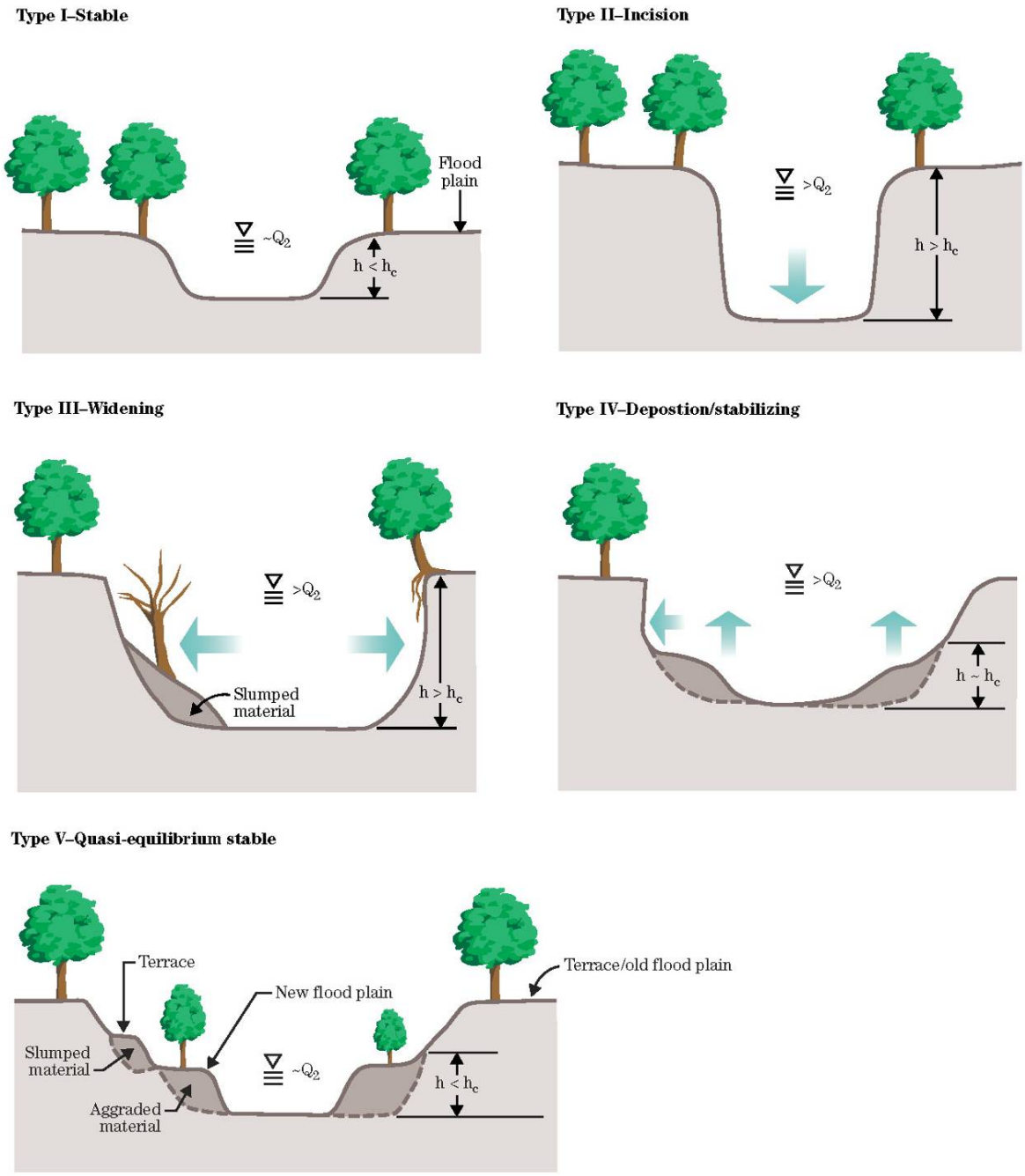


Figure 14: Conceptual model of incising channel evolution developed by Schumm, et al. 1984. Reprinted from USDA-NRCS 2008.

Based on analysis of aerial photography spanning the period 1942-2000, Gordon and Meentemeyer (2006) examined response of the lower Dry Creek channel to dam closure and operation from the tributary junction 1000 feet below Yoakim Bridge (RM 10) to the upstream grade control sill (RM 4). They report an increase in area colonized by riparian vegetation of greater than 70% (Figure 15), and a reduction in the area of the channel corridor occupied by 'active' fluvial features (the stream channel and attendant bare gravel and sand bar surfaces) of over 90%. Additionally, they found that the active channel width decreased in the downstream direction, which is atypical of naturally functioning fluvial systems for which channel width generally increases with watershed area.

Figure 15: Example of vegetative encroachment near Yoakim Bridge. Yoakim Bridge (RM 10.7) is seen at upper left of each frame. Dry Creek flow is from top to bottom of each frame. Left frame is from 1976, right frame is from 2004. Light blue line is estimated limit of active fluvial features in 1976.

Gordon and Meentemeyer also assessed post-dam channel adjustment by comparison of calculated rating curves and measured hydraulic geometry (width, depth, velocity) from discharge measurements made at the Yoakim Bridge gaging station for pre- and post-dam eras. Available discharge measurements for that analysis spanned the period 1960-2003. Comparison of pre-and post-dam rating curves has the potential to provide valuable insights into the trajectory of channel evolution at a gaging station location because they relate basic flow characteristics of stage and discharge. Comparison of hydraulic geometry measured during periodic discharge measurements may also provide valuable insight into channel evolution at the location, provided the measurements are completed at a fixed location through time, such as a cableway or bridge. For their rating curve analysis, Gordon and Meentemeyer developed a single rating curve each from the measurement data for the pre- and post-dam era. Based on their analysis, they concluded that the pre-dam channel was wider and shallower than the post-dam channel, which they attributed to post-dam incision of up to 3.4 feet. They found similar trends in the comparison of pre- and post-dam hydraulic geometry.

However, given that lower Dry Creek was rapidly evolving over the period of record, use of a single rating curve each for both pre- and post-dam conditions could oversimplify the analysis. Given the rapidly evolving channel conditions, new gage ratings would have been developed every few years to maintain the accuracy of gaged discharge data. According to the USGS NWIS database, 35 different rating curves were developed for the gage between 1960 and 1986, and 14 different rating curves were developed over the period 1986-2009. Comparison of the trend in the succession of rating curves would provide a better representation of channel adjustment at the site. Therefore, the results reported by Gordon and Meentemeyer are informative, but should be considered preliminary. The rating tables calculated by the USGS for the period of record were requested for the current study, but were not available at the time of report preparation.

5.2 Field and Analytical Methods

The geomorphic inventory was conducted in two stages. In the initial stage, the senior project geomorphologist floated lower Dry Creek, pausing to review features of note in the channel and on attendant flood prone surfaces. In the second stage, the senior geomorphologist, senior water resources engineer, principal fish biologist and project geologist revisited sites of interest for development of habitat enhancements, based on the initial results of the fish habitat survey and the initial geomorphic inventory. The initial geomorphic inventory was conducted in conjunction with the fish habitat unit inventory (Section 6), with these activities timed to coincide with a typical summer steady state operational discharge. The field geomorphic inventory was combined with subsequent additional analyses for the geomorphic assessment.

5.2.1 Inventory and Assessment

In each of the reaches, the characteristics assessed included 1) basic channel geometry (wetted and active width where appropriate), 2) bed and bank sediment composition, 3) geomorphic indicators of aggradation and degradation, bank erosion, gravel bar development, and floodplain deposition, and 4) areas of interest for locating potential habitat enhancements.

The channel geometry was assessed by measuring representative widths of the channel at riffle locations, their attendant floodprone surfaces and estimated heights of both banks. When possible, geometry measurements were made adjacent to pebble count sample locations. This was repeated within in each reach. Representative measurements of channel geometry were recorded and included in the project database.

Bed sediment surficial size distributions were characterized through Wolman pebble counts (Wolman 1954, Bunte & Abt 2001; Photograph 2). Pebble counts were conducted on select exposed gravel bars as well as within the wetted channel where flow velocities and depths allowed. The planned frequency of pebble counts was approximately 1 per reach, though several additional pebble counts were performed. The location of each pebble count was recorded and included in the project database. Additionally, visual assessments of substrate composition were made for the various habitat types (pools, riffles, and runs) within the reach as a part of the companion fish habitat unit inventory. Bank material composition was visually estimated within each reach.

Photograph 2. Field crew conducting Wolman pebble count.

Areas of active aggradation, degradation, bank erosion, and bar development were identified on field maps and described in field notes. In addition to these characteristics, areas of notable erosion or instability were identified, described, and located on field maps.

Vegetative characteristics were also noted. Occasional incremental tree cores were collected to age trees growing on various ground surfaces within the channel corridor to provide estimates of floodplain and terrace age. Visible bank stabilization installations and grade control structures were also identified, described and located on maps. The results of the inventory were combined with other analyses such as aerial photo interpretation, assessment of hydrologic alteration and basic hydraulic calculations to describe the current function of Lower Dry Creek.

5.3 Results

The current geomorphology of lower Dry Creek expresses the interaction of local geology, watershed characteristics, hydrology, and vegetative characteristics; the legacy of channel evolution and response to land management changes; and the ongoing influence of flow management. Lower Dry Creek is an incised, perennial, alluvial gravel bed stream that has responded to significant human induced hydrologic and geomorphic change over the past 150 years. The following section provides an overview of contemporary geomorphic conditions along Lower Dry Creek between Warm Springs Dam and the creek mouth. More specific details are found on the individual reach summaries found in Appendix A.

5.3.1 General Reach Characteristics

At the time of this report, Lower Dry Creek is primarily composed of pool-riffle and plane-bed morphology (Montgomery and Buffington 1997) with an average channel gradient of 0.18%. The channel planform exhibits relatively low sinuosity (1.13) for a low gradient, alluvial, pool-riffle system, which may in part be influenced by fault lineaments present in the valley (See Section 3.2.3) in addition to past human management. The present active channel has incised within the observed historic meander corridor, which has the capacity to contain maximum flood discharges.

The channel corridor is generally narrow relative to the active channel width, and relatively uniform in width over most of the 16 reaches, with periodic wider sections. The wider sections are a result of bank erosion over time (Figure 16). In general, the wider reaches are located in areas where bank erosion was not effectively controlled by bedrock, bridges, stabilization measures, or vegetation as the channel incised (Photograph 3). Channel planform, flood stages and durations, tributary sediment supply, and backwater from the Russian River are localized influences that have influenced bank erosion through time. Narrow reaches with thin, poorly vegetated riparian zones along lower Dry Creek's deeply incised banks have been and are currently most vulnerable to erosion during higher flood stages. Many segments of terrace banks have been armored by various erosion control methods. However, other segments of terrace banks are currently eroding and are vulnerable during future large floods.

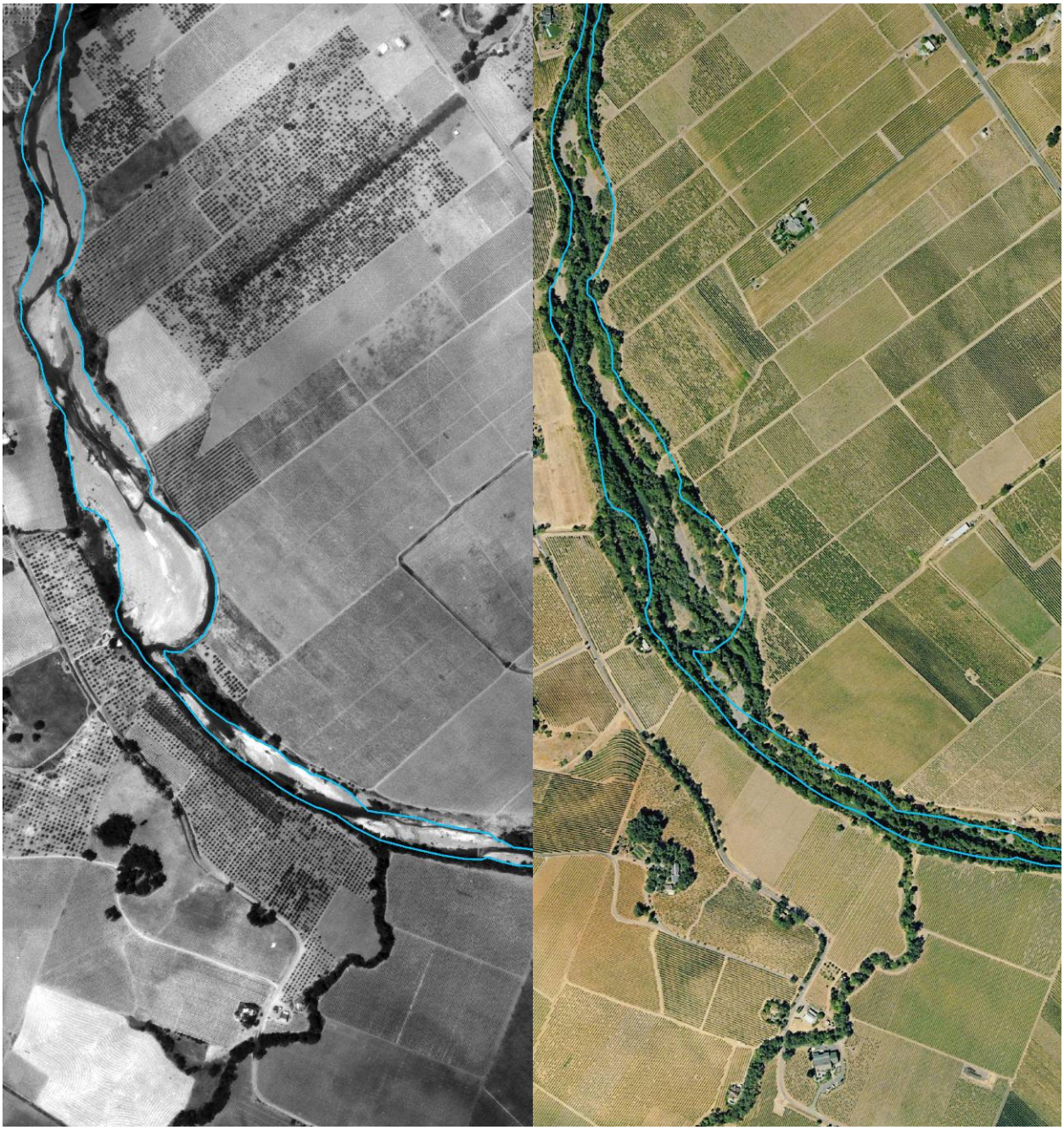
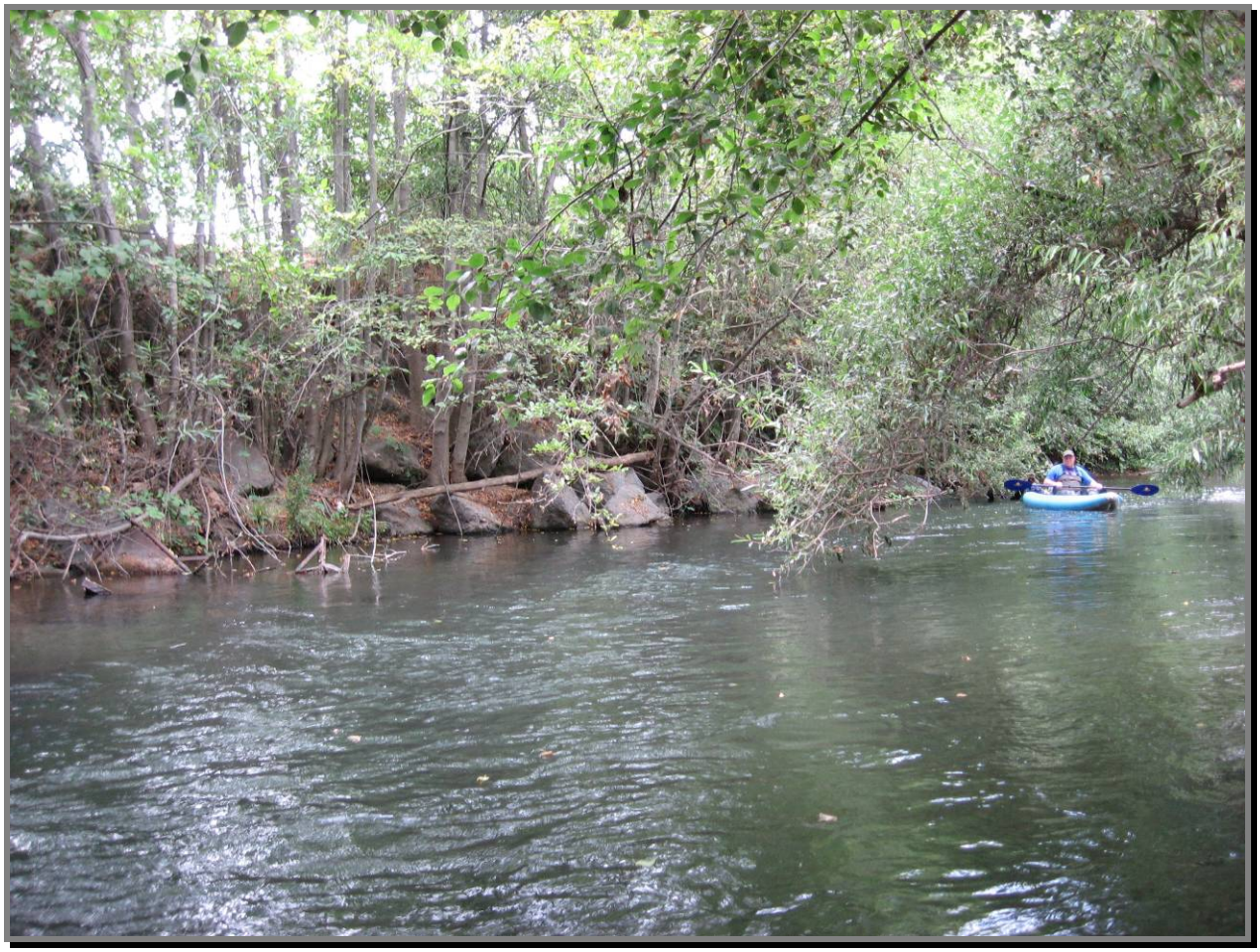


Figure 16: Example of historic bank erosion leading to relatively wider area of channel corridor near confluence of Grape Creek (RM 7.3). Grape Creek is seen at bottom center of each frame. Dry Creek flow is from top to bottom. Left frame is from 1976, right frame is from 2004. Light blue line is estimated limit of active fluvial features in 1976.

For reaches along the western flank of the valley, the available field evidence suggests that the stream bed of lower Dry Creek is founded on (or is within a few feet of) bedrock and/or the resistant depositional units similar to those described by Harvey and Schumm at Grape Creek. Although bedrock outcrops were generally only visible along reach 7, the observations and interpretation made by Harvey and Schumm regarding the two resistant

depositional units (possibly associated with the Glen Ellen Formation) and their stratigraphic position relative to the underlying bedrock are consistent with the conditions observed. The suballuvial depth to bedrock (or the resistant depositional units) for reaches located more toward the center of the valley cannot be accurately estimated based on the currently available data, but could be as little as 5 or 6 feet beneath alluvial deposits within the active stream channel. Downstream of the bridge at Westside Road (reaches 1 and 2), bedrock is anticipated to be significantly deeper as the Dry Creek drainage enters the Russian River floodplain.

While grade is clearly controlled by bedrock exposed at the riffle immediately below Lambert Bridge, there are other riffles that may be controlled by bedrock or a resistant depositional unit. Although bedrock is not directly visible in the stream channel, the proximity and orientation of resistant bedrock ridges on the western flank of the valley relative to the position of several larger riffles encountered along the upper reaches of lower Dry Creek suggest that the gradients there may be controlled by bedrock. Downstream, the locations of the three grade control sills constructed in reach 4 are generally coincident with the southward projection of bedrock ridges on the western flank of the valley. These sills may have been constructed on preexisting grade breaks influenced by underlying bedrock highs.



Photograph 3: Historic bank stabilization site.

5.3.2 Sediment Supply and Hydrologic Alteration

As described previously, widespread, systemic incision occurred historically in response to base-level lowering and other factors. Assessments completed in close proximity to the time of dam closure concluded that systemic degradation of Dry Creek had generally ceased by the time the dam came online (Section 5.1 above). The primary determinant of current geomorphic conditions is the influence of the dam, expressed through modified sediment supply and altered hydrology. Dam construction ceased delivery of bed material from the upper 60% of the watershed. The hydrologic regime has been converted from an ephemeral runoff-based regime to a regime that combines typical characteristics of winter rain and mesic groundwater regimes (Poff and Ward 1989), i.e., moderate winter floods and sustained, relatively high baseflow conditions.

The reduction in bedload supply is most noticeable in Dry Creek between the dam and the confluence of Dutcher (RM 11.8) and Pena (RM 11) Creeks (Reaches 16 to 12). In this 2.9 mile stream section, riffles are relatively absent and the bed is relatively armored, with periodic presence of large blocks (1 to 1.5 feet in diameter) that may be derived from underlying parent rock materials or other sources (discussed further below). A steep riffle located 1.3 miles below the dam outlet (RM 12.6, 2000 feet upstream of Fall Creek) appears to provide grade control for the upstream reach. Of all of the reaches assessed, the floodprone surface is most closely linked to the creek elevation above Pena Creek.

The reduction in bed material supply is moderated by successive tributaries entering Dry Creek. The most significant of these in terms of bed material supply include Dutcher Creek (RM 11.8; Photograph 4), Pena Creek (RM 11), Crane Creek (RM 6.3) and Mill Creek (RM 0.6), based on observations of bed material size, angularity and mineralogy near the respective confluences (Photograph 5). Pena, Crane and Mill Creeks all enter Dry Creek from the West, with headwaters in relatively steep topography in Franciscan Formation geology. Pena and Mill Creeks are the two largest tributaries to Dry Creek, each with watershed area of 22 sq. mi., representing nearly 10% of total Dry Creek drainage area (230 sq. mi.) each.

Photograph 4: Evidence of stream bed incision in Dutcher Creek, below the Dutcher Creek Road Bridge.

Photograph 5: Gravel deposit at Pena Creek confluence.

The stream section between Pena Creek and Westside Bridge (RM 11 to RM 2; Reaches 11 to 3) did not appear to be actively incising or aggrading, though there are areas of active channel adjustment (Photograph 6). In this section, a bedrock outcrop provides bed grade control at Lambert Bridge (RM 6.6; Photograph 7), and three grouted rock grade control sills (Photograph 8) located between RM 3.8 and 3.2 provide bed grade control for the stream. The stream section between Westside Bridge and the confluence (Reaches 2 to 1) appeared to be the most alluvial section, in which the channel position and shape are most readily shaped by fluvial forces (Photograph 9). Some signs of aggradation were observed in this section, with the influence of backwater from the Russian River during floods clearly visible from Mill Creek downstream to the confluence (Photograph 10).

Photograph 6: Active channel meandering into relic terrace deposit at RM 6.4.

Photograph 7: Bedrock outcrop beneath Lambert Bridge, RM 6.6.

Photograph 8: Grade control sill, with fish ladder at top right, RM 3.2.

Photograph 9: View looking downstream from Westside Bridge, RM 2.

During the geomorphic inventory, it was apparent that most of the bed materials, excluding the larger cobbles and boulders, are transported by Dry Creek. There was little armoring of gravels on the bed or low bars. Vegetation limits the mobility of gravel on the higher gravel bars, but recently redistributed gravel was observed through the study area downstream from the first tributary (Schoolhouse Creek). The ability of Dry Creek to mobilize bed material varies throughout lower Dry Creek as some areas appear stable and other areas are slightly aggradational (Reaches 1 and 2). The flood stage that deposited the gravel bars also plays a significant role in the future mobility of that material. Gravel deposited during large floods becomes vegetated in the years following deposition, which tends to stabilize the deposits. The corresponding flood terrace is then slowly eroded by intervening lower discharges. Low gravel bars deposited during relatively smaller floods are generally less vegetated and are mobilized annually. These bars are common at and below major tributaries delivering bedload.

Photograph 10: Deposit of gravel across from Mill Creek confluence (RM 0.6), reflecting backwater influence of Russian River.

The hydrologic regime influences the geomorphology of lower Dry Creek. Regulation has resulted in elevated summer baseflow conditions that when combined with the Mediterranean climate produces near ideal conditions for growth of riparian trees and shrubs. Regulation has also resulted in severe curtailment of major floods, which limits disturbance and removal of newly recruited and established vegetation. The estimated highest maximum peak flow release from the dam (6000 cfs) is less than a 1-year flood for the unregulated period. In the reach, even-aged stands of alder trees dating to various eras (confirmed through selected tree coring) mark the elevations of terraces and bar surfaces that were abandoned or active at the time of dam closure (Photograph 11).

Photograph 11: Riparian trees date alluvial features at RM 10.3 near confluence of Canyon Road Creek. The larger tree at left on terrace dated to 1984-86. The smaller tree at right dated to 1995-97.

This combination of effects has resulted in extensive vegetative colonization of formerly active bar surfaces – elevated baseflow nurtures vegetative growth, while the lack of significant disturbance (flood) flows allows vegetation to flourish. Vegetative colonization of the bar surfaces has stabilized the formerly active morphologic features (Photograph 12), which serves to limit lateral migration of the active channel within the channel corridor, and has the effect of sequestering a reservoir of gravel within the system. The expansion of riparian vegetation within the system has also likely led to greater stabilization of channel corridor banks that were frequently destabilized during the period of adjustment to historic channel incision previously discussed. Areas of bank instability which are exceptions to this can be found in the reach and are consistent with what occurred historically before vegetation became a more dominant geomorphic influence (Photograph 13).

Photograph 12: Vegetative colonization of bar surface, RM 12.3

Photograph 13: Slumped high bank at RM 12.3.

Vegetative colonization of bar surfaces has also lead to an active channel that is efficient at moving gravel supplied to the stream despite the reduced flood flow hydrology. Mature vegetation and dense understory growth hydraulically roughen over bank areas and concentrate high flow velocities in the channel during high flow events (Figure 17). Under the current flow regime, high flow events that do occur have longer durations than similar flows that occurred during the pre-dam period, further facilitating transport of sediment. Combined, these factors have likely contributed significantly to areas of local bed scour since the closure of the dam, as observed by long-time Dry Creek landowners (Rued 2009).

Figure 17: Example of vegetative narrowing of channel corridor near Lambert Bridge (RM 6.6). Lambert Bridge is seen at lower right of each frame. Dry Creek flow is from top to bottom. Left frame is from 1976, right frame is from 2004. Light blue line is estimated limit of active fluvial features in 1976.

Based on field observations, the combination of reduced bed material supply and reduced flood magnitudes and frequencies do not appear to have resulted in incremental systemic degradation or aggradation. It appears that vertical degradation was complete before dam closure. These field observations appear consistent with the conclusions reached by Harvey and Schumm (1985, 1987), and with trends seen in select other rivers with similar combinations of post-dam hydrology and sediment supply (Grant et. al. 2003, Schmidt and Wilcock 2008). Degradation is also kept in check by features which control the bed grade spaced periodically over the reach, discussed above.

Given the legacy of channel degradation in lower Dry Creek and the potential impacts of ongoing degradation on proposed habitat enhancements, a subset of the degradation ranges established by the Corps of Engineers in the early 1960s (resurveyed over the period 1964-1984) should be resurveyed in early 2010 and compared to the historical data as a component of the Phase 2 feasibility analysis. Resurvey and analysis of the degradation ranges will provide the quantitative evidence required to confirm preliminary conclusions based only on field observations.

5.3.3 Channel Characteristics and Capacity

The combined factors of regulated hydrology, altered sediment supply and colonization by riparian vegetation have led to evolution of a contemporary channel shape that is significantly smaller than the historic channel. Today's 'active' lower Dry Creek channel is defined as the predominantly open channel, flanked by riparian vegetation in the overbank areas. A similarly-defined channel in an unregulated, undisturbed stream system might be termed a 'bankfull' channel, which in many systems typically has capacity ranging from the 1- to 5-year return period flood (Wolman and Miller, 1960), and is used as an indicator for many stream processes. We have purposely avoided the use of the 'bankfull' term as a description for the main channel at Dry Creek, to avoid inadvertent comparison of characteristics with those of other unregulated stream systems where the concept is more applicable.

The channel geometry of fluvial systems in equilibrium generally changes consistently in a downstream direction as watershed area increases and tributaries input water and sediment. To assess active channel geometry and capacity for lower Dry Creek, we reviewed measured channel widths and developed estimates of channel capacity at 24 riffle locations spaced over the 16 reaches based on basic field measurements. We then plotted active channel width (Figure 18) and discharge (Figure 19) against drainage area to examine trends.

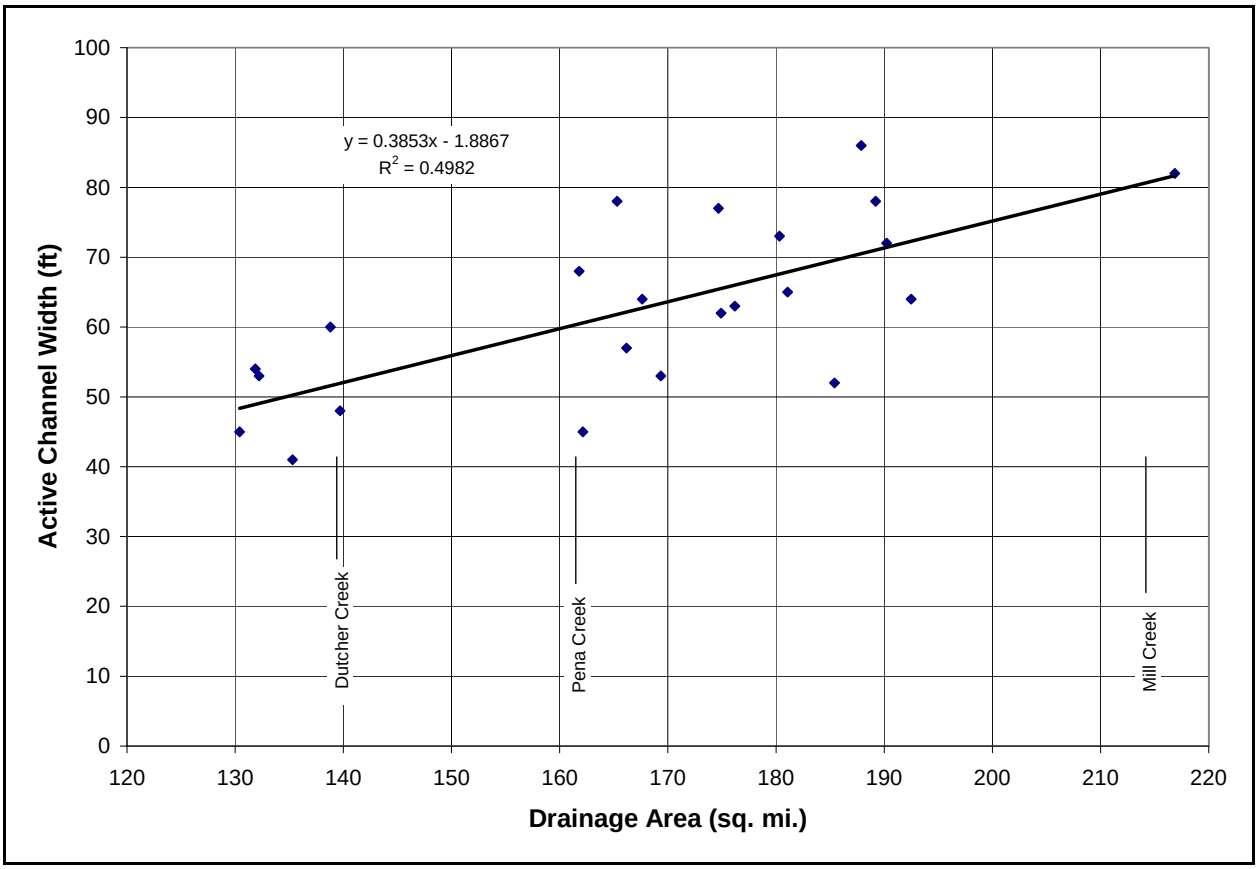


Figure 18: Plot of active channel width vs. drainage area for 24 riffle locations along lower Dry Creek.

The relationship between active channel width and drainage area (Figure 18) shows moderate correlation (R^2=0.5), though scatter is present in the data. In general, channel width at riffles increases with increased drainage area, suggesting the channel is perhaps still evolving towards a condition of equilibrium for the given inputs of water and sediment. The relationship between active channel capacity and drainage area (Figure 19) is poorly correlated (R^2=0.05). This result is not surprising. A strong, positive correlation would assume that the alluvial channel evolved over time with consistent climatically-induced runoff and sediment processes. Many factors which influence lower Dry Creek geomorphology have changed at different rates, some more rapidly than natural conditions, and others which have changed more slowly. The rates of change for a single process may also vary between reaches, due to local factors (e.g., vegetation, variations in corridor width, etc.), and the hydrology for a large segment of the watershed is dissimilar to the downstream tributaries. Although least squares regression suggests a slight decrease in active channel capacity for increase in drainage area, the correlation is too poor to confidently assert this interpretation. The scatter in the data may also be influenced by the approximate discharge estimation method.

The data shown in Figure 19 suggest that the active channel capacity of lower Dry Creek ranges from 300 to 900 cfs, with mean and median values of 559 cfs and 512 cfs, respectively. These values are well below the estimated 2-year peak discharge at the dam of 4000 cfs. Annual peak discharge recorded at the gage below the dam, however, was less than

600 cfs for six of the years between 1985 and 1994, which may reflect a period when the reservoir was being filled. For comparison, the lowest annual peak flow discharge at the Yoakim Bridge gage was 910 cfs in 1990. The range in active channel capacity estimates do correlate well with the mean monthly flow for the months of January – March, which range from 688 to 830 cfs at Yoakim Bridge, and from 464 to 519 cfs below the dam. This comparison suggests that the active channel is primarily controlled by sustained high flow conditions in the winter months, which would also tend to define a limit of woody vegetation.

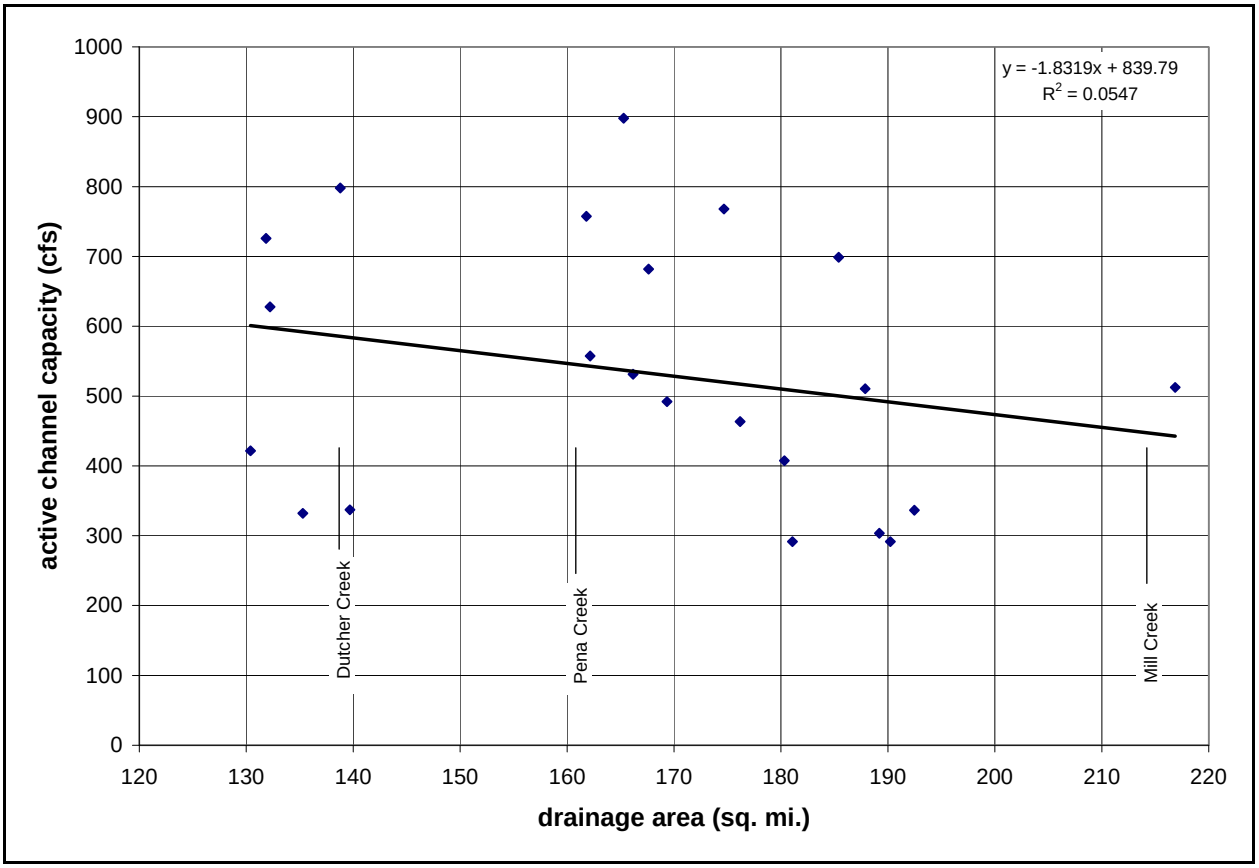


Figure 19: Plot of active channel capacity vs. drainage area for 23 riffle locations along lower Dry Creek.

5.3.2. Bed and Bank Materials

Alluvial terrace and channel deposits in lower Dry Creek are comprised of sand, gravel and cobbles of varying rock types derived from tributaries extending into the adjacent Coast Range ophiolite, Great Valley Complex, and Franciscan Complex.

In the upper reaches of lower Dry Creek (river reach 13 through 15), there are a number of areas in which an array of large blocks (1 to 1.5 feet diameter) are visible along the channel bottom. These blocks are subangular to subrounded, with rounded edges that are not consistent with blocks used in man-made channel armoring (i.e., rip rap). The origin of these blocks is unknown, but one hypothesis is that the blocks are lag deposits from natively derived alluvial fan deposits found in the nearby drainages to the east. Large subangular blocks observed within the exposed stream terraces along these reaches supports this

hypothesis. Alternatively, these blocks may be related to the bed of boulders and cobbles noted by Harvey and Schumm at Grape Creek. These materials were located immediately above the bedrock surface. Visual evidence supporting or refuting this possibility was not found during field reconnaissance. In either case, the presence of these larger blocks within the main channel was not observed downstream of the confluence with Dutcher Creek.

A clear increase in maximum size and angularity of rock clasts found within the stream channel, as well as differences in the constituent rock types, was noted at the confluence and downstream of several of the tributaries, including Dutcher, Pena, and Mill Creek. The sharp increase in clast size and relative angularity suggests that some of these tributaries may have a substantial carrying capacity during high flow events and can deliver a significant sediment load into Dry Creek.

With the exception of sandstone outcrops observed at Bord bridge (reach 15), bedrock outcrops observed along the active stream channel were generally limited to river reach 7, beginning just upstream of Grape Creek, continuing down past the bedrock exposures at Lambert Bridge, and ending near the confluence with Crane Creek. The presence of the large boulders along the channel bottom (possibly related to the erosional unconformity identified at Grape Creek by Harvey and Schumm) in reaches 13 through 15 may be indicative of shallow bedrock. In addition, a large embayment formed by a fallen tree in an embankment observed in reach 14 appeared to expose a resistant sedimentary unit which could be related to the cemented depositional units described by Harvey and Schumm.

Observed bedrock exposures in reach 7 are comprised of interbedded layers of weak siltstone and somewhat stronger, thicker beds of sandstone that appear to be consistent with descriptions of the siltstone, sandstone, and shale units of the Great Valley Complex. At Grape Creek, the bedrock was found to be locally folded along a west-southwest plunging axis approximately parallel to the apparent syncline evident in the mapped Great Valley Complex units exposed on the western flank of the valley.
The alluvial bed of Dry Creek is primarily composed of coarse gravel, but ranges from sand to boulders and bedrock. The sand is generally concentrated in the pool bottoms and other backwatered areas, whereas the flatwaters and riffles are dominated by gravel and cobbles. The surface grain sizes of riffles throughout Lower Dry Creek were specifically analyzed. Riffles in each reach were analyzed as well as the riffles downstream of tributaries and of the major tributaries themselves (Table 9). The 16th, 50th, and 84th percentiles of the grain sizes found in the riffles were calculated. Though the surface grain sizes found in riffles does vary throughout Dry Creek, the median grain size primarily ranges between 20 and 30 mm. There is a slight trend towards decreasing grain size with downstream distance from the dam, but this relationship is weak ($R^2 = 0.07$) (Figure 20). Similarly, the larger grains decrease in size downstream ($R^2 = 0.36$), ranging from 50 to 70 mm in the upstream half of Lower Dry Creek and 40 to 60 mm in the downstream half. Finer grains are fairly uniform in size throughout Lower Dry Creek at approximately 10 mm.

The bed material contributed to Dry Creek from tributaries does not appear to have a substantial effect on the measured surficial grain size in downstream riffles. The tributaries with larger bed material likely increase the size of bed material in Dry Creek, but a strong relationship is not exhibited in the data. The larger material from Pena Creek may contribute

to the spike in grain size about 1.5 miles downstream of the confluence, but at the mouth of Pena Creek, the size of the material is smaller than elsewhere (Table 9). The 84th percentile of bed material in Grape Creek is much greater than elsewhere because of the predominance of bedrock. Large material delivered from Crane Creek may result in a slight increase in size of the 84th percentile of the downstream riffle. Elsewhere, however, there is little impact of tributary bed material input on surficial grain sizes measured at downstream riffles on Dry Creek.

Table 9: Grain sizes for three percentiles of the surficial bed material in riffles throughout lower Dry Creek.

Reach	Unit #	Description	D16	D50	D84
1	D358	Downstream from Mill Creek	11.4	25.9	47.3
2	D320	Downstream from unnamed tributary	9.4	23.2	45.8
3	D305	Upstream of Westside Road Bridge	11.3	30.9	54.2
3	D289	Middle of reach	9.0	24.0	48.6
4	D256		14.4	31.4	59.8
5	Kelly Creek	Near mouth	4.5	11.4	21.48
5	D228		12.0	30.4	58.5
5	D219		5.7	21.8	49.5
6	D199	Downstream of Crane Creek	11.7	29.7	53.9
7	Crane Creek	Near mouth	1.6	9.7	82.7
7	D196	Upstream of Crane Creek	10.7	29.7	59.9
7	D191		10.8	25.0	52.7
7	D171		7.1	16.2	34.7
7	D167		11.3	25.4	53.7
7	Grape Creek	Near mouth	1.6	26.2	256
8	D123		10.7	34.9	71.7
9	D110		11.3	26.4	61.1
10	D099		11.2	44.3	123.9
11	D088	Downstream of Yoakim Bridge	12.3	30.2	80.5
11	D080		6.9	18.4	42.1
11	Peña Creek	Near mouth	8.0	27.6	70.5
11	Peña Creek	Near West Dry Creek Road bridge	14.5	34.9	62.7
12	D072	Downstream of unnamed tributary	9.4	32.8	77.8
13	D044	Downstream of Fall Creek	10.5	35.0	74.2
13	Fall Creek	Near mouth	3.8	16.0	54.4
14	D013		11.4	28.8	61.9
14	D004	Near mouth of Schoolhouse Creek	3.3	25.4	129.9
15	D001	At Bord Bridge	7.4	31.2	85.7

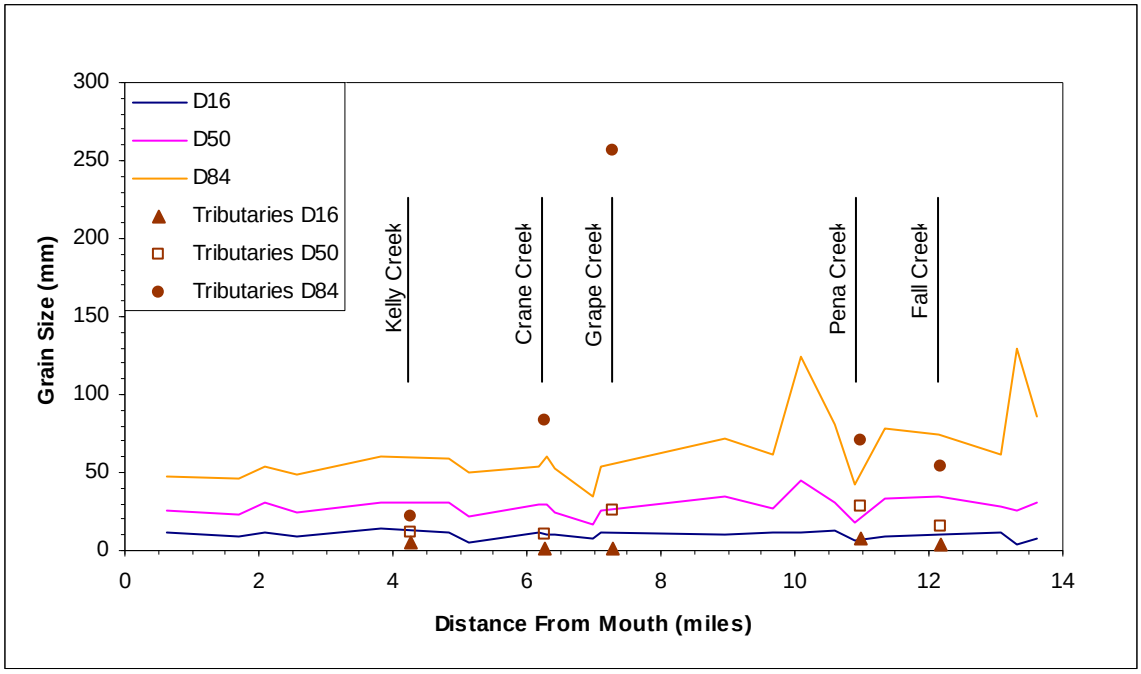


Figure 20: 16th (D16), 50th (D50) and 84th (D84) percentiles of surficial grain size distributions in riffles along Dry Creek and in five tributaries.

5.4 Future Evaluation

Phase 2 of the feasibility analysis will include quantitative evaluation of geomorphic processes in Dry Creek in order to assess enhancement feasibility on a system and project scale. This will include resurvey of a subset of the historic degradation ranges to positively examine whether Dry Creek has degraded further following closure of Warm Springs Dam. These and additional surveyed cross sections will be used to develop a planning level hydraulic model to quantitatively assess trends in fluvial processes, including the continuity of flow and sediment through the project reach.

6 DRY CREEK FISH HABITAT INVENTORY

The goals of this habitat inventory were to census aquatic habitat for coho salmon and steelhead trout in Dry Creek downstream of the Warm Springs Dam, to provide context for the development of fish habitat enhancement alternatives, and to establish a basic pre-treatment baseline against which to measure the effects of future fish habitat enhancement projects.

Between August 26 and September 1, 2009, 13.7 miles of lower Dry Creek were inventoried from Bord Bridge immediately below Warm Springs Dam to the Dry Creek confluence with the Russian River (Reaches 1-15). Habitat conditions were documented at the summer steady-state operational discharge of approximately 100 cfs.

6.1 Salmonids in lower Dry Creek

When Warm Springs Dam was constructed, approximately 153 miles of salmonid habitat was made inaccessible in the upper Dry Creek basin (CDFG 2002). The Warm Springs Hatchery, located at the dam, was built to mitigate for lost fish production from habitat areas above the dam, and is operated by the California Department of Fish and Game (CDFG 2002). The RRBO, which addresses joint river management in the Russian River basin by SCWA, the Army Corps of Engineers and the Mendocino County Flood Control and Water District, requires SCWA to enhance rearing habitat for ESA-listed coho salmon and steelhead trout in lower Dry Creek. This inventory of current habitat conditions was conducted as part of an effort to identify current habitat composition. Measured composition can then be compared to habitat goals and objectives to determine the best course of action for habitat enhancements.

Dry Creek historically supported populations of coho and steelhead, although it only provided marginal salmon habitat when compared to other Russian River tributaries closer to the coast (Hopkirk and Northen 1980). More recently, during 287 electrofishing and 58 spawning surveys in the Russian River over seven field seasons, only 79 coho salmon juveniles and one coho salmon carcass were observed (Coey 2000, in CDFG 2002). Twenty three of the juveniles were found in a single year in one place (Mill Creek, tributary to Dry Creek, Sonoma County: CDFG 2002). In recent years SCWA has been operating downstream migrant traps and conducting electrofishing and snorkel surveys to further document salmonid use. With respect to contemporary conditions in the Russian River basin, lower Dry Creek is seen as a potential resource that is a key component of the regional recovery plan for ESA-listed coho and steelhead. This is due to the relative abundance of cool streamflow during the late summer months, which is regarded as a limiting factor for recovery of these fish in a region where water is scarce during the summer months and typically has water temperatures adverse to salmonid survival. It should be noted that lower Dry Creek also contains a robust population of Chinook salmon. Planning of habitat enhancement efforts will also consider this important species.

Coho and steelhead are present in lower Dry Creek year-round. Adult coho and steelhead enter Dry Creek to spawn in the late fall and winter (Figure 21). Eggs deposited in gravel

nests called redds incubate through the winter and early spring, and fry emerge in springtime. Juvenile coho and steelhead rear in lower Dry Creek for a minimum of one year before emigrating to the sea the following late winter or spring.

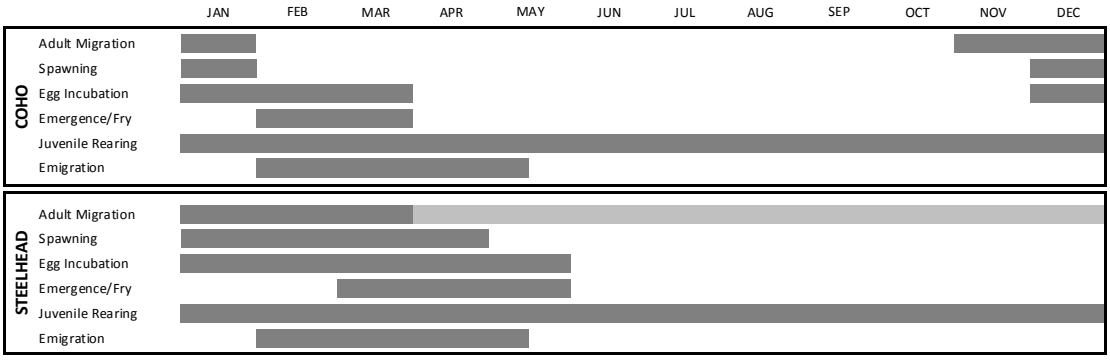


Figure 21: Phenology of Northern Californian coho and steelhead (Entrix, Inc. 2004).

6.2 Habitat Criteria for Coho and Steelhead

Juvenile coho salmon and steelhead tend to use different stream habitats. Coho juveniles prefer the slow velocities found in slackwater pools and backwater areas as well as off channel ponds. Juvenile steelhead prefer areas of higher velocity and are usually found in riffle and run type habitats. Preference criteria for coho and steelhead habitat in Californian salmonid streams have been developed for variables that were measured as part of the habitat inventory (see Table 10).

Other important habitat parameters may include canopy cover, riffle embeddedness, streamflow, water velocity, temperature, water quality (e.g. total suspended solids), instream wood volume, primary productivity, macroinvertebrate abundance and diversity, floating biomass, and other parameters.

Table 10: Preference criteria for coho and steelhead habitat in Californian salmonid streams (CDFG 2002, 2004).

Proportions and Frequencies of Habitat Types

- Pools >3 feet deep comprise >50% of Reach length
- Riffles comprise 15 to 30% of Reach Length
- Pool frequency is >50%

Channel Morphology

- Channel is connected to its floodplain (slightly entrenched)
- Shallow edge habitat is available to fry for rearing
- Side-channels and alcoves are abundant

Water Depth

- Water depth >7.1 inches for adult migration
- Residual pool depth >3 feet
- Water depths between 10 and 48 inches for juvenile rearing

Cover and Complexity

- >40% Instream Shelter Percent Cover[3]
- Instream Shelter Complexity[4] (Shelter Value) >2
- Shelter Rating[5] >100
- Instream Woody Debris is abundant

Substrate

- Spawning gravel sizes (11.4 mm to 128 mm)
- Salmonid Fry Rearing gravel/small cobble sizes (32 mm to 128 mm)
- <10% fine sediment in redds for optimum egg incubation
- <20% fine sediment in riffles for spawning and rearing

[3] Instream Shelter Percent Cover: the area of a habitat unit occupied by instream shelter, estimated from an overhead view.
[4] Instream Shelter Complexity (Shelter Value): a relative measure of the quantity and composition of the instream shelter where 0 is no shelter and 3 is complex shelter.
[5] Shelter Rating: The product of shelter complexity and instream shelter percent cover, values range from 0 – 300.

6.3 Summary of available data

Several prior studies have examined aspects of fish habitat in lower Dry Creek (Table 11). However, no census of habitat unit dimensions, instream cover, and substrate has been conducted. Collectively, these studies serve as a coarse indicator of potential limiting factors and general habitat conditions in Dry Creek.

Table 11: Previous studies on Dry Creek related to coho and steelhead habitat parameters.

Authors, Year	Report Title	Parameters Measured
Winzler & Kelley 2001	Dry Creek Survey, Sonoma County, California	Velocity, Substrate, Channel Shape
CDFG 1953	Rough Fish Control Project – Sonoma County Shocking Survey, August 18-28, 1953	Fish community and abundance
Winzler & Kelley 1978	Evaluation of Fish Habitat and Barriers to Fish Migration, Russian River Mainstem and Lower Dry Creek	Fish passage barriers and fish habitat
Hopkirk & Northen 1980	Technical Report on Fisheries of the Russian River	Fisheries
Baracco/CDFG, 1977	Instream flow requirements in Dry Creek, Sonoma County, below Warm Springs Dam	Fisheries, Flow
McBride & Strahan 1984	Establishment and Survival of Woody Riparian Species on Gravel Bars of an Intermittent Stream	Riparian Vegetation
Gordon & Meetenmeyer, 2006	Effects of dam operation and land use on stream channel morphology and riparian vegetation	Riparian Vegetation
CDFG 2002	Russian River Basin Fisheries Restoration Plan	Limiting Factors, Historical Resources
ENTRIX 2004	Russian River Biological Assessment, Interim Report 8: Russian River Estuary Management Plan	Russian River Coho and Steelhead Life Cycles
ENTRIX 2004, Appendix F	Flow-Habitat Assessment Study	Flow, Velocities, Substrate, Qualitative Estimates of Habitat

6.4 Methods

Habitat survey methods were developed by adapting elements from several published inventory methods in order to balance data needs and repeatability with practicality and efficiency of collection. The methodology used fundamentally follows the techniques described by Bisson et al. (1982), the more recent standards published as the USFS Region 6 Level II stream survey methodology (USFS 2006), and the California Department of Fish and Game methodology (Flosi et al 1998), and were adapted to fit the goals of the study. The inventory methodology began with reach delineation (Section 3.5), then proceeded with field identification and measurement of individual habitat units, and concluded with a synthesis of the data by reach segment.

6.4.1 Habitat Unit Types

In the field, fish habitat units were identified as pools, scour pools, riffles, flatwaters, cascades, alcoves, or side channels and were measured and recorded on standard data sheets (see Appendix C). Individual habitat unit definitions were as follows:

- Main Channel Pool (P): Pools are areas with very low velocities and multiple flow vectors, spanning at least 60% of the channel width, with minimum residual depths of 2.0 feet. Water surfaces are flat.
- Scour Pool (SP): Pools that consist of less than 60% of the channel width and are often associated with large wood, sharp meander bends, or boulders and have residual pool depths of at least 2.0 feet.
- Riffle (R): Riffles have obvious surface turbulence and are typically shallow water with low to moderate slopes (<4%). Water velocities are greater than 1 ft/s.
- Flatwater (F): Flatwaters have little surface turbulence and lack significant residual depth (less than 2 feet), with water velocities greater than pools. Flatwaters are deeper than riffles. Water surfaces are gently sloping, and velocity is less riffles.
- Cascade (C): Cascades are steep gradient (>4%) riffles with short falls, plunges or chutes typically dominated by boulders or bedrock.
- Alcove/Backwater Pool. (A): Alcove/backwater pools are pools located off the main channel in alcove or backwater areas. These units do not have a downstream flow component at the time of the survey.
- Side Channel Pool/Riffle/Flatwater (SC/P, SC/R, or SC/F): Side channels split from the main channel and reconnect downstream. These are categorized as side channel pools, riffles, or flatwaters based on the dominant habitat type in the side channel.

6.4.2 Habitat Unit Measurements

The following measurements were made at each habitat unit identified:

- Unit Length: Unit lengths were measured using a portable hip chain or recorded using survey grade GPS. While actual measured lengths recorded in the field can be expected to be different than those lengths measured off of air photos or topographic mapping, we adjusted the measured data to the river stationing found on the GIS base

maps. Regular station locations were recorded using a hand held GPS unit to facilitate accuracy.

- Pool Maximum Depth: The maximum depth in each pool was measured using a stadia rod.
- Pool Tail Crest Depth: The average depth of the pool tail-out crest was measured using a stadia rod.
- Average Depth: Several measurements (ocular and/or with stadia rod) were taken in each riffle and flatwater to define average depth for the unit.
- Average Wetted Width: An ocular measurement of average wetted width was be made at each unit. Ocular measurements were calibrated with physical measurements at each Nth unit (below), consistent with USFS protocol.
- Woody Debris Count: Instream woody debris was defined using modified CDFG criteria. For any wood to be counted, it must have had a minimum length of 6 feet. Wood was categorized as small, medium, or large based on its diameter. Small wood was between 6 and 12 inches diameter, medium wood was between 12 and 20 inches in diameter, and large wood was greater than 20 inches in diameter. In addition, woody debris was classified as living or dead. Number of pieces of qualifying woody debris was tallied for each unit, which was converted to frequency per unit length during post processing.
- Instream Shelter Complexity: Complexity of instream shelter for pools and flatwaters was rated between 0 and 3, analogous to CDFG protocol.
- Percent Cover: The approximate proportion the total area of habitat unit occupied by cover features was estimated, analogous with CDFG protocol.

Photograph 14: Overhanging willows and other vegetation providing cover.

- Dominant and Subdominant Shelter Types: The dominant shelter type (LWD, overhanging vegetation, submerged vegetation, boulders, etc) present within each pool and flatwater was identified along with the subdominant shelter type.
- Edge Habitat Presence/Absence: In each habitat unit, the presence or absence of an area greater than 25 square feet[6] of shallow, slow water habitat less than 5 inches deep was recorded.

Photograph 15: Example of shallow "Edge" habitat in Reach 7.

- Substrate: Dominant and sub-dominant substrate type for each habitat unit was reported, consistent with CDFG protocol. The size classes, where D is the diameter of the b axis of the particle being measured, are listed below:

  F – Fines (D < 0.0625mm)
  S – Sand (0.0625 mm < D < 0.08 in)
  G – Gravel (0.08in < D < 2.5in)
  SC – Small Cobble (2.5in < D < 5in)
  LC – Large Cobble (5in < D < 10in)
  B – Boulders (10in < D)
  W – Bedrock

- Comments: Comments included presence of invasive vegetative species, springs or tributaries, installed structures, other hydromodifications, and other features of note.

6.4.3 Nth Unit Measures

Additional detail on habitat features were recorded at a minimum of 10% of the total units for each habitat type in each reach (Flosi et al 1998, USFS 2006). These surveyed units are termed nth units, and are taken to represent reach-average conditions. Measurements included the following:

- Average Wetted Width: Average width of the wetted portion of the channel was measured with both a physical and an ocular measurement. The physical

[6] Based on pre-inventory field discussions with NMFS.

measurement was used to calibrate ocular measurements made at each habitat unit. Calibration occurred in post-processing of the data, consistent with USFS protocol.

- Other Fisheries Observations: Any fish species observed during the habitat survey was identified, as feasible, and approximate size estimated. These observations were noted in the particular habitat unit in which the fish was observed. Additional habitat features such as areas of spawning gravel accumulation, high quality side channel rearing habitat, and boulder fields within the river channel were noted in the comments section of the data sheets or in field notebooks.

6.5 Results

6.5.1 Aquatic habitat

A summary of results for the habitat inventory of lower Dry Creek are listed in , and are described below for Reaches 1-15. A habitat survey was not conducted for Reach 16, the upper most reach in the tailwater of the dam due to safety considerations. Results are described in greater detail within the individual reach summaries included in Appendix A.

6.5.2 Channel Morphology

Lower Dry Creek flows at an average 0.18% gradient through a channel corridor incised into the former floodplain, which spans nearly the entire width of lower Dry Creek valley. Channel morphology in lower Dry Creek is primarily plain-bed with some reaches displaying pool-riffle morphology (Montgomery and Buffington, 1997). Some downstream reaches resemble C-type channels, with most reaches showing F-type entrenchment levels (Rosgen 1996) Mean active channel metrics were calculated based on measurements taken at riffle crests. The average active channel width was 61.7 feet (stdev 14.8, n=26) and the average active channel depth was 2.3 feet (stdev 0.6, n=26). The average floodprone width was 102.1 (stdev 33.9, n=26). The average active channel width:depth ratio was 26 and the and average entrenchment ratio was 1.7.

6.5.3 Habitat Unit Classification

As a percentage of main channel habitats (Figure 22), 23% of the lower 13.7 miles of Dry Creek are pools, 7% are scour pools, 26% are riffles, 44% are flatwaters, and less than 1% cascades. The proportional amount of riffle habitat appears to correlate moderately with tributaries entering the reach below the dam. Relative increases in percent riffle can be seen downstream of Schoolhouse Creek (between reaches 14 and 15), Pena Creek (between reaches 11 and 12), Crane Creek (downstream end of reach 7) and Mill Creek (between reaches 1 and 2). The two cascades were under Lambert Bridge in Reach 7, and over the upstream sill in Reach 4. While riffles represent 26% of all mainstem habitats by frequency, they represent only 12% of the mainstem length.

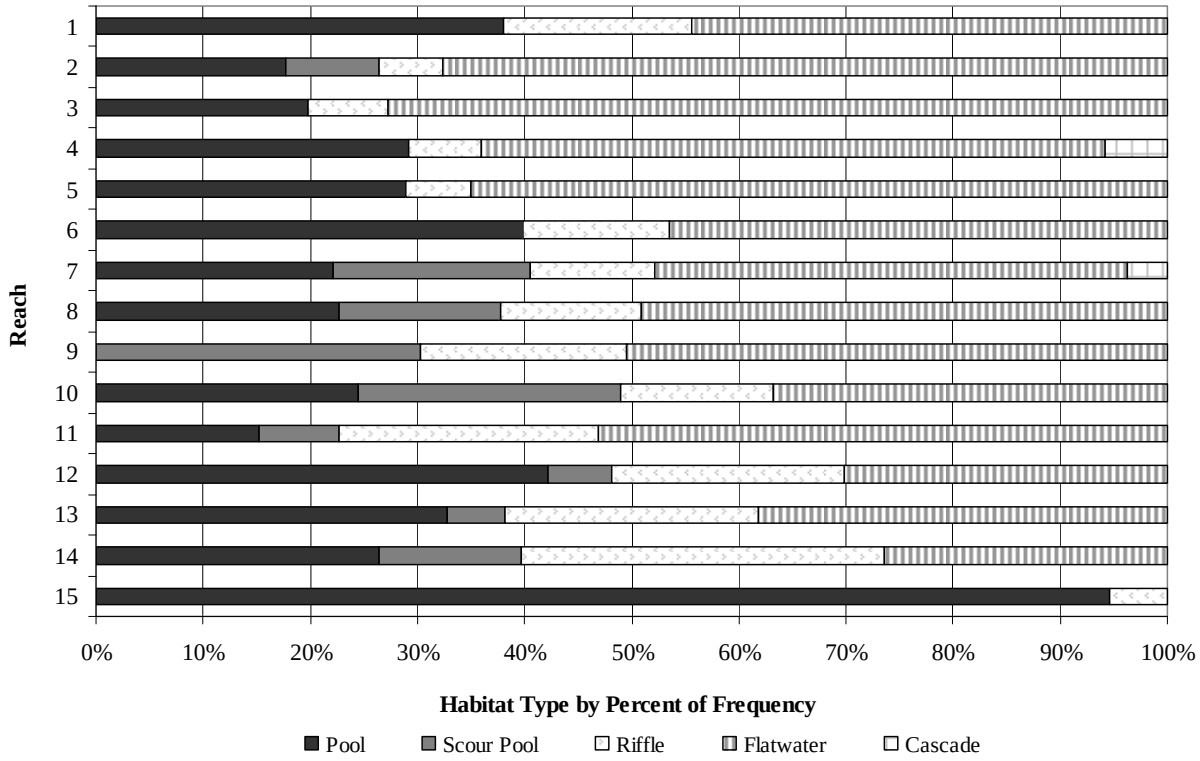


Figure 22: Distribution of habitat types by relative frequency for Reaches 1 through 15.

Table 12: Lower Dry Creek Habitat Inventory Results Summary, reaches 1 through 15.

		REACH 1	REACH 2	REACH 3	REACH 4	REACH 5	REACH 6	REACH 7	REACH 8	REACH 9	REACH 10	REACH 11	REACH 12	REACH 13	REACH 14	REACH 15
	river miles	0 to 0.7	0.7 to 2.0	2.0 to 3.0	3.0 to 4.1	4.1 to 5.4	5.4 to 6.2	6.2 to 7.5	7.5 to 9.0	9.0 to 9.8	9.8 to 10.3	10.3 to 11.0	11.0 to 11.7	11.7 to 12.6	12.6 to 13.3	13.3 to 13.6
	length (miles)	0.7	1.3	1.0	1.1	1.3	0.8	1.3	1.5	1.0	0.6	0.7	0.7	0.8	0.7	0.3
% total l frequency	**main channel pools**	32	16	17	25	26	35	19	19	0	20	13	37	29	25	50
	scour pools	0	8	0	0	0	0	16	13	23	20	7	5	5	13	0
	riffles	32	14	22	20	16	24	23	26	38	30	33	32	33	38	50
	flatwaters	37	62	61	50	58	41	39	42	38	30	47	26	33	25	0
	cascades	0	0	0	5	0	0	3	0	0	0	0	0	0	0	0
	# side channels	2	3	8	3	1	0	3	0	0	1	1	3	0	1	0
	# alcoves	4	6	4	8	2	0	8	1	1	3	1	1	3	2	1
% total length	**main channel pools**	39	18	25	59	30	60	45	36	0	26	13	49	41	26	97
	scour pools	0	3	0	0	0	0	22	21	49	25	2	7	6	12	0
	riffles	15	5	6	6	6	12	10	11	15	12	21	19	21	32	3
	flatwaters	47	73	69	34	64	28	22	32	37	38	64	25	33	30	0
	cascades	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
avg width (feet)	**wetted channel**	45.6	45.6	47.7	51.9	48.4	48.6	47.7	45.8	51.1	47.6	46.5	46.0	43.5	48.1	39.0
	active channel	62.5	68.0	82.0	52.0	69.0	n/a	58.5	58.5	57	78	56.6	54.0	41.0	65.0	45
	floodprone	137.5	140.0	110.0	112.0	86.5	n/a	81.0	70.5	95	87.0	78.0	93.0	62	139.0	126
	avg. active channel depth	2.1	2	1.35	2.15	1.8	n/a	2.5	2.4	2.8	2.4	2.6	2.6	2.3	2.6	2.9
	width:depth	30	40	48	19	39	n/a	24	24	21	32	22	21	18	25	15
	entrenchment	2.2	2.02	1.4	2.2	1.3	n/a	1.6	1.2	1.7	1.1	1.4	1.7	1.5	2.1	2.8
avg depth (feet)	**pools max**	4.0	4.3	4.6	5.3	4.9	5.5	4.8	4.7	4.2	6.3	5.1	5.5	5.7	5.7	7
	pools residual	2.7	2.8	2.4	3.8	3.4	4	3.5	3.4	3.0	5.0	4.3	3.9	3.8	4.4	4.5
	riffle	1.1	0.9	1.1	1.2	1.0	0.9	1.0	1.0	0.9	1.1	1.0	1.4	1.2	1.1	2
	flatwaters	1.4	1.5	1.4	1.3	1.5	1.5	1.4	1.4	1.5	1.9	1.8	2.0	2.2	2.3	
	cascade				0.9			1.1								
	side channel	0.6	1.3	1.8	0.9	0.5		0.8			0.3	1.0	1.6		1.1	
	alcove max	1.0	2.0	1.4	1.7	1.0		2.0	2.0	1.5	2.6	2.3	2.5	2.2	3.5	3
	% cover (mainstem habitats)	17	26	24	22	24	23	26	18	20	25	19	24	19	20	19
	complexity value (mainstem habitats)	2.1	2.7	2.7	2.5	2.6	2.6	2.6	2.6	3.0	3.0	3.0	2.8	2.7	2.7	2.0
	shelter rating (mainstem habitats)	35	69	65	55	61	59	67	47	59	74	56	67	51	54	37
	edge habitat frequency (mainstem habitats)	38%	39%	60%	58%	40%	29%	43%	47%	31%	36%	12%	26%	33%	19%	33%
wood	**pieces per mile**	96.9	141.9	165.4	184.9	233.9	195.6	190.5	193.6	192.8	361.8	269	176.6	159.9	117	62.9
	% live wood	42%	50%	43%	37%	31%	38%	34%	23%	19%	17%	29%	37%	51%	66%	70%
	# pieces S, M, L	41, 14, 9	158, 71, 13	174, 54, 30	177, 66, 15	229, 47, 20	110, 29, 15	231, 57, 8	233, 55, 8	124, 22, 9	171, 55, 9	132, 52, 12	122, 36, 3	100, 35, 6	64, 29, 0	13, 7, 0
	# pebble counts	1	1	2	1	2	1	4	1	1	1	2	1	1	2	1
% frequency in riffles	**spawning gravels** (11.4 to 128 mm)	84%	79%	81%	89%	80%	84%	80%	82%	81%	69%	73%	77%	83%	69%	67%
	fry rearing gravels (32 to 128 mm)	39%	33%	42%	49%	41%	45%	36%	53%	36%	45%	33%	51%	55%	37%	37%

6.5.4 Pool Dimensions

In higher order streams, CDFG categorizes pools greater than 3 feet deep as *primary pools*. Most pools in Dry Creek had maximum depths greater than 3 feet (Figure 23) with an average maximum pool depth of 5.2 feet (stdev 1.4, n=93). Pool depths generally decreased in the downstream direction, with a greater proportion of scour pools in the middle to upstream end of the survey. The channel width for main channel pools (49.0 feet) was slightly higher than that for flatwaters (47.3 feet) or riffles (44.7 feet), but the average width of scour pools was only 45.7 feet. The average pool residual depth was 3.6 feet (stdev 1.3, n=93) with relatively uniform pool crest depths of 1.5 feet (stdev 0.3, n=93) on average.

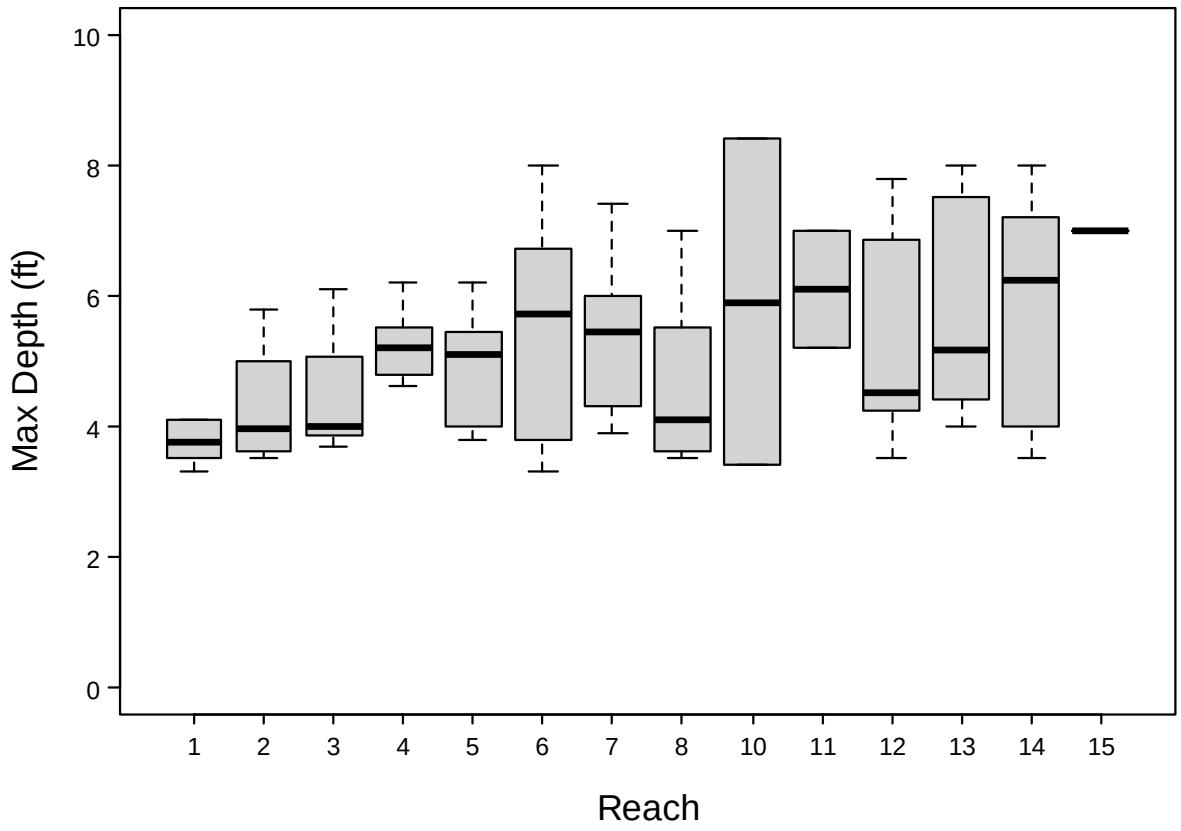


Figure 23: Standard box plot[7] depicting maximum pool depths. Median values are shown by the thick horizontal black lines. The 25th – 75th percentile range is contained within the gray-shaded box.

[7] Standard boxplot: The 25th – 75th percentile range of the data - the 'interquartile range' (IQR) - is contained within each gray-shaded box, and the medians are shown by the thick horizontal black lines. The upper 'whisker' represents the 75th percentile + 1.5*IQR. The lower 'whisker' represents the 25th percentile – 1.5*IQR.

6.5.5 Riffle and Flatwater Dimensions

In lower Dry Creek, the average riffle depth was 1.1 feet (stdev 0.3, n=79) and the average flatwater depth was 1.6 feet (stdev 0.4, n=133). The average riffle depths (
Figure 24) were more consistent than flatwater depths (Figure 25), with deeper flatwaters observed in the upstream third of lower Dry Creek. Overall, there was far more flatwater than riffle habitats (44% of the total length versus 12% for riffles). The average riffle width was 44.7 feet (stdev 9.1, n=79) and the average flatwater width was 47.3 feet (stdev 7.5, n=133). Riffles were much shorter than flatwaters, with an average length of 110.1 feet (stdev 76.4, n=79) versus 227.8 feet (stdev 182.07, n=133) for flatwaters. The pool:riffle ratio was 1.2:1 (93 pools to 78 riffles).

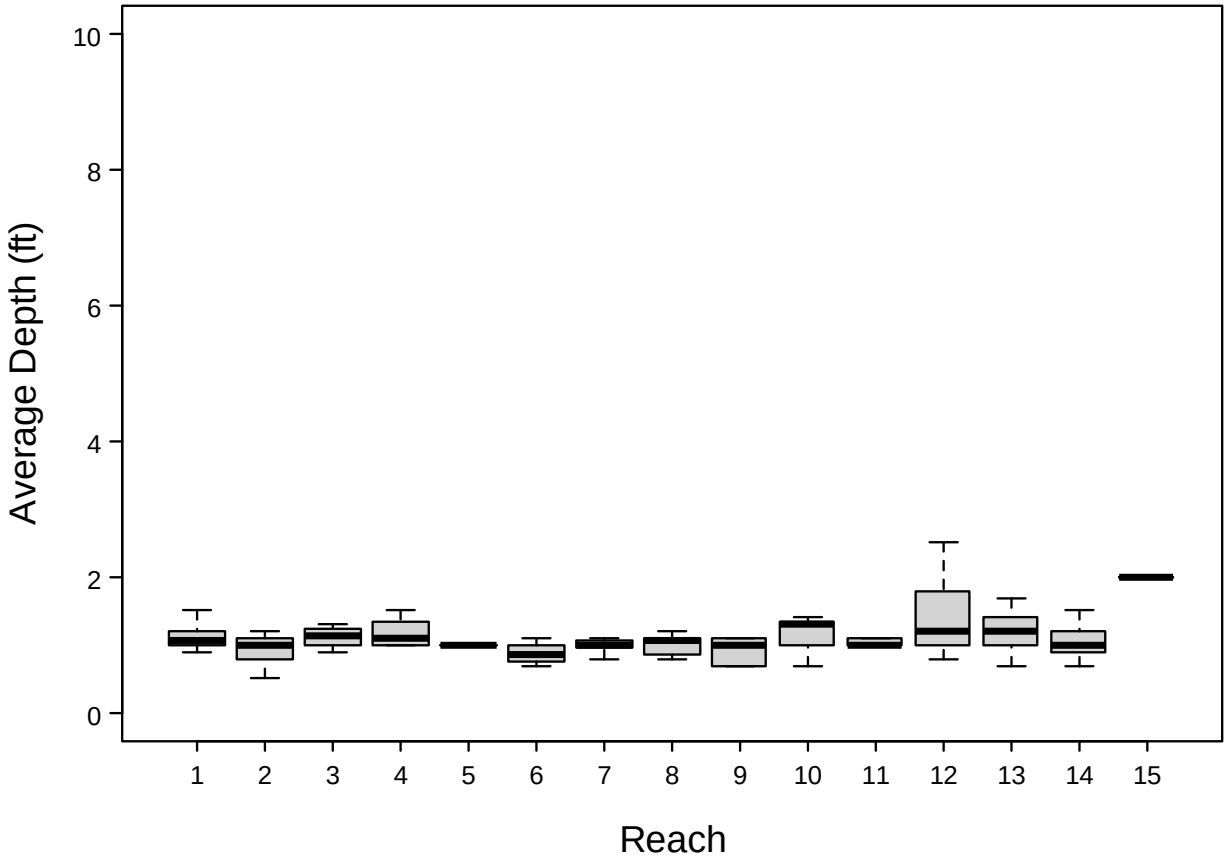


Figure 24: Standard box plot[7] depicting average riffle depths. Median values are shown by the thick horizontal black lines. The 25th – 75th percentile range is contained within the gray-shaded box.

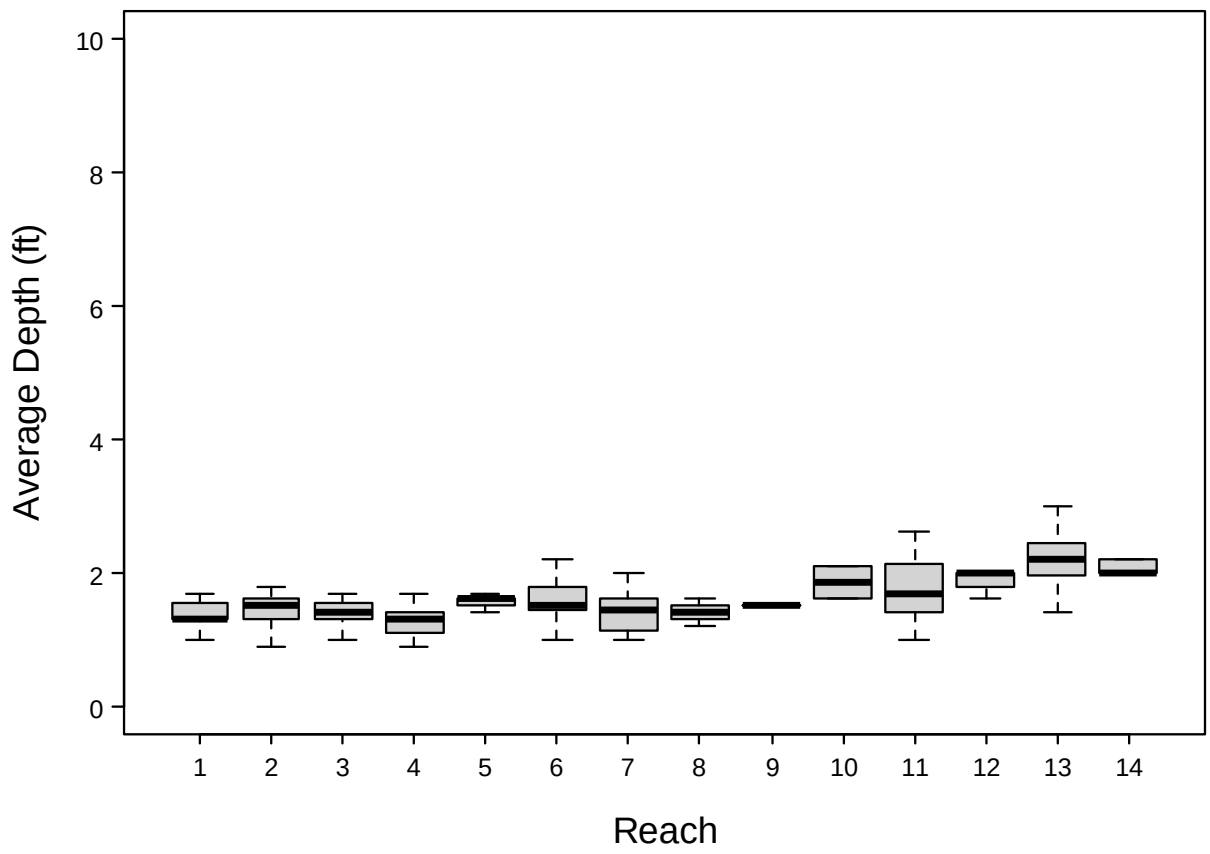


Figure 25: Standard box plot[7] depicting average flatwater depths. Median values are shown by the thick horizontal black lines. The 25th – 75th percentile range is contained within the gray-shaded box.

6.5.6 Substrate

Pebble counts were conducted in riffles in all surveyed reaches (Figure 26). The gravel sizes in the sampled riffles generally meet coho and steelhead spawning requirements, with ample proportion (67% to 89%, with an average of 79%) of ideally sized gravels and cobbles (11.4 to 128mm). In addition, the proportion of ideally-sized substrate for fry rearing (32 to 128 mm) ranged from 33% to 55%, with an average of 42%. Based on the pebble count data, sediment sand-sized and smaller comprised up to 10% of surface substrate in the sampled riffles, with an average sampled proportion of 5%.

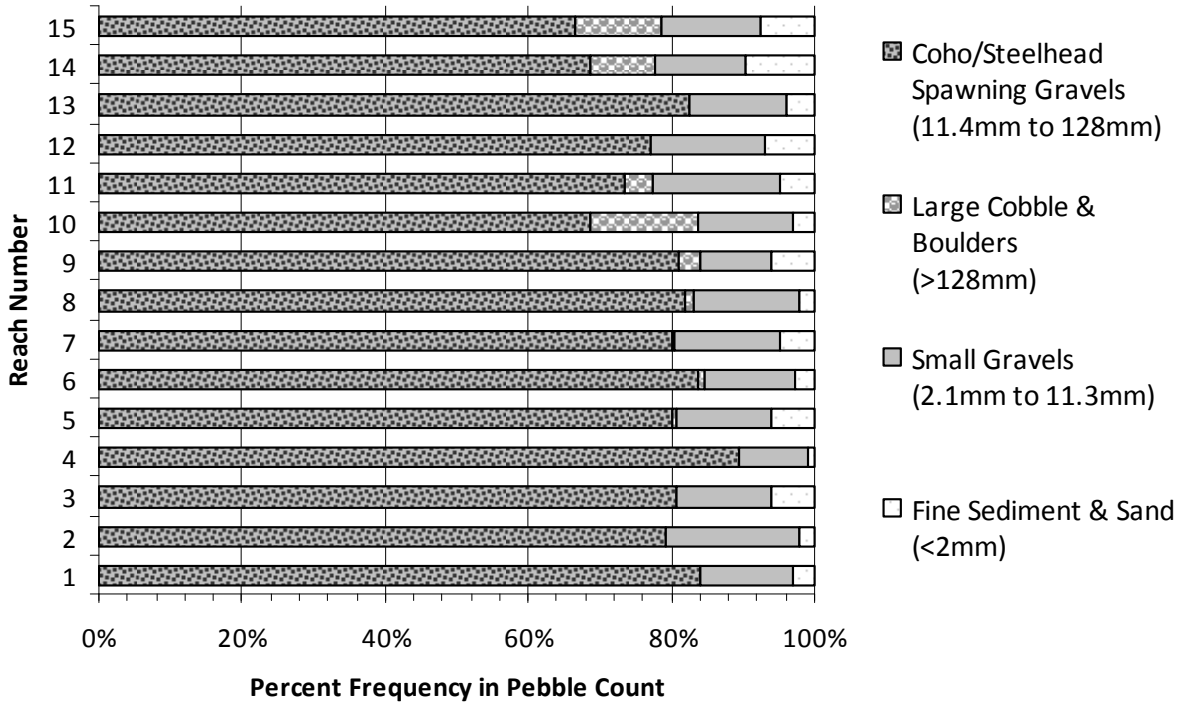


Figure 26: Riffle surface substrate size distribution by reach, based on pebble count sampling of representative riffles in each reach.

Dominant and subdominant substrates were categorized for all habitat units. In 81% of all pools, the dominant substrate was gravel, with sand recorded as the dominant substrate for 13% of pools, and cobble for 3% of pools. The subdominant substrate was primarily sand (64% of pools), with some cobble (20% of pools) and gravel (13% of pools). 3% of pools had some boulder or bedrock substrate.

Riffle beds were most dominated by gravels (81% of riffles) and small cobbles (17% of riffles), with a subdominant substrate of small cobbles (79% of riffles) and gravels (14% of riffles). Dominant flatwater substrate was primarily gravel (93% of flatwaters), with subdominant substrate of sand (49% of flatwaters) and cobble (46% of flatwaters). In the two cascades, dominant substrate was bedrock with boulders, and some cobble.

In side channel pools (SCPs), dominant substrate was most often fine sediment (40% of SCPs), gravel (30% of SCPs), or sand (30%of SCPs), with subdominant substrate of sand (60% of SCPs), cobble (10% of SCPs) and fine sediment (20% of SCPs). In side-channel riffles (SCRs), dominant substrate was gravel (100% of SCRs) with small cobble (75% of SCRs) and sand (25% of SCRs) as subdominant substrates. In side-channel flatwaters (SCFs), dominant substrates were gravels (100% of SCFs), with subdominant substrates of sand (78% of SCFs) or cobble (22% of SCFs). Alcoves were most often lined with fine sediment (52% of alcoves), followed by gravel (37% of alcoves), with occasional sand and small cobble. Subdominant substrate was sand (50% of alcoves), or gravel (27% of alcoves), fine sediment (16% of alcoves) or cobble (7% of alcoves).

In some areas, boulder riprap has fallen or been recruited into the channel bottom providing cover for fish. Where tributaries flow into Dry Creek, smaller gravels and fine sediments are

often deposited in small fans. A more detailed description of substrate characteristics can be found in the geomorphic summary included in this report.

6.5.7 Instream Woody Debris

Instream woody debris totaled an average of 183 pieces of wood per mile in lower Dry Creek, with variability from reach to reach, including 63 pieces per mile in Reach 15 to 362 pieces per mile in Reach 10. Figure 27 shows the pieces of small, medium, and large wood per mile by habitat type for all reaches combined. No wood was observed in the two cascade habitat units.

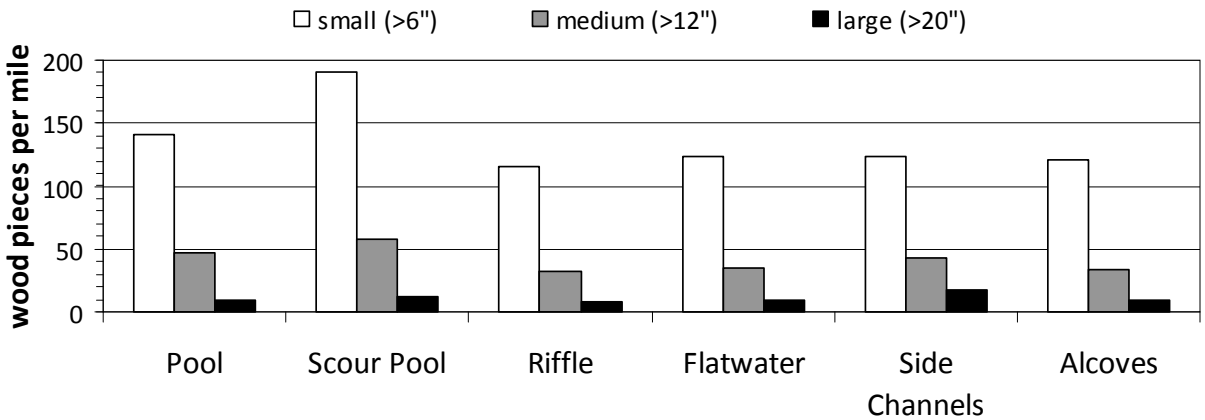


Figure 27: Wood pieces per mile across habitat types.

We also classified wood as living or dead. 46% of all the pieces counted were living, with 44% of the large pieces living, and 46% of the small and medium pieces living. Recent publications by Opperman and others (2005, 2006, 2008) and Thompson et. al. (in press) highlight the geomorphic and ecological importance of living wood in Northern Californian stream systems.

6.5.8 Side Channels & Alcoves

In general, there were a greater number of off-channel habitats in the lower half of lower Dry Creek. A total of 44 alcoves and 27 side channels were measured. In addition, two very small alcoves were described, but not measured. Of the 27 side channels, 10 were side channel pools, and 17 were split between side channel flatwaters and side channel riffles.

20% of the alcoves were over 100 feet long, 34% were less than 50 feet long. One alcove was 1500 feet long. On average, alcoves were 14.4 feet wide (stdev 7.1, n=45) with an average maximum depth of 1.9 feet (stdev 1.1, n=44). The average side channel pool length was 214 feet, with 45% over 100 feet long, and one 2500 feet long. The average side channel pool width was 17.7 feet (stdev 11.3, n=9) and the average maximum depth was 2.2 feet (stdev 1.1, n=9). The average side channel riffle length was 67.5 feet (stdev 36.5, n=8), with a width of 17.6 feet (stdev 8.8, n=8), and a depth of 0.6 feet (stdev 0.3, n=8). The average side channel flatwater was 173.1 feet long (stdev 152.5, n=9), with a width of 15.7 feet (stdev 7.2, n=9), and a depth of 0.9 feet (stdev 0.3, n=9). Six out of the nine side channel flatwaters were over 100 feet long, with one 250 feet long, and another 550 feet long.

6.5.9 Instream Cover & Shelter Complexity

Average cover in pools (27%) was higher than in flatwaters (22%), and cover was greater in flatwaters than in riffles (15%). The two cascade habitat units contained 73% percent cover, due to a high percentage of cover provided by bedrock and boulders that resulted in shelter ratings of 285 and 100. Shown in Figure 28, pools were rated with the highest instream shelter complexity, followed by flatwaters, cascades, and riffles. This complexity was mostly associated with overhanging willows and other vegetation, and with small woody debris.

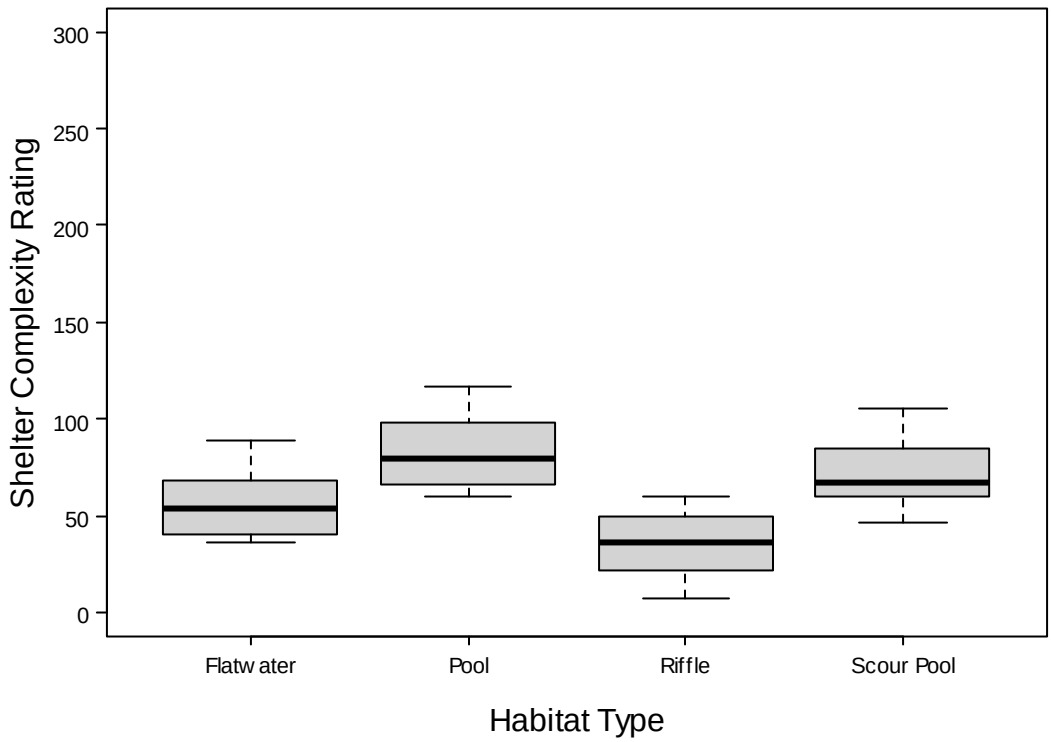


Figure 28: Standard box plot[7] depicting shelter complexity ratings for mainstem habitat types. Median values are shown by the thick horizontal black lines. The 25th – 75th percentile range is contained within the gray-shaded box.

Off-channel habitats generally had much higher cover than main channel units. The average cover in side channels was 41% and in alcoves it was 58%. Higher cover was due to aquatic vegetation, small woody debris, and overhanging shrubs and trees. Shown in Figure 29, Higher complexity values were assigned to side channel pools and alcoves, with side channel flatwaters and side channel riffles receiving the lowest complexity values overall.

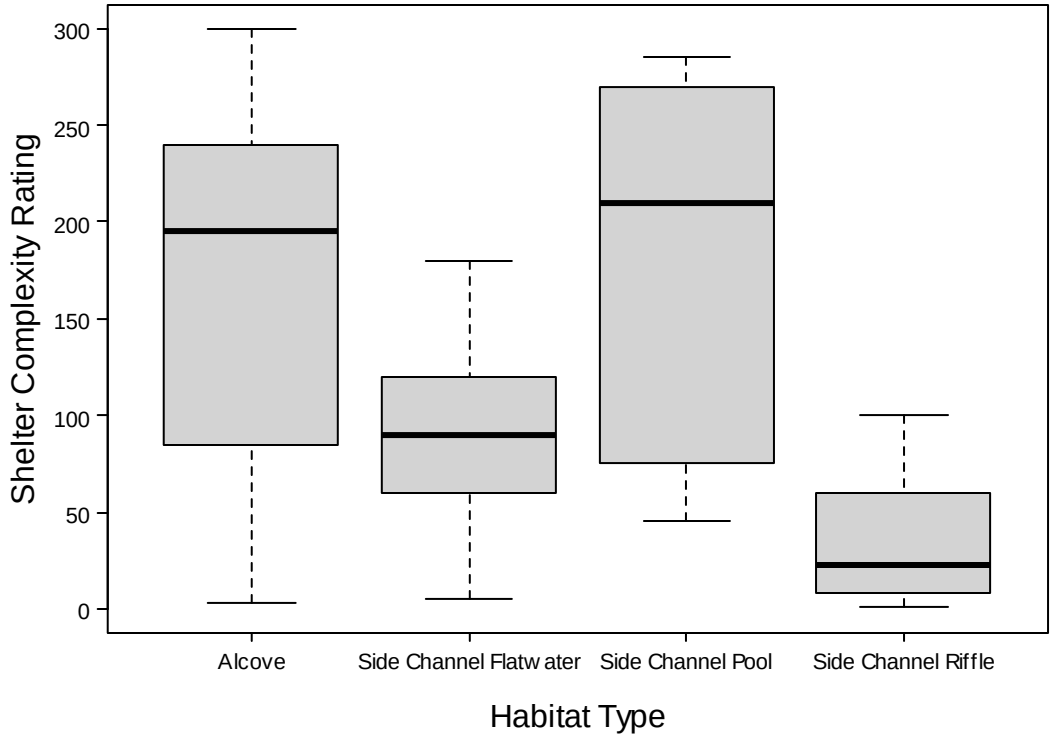


Figure 29: Standard box plot[7] depicting shelter complexity ratings for off-channel habitat types. Median values are shown by the thick horizontal black lines. The 25th – 75th percentile range is contained within the gray-shaded box.

6.5.10 Frequency of Edge Habitat

Overall, edge habitat was present in 41% of all habitat units. Edge habitat was most often associated with side channels (59%) and alcoves (71%). 37% of flatwaters contained edge habitat, whereas it was associated with only 35% of main channel pools and 27% of scour pools. Riffles contained the lowest frequency of edge habitat, with only 18%. One of the two cascades contained edge habitat.

6.5.11 Estimation of Pool Velocities

Water velocities in pools at the time of the habitat inventory were estimated using approximate methods for purposes of general evaluation. Velocity estimates were calculated over the discharge range 80 cfs to 105 cfs, which bracket the discharges observed at the USGS streamgages on lower Dry Creek during the dates of the 2009 habitat inventory field effort. The estimates were based on the average pool width, maximum pool depth, and an assumed creek bed shape approximated by a half-ellipse[8]. Because these estimates were made based on maximum pool depths, they could be considered conservative (i.e. slower) relative to average pool velocities throughout the pool units. Figure 30 shows the results of the velocity estimates for the 93 pools in Dry Creek for discharges of 80 cfs and 105 cfs. The average main channel pool velocity calculated in this manner was 0.46 ft/s (stdev 0.15, n=93) at 80 cfs and 0.61 ft/s (stdev 0.21, n=93) at 105 cfs. While based on approximate methods only, the estimated velocities

[8] For the velocity back-calculation, we assumed the channel was shaped like the bottom half of an ellipse. Area of the ellipse is calculated with the equation: $A = \pi ab$, where a and b are ½ of the width and ½ of the height respectively. By substituting maximum pool depth for b, and average wetted width for a, and multiplying by 0.5 we approximated channel area. Estimated velocity was then calculated as $V=Q/A$, where Q is the stream discharge.

appear to generally concur with the measured velocities reported in the 2001 flow-habitat assessment (Entrix 2004). All of the average velocities for main channel pools measured for the 2001 study and calculated based on the 2009 habitat inventory data exceed the pool velocity criteria stated in the RRBO as optimal for juvenile coho rearing (discussed further below).

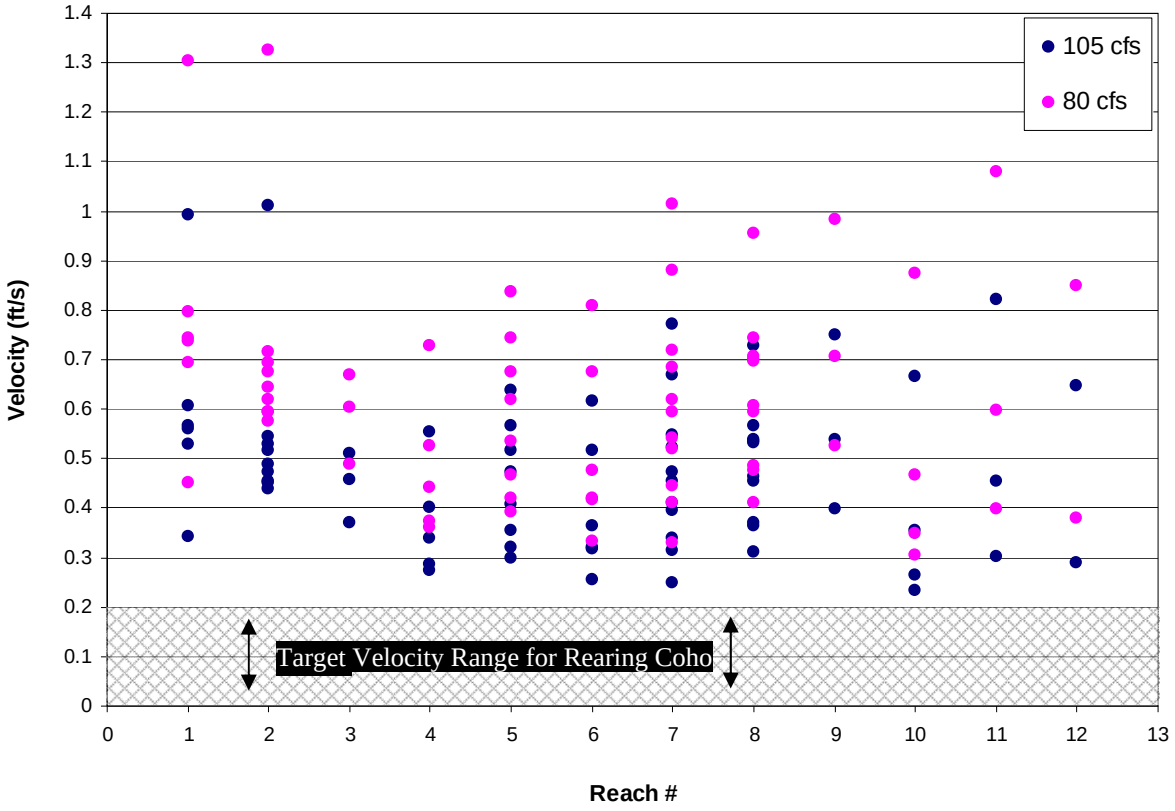


Figure 30: Estimated velocities for lower Dry Creek pools based on 2009 habitat inventory data. Velocities were calculated at 80 and 105 cfs to capture the typical range of discharge in Dry Creek during the time of the habitat inventory. The cross-hatched area is the target velocity range for coho rearing habitat (< 0.2 ft/s).

6.5.12 Man-made Features

Although we did not specifically measure lengths of bank erosion, eroding banks were observed in Reach 1 and in Reach 7. We did record bank stabilization efforts and other man-made features in the creek where visible (Photograph 16). These were added to the existing feature GIS layer, and are described in the Reach Summaries (Appendix A) in greater detail. Overall, there were a high number of bank stabilization efforts using riprap, cars, creosote-preserved wood fences, steel I-beams, and chain-link fence.

Photograph 16: Man-made features in Dry Creek.

6.5.13 Riparian Observations

We did not measure canopy cover, but the riparian forest along lower Dry Creek is one of its most prominent features. In many reaches, it formed a 'green tunnel' completely enclosing the active stream (Photograph 17). Riparian forests are especially important for supporting the food base and providing structure for juvenile salmonids. Species observed along lower Dry Creek included Fremont cottonwood (*Populus fremontii*), Hinds walnut (*Juglasn hindsii*), white alder (*Alnus rhombifolia*), California box elder (*Acernugundo ssp. Californicum*), Oregon ash (Fraxinus latifolia), coast live oak (*Quercus agrifolia*), California bay (*Umbellularia californica*), and abundant willows of various species.

Photograph 17: Dry Creek's riparian forest.

6.5.14 Wildlife Observations

We observed quite a few mergansers, great blue herons, and kingfishers, along with river otter scat. These observations would seem to indicate an available fish-based food base for these fauna. We also observed a great number of young frogs near the mouth of Pena Creek, and a number of turtles. Small, unidentified fish jumped as schools in several pools, and we also observed a number of juvenile rainbow trout.

6.6 Comparison of Habitat Inventory Results to the 2008 RRBO Criteria

The RRBO recommends a Reasonable and Prudent Alternative for lower Dry Creek, including several criteria to guide development of habitat enhancement. These are summarized and compared with results of the 2009 habitat inventory in Table 13. Selected results of the comparison include the following:

- The RRBO specifies that pools should comprise 33-67% of habitat area. Total pools (pools and scour pools) represent 30% of all habitat units, based on the 2009 habitat inventory.
- Pool:riffle ratios that fall within the 0.5 – 2.0 range specified by the RRBO are found in the study reaches. However, only 12% of the length of Dry Creek is comprised of riffles, which highlights the proportional deficit of this habitat type.
- The average residual depth of 3.6 feet for pools in lower Dry Creek falls within the range specified by the RRBO (2 – 4 ft).
- The 2008 RRBO specifies that ample large woody debris should be present. The 2009 habitat inventory found a moderate amount of large woody debris. Abundance of dead woody debris peaks in the middle of the reach, while live woody debris is more evenly distributed. Additional detail of LWD present in lower Dry Creek is discussed in section 6.7.
- The RRBO specifies that off-channel habitat should be available. Dry Creek has an average of 4.7 (stdev 4.1, n=71) off-channel habitats per reach, including alcove, side-channel pool/riffle/flatwater units. Alcove and side channel habitats were more abundant in the lower half of Lower Dry Creek, while edge habitat was also slightly more abundant in the same area. Five of the reaches have no off-channel habitats.
- The RRBO specifies that habitat quality should be near ideal. The current inventory found main channel percent cover and main channel shelter complexity ratings to be less than habitat standards. Additionally, as discussed previously, estimated pool velocities exceed RRBO criteria.

Table 13: Comparison of 2009 Dry Creek Habitat Inventory results with 2008 Russian River Biological Opinion criteria for Dry Creek.

2008 RRBO CRITERIA	Measured Characteristics (2009 Habitat Survey)	Lower Dry Creek Average	REACH 1	REACH 2	REACH 3	REACH 4	REACH 5	REACH 6	REACH 7	REACH 8	REACH 9	REACH 10	REACH 11	REACH 12	REACH 13	REACH 14	REACH 15
Pool Abundance: 33%-67%	Pool Abundance[9]																
	% by Frequency	30%	32%	24%	17%	25%	26%	35%	35%	32%	23%	40%	20%	42%	34%	38%	50%
	% by Habitat Area	46%	39%	21%	26%	62%	30%	62%	69%	57%	45%	53%	13%	60%	48%	39%	99%
Pool Frequency: 0.5 to 2	Pool Frequency (Pools : :Riffles)	1.2	1.0	1.2	0.8	1.3	1.6	1.5	0.9	0.8	0.0	0.7	0.4	1.2	0.9	0.7	1.0
Residual Pool Depth: 2 - 4 ft	Residual Pool Depth (ft)	3.6	2.0 - 4.1	2.1 - 3.9	2.3 - 2.5	3.1 - 4.6	2.3 - 4.7	2.1 - 6.6	2.5 - 6.2	2.0 - 5.8	2.5 - 3.7	2.3 - 7.0	3.5 - 5.0	2.2 - 6.6	2.4 - 6.0	2.4 - 6.8	4.5
Pool Velocity: < 0.2	Pool Velocity (ft/s)[10]	0.5	0.3 – 1.3	0.4 – 1.3	0.4 – 0.7	0.3 – 0.7	0.3 – 0.8	0.3 – 0.8	0.3 – 1.0	0.3 – 1.0	0.4 – 1.0	0.2 – 0.9	0.3 – 1.1	0.3 – 0.9	0.3 – 0.7	0.2 – 0.8	0.3 – 0.4
Pool Size: 500 - 2700 ft^2	Pool Size (ft^2)	22713	12106	7156	22308	40790	12243	21159	21529	20572	31128	19162	8242	13024	13363	8263	89650
Woody Debris: Ample LWD	Woody Debris pieces/mile[11]	182.8	96.9	141.9	165.4	184.9	233.9	195.6	190.5	193.6	192.8	361.8	269	176.6	159.9	117	62.9
Off-Channel Habitat: Available	Off-Channel Habitat # of Side Channels, Alcoves	4.7	6	9	12	11	3	0	11	1	1	4	2	4	3	3	1
	Area (ft^2)	9283	3390	2200	51735	8700	720	-	14450	-	-	490	2500	7020	-	1620	-
Habitat Quality: "Near Ideal"	Habitat Quality % Cover[12] Shelter Rating [13]	32% 88	26% 65	40% 108	42% 122	28% 67	28% 74	22% 59	39% 104	21% 58	38% 114	40% 111	17% 49	35% 104	35% 104	23% 62	39% 112

[9] Includes main channel pools and scour pools
[10] Range of velocities estimated for 80 – 105 cfs is shown for each reach. Velocity calculations are estimates based on discharge and habitat dimensions measured at the time of the 2009 habitat survey, described in Section 6.5.11. Velocities measured in the 2001 Entrix report ranged from 0.4 – 1.3 ft/s.
[11] This includes mainstem habitats only.
[12] Includes main channel, side channel and alcove habitats.
[13] Includes main channel, side channel and alcove habitats.

6.7 Discussion of Woody Debris Loading

The relationship between dead instream wood and salmonid habitat is well recognized for conifer-dominated ecosystems in the West, but recent studies have revealed the important role of living wood in angiosperm-dominated forests in Northern California, where the primary riparian tree species include California bay laurel (*Umbellularia californica*), white alder (*Alnus rhombifolia*), big-leaf maple (*Acer macrophyllum*), canyon live oak (*Quercus chrysolepis*), and willows (*Salix spp*.) (Opperman 2005).

When compared with dead instream wood of similar dimensions, living wood in these ecosystems may be more persistent because of its greater resistance to decay and greater stability due to a living rootmass, and may provide more structural complexity, hydraulic roughness, and retentive capacity (Opperman et al. 2008). In hardwood-dominated ecosystems where riparian tree regeneration from seed is constrained or where dead wood is not produced by very large trees, livewood is expected to alter the scaling relationships between wood dimensions and channel size (Opperman et al. 2008).

Our survey counted a total of 2,865 pieces of wood within the 13.9 mile section of lower Dry Creek. 46% of these wood pieces were living. With the assumption that each piece of wood counted was between 10 and 20 feet long, we estimate between 40 m^3/hectare to 80 m^3/hectare of instream wood was present within the wetted channel of lower Dry Creek.

Thompson et al. (2008) compared instream wood loading across regions of western North America (Table 14). While the 40-80 m^3/ha estimated for lower Dry Creek compares with the average for small streams flowing through private lands in Northern California (42 m^3/ha), it is less than that measured in protected watersheds (115 m^3/ha). While the available woody debris in Dry Creek is found at lower than optimal density, it is an important resource for salmonids and other biota in the creek.

Table 14: Comparison of instream wood loading (m3/ha) across regions of western North America. Reprinted from Thompson et. al. 2008.

Region	n	Mean (SD)	Median (interquartile)	Maximum
Pacific Northwest (BC, WA, OR)[a]	62	752 (810)	535 (315, 858)	4500
Sierra Nevada conifer[b]	12	160 (99)	159 (108, 209)	=382
No. CA hardwood, protected watersheds[c]	9	115 (33)	107 (93, 137)	=173
No. CA hardwood, private land[c]	23	42 (43)	20 (14, 59)	=146
So. CA hardwood (this study)	15	47 (58)	17 (11, 58)	=164

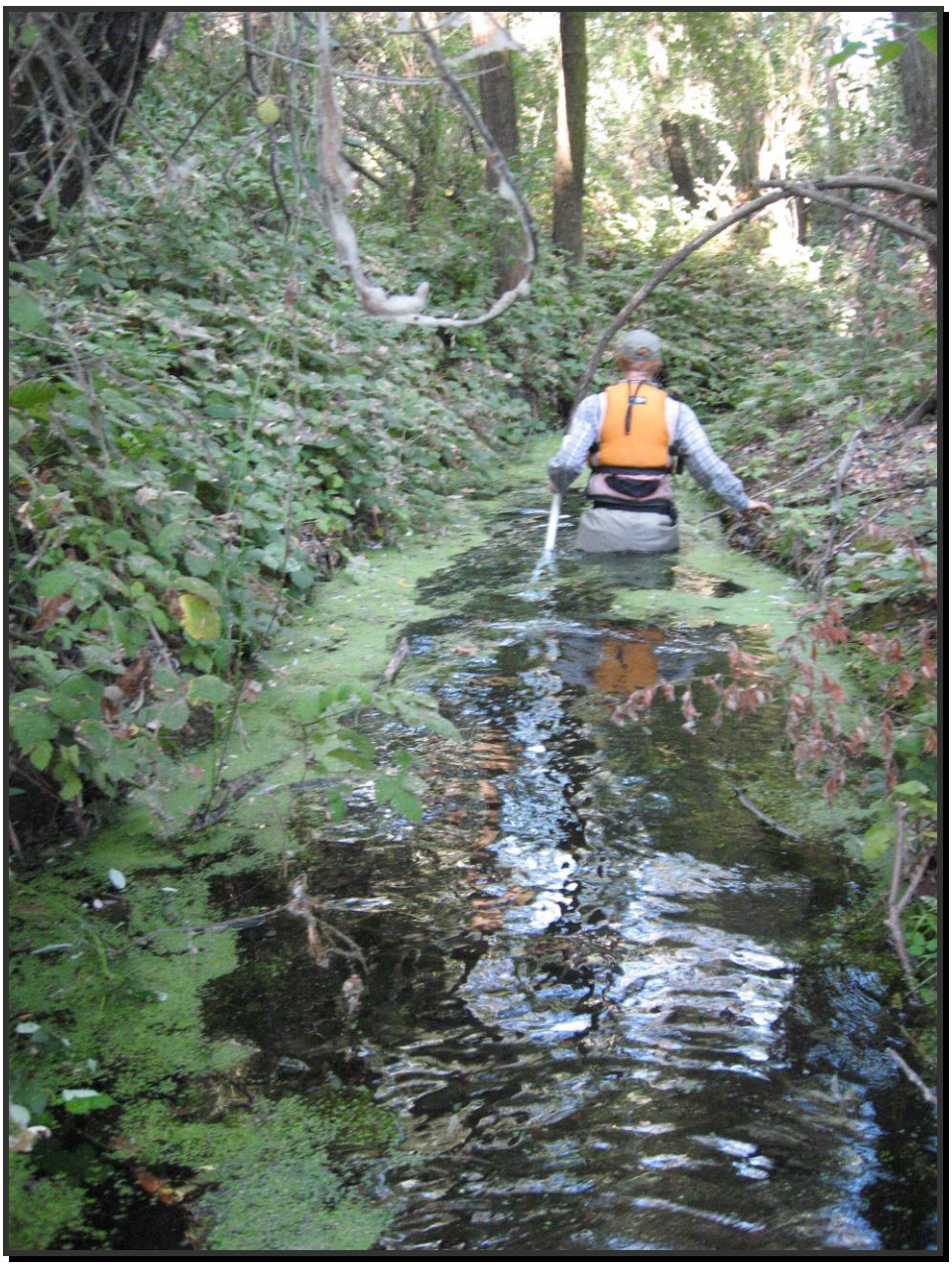
[a] Data from Andrus and others (1988), Harmon and others (1986), and Keller and Tally (1979).
[b] Data from Berg and others (1998)
[c] Data from Opperman (2005)

7 PREVIEW OF ENHANCEMENT OPPORTUNITIES

The recommended Reasonable and Prudent Alternative contained in the RRBO requires enhancement of six miles of lower Dry Creek to provide near ideal summer rearing conditions for coho and steelhead at the proposed steady state operational discharge (approximately 100 cfs), with an emphasis on coho. The six miles of enhancements are to be distributed over the 13.9 miles, implemented at a minimum of eight locations on the creek. It is intended that the enhancements for summer rearing will also integrate characteristics to provide winter rearing and refugia habitat. The enhancements are to be implemented with a phased approach which allows for evaluation of the effectiveness of the enhancements as the effort progresses (NMFS 2008).

As discussed above, the RRBO offers specific criteria with respect to desired main channel rearing habitat characteristics. The RRBO also stresses the availability of off-channel habitats in low velocity areas with substantial cover. Finally, the enhancement techniques should consider 'log or rock weirs, deflectors, log jams, constructed alcoves, side channels, backwaters, and dam pools that have successfully increased the quantity and quality of summer and winter rearing habitat for coho and steelhead' (NMFS 2008). The terms identified in the RRBO necessarily focus on criteria at the habitat unit scale over a subset of Lower Dry Creek. However, fluvial systems such as Dry Creek are characterized by longitudinal, vertical, lateral and temporal physical and biological process pathways. It will be necessary to assess feasibility at the system scale (WSD to confluence) to assess continuity in these processes in order to affirm the feasibility and sustainability of the enhancement work which is likely to be implemented at the project scale.

Based on the 2009 fish habitat inventory (Section 6) which was completed at the approximate steady state discharge, Lower Dry Creek currently contains 30% total pools (23% main channel pools and 7% scour pools), 26% riffles, and 44% flatwaters (by relative frequency), with average maximum and average residual pool depths of 5.2 and 3.6 feet, respectively. Overall pool habitat quality does not meet desired characteristics. Additionally, velocity estimates suggest that pool velocities are higher than 0.2 ft/s, falling outside the range described in the RRBO. Furthermore, length of riffle habitat is low, and a limited amount of alcove habitat was identified (Photograph 18). Based on these results and additional discussion with stakeholders, a suite of proposed enhancements will be developed in successive phases of the project. The proposed enhancements are likely to include combinations of mainstem pool and riffle enhancement, off-channel backwater and alcove enhancement and creation (Photograph 19), side-channel enhancement and creation (Photograph 20), and enhancement and stabilization of streambanks using bioengineering or similar techniques where appropriate. For example, based on the results of the habitat survey, enhancement with large woody debris may improve pool quality in terms of percent cover and shelter complexity rating. Enhancements of riffles may include expanding existing riffles or constructing new 'seed' riffles in appropriate locations, which might be considered to supplement sediment supply in certain reaches. Streambank enhancements may address chronic erosion in critical locations and provide additional cover along the channel margins.



Photograph 18: Alcove habitat in Dry Creek.

Photograph 19: Potential backwater channel / side channel analog site on Dry Creek upstream of Westside Bridge, RM 2.2. Additional large woody debris would be included in proposed designs of similar habitat.

Photograph 20: Constructed side channel habitat.

System- and project-scale feasibility will be assessed in the next phase of the study. However, areas of interest for potential enhancement were noted during the geomorphic and habitat inventory fieldwork in August-September 2009. These areas of interest were revisited by the senior project geomorphologist, fish biologist, hydraulic engineer and geologist in October 2009 to review potential enhancement opportunities, constraints, apparent limiting factors and design concepts.

Areas for potential enhancement of pools, riffles and streambanks are numerous along lower Dry Creek. Therefore, more effort was focused on identifying locations to enhance and create off-channel alcove and backwater, and side-channel habitat. These types of habitats have been proven to be particularly productive for rearing of coho salmon. While opportunities for these habitat types exist in lower Dry Creek, potential challenges are posed by Dry Creek's narrow, incised reaches, which lack available lateral areas within close elevation range of the active channel. Additional constraints on enhancement vary over the length of lower Dry Creek and include local factors such as sediment supply, elevation relative to active channel, local grade control features and the backwater influence of the Russian River.

The maps in Appendix B show locations of interest for creation of off-channel and side channel habitat. Also shown are the pools and riffles identified in the habitat unit inventory. Candidate sites for enhancement of streambanks are not specifically shown but are numerous throughout the reach. Streambank enhancements would potentially be implemented in conjunction with off-channel, side-channel and/or pool enhancements, depending on the characteristics of each site. It is anticipated that enhancement 'reaches' will be developed which would include a combination of off-channel / side-channel, mainstem pool and riffle, and bank stabilization enhancements as a package.

Phase 2 of the study will assess the feasibility of habitat enhancement in the areas of interest shown in Appendix B. Based on the results of the feasibility assessment, a list of project opportunities for which feasibility has been established will be developed. Conceptual designs will be developed for the sites deemed feasible. In conjunction with development of conceptual designs, the opportunities will subsequently be ranked based on factors (with appropriate weighting) that may include the following and other considerations:

- anticipated benefit to available habitat,
- distance downstream of the dam,
- distance downstream of a major tributary junction,
- landowner input and recommendations,
- resource agency input and recommendations,
- parcel density, and
- relative cost.

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8 APPENDIX A – DETAILED REACH SUMMARIES

REACH 1 (RM 0 to RM 0.7) **Russian River Confluence to Mill Creek Tributary Junction**

Reach 1 is defined by two major confluences: Dry Creek's confluence with the Russian River at Dry Creek river mile 0, and second the confluence of Dry Creek's second largest tributary, Mill Creek, on the right[1] bank at river mile 0.7 (Figure 1). Another confluence occurs at river mile 0.4, where an unnamed tributary enters on the left bank and has deposited small gravels at its mouth. Confluences are often ecological hotspots of diversity and productivity, due to the mixing of cold and warm waters, local heterogeneity in substrate, nutrient inputs, and hydraulics (Kiffney et al. 2006). In the Russian River watershed, Hopkirk and Northen (1980) emphasize the importance of tributary confluences: "Even if the tributary dries up during the summer, it forms an embayment on the mainstem, where water velocity is reduced and young fish and small prey species can seek shelter from mainstem predators. The roach, a small minnow native to the system, was recorded by Pintler and Johnson (1957) as being common on the mainstem [Russian River] only around the mouths of tributaries. Even the tuleperch, a native live-bearing species, enters the mouths of tributaries to deliver its young" (Hopkirk and Northen, 1980). Drastic differences in water temperature between the Russian River

Figure 1: (upper left) looking down the Russian River at the Dry Creek confluence, (upper right) looking up the mouth of Dry Creek, (lower left) the mouth of Mill Creek, and (lower right) the mouth of the unnamed tributary.

[1] In the individual reach summaries, right and left bank designation defined as looking downstream.

and Dry Creek provide cold water refugia for mainstem species.

Extending from the confluence with the Russian River upstream to the Mill Creek confluence, Reach 1 is a single-thread channel with a few vegetated gravel bars. The channel alternates primarily between pools and flatwaters. There are six main channel and two side channel riffles in this reach that range in length from 40 to 80 ft. Although historical incision has occurred (the terraces are 10 to 15 ft above the channel bed), the channel is currently vertically stable. The Russian River provides grade control for this reach, but the backwater created by the Russian River may cause some aggradation with the high sediment load from upstream and from Mill Creek.

Channel change suggested by results from historical aerial photograph analysis was corroborated during the geomorphic investigation. The channel in Reach 1 has been active since the dam was built. The channel has generally become narrower over time, but the channel has migrated frequently through the wide riparian area. The channel is currently less sinuous than in 1983 and 1998 but has a similar sinuosity to the channel in 1993. Some of the abandoned channels are still visible in the floodplain and riparian area and may provide opportunities for habitat enhancement.

Other remarkable features in Reach 1 include the active summertime USGS stream flow gage at river mile 0.16 and the abandoned seasonal Basalt Road crossing at river mile 0.05, where streambanks remain unvegetated. Another exposed area was recorded where Mill Creek enters Dry Creek. Last, a hand-built cobble dam at river mile 0.03 had been breached and did not block fish passage (Figure 2).

Figure 2: (left) A hand-built cobble dam across Dry Creek, (right) Unvegetated streambanks at the Mill Creek confluence.

Habitat Classification

The total length of Reach 1 is 0.7 miles and is comprised of 32% pools, 37% flatwater, and 32% riffles by relative frequency (Figure 3). Riffles comprise only 15% of Reach 1 by length. At the time of the survey, the average wetted width was 45.6 ft. The average active channel width was 62.5 ft and the flood prone width was 137.5 ft.

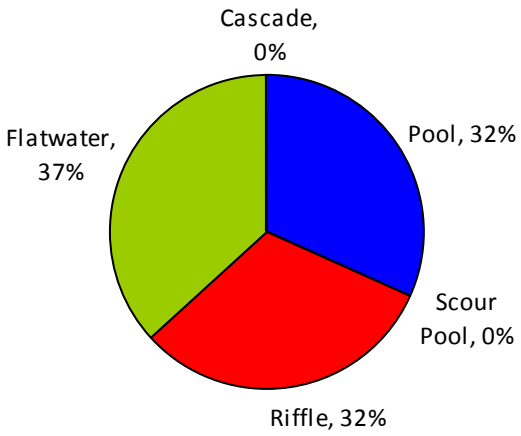


Figure 3: Proportion of Habitat Units by Relative Frequency in Reach 1

Based on a pool-riffle spacing, low confinement, and a gradient of 0.2%, Reach 1 appears to be an alluvial pool-riffle, response reach (Montgomery and Buffington, 1997). Reach 1 resembles a "C4" channel type, with a high active channel width-to-depth ratio of 30 and a moderate entrenchment ratio of 2.2 (Rosgen, 1996). Point bars and gravel islands are common in this reach, and most banks are vegetated with a maturing hardwood riparian forest.

Figure 4: (left) A typical pool in Reach 1 with overhanging vegetation, (right) the 150', glide-dominated side-channel.

Pools

Six pools were measured in Reach 1. The average maximum pool depth was 4.0 feet (Figure 5). Several of these pools resembled flatwaters for short reaches, and several of the flatwaters contained short pools. All of the pools had maximum depth greater than 3 feet. Residual pool depths averaged 2.7 feet, and pool crest depths averaged 1.3 feet. Substrate in pools was most often gravel with sand.

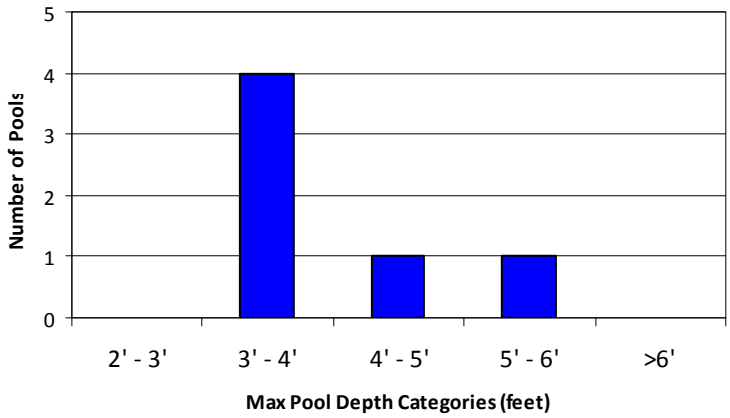


Figure 5: Maximum Pool Depths in Reach 1

Riffles & Flatwaters

There were 6 riffles and 7 flatwaters in Reach 1. The average riffle depth was 1.1 (st.dev. 0.2) and average flatwater depth was 1.4 (st.dev. 0.2). The riffles are composed of coarse gravel and small cobbles and the flatwaters are primarily gravel and sand. The D50 of the bed material in the riffle immediately downstream of Mill Creek is 26 mm, coarse gravel (Figure 6). The majority of the clast sizes were coarse gravel, with only 3% of the samples less than 2 mm (sand/fine sediment). In flatwaters, substrate was most often observed as gravel with small cobble. A greater portion of sand on the streambed was observed in this reach compared with others.

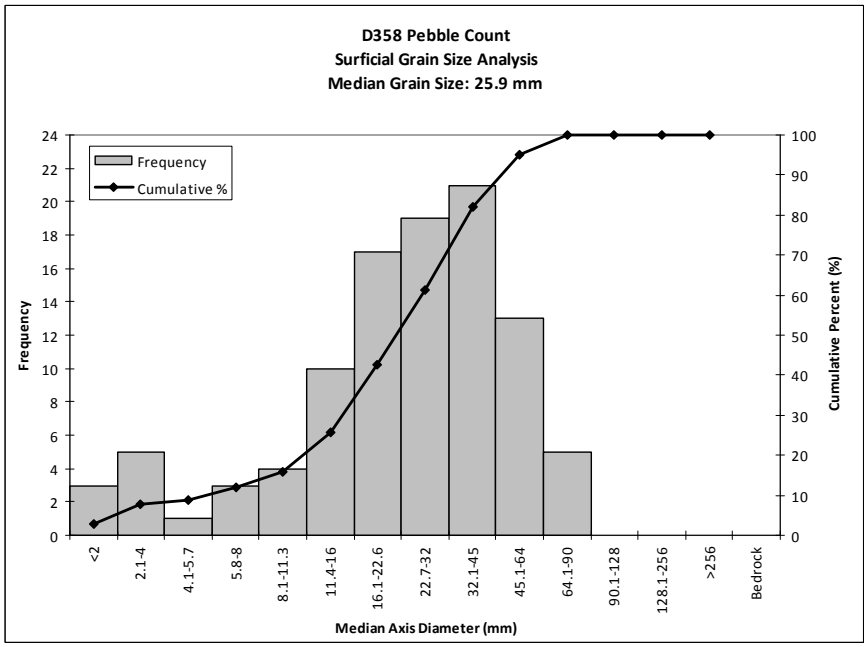


Figure 6: Grain size distribution for riffle downstream from Mill Creek (habitat unit #358).

Side Channels

We measured two side channels in Reach 1. The first side channel, a 150' flatwater, occurred just upstream of the USGS stream flow gage, where the river splits around a vegetated island. The other side channel, predominantly a riffle, connected a pool with a downstream riffle and was only 60 feet long. There was very little instream cover in either of these side-channels. Gravel with sand was the dominant substrate.

Alcoves

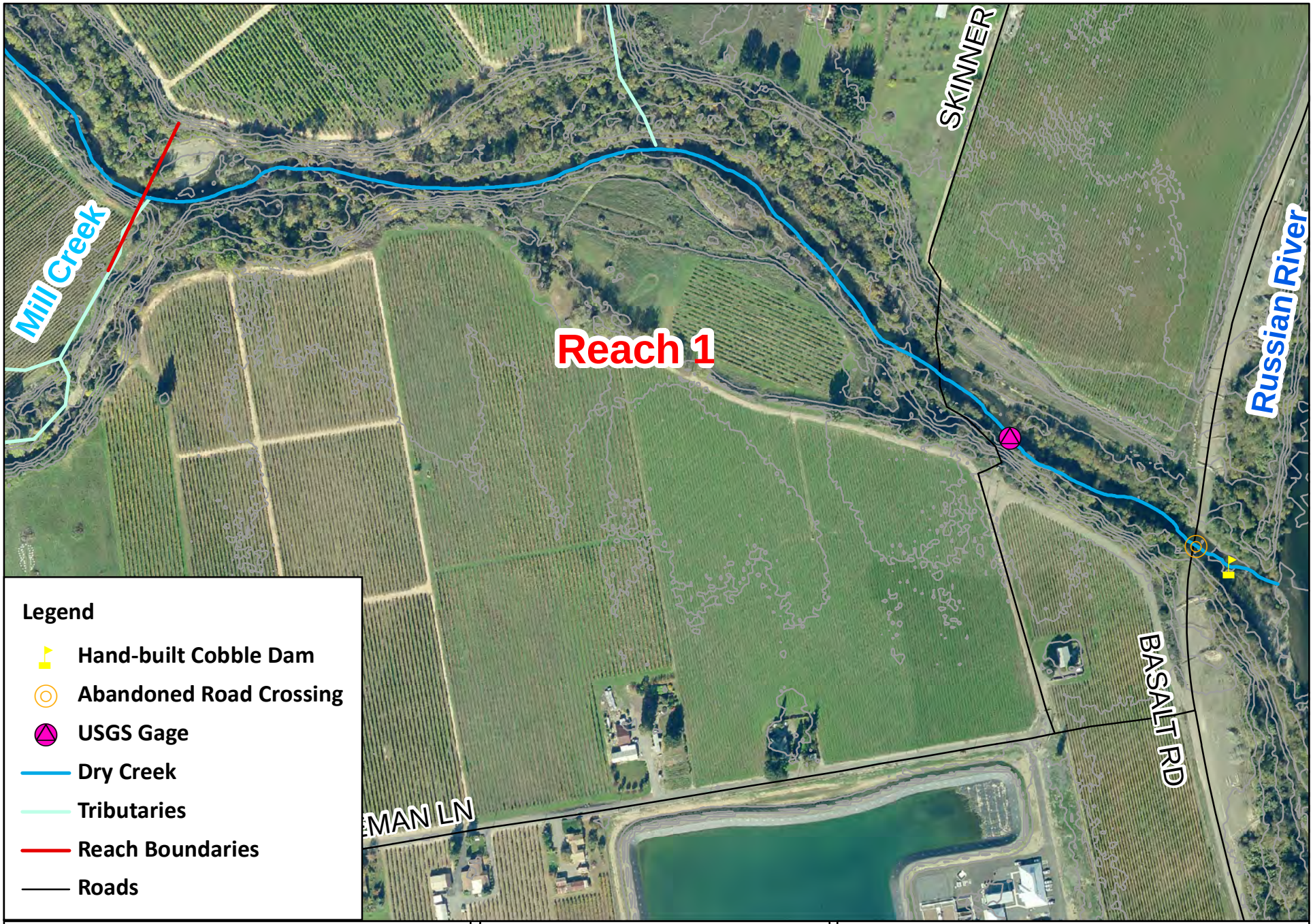
In the four alcoves measured in Reach 1, substrate was fine sediment with gravel. Two alcoves near the mouth of Dry Creek were associated with flatwaters, while the two others are located just downstream of Mill Creek's confluence, and were associated with pools. These four alcoves are all small and shallow, averaging 425 square feet in area (stdev. 99.8), with an average maximum depth of 1.0 feet (stdev. 0.6). Instream cover in the alcoves is provided by terrestrial vegetation, but also by aquatic plants and algae.

Instream Cover & Woody Debris

Compared with other reaches, Reach 1 contains much less wood (only 86 pieces per mile) and less instream cover and edge habitat. Of the 23 pieces of wood greater than 1' diameter observed in Reach 1, 13 were found in pools. Pools and alcoves have the highest number of pieces of wood per length. Flatwaters contained slightly more wood than riffles, greater instream cover, as well as a greater frequency of edge habitat. Most cover was provided by willows and other vegetation interacting with the water, and also by small woody debris. In alcoves, aquatic vegetation and algae provided additional cover. CDFG sets desirable criteria for instream cover and shelter rating at >40% and >70, respectively (Coey, 2002), and no habitat type except alcoves met these criteria. Relatively few of the mainstem habitat units contained edge habitat, although side channels and alcoves did provide similar habitat.

Table 1: Instream woody debris, cover, and edge habitat frequency for Reach 1.

	wood pieces/mile				instream cover		
	small 6" - 12"	med 12" - 20"	large >20"	total	% cover	shelter rating	% units with edge habitat
Pools	98.8	34.2	15.2	148.1	26%	64	33%
Riffles	10.1	20.2		30.2	8%	13	0%
Flatwaters	40.6	12.2	16.2	53.0	17%	36	43%
Side Channels	25.1			25.1	20%	30	100%
Alcoves	72.0		24.0	96.0	61%	184	75%
	mainstem wood pieces/mile			96.9			



N
W E
S

0 300 600 Feet

DRY CREEK
Reach 1 Feature Map

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Hood River, OR 97031
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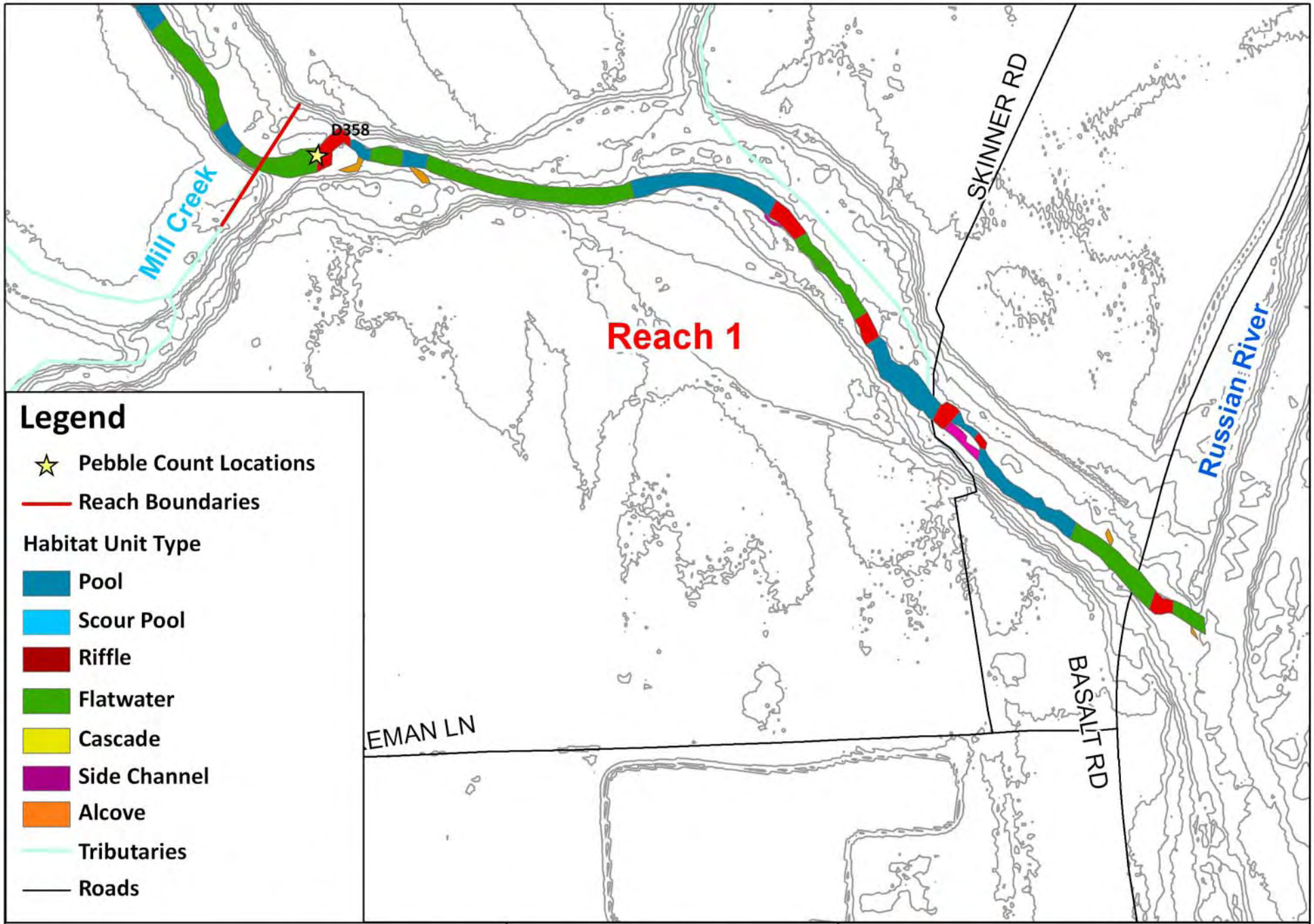

N W E S

0 400 800 Feet

DRY CREEK
Reach 1 Habitat Units

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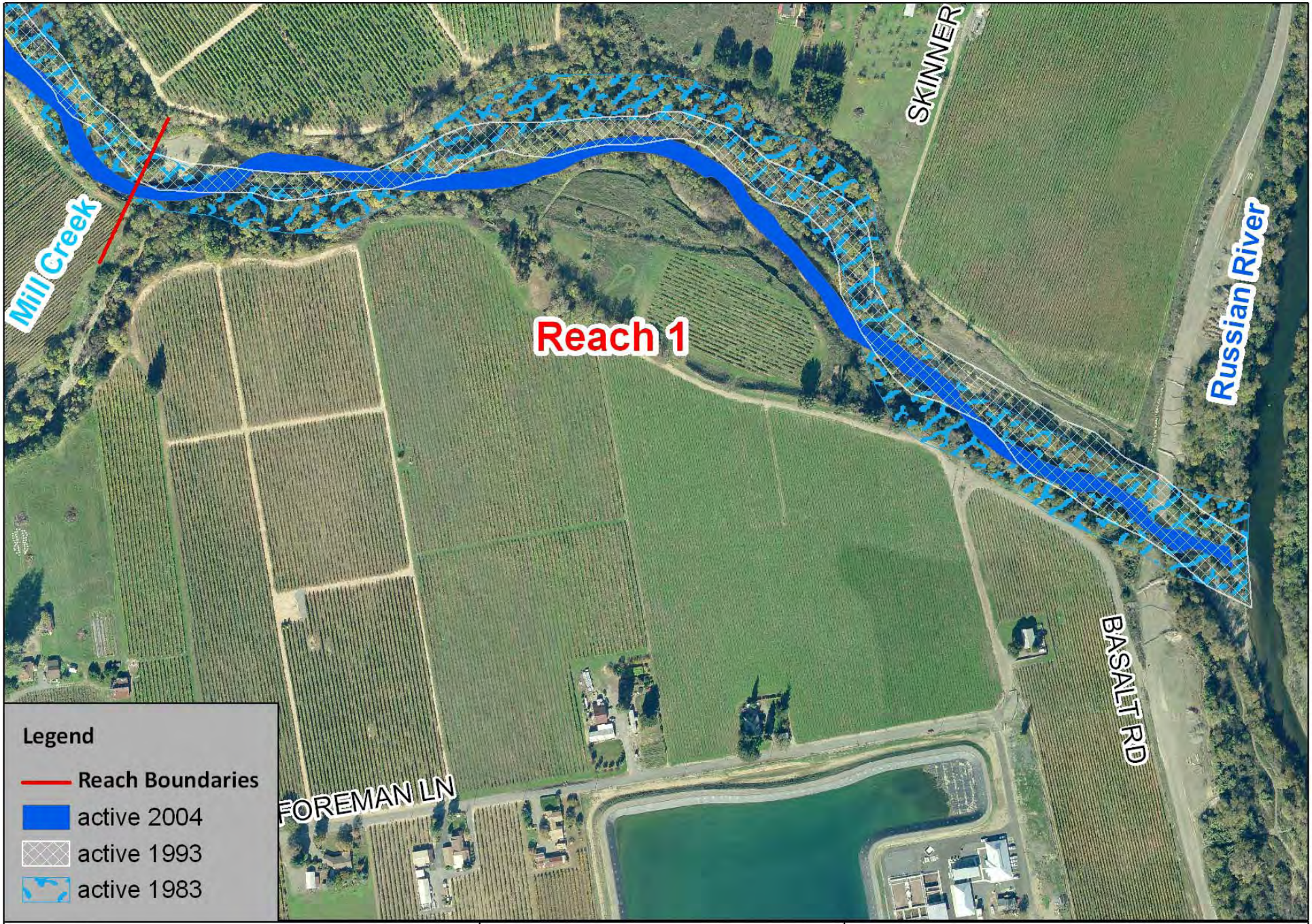

N W E S

0 350 700 Feet

DRY CREEK
Reach 1 - Channel Position Map

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REACH 2 (RM 0.7 to RM 2.0) **Moderately Confined and Well Armored from Mill Creek to the Westside Road Bridge**

Reach 2 of Dry Creek extends from the Mill Creek confluence upstream to about 100 ft downstream from the Westside Road Bridge. Reach 2 was a relatively straight reach with many riprap-armored streambanks. There were several long, narrow side channels and six alcoves, one of which was associated with the inlet of a dry, unnamed tributary at river mile 1.9.

Over the last century the channel has become narrower, but there has been little channel migration. The only location with substantial channel change is from river mile 1.5 to the reach boundary at river mile 2.0. Here, the 1983 channel is now the floodplain and may provide opportunities for constructing backwater channels for habitat. Although the narrowing likely coincided with channel incision (the terrace is approximately 10 to 15 ft above the channel bed), the channel is currently relatively vertically stable. The sediment load through this reach, like Reach 1, is high and there may be some minor aggradation occurring.

Figure 7: (left) Boulder riprap along streambanks, (right) a pool with riprap along the right bank.

Habitat Classification

Reach 2 was 1.3 miles long, primarily comprised of flatwater habitat units (62%), with pools and scour pools representing 24%, and 14% riffles by relative frequency (Figure 8). Riffles comprise only 5% of the total length. There are five riffles with lengths ranging from 60 to 90 ft. The channel geometry is similar to Reach 1. The wetted width is 45.6 ft, and the active channel width is 68 ft with an active channel depth of 1.7 feet. The floodprone widths were 90 and 190 feet.

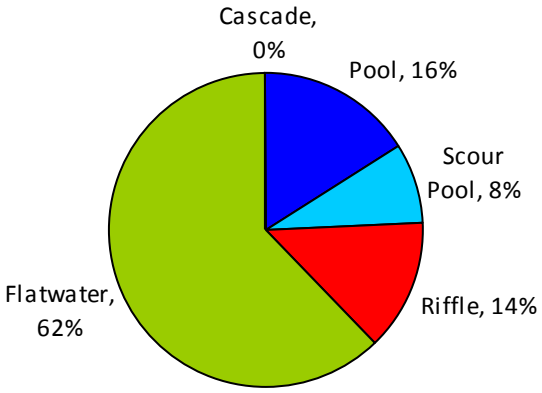


Figure 8: Proportion of Habitat Types by Relative Frequency in Reach 2

The average reach gradient was 0.2%. Reach 2 resembles a plane-bed channel morphology,

with long stretches of relatively featureless bed and few gravel bars and no islands (Montgomery and Buffington, 1997). Two different entrenchment ratios were measured in riffles in Reach 2; at the upstream end of the reach entrenchment was 2.6, and in the middle of the reach, the entrenchment ratio was 1.4. A high active channel width:depth ratio was measured at both sites (35 and 46, respectively). Due to the constrained nature of the channel by bank stabilization measures along most of Reach 2, it more resembles an “F4” channel type (Rosgen 1996).

Figure 9: Glide habitat units in Reach 2, with riprap along the banks.

Pools

All of the 6 pools and 3 scour pools in Reach 2 were more than three feet deep, thus qualifying as CGFG primary pools (Coey 2002). The average maximum pool depth was 4.3 feet (st.dev. 0.8). The average residual pool depth was 2.8 feet, with an average pool crest depth of 1.5 feet. Substrate in pools was gravel with sand.

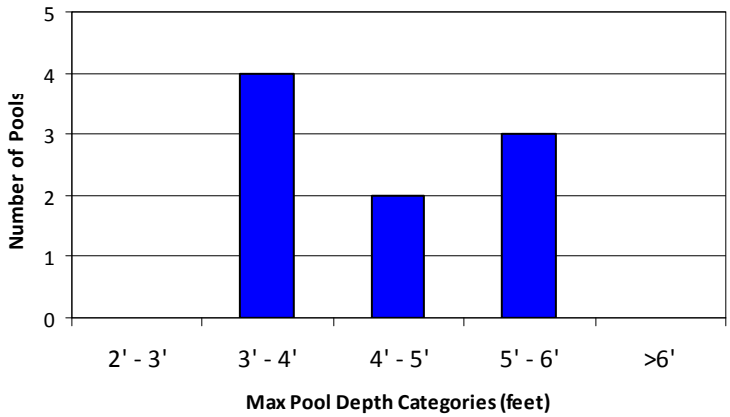


Figure 10: Maximum Pool Depths in Reach 2.

Riffles & Flatwaters

Average riffle depth in Reach 2 was 0.9 feet (st.dev. 0.3). Average flatwater depth was 1.5 feet (st.dev. 0.3). The flatwaters are composed primarily of gravel and sand and the riffles are composed of coarse gravel and small cobbles. The riffle below the tributary at the upstream end of the reach is dominated by medium to very coarse gravel with a median grain size of 23 mm. Substrate in both riffles and flatwaters was categorized as gravel with small cobbles and sand.

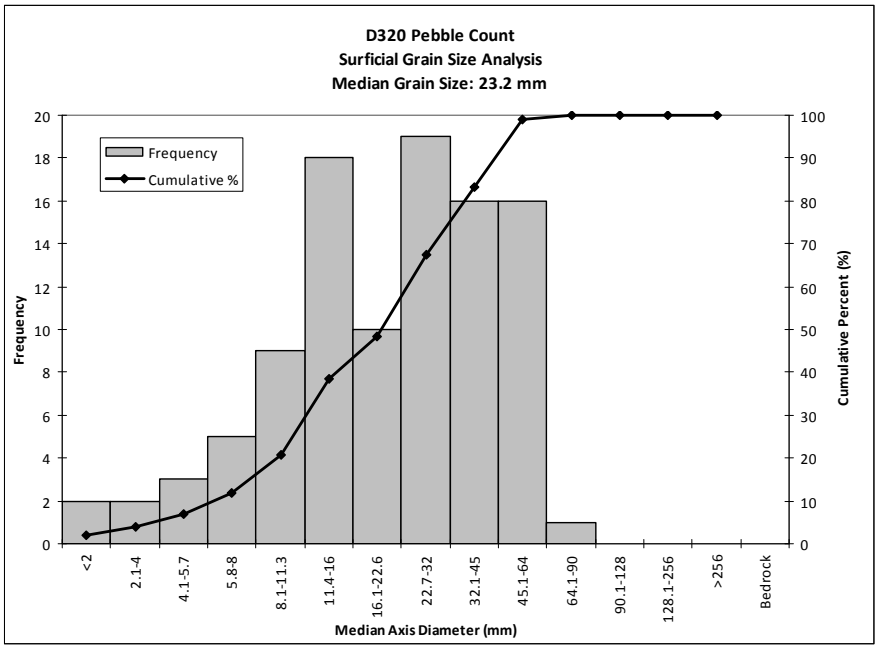


Figure 11: Grain size distribution for riffle downstream of the unnamed tributary, downstream from Westside Road (habitat unit #320).

Side-Channels

Of the three side channels in Reach 2, two were pool dominated, and the third consisted mainly of flatwater habitat. Each side channel was narrow (average 7 feet) and long (113 feet long on average). Substrate was gravel with sand and small cobble.

Alcoves

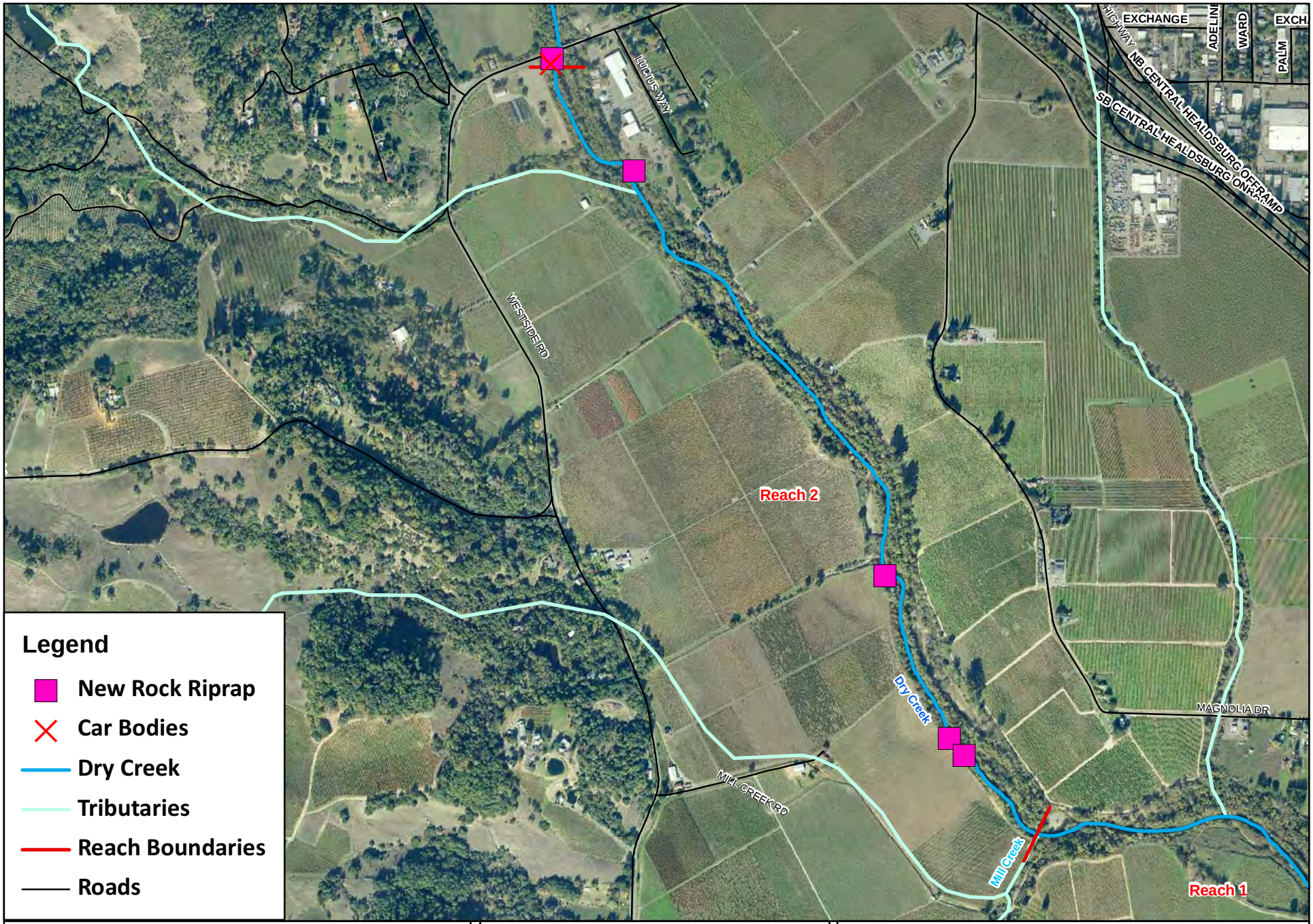
All six alcoves in Reach 2 were narrow (average width 11 feet), and most ranged from 40 to 90 feet long, with one exception. Near the unnamed tributary junction at river mile 1.9, one alcove was 250 long and followed the incised floodplain wall upstream. Substrate in the alcoves was mostly fine sediment, with sand and gravels.

Instream Cover & Woody Debris

Most instream cover in Reach 2 was provided by terrestrial vegetation interacting with the water or within 6" of the water surface, and secondarily by small woody debris. In the alcoves, abundant aquatic vegetation provided additional cover. More abundant and larger woody debris was found in scour pools (Table 2). The highest cover and shelter ratings were found in narrow side-channels, with thick overhanging vegetation and abundant small woody debris. All alcoves provided edge habitat, with an edge frequency of about 40% in other habitat types.

Table 2: Instream woody debris, cover, and edge habitat frequency for Reach 2.

	wood pieces/mile				instream cover		
	small 6" - 12"	med 12" - 20"	large >20"	total	% cover	shelter rating	% units with edge habitat
Pools	90.1	55.8	12.9	158.7	29%	87	50%
Scour Pools	93.5	46.7		140.2	27%	62	33%
Riffles	125.1	55.6	27.8	208.4	17%	48	40%
Flatwaters	96.2	45.0	7.2	148.4	27%	71	17%
Side Channels	248.5	46.6	15.5	310.6	77%	204	67%
Alcoves	138.2	49.3		187.5	61%	174	100%
	mainstem wood pieces/mile			141.9			



N
W E
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0 750 1,500 Feet

DRY CREEK
Reach 2 Feature Map

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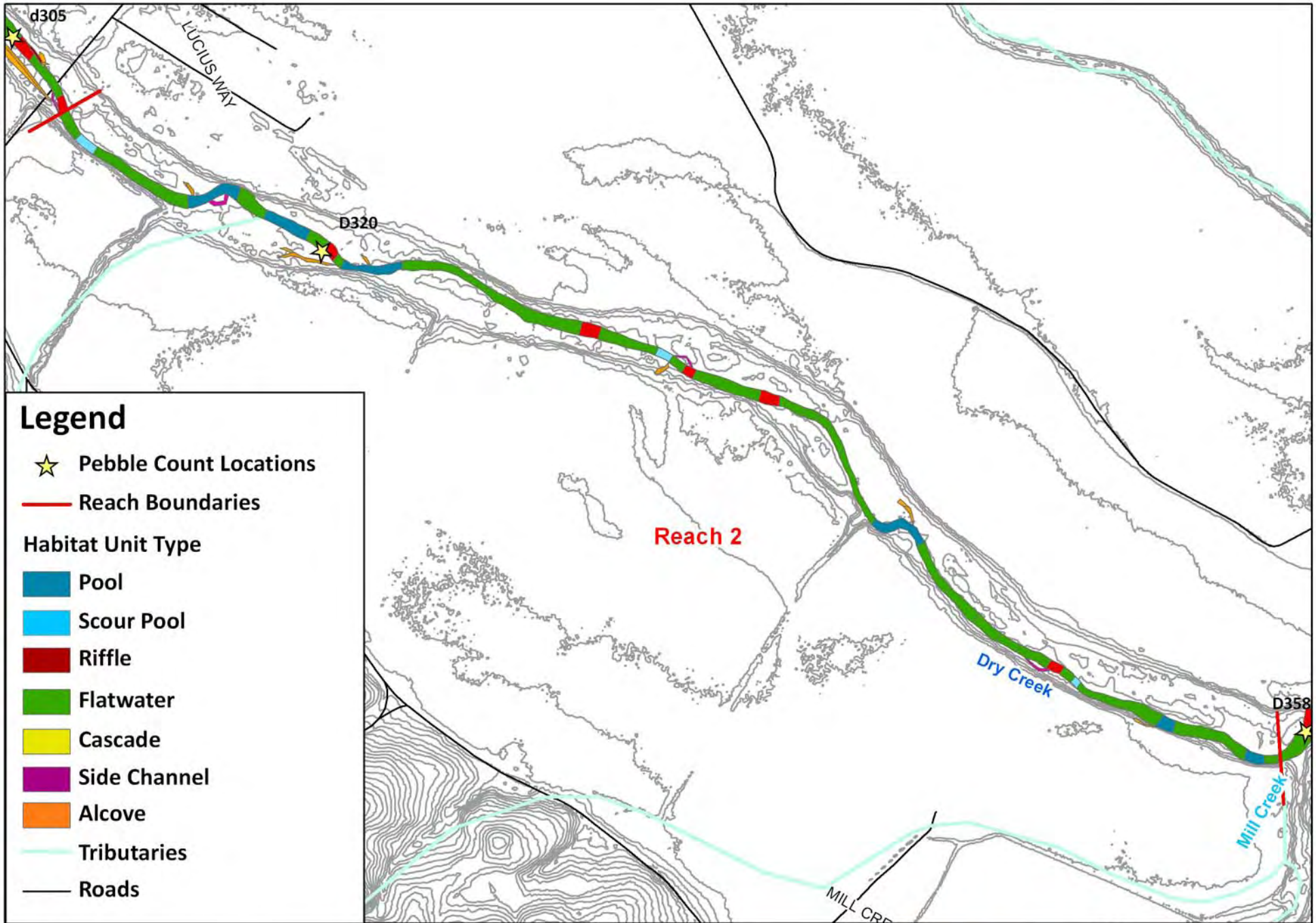

0 600 1,200 Feet

DRY CREEK
Reach 2 Habitat Units

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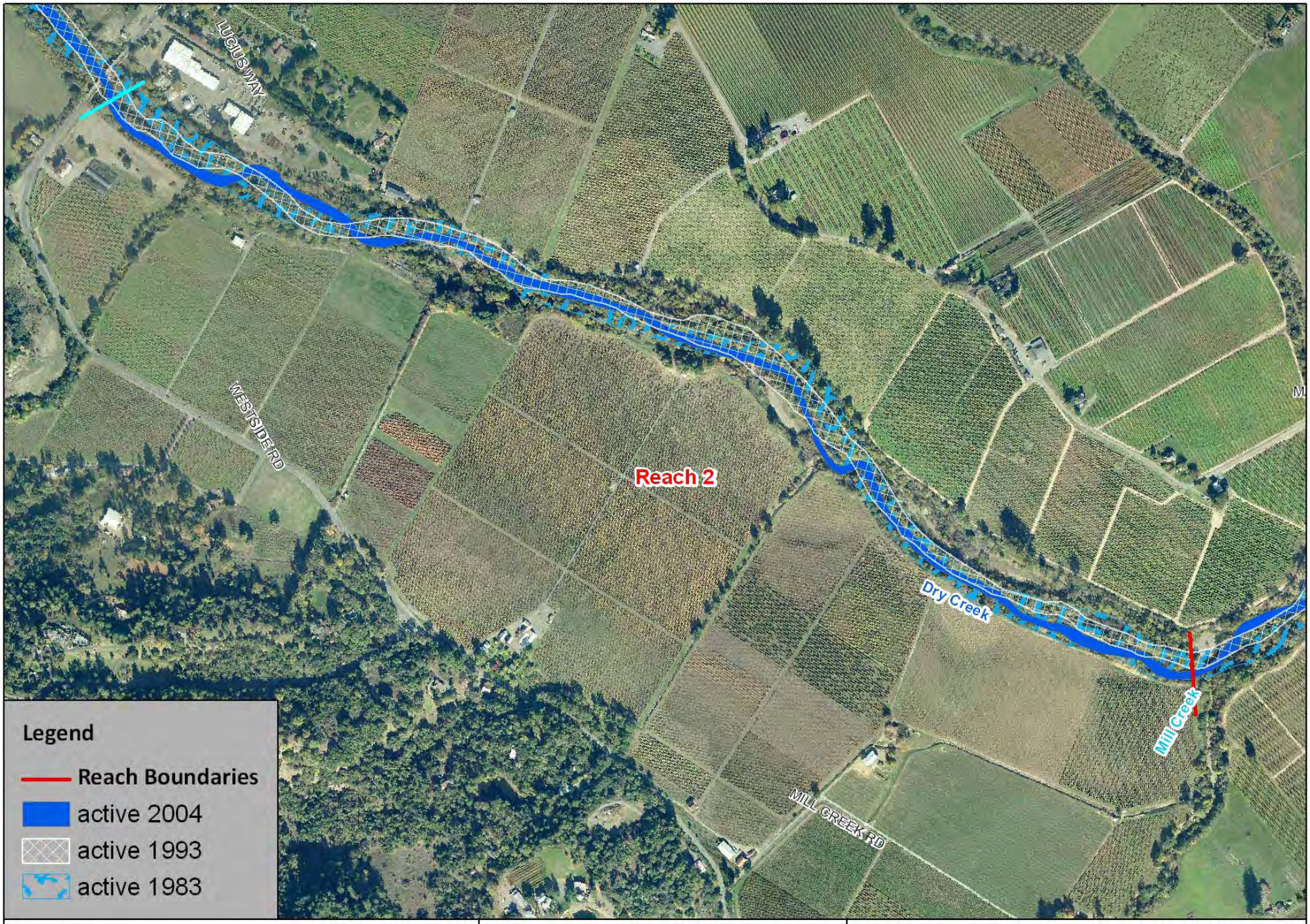

0 600 1,200 Feet

DRY CREEK
Reach 2 - Channel Position Map

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REACH 3 (RM 2.0 to RM 3.0) **Active Incised Floodplain, from the Westside Bridge to a fault lineament downstream of the gradient sills**

Reach 3 was less confined than Reach 2, and contains eight side channels, six of which are over 100 feet long. Abundant alcoves and side-channels may provide substantial channel and habitat complexity, and may serve as templates for off-channel habitat design and construction in other areas. One intermittent tributary enters at river mile 3.0 on the right[2] bank (unmapped). Stream stabilization efforts using I-beams and chainlink fence have failed at river mile 2.95. The Dry Creek screw trap is located at river mile 2.0, under the Westside Road bridge at the downstream end of the reach. A mapped levee runs along the right bank for 1300 feet in at the upper end of Reach 3, but the stream has meandered away from it, and it was not noted during the survey.

The upstream reach boundary is at the approximate downstream influence of the three grade control structures in Reach 4 and is where the southeast/northwest trending lineament intersects Dry Creek. Upstream of this point the lineament is located approximately along Dry Creek to river mile 5.35. It is unlikely that the lineament impacts the current processes shaping the channel and riparian corridor, but the historic location of the channel may have been influenced by the location of the lineament.

Figure 12: (upper left) Westside Road bridge and screw trap, (upper right) mouth of intermittent stream, (lower left) failed I-beam and chainlink bank armor, and (lower right) side channel pool.

[2] In the individual reach summaries, right and left bank designation defined as looking downstream.

The channel in this reach is active and has been migrating frequently since the dam was constructed. The current channel is slightly less sinuous than during the 1980s and 1990s, but the older channels are now productive side channels flowing through dense riparian vegetation. This is the case particularly downstream of river mile 2.5 where a side channel that is up to 75% of the width of the main channel splits and meanders along the left terrace edge. This channel maintains pools of varying depths and flatwaters and has substantial quantities of large and small woody debris. An alcove along the right bank extends from the Westside Road Bridge upstream to about River Mile 2.05. This is a long, narrow channel, but there is no upstream inlet. At high flows, this alcove likely becomes reconnected to the main channel at the upstream end.

Degradation has likely not occurred in Reach 3 since the dam was built and there may be some aggradation. There are extensive gravel bar deposits and some alders were observed to be slightly buried or closer to the water surface. During flood flows, bedload may be transported and deposited in large volumes, leading to the higher degree of channel change and lateral instability in this reach.

Figure 13: (left) a typical pool in Reach 3, (right) one of the three riffles in Reach 3.

Habitat Classification

Reach 3 is comprised of 61% flatwater habitat, 17% is mainstem pool (0% scour pool), and 22% riffle by relative frequency. Only 6% of the 1.0 mile length of Reach 3 is riffle habitat by length. Nearly 70% of the wetted channels are composed of flatwaters and pools and almost 25% are side channels and alcoves. It was noted that flatwaters often contained very short pool units and visa versa. There are four riffles ranging in lengths from 70 to 110 ft. The average channel wetted width in the single-thread portions of the channel is about 48 ft. The active channel and flood prone widths are 82 and 110 ft respectively; these widths would

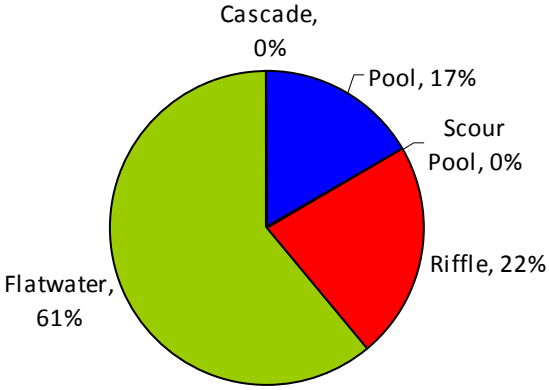


Figure 14: Proportion of Habitat Types by Relative Frequency in Reach 3

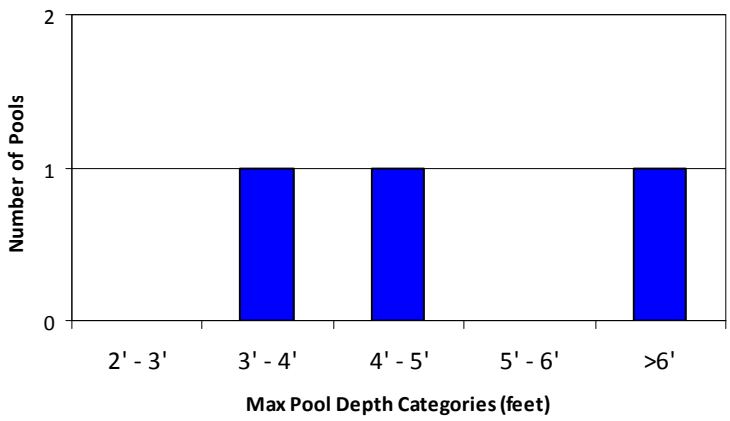
be greater in the multi-thread portions of the channel. The average active channel depth was 1.7 feet.

Reach 3 resembles plane-bed morphology based on long flatwater units and few riffles (Montgomery and Buffington, 1997). The entrenchment ratio was 1.35 and the average active channel width:depth ratio was 48. The incised nature of the floodplain caused this reach to resemble an “F4” type channel (Rosgen, 1996).

Pools

There were a total of three pools in Reach 3, with an average maximum depth of 4.6 feet (st.dev. 1.3). All three pools were greater than 3 feet deep (Figure 15). The average residual pool depth was 2.4 feet for main channel pools. The average pool crest depth was 1.3 feet. Observed substrates in pools were gravel with sand.

Figure 15: Maximum Pool Depths in Reach 3.

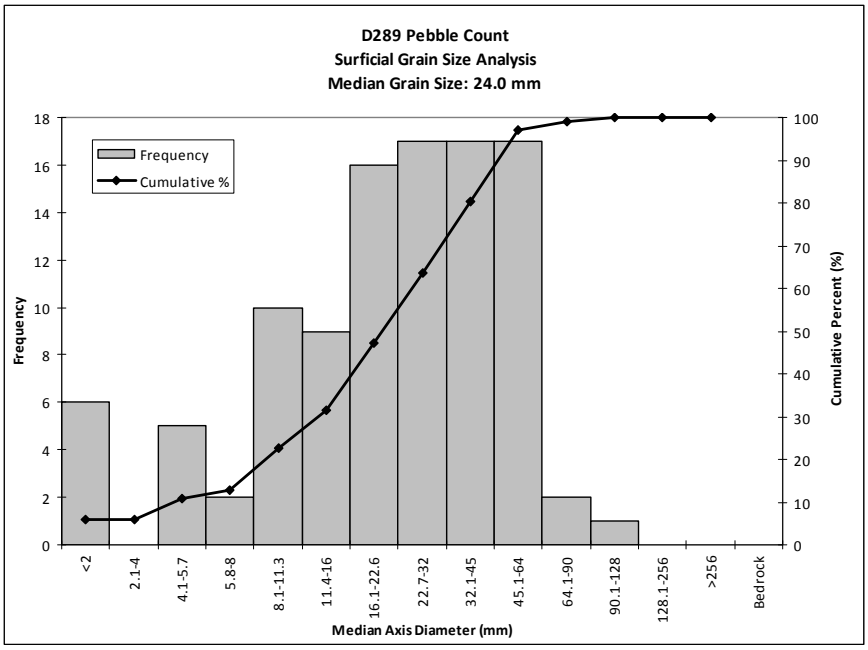


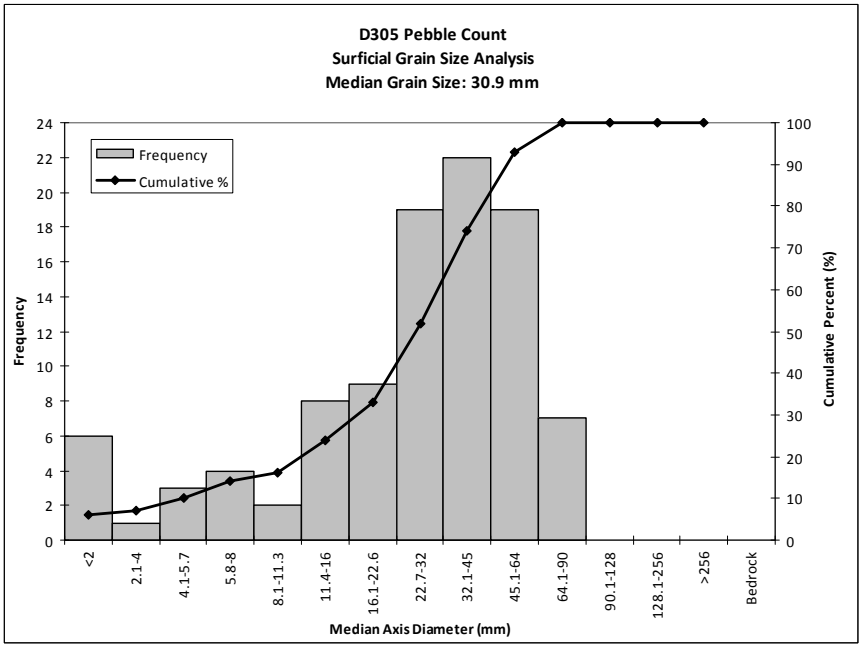
Riffles & Flatwaters

Average riffle depth was 1.1 feet (st.dev. 0.2), and the average flatwater depth was 1.4 feet (stdev 0.2). The bed material in reach 3 ranges from sand to small cobbles; flatwaters are primarily composed of gravel and sand and the riffles are composed of gravel and small cobbles.

Two pebble counts were conducted in riffles in Reach 3 (D305 and D289). One was the first riffle upstream of the Westside Road bridge, the second was about half-way through the reach. The median grain sizes of the two riffles in this reach were coarse gravel at 24 and 31 mm (Figure 16). 85% of the sediments were within desirable spawning gravel sizes (11.4mm to 128mm), and 42% within desirable coho/steelhead rearing sediment sizes (32mm to 128mm). 6% of the samples were fine sediment or sand (<2mm).

Figure 16: Grain size distribution for riffles in the middle of reach 3 (habitat unit #289) and just upstream of the Westside Road bridge (habitat unit #305).





Side-Channels

In the eight side channels, most of the substrate was fine sediment and sand, with some gravel. Seven out of the eight side channels were pool-dominated, with one flatwater-dominated. Maximum depths in pool-dominated side-channels averaged 2.9 feet, with only one over three feet deep. The flatwater-dominated side channel was 0.8 feet deep on average. There was one long side-channel on left side that extends for a few hundred feet with pools and flatwaters, woody debris and other cover. This side-channel is deep

(~3.5’) and wide (~30’) and abuts the terrace wall. A smaller side channel and alcove on the channel right side provides additional habitat.

Figure 17: (top row) side-channel habitat units, (bottom row) alcoves in Reach 3.

Alcoves

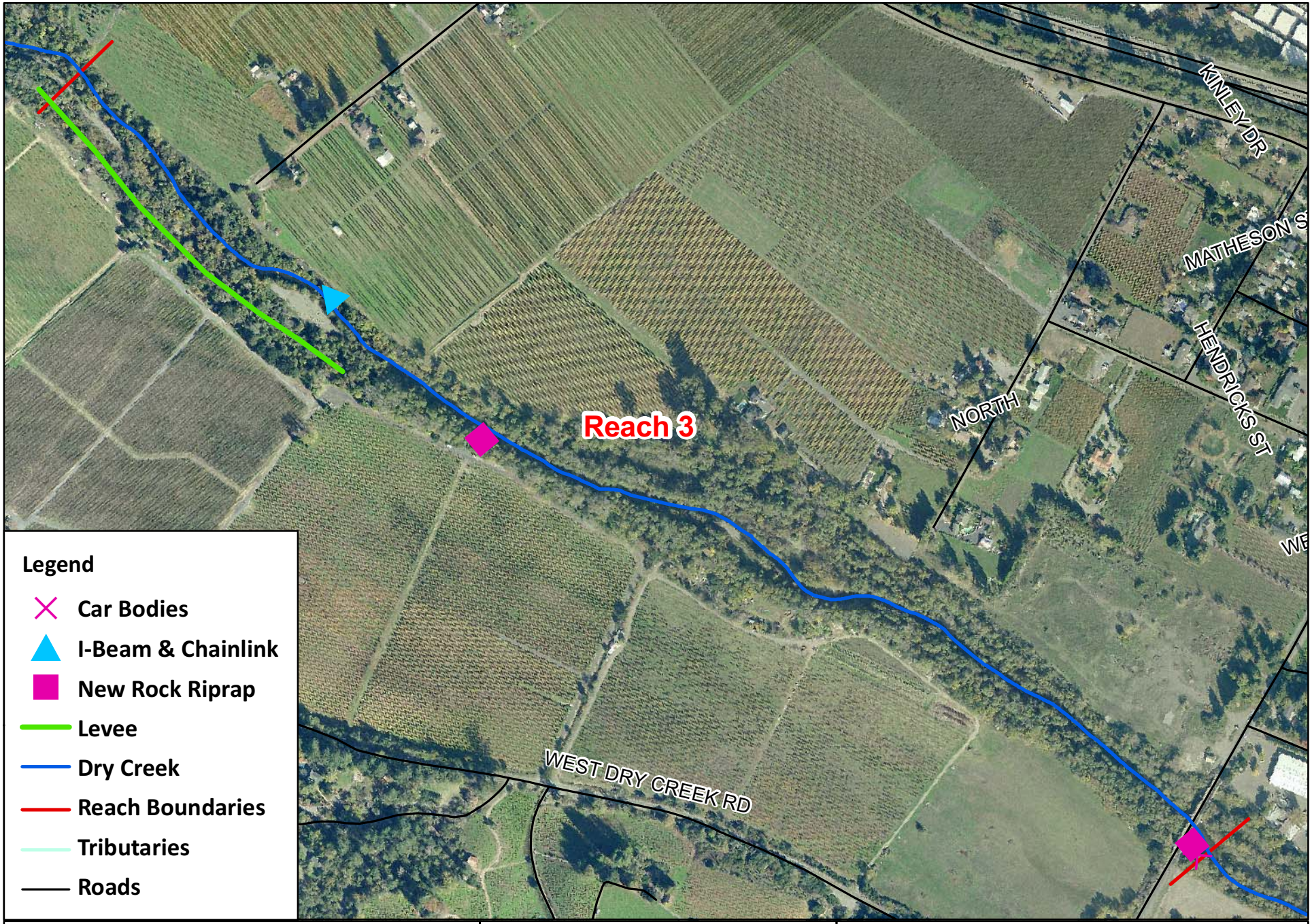
There were four alcoves in Reach 3. Substrate in alcoves is mainly fine sediments and sand, with some gravel. The average maximum depth of alcoves was 1.4 feet, with only one over three feet deep. There were several longer alcoves, including a 1500 foot alcove that flows along the base of a right bank terrace into a small side channel just downstream from the Westside Road bridge. A second very long alcove could not be fully investigated because we did not have landowner permission to access the area.

Instream Cover & Woody Debris

A total of 166 pieces of wood per mile were counted, with most pieces found in flatwaters and side channels (Table 3). While scour pools contained less small and medium sized wood than most other habitat types, the majority of large (>20" diameter) wood was observed in scour pools. Trees and shrubs interacting with the water provided the majority of cover in all habitat types, except for alcoves, where aquatic vegetation provided abundant cover. Additional cover was provided by small woody debris, root masses in riffles, aquatic vegetation in flatwaters and side channels, and large wood and boulders in scour pools. Edge habitat occurred in 18 out of 30 habitat units, primarily along the channel margins in flatwaters, and in side-channels, and alcoves.

Table 3: Instream woody debris, cover, and edge habitat frequency for Reach 3.

	wood pieces/mile				instream cover		
	small 6" - 12"	med 12" - 20"	large >20"	total	% cover	shelter rating	% units with edge habitat
Pools	120.0	23.2	11.6	154.8	27%	71	0%
Riffles	78.8	31.5	15.8	126.1	7%	14	25%
Flatwaters	118.5	38.6	15.7	172.8	30%	89	64%
Side Channels	76.6	39.6	26.4	142.7	63%	188	75%
Alcoves	74.6	8.6	14.3	97.6	84%	251	100%
	mainstem wood pieces/mile			165.4			



0 400 800 Feet

DRY CREEK
Reach 3 Features

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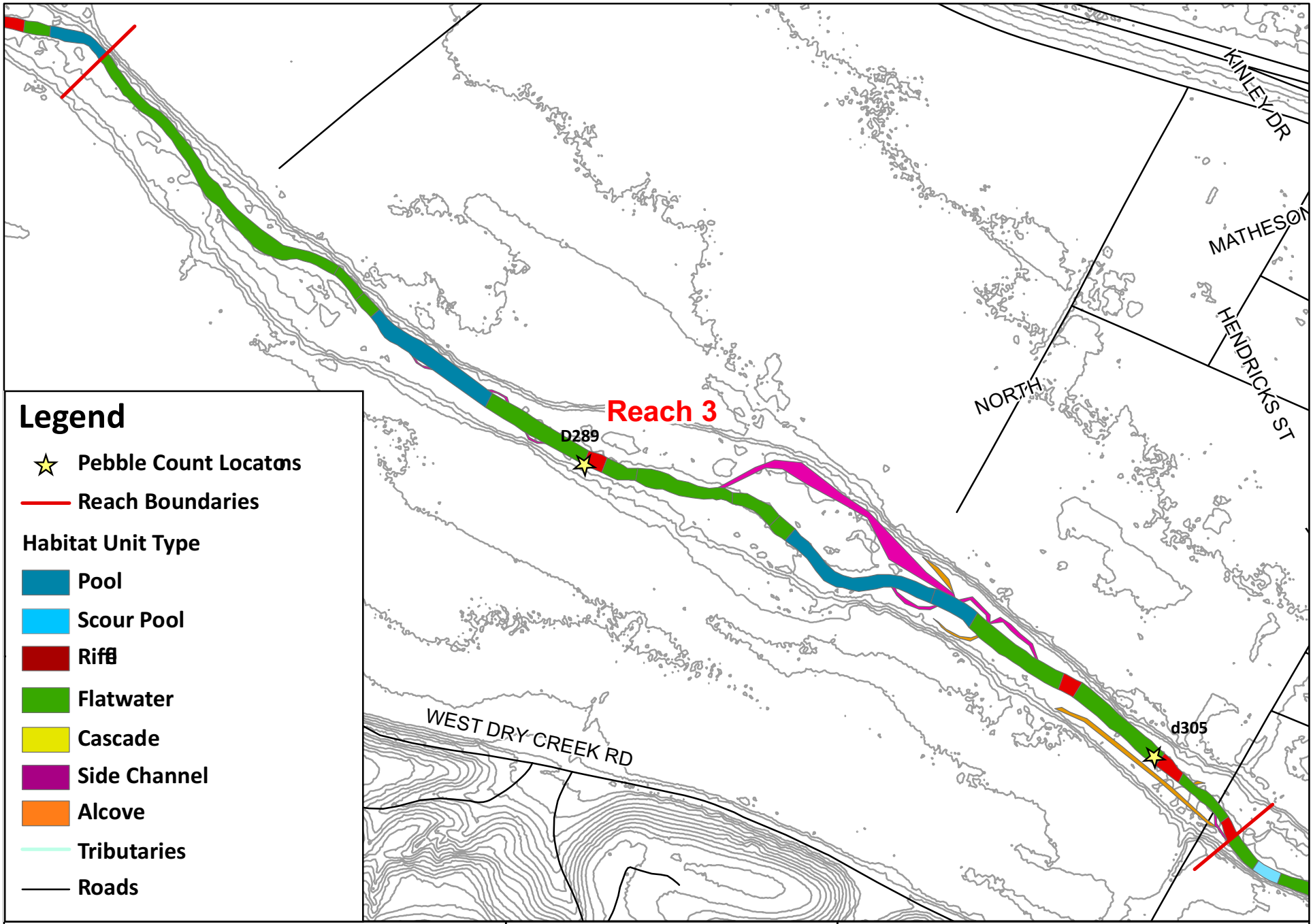

0 500 1,000 Feet

DRY CREEK
Reach 3 Habitat Units

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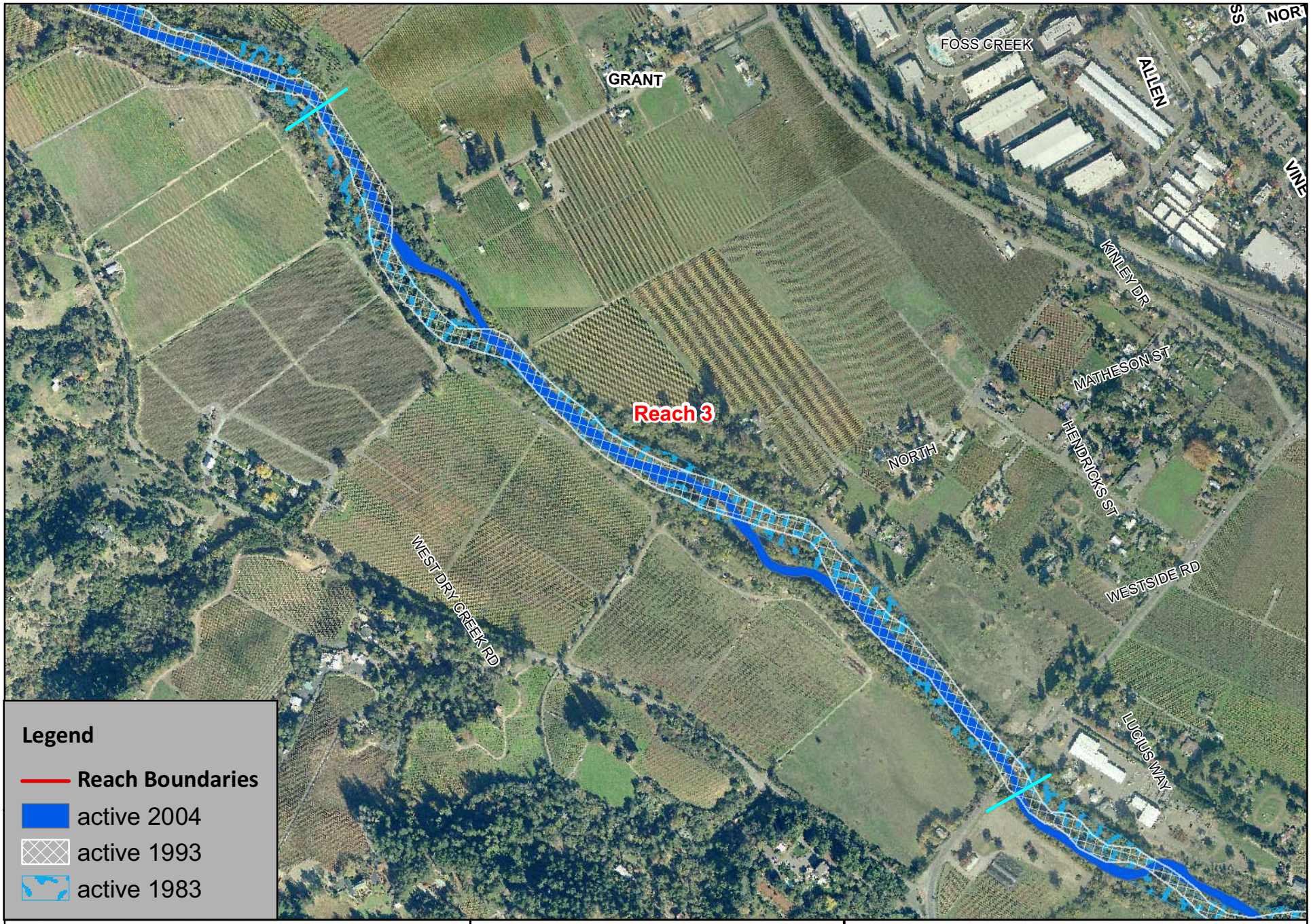

0 500 1,000 Feet

DRY CREEK
Reach 3 - Channel Position Map

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REACH 4 (RM 3.0 to RM 4.1) **Three Constructed Gradient Sills with a fault running alongside, to the top of the upper backwatered pool**

Three gradient sills were constructed in 1983 by the ACOE to slow migrating nick points and associated channel incision in lower Dry Creek. This reach is vertically stable due to the check dams. The backwatered pools created by each sill extended several hundred feet upstream, forming a pool-dominated reach. The upper sill (RM 3.8) consisted of a cascade down two sets of boulder falls, 2' and 1' in height. The middle sill (RM 3.5) was 200' long, 10' wide, and 3' in height. The lower sill (RM 3.3) was 100' long, 10' wide, and 1 foot tall. Each sill has a fish ladder to provide passage through the short cascades. Rock riprap covers than right bank between the upper and middle sill, and short sections of boulder riprap cover both banks upstream and downstream of each sill. An unnamed tributary enters Dry Creek just downstream of the lower sill at river mile 3.25.

Through Reach 4, the channel has become less sinuous since the dam was built, though minor channel migration has continued. Three side channels and eight alcoves were identified in this reach, and these are located primarily along previous channel paths.

Figure 18: (upper left) lower sill, (upper right) upper sill,
(lower left) ladder on middle sill, (lower right) middle sill.

Habitat Classification

This reach is primarily composed of flatwaters (50%) pools (25%) backwatered behind check dams, and riffles (20%) at and just downstream of the dams. Four riffles were identified ranging in length from 50 to 80 ft and comprise 6% of the 1.1 mile mainstem length for the reach on a length basis. At each sill, a short cascade of water pours over the structure.

The channel in this reach has steep banks as the average wetted width and active channel widths are the same at 52 ft. The active channel depth was 2.7 feet. The average flood prone width is more than double at 112 ft. The floodplain in Reach 4 is approximately 3 to 4 ft above the bed and adjacent terraces are 10 to 15 ft above the channel bed.

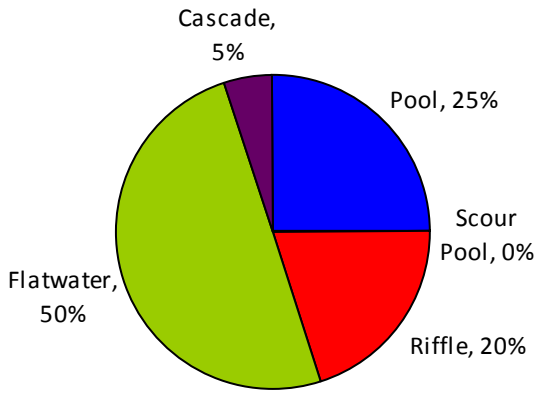
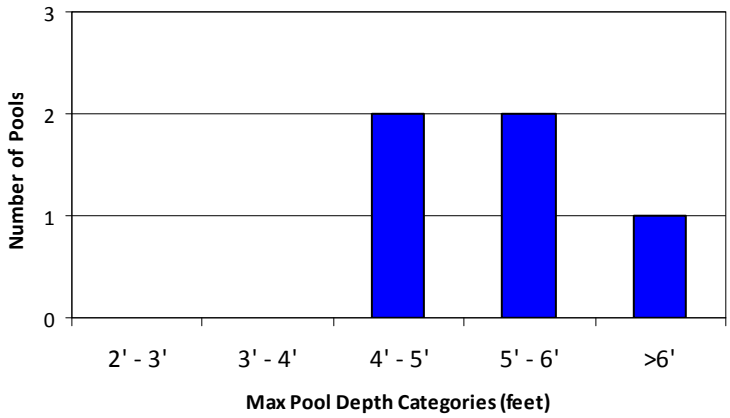


Figure 19: Proportion of Habitat Types by Relative Frequency in Reach 4

Pools

All five pools in Reach 4 were greater than 3 feet deep (Figure 20). The average maximum pool depth was 5.3 feet (st.dev. 0.6). The average residual pool depth was 3.8 feet, and the average pool tail crest depth was 1.6 feet. Substrate observed in pools was gravel with sand.

Figure 20: Maximum Pool Depths in Reach 4.



Riffles, Flatwaters & Cascades

In Reach 4, the average depth of riffles was 1.2 feet, 1.3 feet in flatwaters, and 0.9 feet in cascades. The bed material in Reach 4 ranges from sand to small cobbles, but is primarily composed of coarse to very coarse gravel. Gravel and some sand make up the majority of the channel bed in the pools and flatwaters and the riffles are composed primarily of gravel with a few small cobbles. In cascades, most of the substrate was boulders with large cobbles. The dimensions of the riffle downstream of the upper check dam, where the pebble count was conducted (D256), partly resembled a flatwater. The median grain size of the riffle below the most upstream check dam was 31 mm, coarse gravel (Figure 21). The frequency of fine sediment was 1%. 89% percent of the surface substrate was within ideal spawning sizes for coho and steelhead (11.4 to 128 mm), and 49% was within ideal juvenile rearing clast sizes (32 to 128 mm).

Figure 21: Grain size distribution for riffle below the most upstream check dam (habitat unit #256).

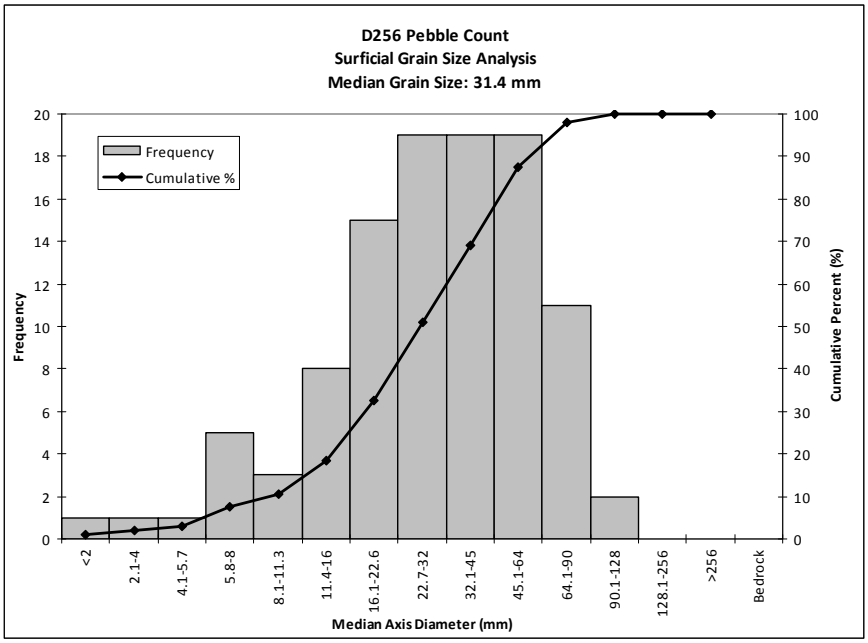


Figure 22: (upper left) long pool above upper sill, (upper right) alcove off upper sill, (lower left) side-channel habitat, (lower right) aquatic vegetation in alcove near middle sill.

Side-Channels

In Reach 4, three side channels were observed. Two of the side-channels were on the right side between the upper and middle sills, each with a pool in the middle and riffles and their entrances and exits. Their average depths were 0.5 and 0.7 feet. The third size-channel occurred where the creek split around an island downstream of the middle sill. The left channel, which was primarily flatwater habitat, was slightly smaller than the main channel to the right, with an average depth of 1.5. Substrates observed in side channels were classified as gravel with small cobbles and sand.

Alcoves

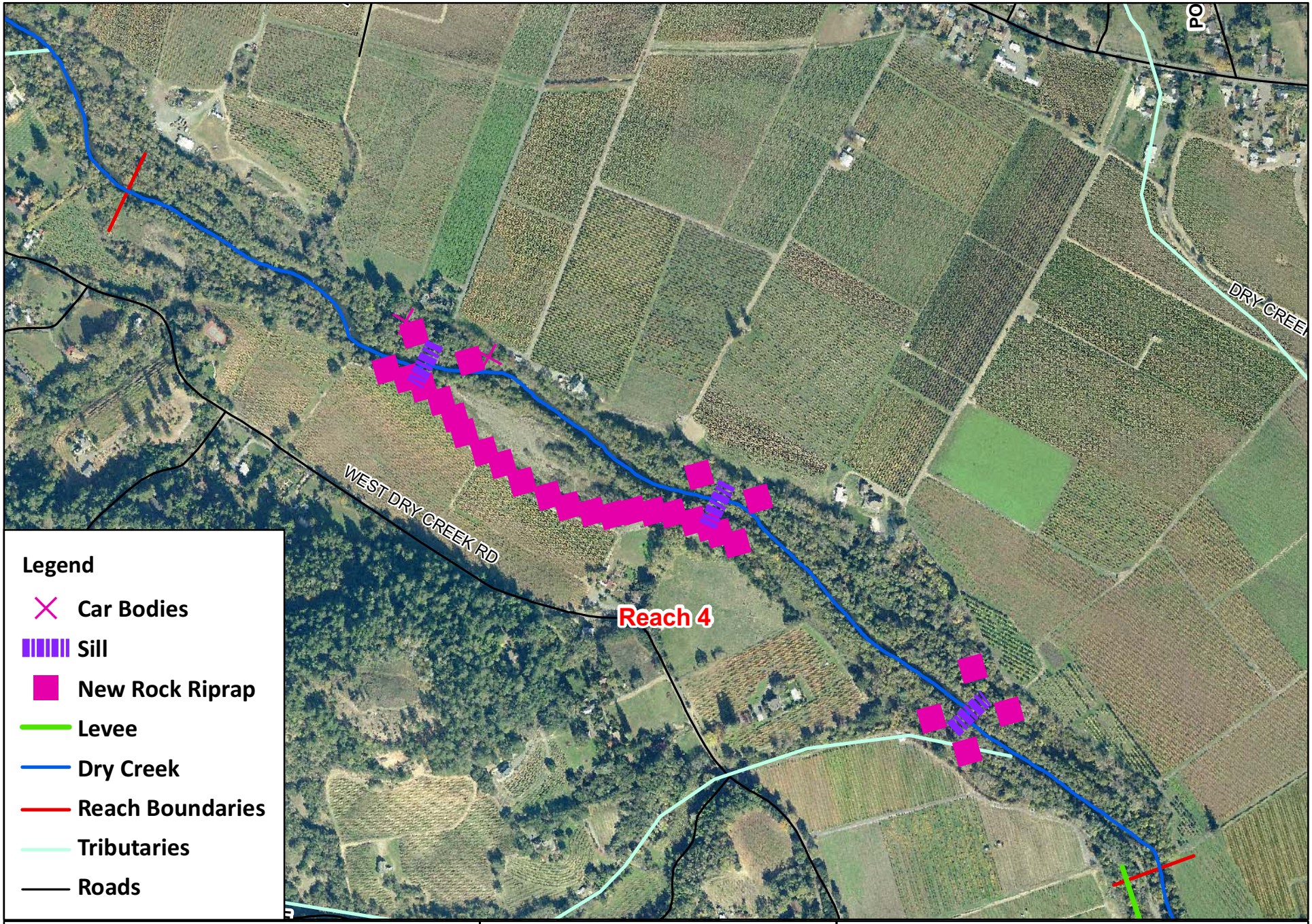
There were eight alcoves in Reach 4. Several were associated with the areas around the sills. There were two alcove pools on the right side of channel near the middle sill, with one upstream and the other downstream of the structure. The average maximum depth of the alcoves was 1.7 (st.dev. 0.9), with only one over three feet deep. Substrate in the alcoves was fine sediment and gravels with sand.

Instream Cover & Woody Debris

Overall, Reach 4 contained 185 pieces of wood per mile, with the greatest densities in pools, riffles, and side channels. Eight of the fifteen large pieces of wood were found in pools. The cascade and alcove habitats had more instream shelter and cover than ,riffles, and flatwaters. The side-channels in Reach 4 offered lower than ideal instream cover. Cover was provided in pools by terrestrial vegetation and small woody debris. In riffles, most cover was provided by woody debris, and secondarily by root masses and overhanging vegetation. In flatwaters, overhanging vegetation and root masses provided cover, along with some small woody debris. In cascades, cover was provided by boulders, with some overhanging terrestrial vegetation. Cover in alcoves was mainly provided by aquatic vegetation, with root masses, terrestrial vegetation, and some small woody debris. In side-channels the limited cover was mainly provided by small woody debris and root masses. Edge habitat was present in 5 pools, 5 flatwaters, and the majority of side-channels and alcoves.

Table 4: Instream woody debris, cover, and edge habitat frequency for Reach 4.

	wood pieces/mile				instream cover		
	small 6" - 12"	med 12" - 20"	large >20"	total	% cover	shelter rating	% units with edge habitat
Pools	145.3	66.6	10.6	222.5	38%	114	60%
Riffles	168.8	61.4	15.3	245.6	12%	26	0%
Flatwaters	88.8	15.7	7.8	112.3	16%	37	70%
Cascade	0	0	0	0.0	50%	100	0%
Side Channels	196.1	90.5	30.2	316.8	12%	23	67%
Alcoves	138.8	36.2	12.1	187.1	43%	101	75%
	mainstem wood pieces/mile			184.9			



N W E S

0 500 1,000 Feet

DRY CREEK
Reach 4 Features

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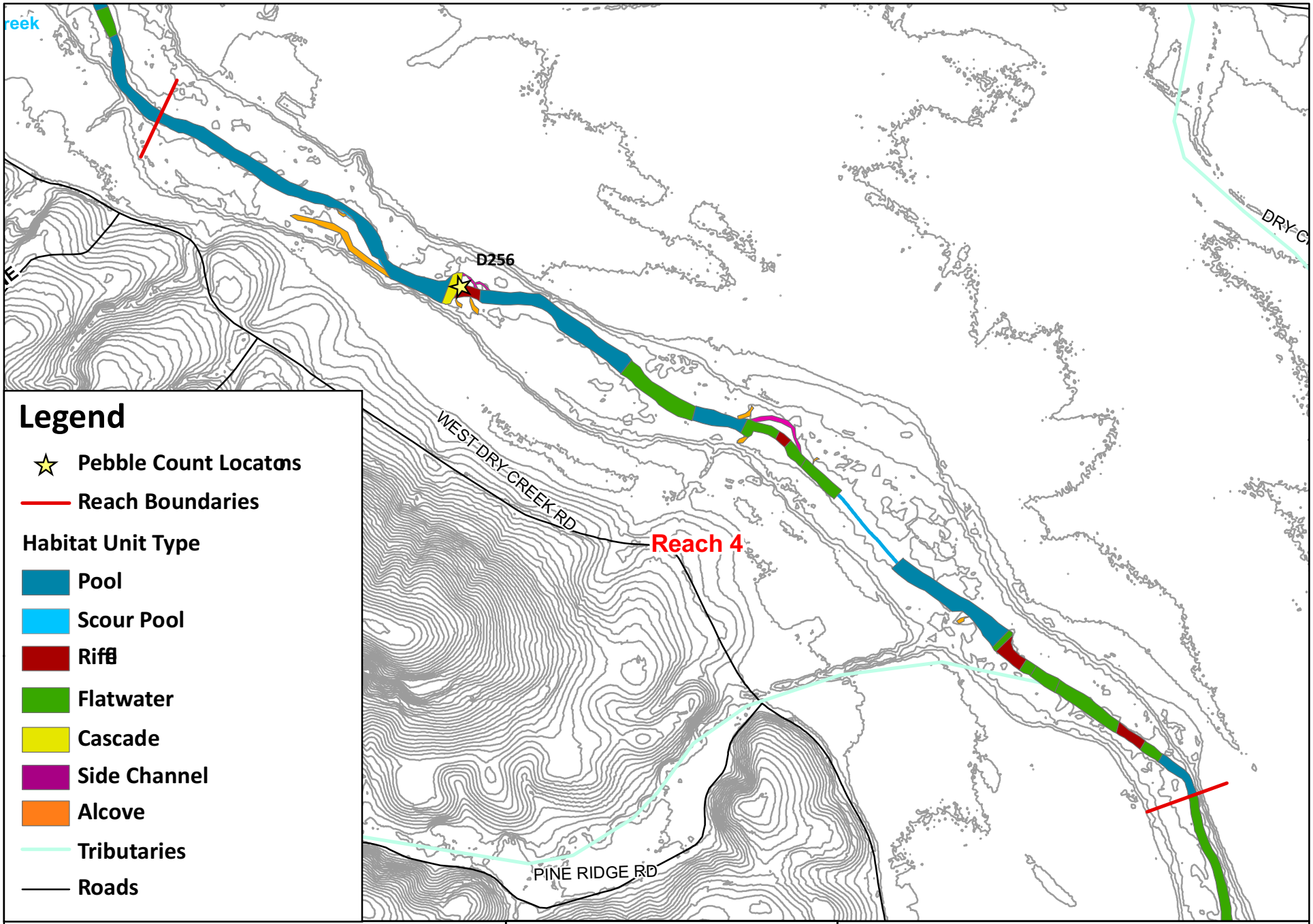

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Reach 4 Habitat Units

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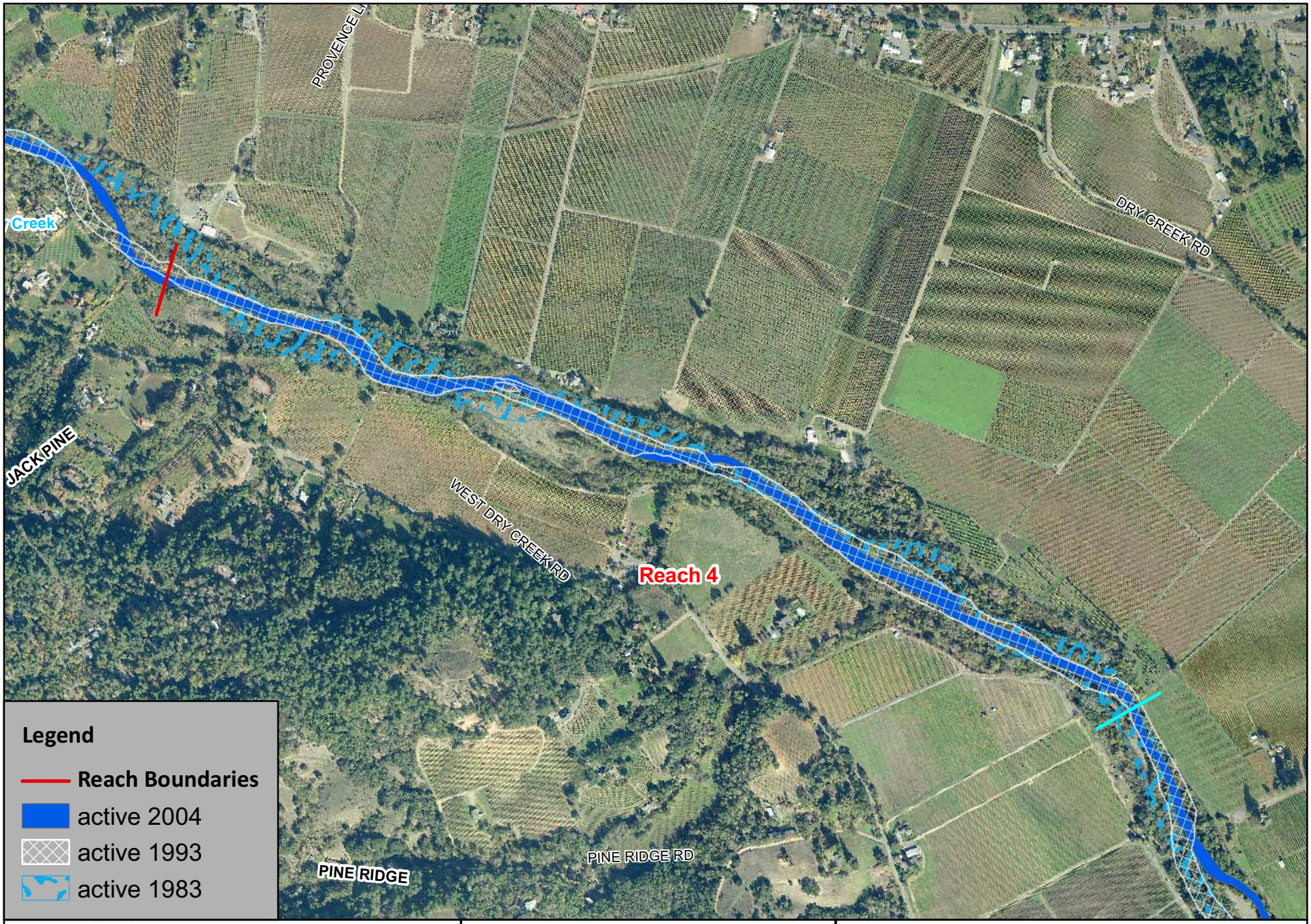

N E S W

0 500 1,000 Feet

DRY CREEK
Reach 4 - Channel Position Map

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REACH 5 (RM 4.1 to RM 5.4) **Kelley Creek and Hidden Concrete Slabs, upstream of the sill-influenced pool to the end of the adjacent fault lineament**

A fault lineament runs along most of Reach 5, which is a single-thread channel extending upstream from the upper check dam pool to river mile 5.4, just upstream of where the channel diverges from the lineament. It is a fairly straight reach composed of long pools, with two tributary junctions. Kelley Creek enters Reach 5 at on the right[3] bank at river mile 4.3 in the lower end of the reach. Upstream from the Kelley Creek junction, an unnamed tributary enters Dry Creek on the left bank at river mile 4.6. The mouth of Kelley Creek is covered in fine sands with small gravels (Figure 23). The unnamed tributary is steep and dry, except for mouth. 20 feet up the unnamed creek channel from its confluence, a 3 foot nick point was observed. The riparian zone in this reach is narrow, especially upstream of the two tributaries.

Figure 23: (left) mouth of Kelley Creek, (right) mouth of unnamed tributary.

The channel has narrowed since the earliest aerial photographs in 1942, but there has been little channel migration upstream from the unnamed tributary at approximately river mile 4.6. The 10 to 15-ft terraces relatively close to the channel banks limit the degree of channel migration. Also limiting channel migration are the bank stabilization projects that have been implemented, particularly the concrete slabs lining both banks in the upper half of this reach. Even with these channel modifications, bank and terrace erosion does occur as was observed at river mile 4.55 where the channel meanders east.

Downstream from this unnamed tributary junction at river mile 4.6, the influx of water and bed load from the unnamed tributary on the left bank and Kelley Creek on the right bank has likely resulted in the frequent channel changes that have occurred in the last three decades.

[3] In the individual reach summaries, right and left bank designation defined as looking downstream.

Habitat Classification

Reach 5 is primarily composed of flatwaters (58%) and pools (25%) with a few riffles (16%) by relative frequency, Figure 24). Riffles represent only 6% of this 1.3 mile-long reach on a length basis. The wetted width at the time of the survey was 48 ft. There are five riffles ranging in length from 45 to 90 ft.

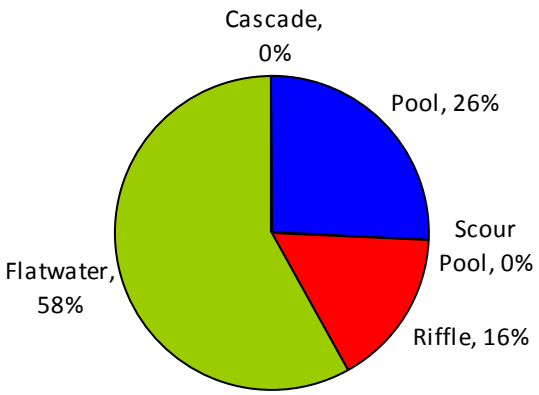


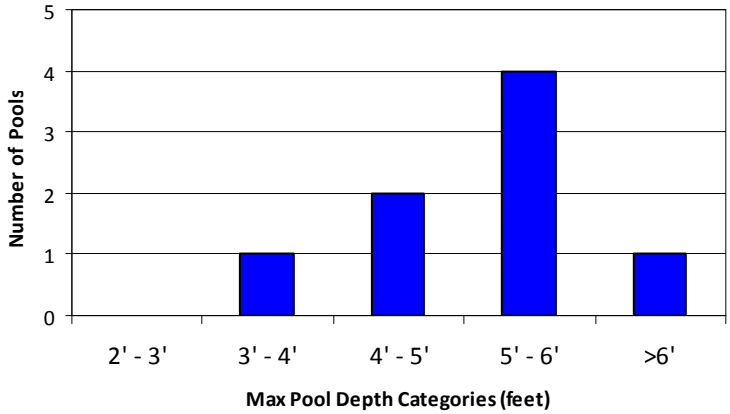
Figure 24: Proportion of Habitat Types by Relative Frequency in Reach 5

Reach 5 is typified by plane-bed morphology with long flatwaters and an entrenched floodplain (Montgomery and Buffington, 1997). The average active channel width was 69.0 feet, the active channel depth 1.8 feet, and the average floodprone with was 86.5 feet. With a active channel width:depth ratio of 39 and an entrenchment ratio of 1.25, Reach 5 resembles an "F4" channel type (Rosgen 1996).

Pools

There were 8 pools in Reach 5 with an average maximum depth of 4.9 feet (stdev 0.9). All pools in Reach 5 were greater than 3 feet deep (Figure 25). The average residual pool depth was 3.4 ft, with an average pool crest depth of 1.5 ft. Substrate in pools was gravel with sand.

Figure 25: Maximum Pool Depths for Reach 5.

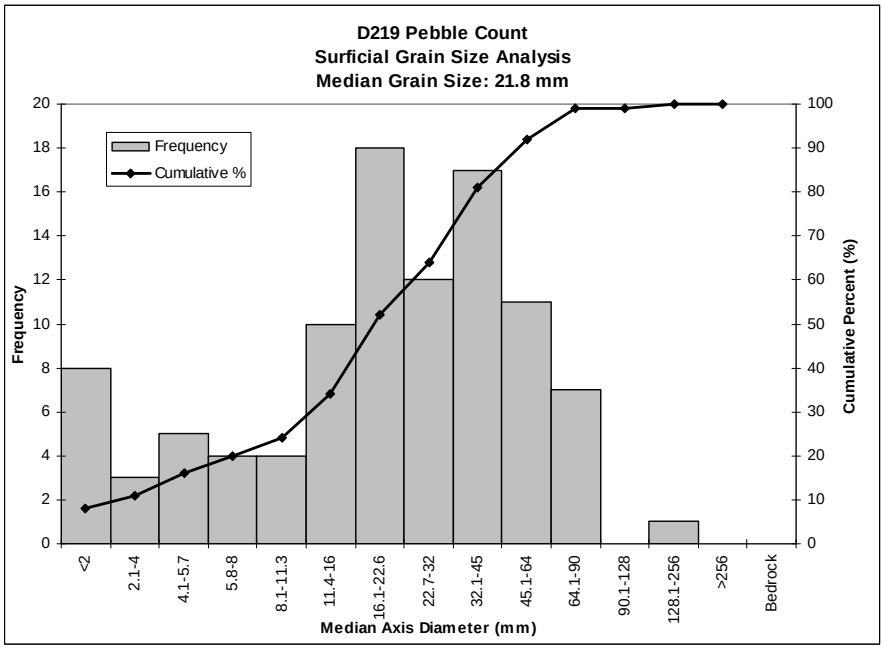


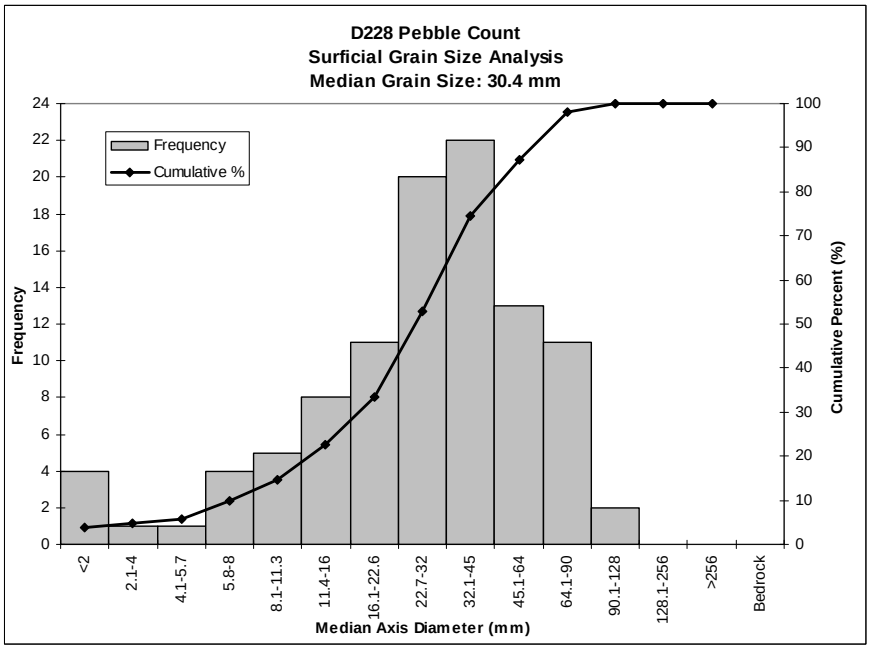
Riffles & Flatwaters

The average depth of riffles in Reach 5 was 1.0 feet, and the average depth of flatwaters was 1.5 feet. The bed material in this reach is primarily gravel with some sand in the pools and small cobbles in the flatwaters and riffles. Two pebble counts were conducted in riffles within Reach 5, both upstream of Kelley Creek. The riffles are primarily

composed of coarse to very coarse gravel with median grain sizes of 22 and 30 mm (Figure 26). 4% and 8% of the substrate was sand/fine sediment (<2mm). 80% was coho and steelhead spawning gravel (11.4 to 128mm), and 42% was ideal juvenile rearing size (32 to 128 mm).

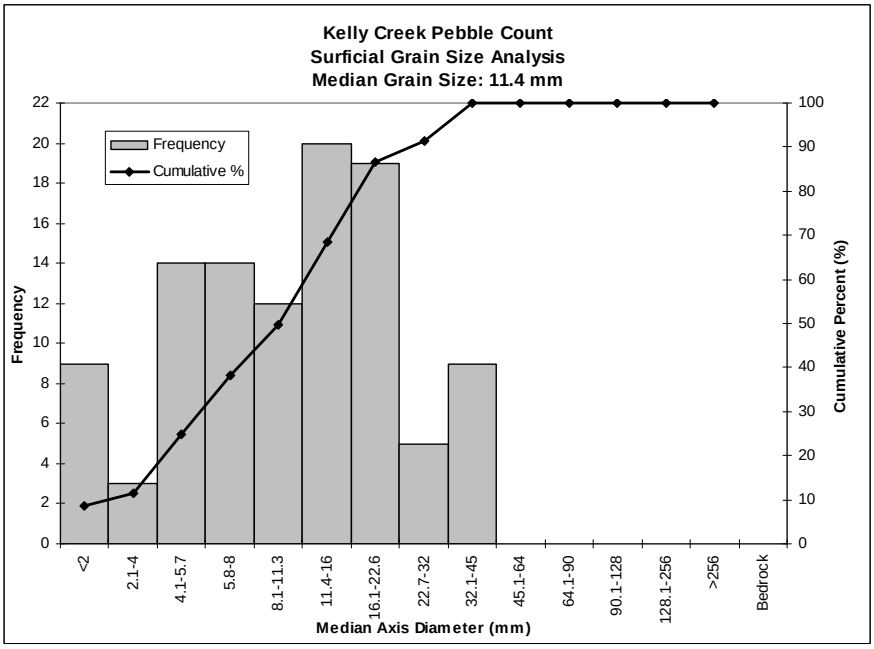
Figure 26: Grain size distribution of two riffles in the stable section of reach 5 upstream of both tributaries (habitat units #219 and 228).





The bed material in Kelley Creek is primarily fine to medium gravel but ranges from sand to very coarse gravel. The median grain size near the mouth of Kelley Creek is 11 mm, medium gravel (Figure 27). The smaller grain sizes being discharged by Kelley Creek are likely transported readily during higher flows on Dry Creek.

Figure 27: Grain size distribution for the channel bed of Kelley Creek near its confluence with Dry Creek.



Side-Channels

There was one short, riffle-dominated side channel in Reach 5. It was 60 feet long, 12 feet wide, with an average of 0.5 feet deep. Observed substrate was gravel with small cobble.

Figure 28: (left) riffle habitat unit, (right) long, deep pool with woody debris.

Alcoves

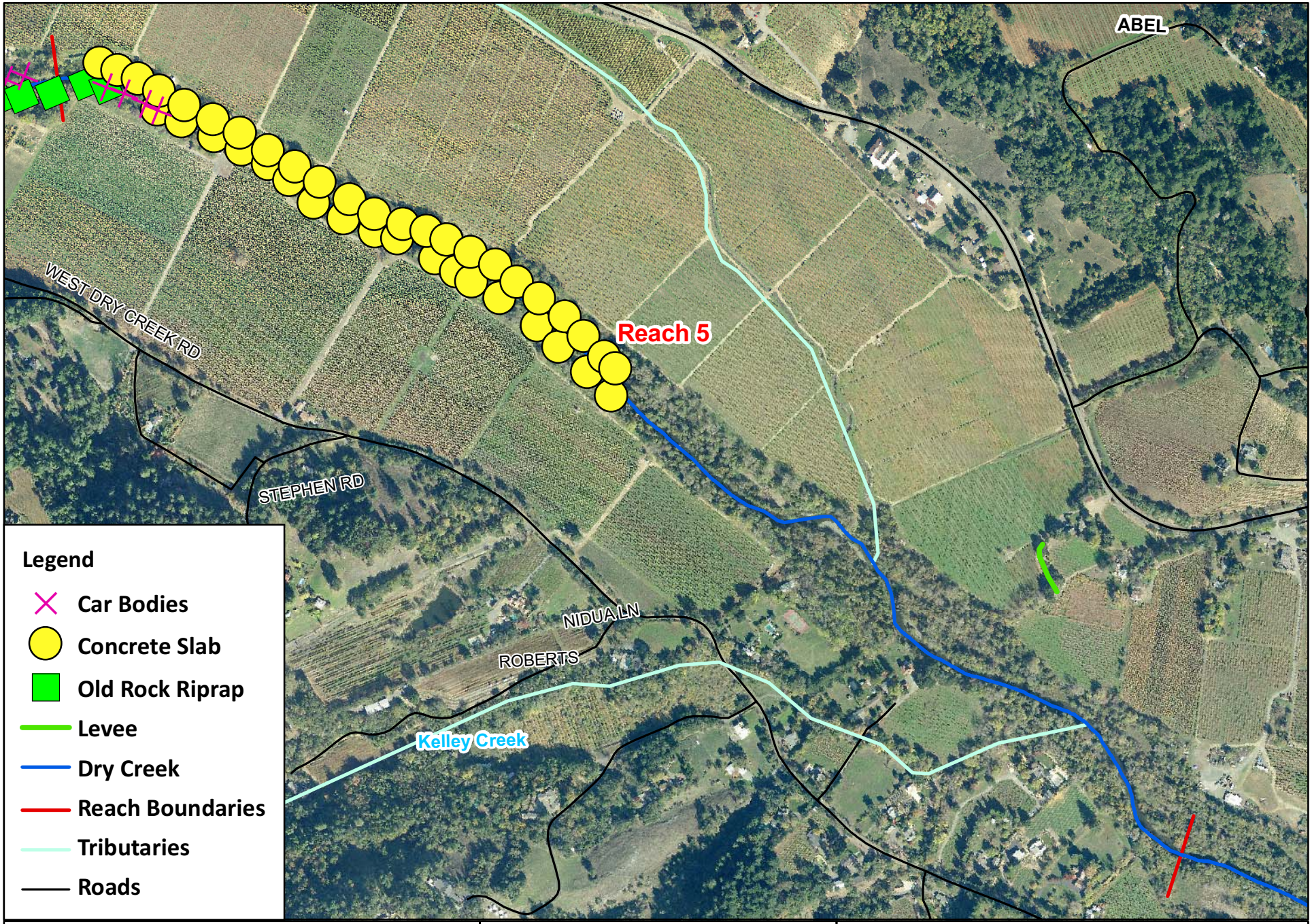
There are two medium-sized alcoves in Reach 5, one was 45 by 5 feet and 0.5 feet deep, and the other was 60 by 10 feet and 1.5 feet deep. Observed substrate was fine sediment with gravels.

Instream Cover & Woody Debris

In Reach 5, there were an average of 234 pieces per mile of wood in the mainstem channel (Table 5). Overall, pools contained the highest densities of wood pieces, followed by side channels and alcoves. Out of 20 large wood pieces (>20" diameter) counted, sixteen were found in mainstem pools. Cover was provided by terrestrial vegetation and small woody debris, with some root mass cover in riffles and flatwaters, and some cover in alcoves provided by aquatic vegetation. Edge habitat was observed in four flatwaters and six pools, and in the side-channel and alcoves.

Table 5: Instream woody debris, cover, and edge habitat frequency for Reach 5.

	wood pieces/mile				instream cover		
	small 6" - 12"	med 12" - 20"	large >20"	total	% cover	shelter rating	% units with edge habitat
Pools	224.8	40.1	26.8	267.1	22%	60	50%
Riffles	103.0	44.1	0.0	147.1	16%	36	0%
Flatwaters	166.3	35.3	12.6	214.2	26%	69	33%
Side Channels	264.0			264.0	20%	40	100%
Alcoves	150.9	50.3		201.1	55%	165	100%
	mainstem pieces/mile			233.9			



N E S W

0 500 1,000 Feet

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Reach 5 Features

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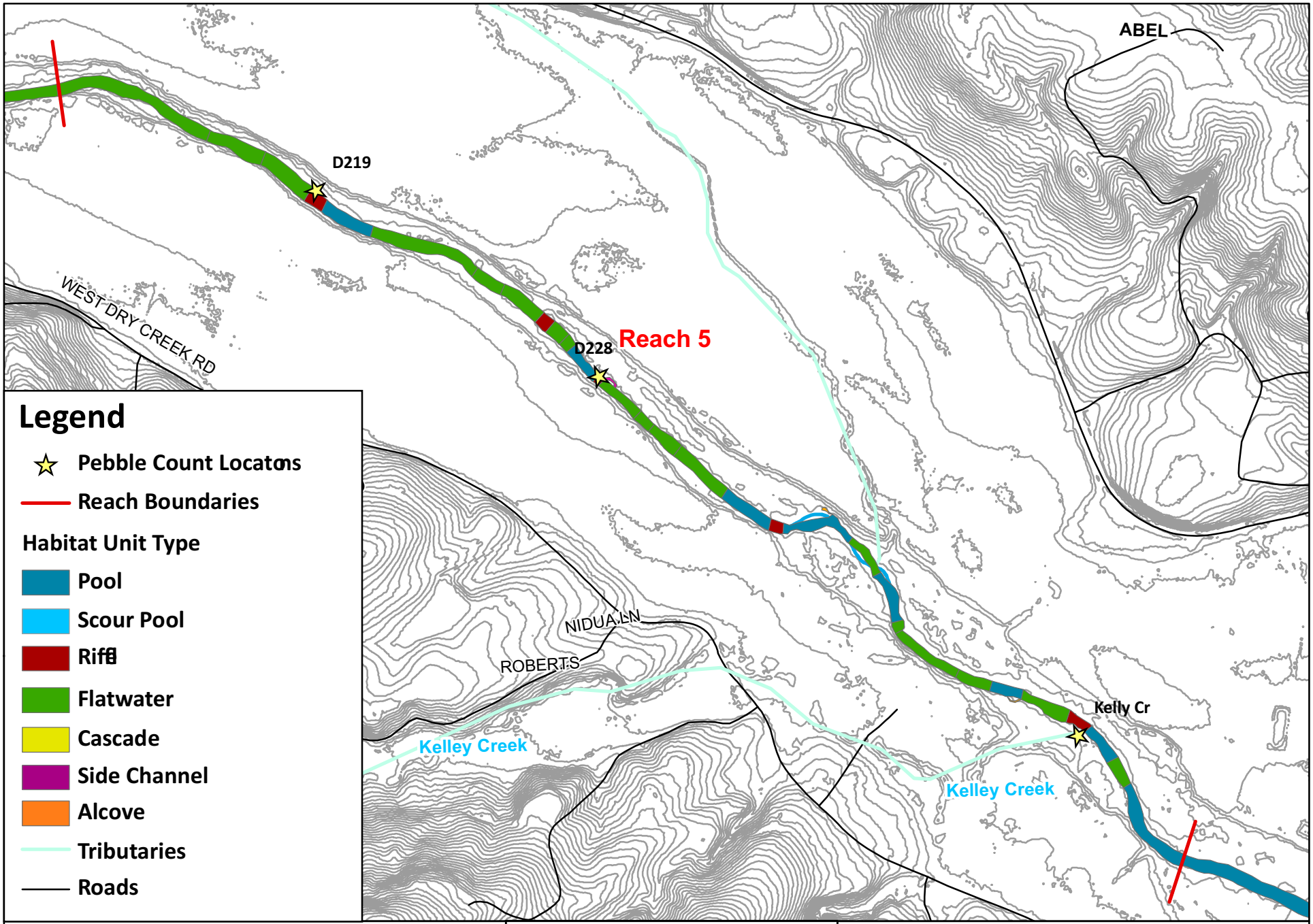

DRY CREEK
Reach 5 Habitat Units

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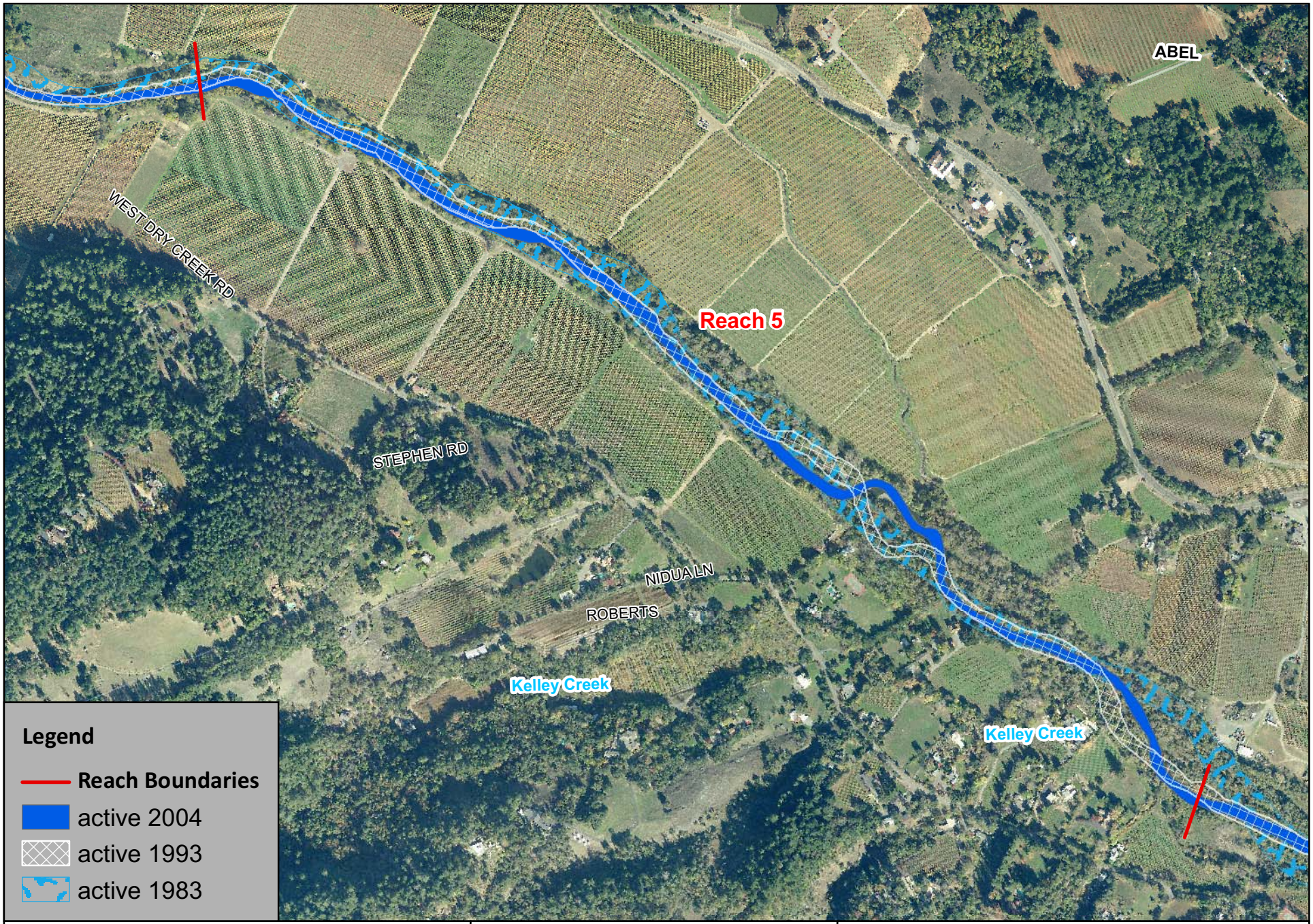

N E S W

0 500 1,000 Feet

DRY CREEK

Reach 5 - Channel Position Map

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REACH 6 (RM 5.4 to RM 6.2) **Moderately confined from the end of fault influence to the first bedrock outcrop**

Reach 6 is a single-thread channel that has narrowed over time but has not experienced substantial amounts of channel change. It extends upstream from reach 5 to river mile 6.2, about 500 ft downstream from the confluence of Crane Creek on the right[4] bank. Access to the floodplain was restricted through much of this reach due to landowner concerns, so information regarding this reach is limited. No tributaries flow into Dry Creek in this reach.

A PIT tag antenna was located in the middle of the reach at the time of the survey (Figure 29). Car bodies and riprap were observed for 500 feet along the streambanks at the downstream end of the reach. The upstream end of this reach terminates at the first visible expression of bedrock in the channel.

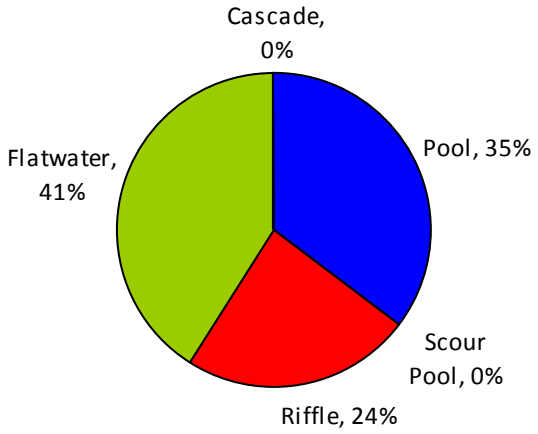
Figure 29: (left) adult fish monitoring station, (right) scour pool.

Habitat Classification

By relative frequency, Reach 6 is composed of 35 % pools, 41% flatwaters, and 24% riffles (Figure 30). Riffles range in length from 60 to 120 ft and account for 12% of the main channel on a length basis. The average wetted width at the time of the survey was 49 ft.

It was plane-bed morphology with an low gradient, with four of the seven pools longer than 300 feet long. Due to concerns over landowner permissions, no active channel or floodprone measurements were made.

Figure 30: Proportion of Habitat Types by Relative Frequency in Reach 6

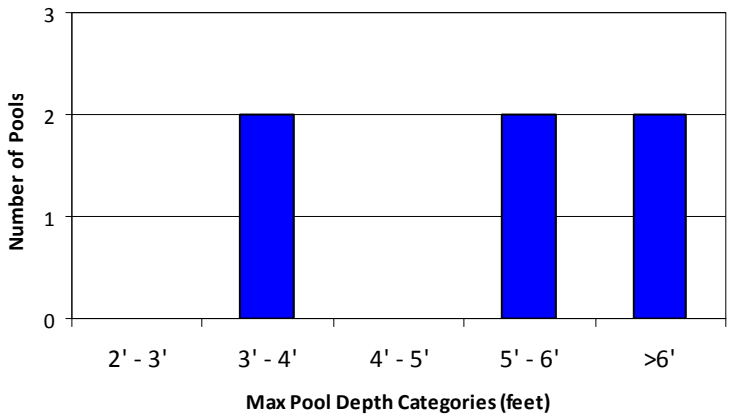


[4] In the individual reach summaries, right and left bank designation defined as looking downstream.

Pools

The average maximum pool depth was 5.5 (stdev. 1.8), and average residual pool depth was 4 feet. All of the six pools were greater than 3 feet deep (Figure 31). Substrate in pools was gravel with sand and some small cobble.

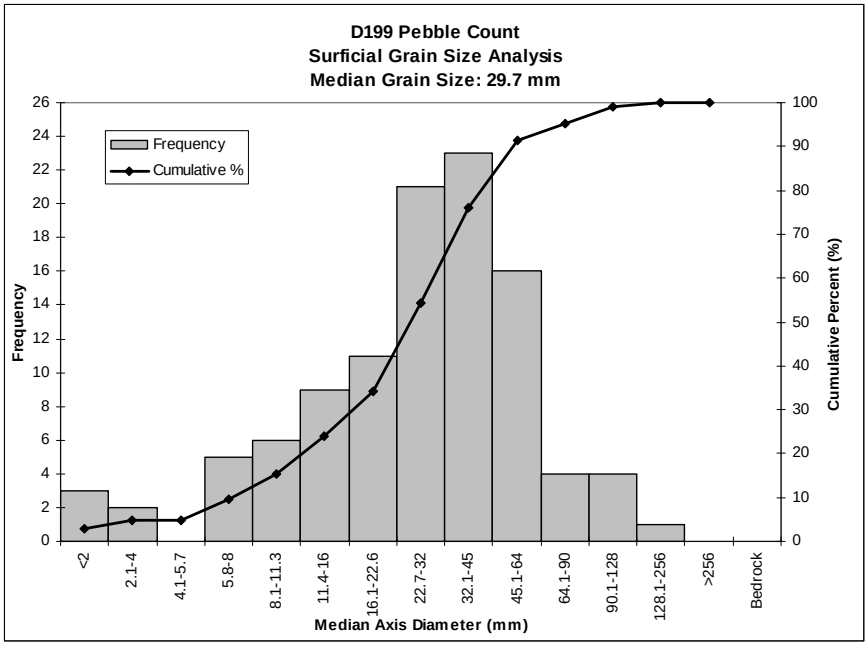
Figure 31: Maximum Pool Depths in Reach 6.



Riffles & Flatwaters

The average depth of riffles was 0.9, and the average depth of flatwaters was 1.5. Bed material in Reach 6 is primarily gravel with some sand in the pools and small cobbles in the flatwaters and riffles. The bed material in the riffle at the upstream extent of the reach ranges from sand to large cobbles but is primarily coarse to very coarse gravel. The median grain size is 30 mm, coarse gravel (Figure 32). The majority of samples fell within the very coarse gravel and coarse gravel size categories. 84% of the substrate was within desirable size classes for coho/steelhead spawning (11.4 to 128mm), and 45% fell within desirable sizes for juvenile rearing (32 to 128mm). 3% of the samples were fine sediment and sand (<2mm).

Figure 32: Grain size distribution for riffle about 500 ft downstream from Crane Creek (habitat unit #199).



Side-Channels & Alcoves

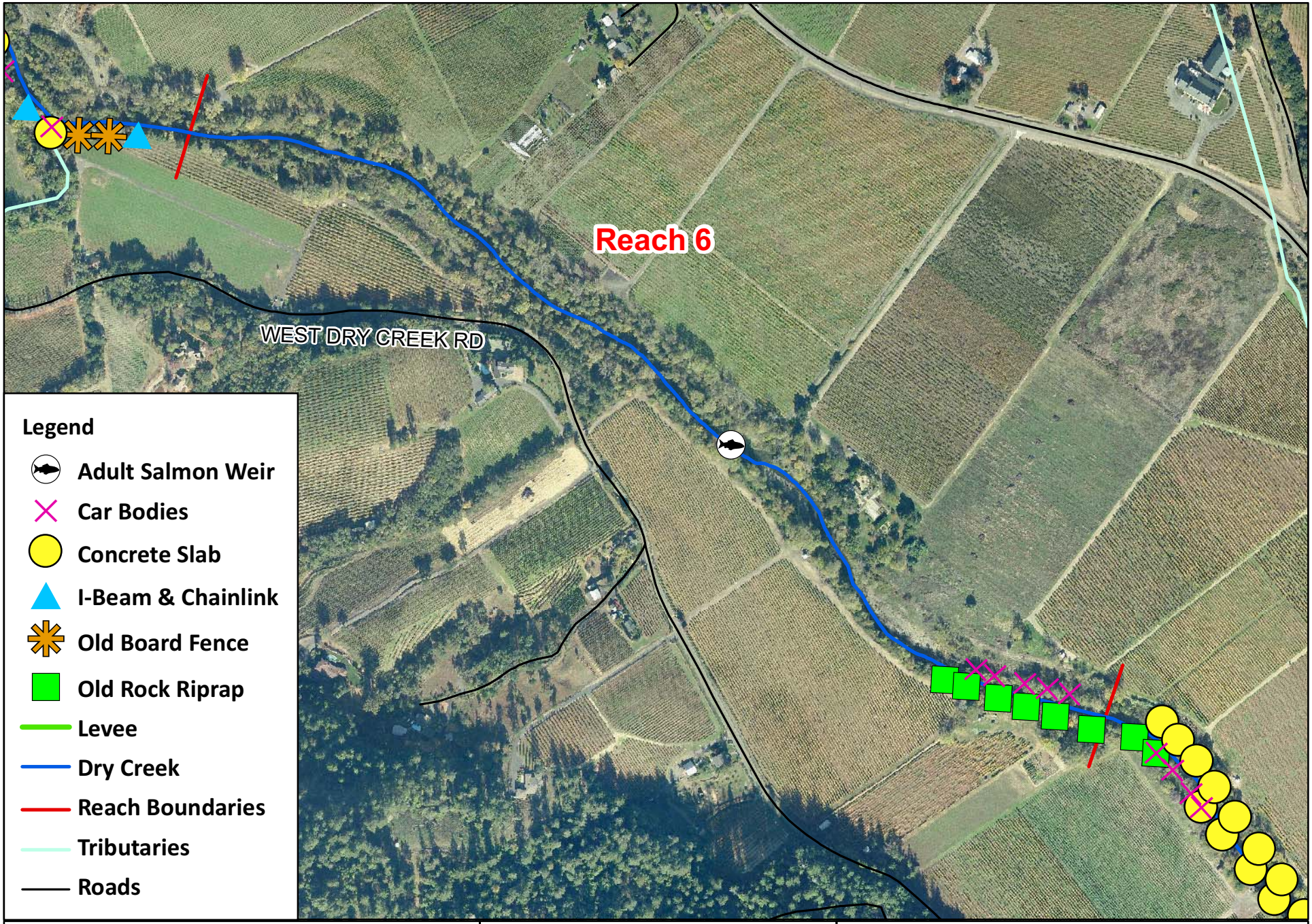
There were no side-channels or alcoves observed in Reach 6.

Instream Cover & Woody Debris

There were 196 pieces of wood per mile in Reach 6 (Table 6). The highest density of wood was found in pools, and 8 out of the 14 large wood pieces (>20” diameter) in Reach 6 were also found in pools. Most of the cover was provided by terrestrial vegetation and small woody debris, with some cover provided by large woody debris and root masses. Edge habitat was present in two pools and three flatwaters.

Table 6: Instream woody debris, cover, and edge habitat frequency for Reach 6.

	wood pieces/mile				instream cover		
	small 6" - 12"	med 12" - 20"	large >20"	total	% cover	shelter rating	% units with edge habitat
Pools	123.1	25.5	17.0	165.5	35%	98	33%
Riffles	72.8	10.4	20.8	103.9	16%	31	0%
Flatwaters	204.8	72.8	22.8	300.4	17%	47	43%
	mainstem pieces/mile			195.6			



N
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0 500 1,000 Feet

DRY CREEK
Reach 6 Features

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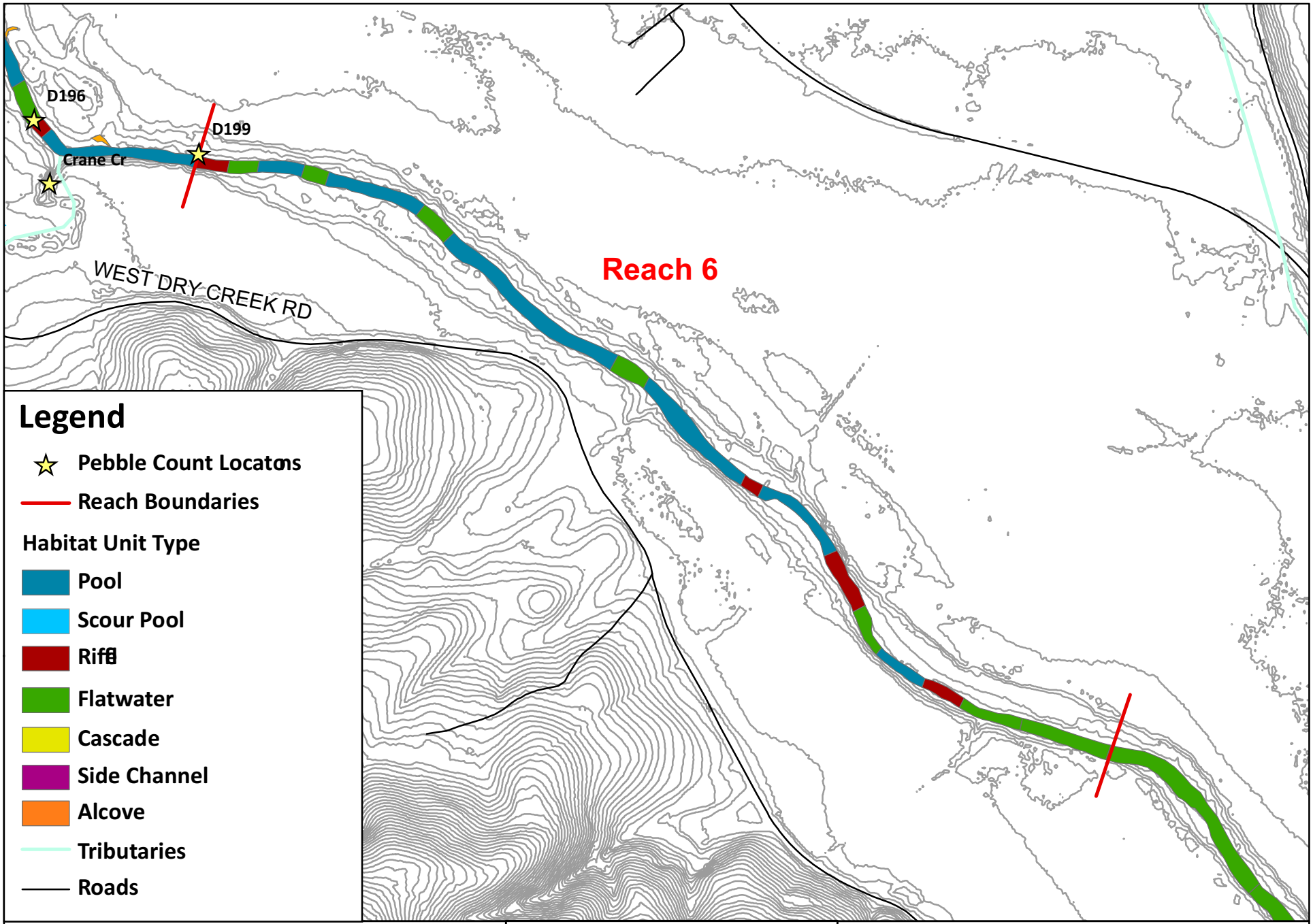

N
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Feet

DRY CREEK
Reach 6 Habitat Units

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N
W E
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0 500 1,000 Feet

DRY CREEK
Reach 6 - Channel Position Map

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REACH 7 (RM 6.2 to RM 7.5) **Crane Creek to Grape Creek, from the beginning of Bedrock Outcrops to the end of Bedrock Outcrops**

Reach 7 extends upstream from below Crane Creek to about 1000 ft upstream of Grape Creek at river mile 7.5. Two important tributaries, Grape Creek and Crane Creek, enter Reach 7 at river miles 7.2 and 6.3, respectively. Crane Creek is a steep, deeply incised tributary with exposed bedrock at its mouth and compacted sands and gravel on its steep banks. A mapped, unnamed tributary enters Dry Creek at river mile 6.6, but was not noted in the survey. A valley landmark, Lambert Bridge, crosses Dry Creek at river mile 6.6.

Multiple bedrock outcrops are visible along the channel bed in this reach and the reach boundaries were located to encompass all of these outcrops. Though the channel has narrowed as it has incised through this reach, there have been only minor amounts of channel migration since the 1940s. The channel is more sinuous than downstream, but the riparian corridor is narrow, and there is little room for substantial channel migration. Although the riparian corridor is narrow through this reach there is some room for habitat enhancement upstream from Crane Creek and downstream from Grape Creek where minor channel changes have occurred historically.

Figure 33: (upper left) cascade under Lambert Bridge, (upper right) mouth of Crane Creek, (lower left) bedrock outcrop, (lower right) riffle where Grape Creek enters Dry Creek.

Substantial incision has occurred through this reach, but the bedrock outcrops have limited further degradation. The most apparent bedrock outcrop is the bedrock cascade under the Lambert Bridge, but there are also outcrops at river mile 6.4 between the unnamed tributary and Crane Creek, at the mouth of Grape Creek and upstream of Grape Creek. These occasional bedrock extrusions provide cover for fish, influence pool formation, and control stream gradient. Despite the bedrock outcrops, the dominant substrate is gravel, followed by sand.

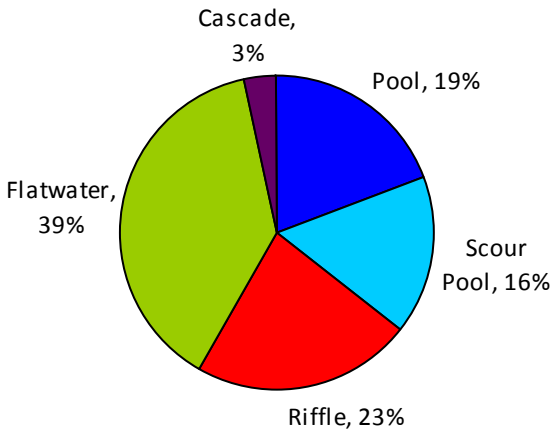
Bank stabilization efforts in Reach 7 include boulder riprap, old cars on the banks, concrete slabs, I-beam and chain link fence, and old board fence protecting banks just downstream of Crane Creek on the right bank. At river mile 7.0, eight large boulders have been placed in a triangle formation in the center of a cobble-gravel flatwater. The cascade under Lambert Bridge is made up of bedrock, boulders, and chunks of concrete, with an approximate 2’ drop. An 8’-high eroding streambank is exposed along outer bend of at river mile 6.4.

Figure 34: (upper left) Failed I-beam and chainlink fence stabilization efforts, (upper right) car bodies in the banks, (lower left) erosion along an outside bend, (lower right) a triangular boulder cluster in Dry Creek.

Habitat Classification

Reach 7 contains 35% pool habitat, 39% flatwater, 23% riffle, and 3% cascade (under Lambert Bridge) by relative frequency (Figure 35). Riffles represent only 10% of the 1.3 miles of main channel on a length basis. There are a few side channels and alcoves, one cascade and seven riffles ranging in length from 50 to 60 ft.

Figure 35: Proportion of Habitat Types by Relative Frequency in Reach 7



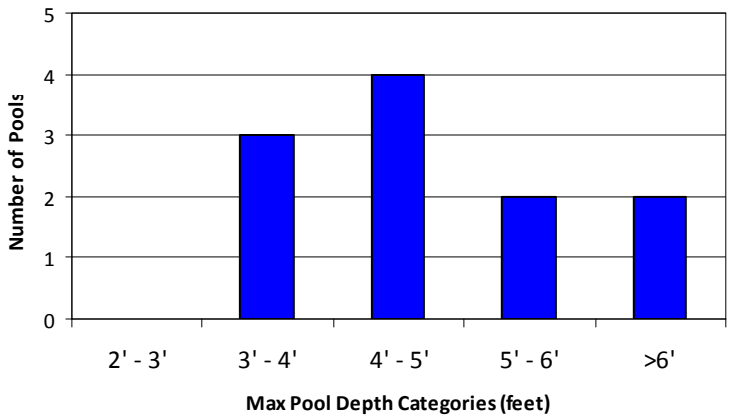
The average wetted width during the survey was 48 ft and the active channel and flood prone widths are 58.5 and 81 ft respectively. The average active channel depth was 2.5 ft. Adjacent terraces are about 10 ft above the channel bed.

Reach 7 is an F-type channel, due to its entrenched floodplain and a moderate-to-high width:depth ratio. However, in some segments of Reach 7, erosion, avulsion, and deposition are evidenced by a number of high quality alcoves, side-channels, and gravel bars and by creative bank stabilization efforts using I-beams, old cars, and boulder riprap.

Pools

The average maximum mainstem pool depth in Reach 7 was 5.4 feet (st.dev. 1.3), and the average maximum scour pool depth was 4.1 feet (st.dev. 0.4). Within Reach 7, a number of deep scour pools are associated with woody debris. All 11 pools are greater than 3 feet deep (Figure 36). Several of the pools include flatwaters shorter than a wetted channel width. In some areas, the water pools in the bedrock. The average residual pool depth was 3.5 ft., and the average pool crest depth was 1.4 ft. Ocular estimates of substrate identified gravel with sand covering the streambed in pools.

Figure 36: Maximum Pool Depths in Reach 7.

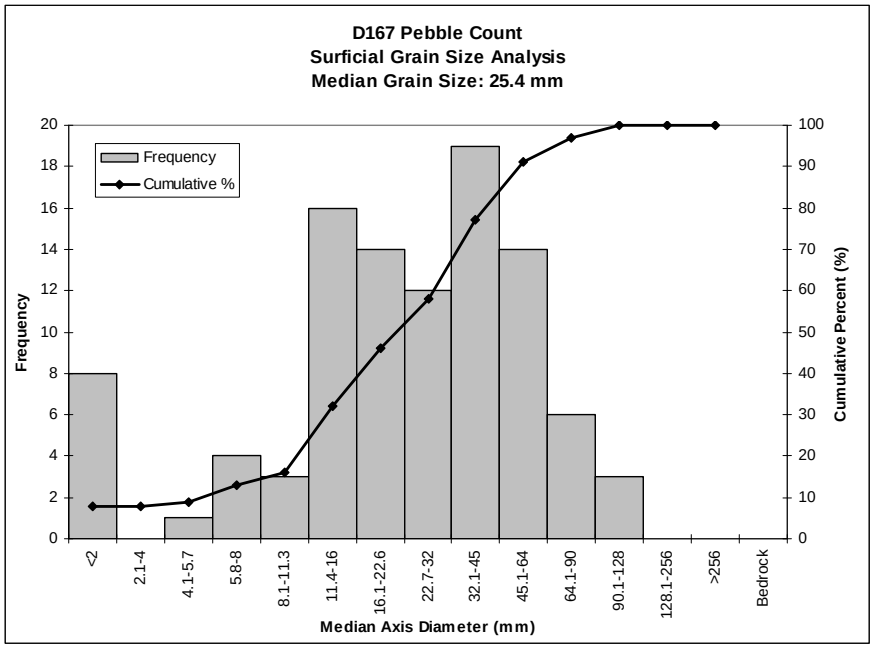


Riffles, Flatwaters & Cascade

The average depth is 1.0 feet for riffles, and 1.4 feet for flatwaters. The bed material through reach 7 is primarily gravel with some sand in the flatwaters and pools and small cobbles in the riffles. Riffles are primarily composed of coarse to very coarse gravels with material ranging from sand to small cobbles. Bedrock composed most of the bed material in the cascade and was identified in a few other locations through the reach. The single cascade under Lambert Bridge was bedrock-based, with boulders.

Pebble counts were conducted in four riffles in Reach 7, as well as in the mouths of Grape Creek and Crane Creek. The median grain size of four sampled riffles ranged from 16 to 30 mm (Figure 37). Most samples were medium gravels through very coarse gravels. 80% of all samples were within desirable coho/steelhead spawning sediment sizes, and 36% was within juvenile rearing size classes. 5% of the samples were fine sediments or sand (<2mm). A thick biomat of algae was observed to cover the gravel-sand substrate in several flatwaters.

Figure 37: Grain size distribution for four riffles between Grape Creek and Crane Creek.



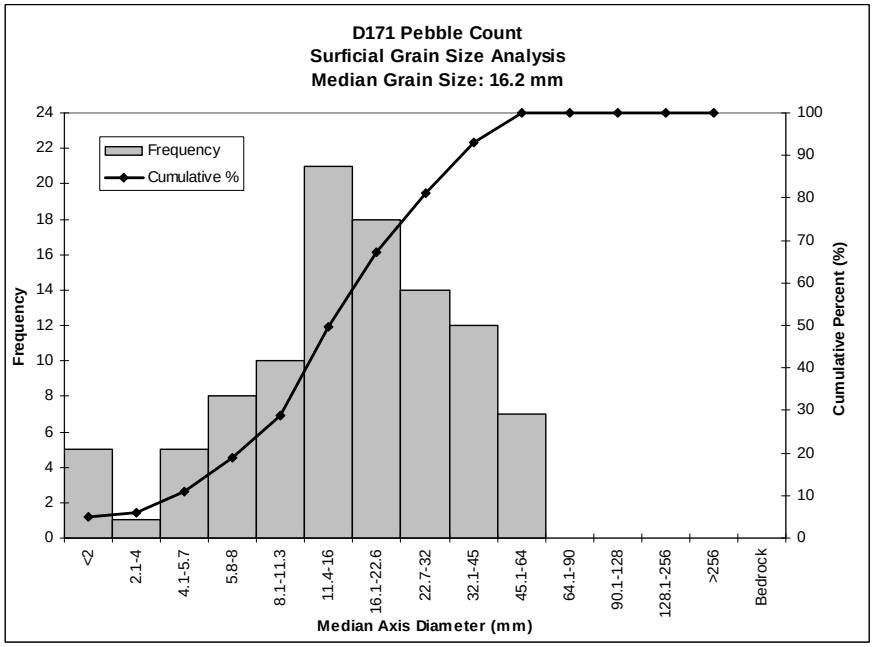
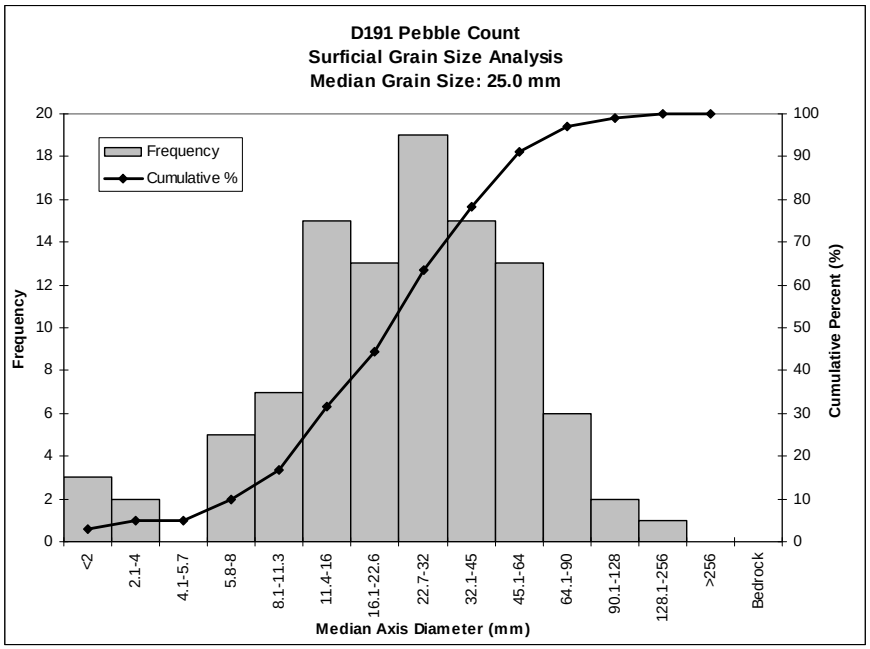
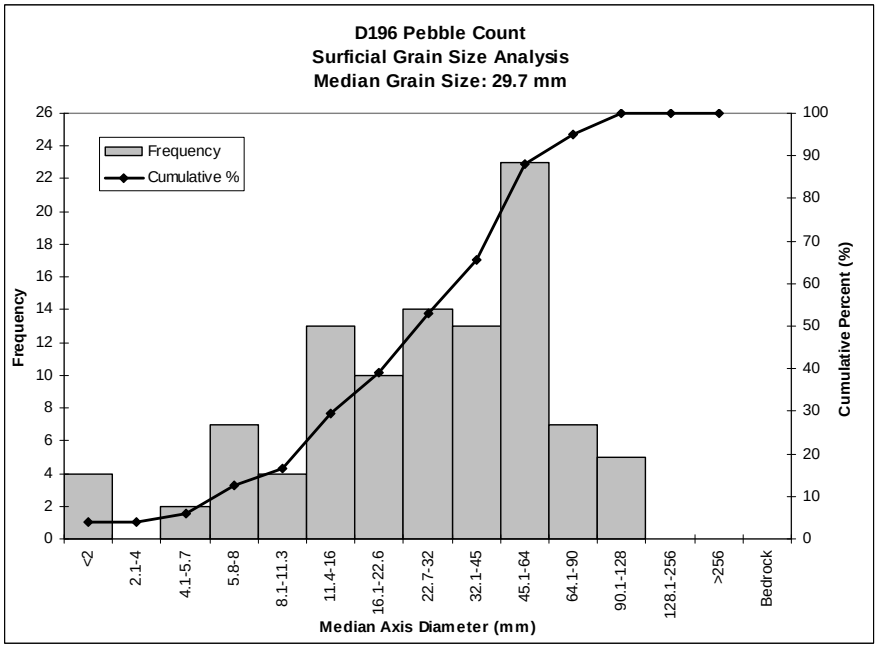


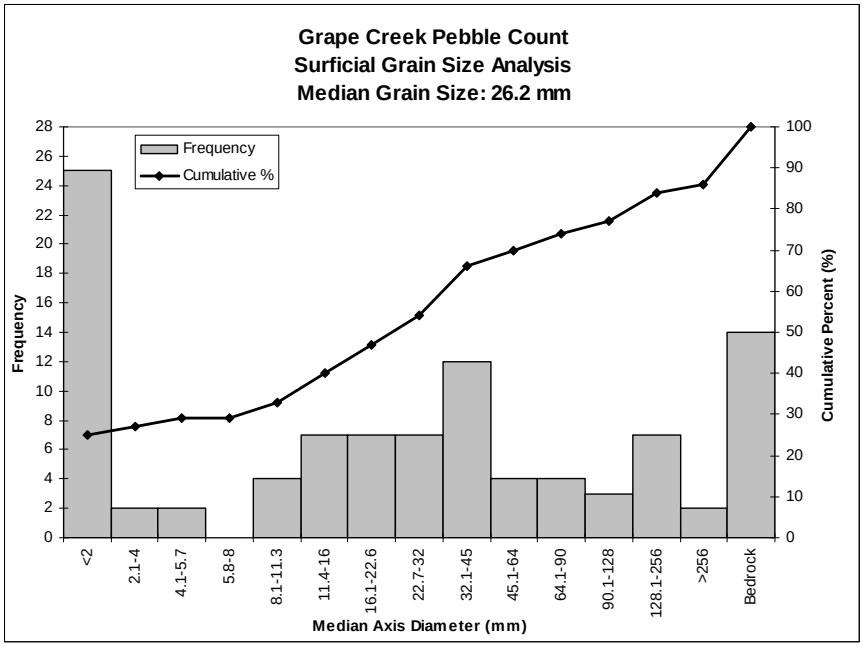
Figure 37, continued: Grain size distribution for four riffles between Grape Creek and Crane Creek.

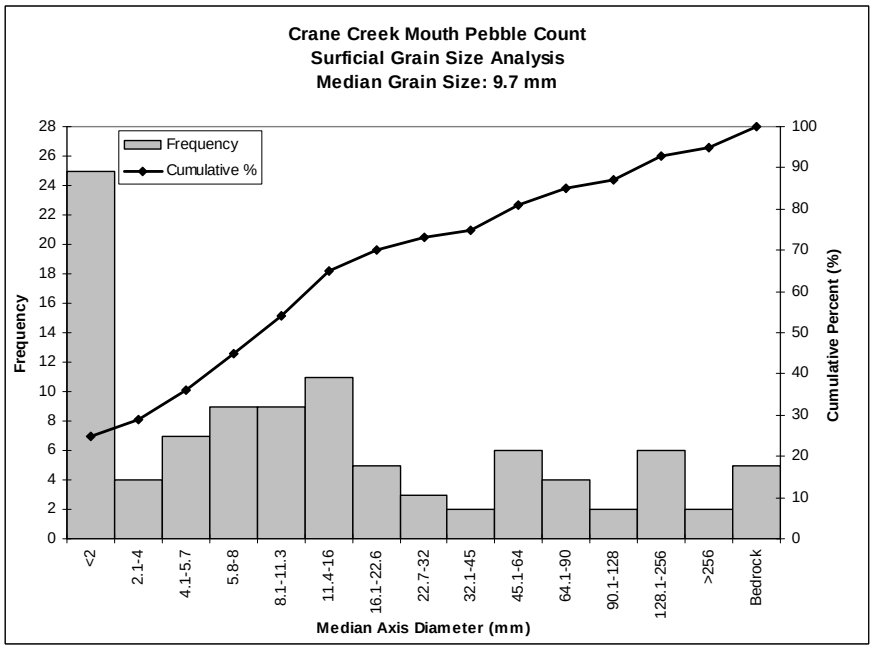




The bed material in Grape Creek is variable, ranging from sand to small boulders and bedrock. Though the median grain size is coarse gravel (26 mm), 25% of the material is sand and 14% is bedrock. The bed material in Crane Creek is similar to that in Grape Creek with 25% being sand and no other size class composing more than 9% of the material. The median grain size of Crane Creek is medium gravel (10 mm) (Figure 38).

Figure 38: Grain size distribution for the channel beds of Grape Creek and Crane Creek near their confluences with Dry Creek.





Side-Channels

Of the three side-channels in Reach 7, two were flatwater dominated and the third was riffle-dominated. The average side-channel depth was 0.8 feet. One of the flatwater-dominated side channels was 530 feet long (Figure 39), and 20 feet wide. This side-channel contained pools and riffles, as well as longer flatwater sections, with gravel with

small cobble substrate. The other two side channels were shorter (30 feet and 70 feet long), with bedrock and gravel substrate with sand. The area where Grape Creek enters was very complex, with a long alcove along the left valley wall that serves as a side channel in higher flows.

Figure 39: (left) wood associated with a scour pool, (right) side channel D183.

Alcoves

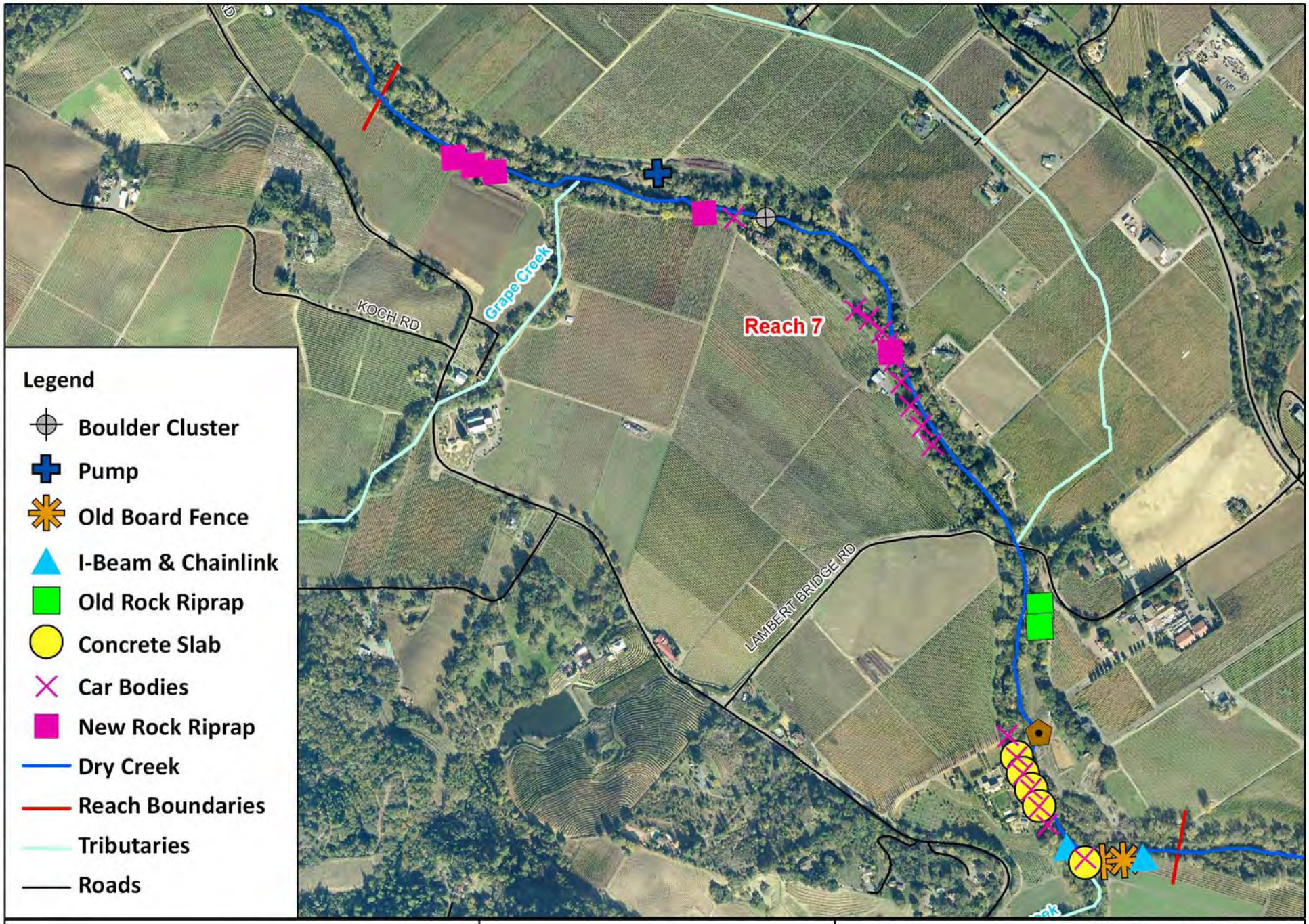
There are eight alcoves in Reach 7. The average maximum depth was 2.0 feet (st.dev. 1.0). Just downstream of Grape Creek, a long 400 foot alcove/canal was dug out and cleaned on the left bank, with an irrigation pump up on the left bank terrace. Substrate in the alcoves was gravel with sand, small cobble, and fine sediments. An additional 25'-long alcove, which was about 5' wide, was observed on the left bank of a scour pool at the head of the reach, but was deemed too small to count as a habitat unit.

Instream Cover & Woody Debris

There are a total of 287 pieces of wood in Reach 7, with 193 pieces per mile in the mainstem (Table 7). The highest densities of wood were found in pools and riffles, followed by flatwaters, then side-channels and alcoves. 5 out of the 8 large wood pieces (>20" diameter) were found in pools. Cover was provided by overhanging vegetation, terrestrial vegetation growing in the water, and small woody debris, and also by boulders, bedrock, and root masses. Edge habitat was present in 44% of the habitat units.

Table 7: Instream woody debris, cover, and edge habitat frequency for Reach 7.

	wood pieces/mile				instream cover		
	small 6" - 12"	med 12" - 20"	large >20"	total	% cover	shelter rating	% units with edge habitat
Pools	162.5	47.9	3.4	213.8	41%	117	50%
Scour Pools	165.6	44.9	10.4	220.9	22%	67	40%
Riffles	129.3	38.0	15.2	182.6	22%	49	29%
Flatwaters	103.0	21.3	0.0	124.4	17%	41	33%
Cascades	0.0	0.0	0.0	0.0	95%	285	100%
Side-Channels	120.9	24.2	0.0	145.1	40%	80	33%
Alcoves	126.7	10.6	5.3	142.6	39%	87	75%
	mainstem pieces/mile			190.5			



N
W E
S

0 750 1,500 Feet

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Reach 7 Features

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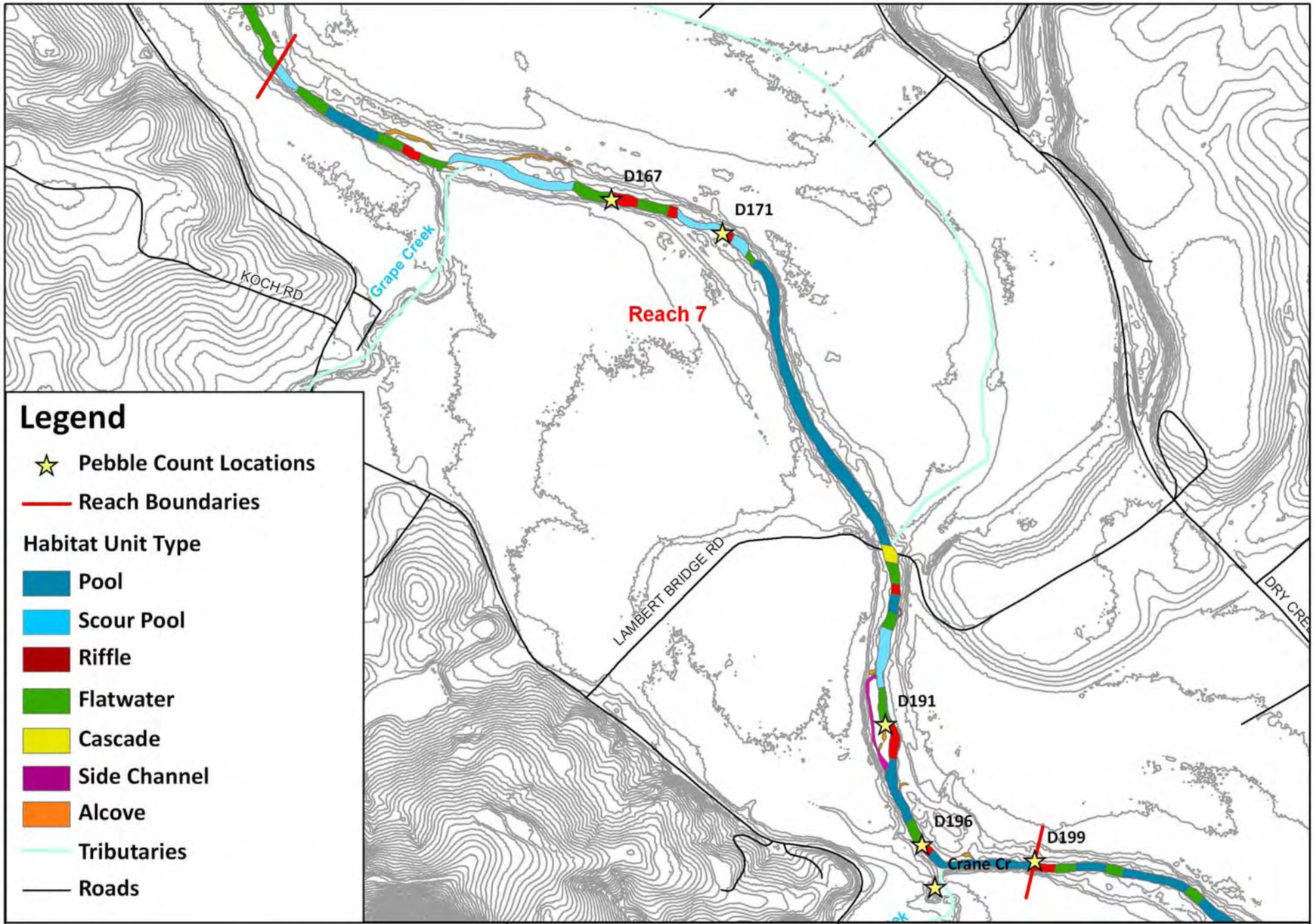

N
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0 750 1,500 Feet

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N
W E
S

0 600 1,200 Feet

DRY CREEK
Reach 7 - Channel Position Map

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REACH 8 (RM 7.5 to RM 9.0) **Moderately Confined with Bank Stabilization Features**

Nearly all of the various types of bank stabilization techniques applied in Dry Creek are present throughout Reach 8 (Figure 40). Approximately 2500 feet of banks are armored with large boulder riprap, some of it including car parts intermingled with the boulders and riprap. An old truckbed is used to stabilize one streambank at river mile 8.8, and a mix of metal pipes, logs, and rocks have been used to shore up another bank at river mile 7.9. Board fence lined 750 feet of the right[5] bank at river mile 8.5. A dry, unnamed tributary enters on the left bank at river mile 8.9.

Reach 8 is a single-thread channel extending 1.5 miles upstream from Grape Creek to river mile 9. The upstream reach boundary location is about 1700 ft downstream from the alignment of the lineament and the channel planform. The channel has incised and narrowed since the 1940s, but the general planform and channel location has remained similar for about half of the reach. Near the upstream reach boundary and the unnamed tributary, as well as between the downstream reach boundary and river mile 8.2, there has been moderate channel migration and changes in planform since the 1940s. Since the dam was built, however, the planform and location of the channel have remained relatively stable. The areas with different channel locations prior to the dam construction have a slightly wider riparian area and the old channels may provide opportunities for habitat enhancement.

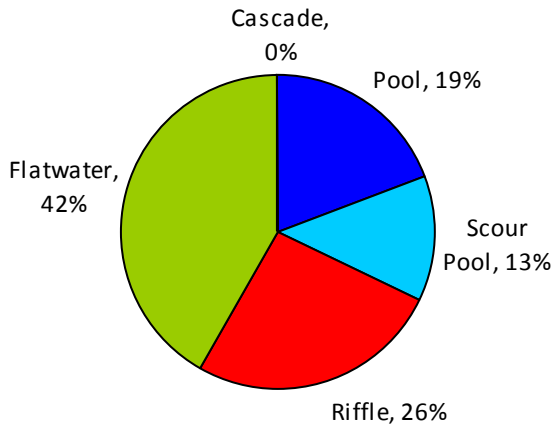
Figure 40: Bank stabilization features. (upper left) Board Fence, (upper right) boulder riprap with car parts, (lower left) a truck bed, (lower right) metal poles with logs and rocks.

[5] In the individual reach summaries, right and left bank designation defined as looking downstream.

Habitat Classification

The channel in this reach is composed of pools (32%), and flatwaters (42%) and also contains 26% riffles on a frequency basis(Figure 41). The 8 riffles range in length from 50 to 100 ft and account for 11% of mainstem reach on a length basis. The average channel widths are similar to reach 7: The wetted width was 46 ft, the active channel width is 58.5 ft and the flood prone width is 70.5 ft. The average active channel depth in the riffles was 2.4 ft. The adjacent terraces are up to 15 ft above the channel bed.

Figure 41: Proportion of Habitat Types by Relative Frequency in Reach 8

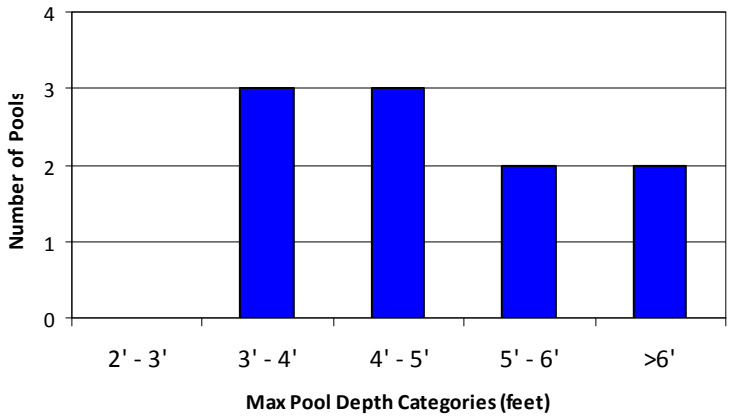


The total length of Reach 8 was 1.5 miles. Reach 8 resembled an F4-type channel due to its low entrenchment ratio (1.2) and high active channel width:depth ratio (24).

Pools

There were ten pools in Reach 8, four of which were identified as scour pools. All ten pools had maximum depths greater than 3 feet, with an average maximum pool depth of 4.7 feet (Figure 42). The average residual pool depth was 3.4 ft, and the average pool crest depth was 1.4 ft. Most substrate in pools was gravel with sand and small cobble, with several pools dominated by sand, and one with boulder substrate due to boulder riprap dropped into the channel.

Figure 42: Maximum Pool Depths in Reach 8.



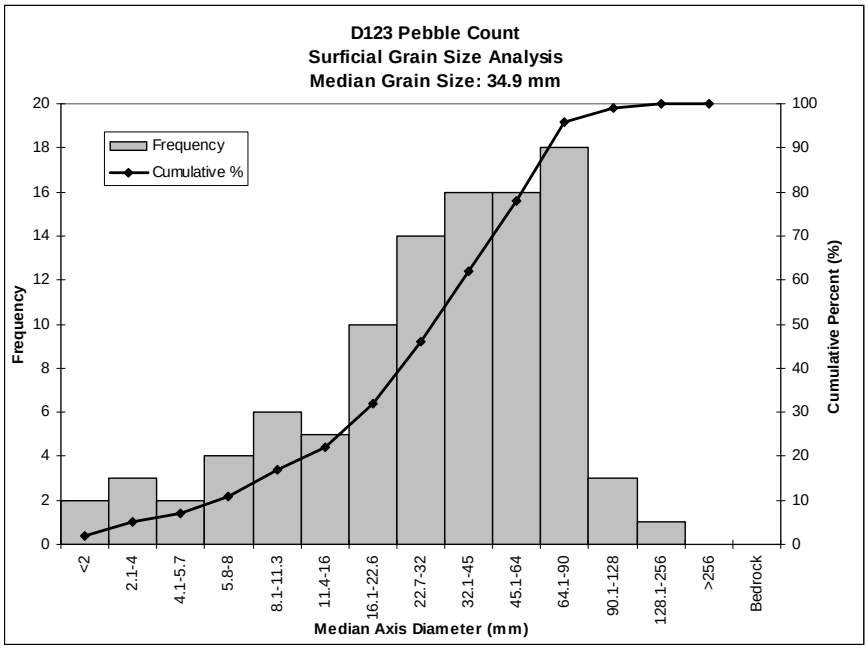
Riffles & Flatwaters

There were 8 riffles and 9 flatwaters in Reach 8. The average riffle depth was 1.0 feet and the average flatwater depth was 1.4 feet. The substrate in riffles was gravel with small

cobble, and in flatwaters it was gravel with small cobble and sand. A pebble count was conducted in the in a riffle at the upstream extent of the reach (Figure 43). Bed material ranges from sand to large cobbles but is primarily composed of coarse to very coarse gravel. The median grain size of this riffle was 35 mm or coarse gravel (Figure 44). 82% of the sediment sampled was with the ideal coho/steelhead spawning sizes (11.4mm to 128mm), and 52% was within coho rearing sediment sizes (32mm to 128mm). 2% of the sediments were fine or sand (<2 mm).

Figure 43: (left) conducting a pebble count in a riffle, (right) pool habitat in Reach 8.

Figure 44: Grain size distribution for the riffle at the upstream extent of reach 8 (habitat unit #123).



Side-Channels

No side channels were observed in Reach 8.

Alcoves

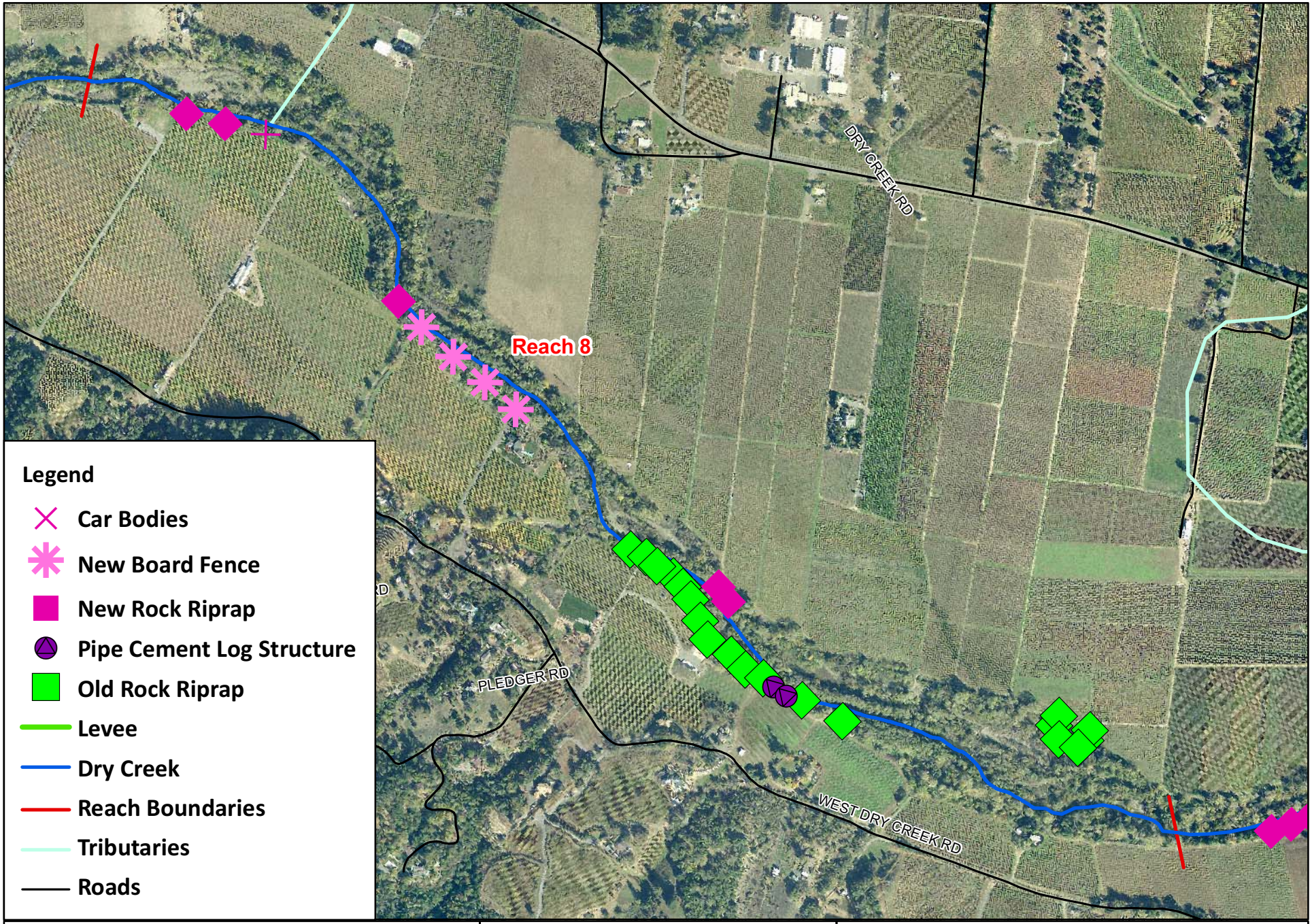
One alcove was measured in Reach 8. It was 15 feet wide, 110 feet long, with a maximum depth of 2 feet. Substrate in the alcove was gravel with fine sediment.

Instream Cover & Woody Debris

194 pieces of wood per mile were counted in Reach 8. Six out of the 8 pieces of large wood (>20” diameter) were found in pools, the other two were in a riffle. The highest densities of wood were in pools and the alcove, most of the wood falling into the small (6 to 12” diameter) category. The lowest cover and complexity was found in flatwaters, with only 13% cover and a complexity rating of 30. In Reach 8, the majority of instream cover was provided by terrestrial vegetation and small woody debris, with root masses providing limited cover in riffles and flatwaters. Boulders provided some additional cover in several pools, where bank stabilization boulders had tumbled into the channel. In addition, only a third of flatwaters contained edge habitat, whereas edge habitat was identified in most mainstem pools and in the alcove.

Table 8: Instream woody debris, cover, and edge habitat frequency for Reach 8.

	wood pieces/mile				instream cover		
	small 6" - 12"	med 12" - 20"	large >20"	total	% cover	shelter rating	% units with edge habitat
Pools	158.5	36.7	7.7	203.0	22%	66	67%
Scour Pools	212.9	61.3	6.5	280.6	17%	50	50%
Riffles	134.0			134.0	18%	46	38%
Flatwaters	113.9	27.9	4.3	146.1	16%	40	38%
Alcove	480.0	192.0		672.0	30%	90	100%
	mainstem pieces/mile			193.6			



0 700 1,400 Feet

DRY CREEK
Reach 8 Features

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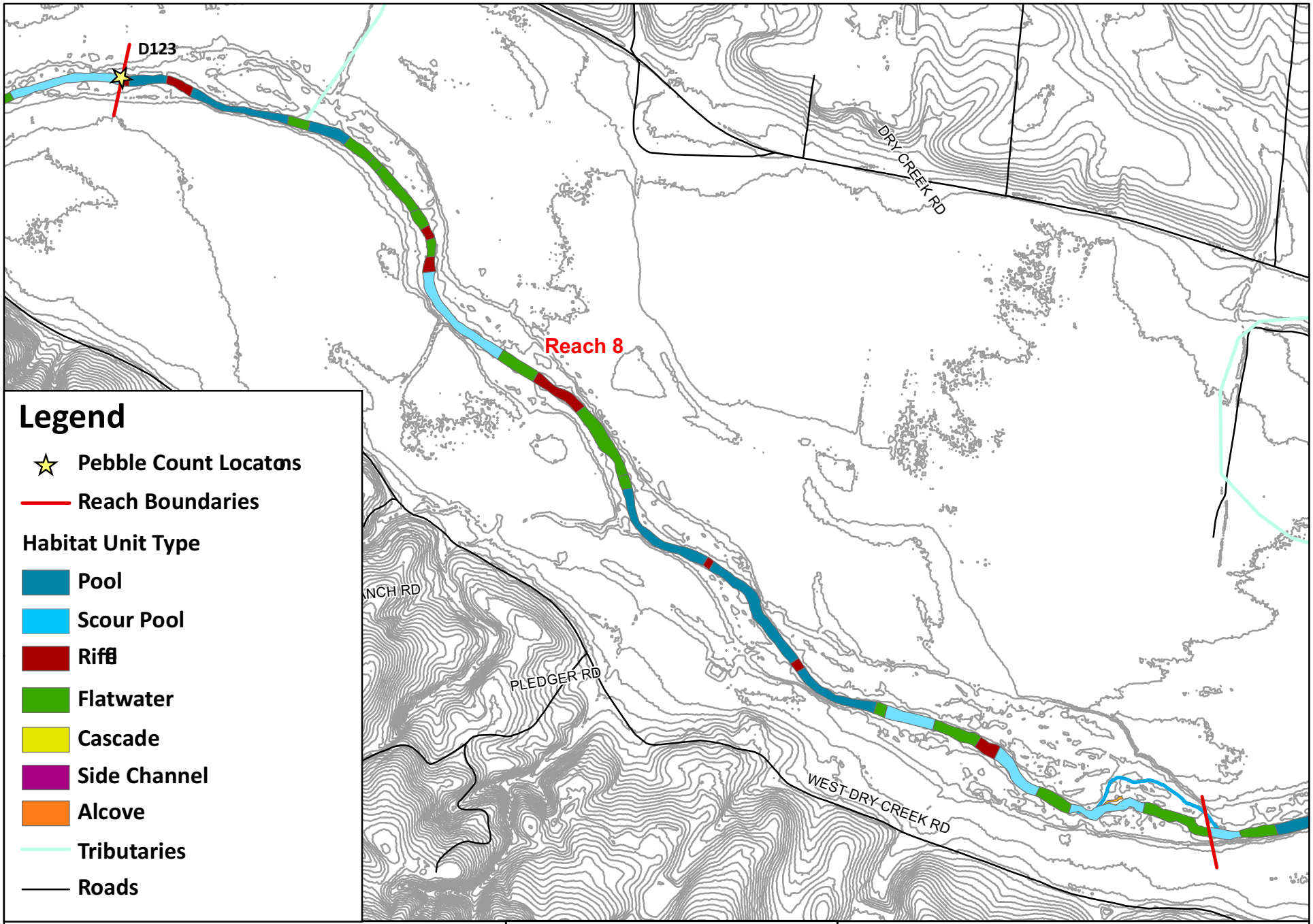

0 700 1,400 Feet

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0 500 1,000 Feet

DRY CREEK
Reach 8 - Channel Position Map

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8 APPENDIX A – DETAILED REACH SUMMARIES

REACH 9 (RM 9.0 to RM 9.8) **Confined along a fault lineament, elevated former channels**

Reach 9 is a single-thread channel extending upstream to the lower extent of a long stretch of new rock riprap bank stabilization on the right[6] bank. The upper reach boundary is also about 800 feet downstream of where the west lineament diverges from the channel. The Dry Creek channel flows along, or close to, this lineament for about half of the length of Reach 9. There is little sinuosity in this reach and there has been little channel change since the 1940s, other than channel narrowing resulting from channel incision. In some areas, the older and wider channel bed provides opportunities for habitat enhancement. These older channel beds are elevated a few feet above the current channel bed and are often separated from the current channel by alder 'fences' (Figure 45), but habitat could be created with some excavation.

Notable features include a pipe that runs under the creek at river mile 9.4, where the first bedrock was observed as part of the active streambank. A culvert appears to drain directly to the creek at river mile 9.75. Otter scat was also observed in this reach full of crawdad exoskeletons. A former channel ran along the left bank for more than 500 feet. It was protected by a well-vegetated straight berm. The former channel is a long, mostly dry side-channel with one wet alcove. It is filled with alluvial gravel substrate and includes an old rope swing hanging above the dry former channel. Trees grow along the berm in a very straight line. Lastly, a thick layer of algae was observed growing on the substrate of several of the flatwaters and pool tail-outs (e.g. river mile 9.6, in a flatwater).

[6] In the individual reach summaries, right and left bank designation defined as looking downstream.

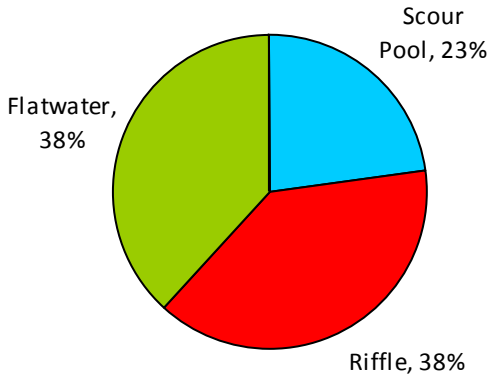
Figure 45: (upper row) pool habitat with riprap bank protection, (lower left) alcove habitat, (lower right) former channel along left bank, protected by a long, straight berm vegetated by even-aged alders.

Habitat Classification

Reach 9 is comprised of 23% pool habitat, 38% flatwater habitat, and 38% riffle habitat by relative frequency (Figure 46). Of the 1.0 mile long reach, there are four riffles that are 65 to 200 ft long representing 15% of the reach on a length basis. The average wetted channel width was 46.0 (st.dev. 9.4).

The average active channel width was 54.0 feet, the active channel depth was 2.6 feet, and the average floodprone width was 93.0 feet. The reach resembled an F4 channel type, with an entrenchment ratio of 1.7 and a active channel width:depth ratio of 22.

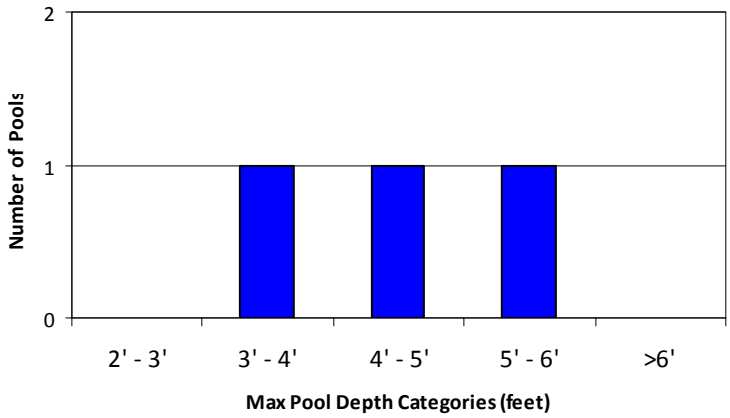
Figure 46: Proportion of Habitat Types by Relative Frequency in Reach 9



Pools

There were three scour pools in Reach 9, one of which contained two very short riffles and a small flatwater section that were shorter than the average wetted width of the channel, and were therefore not classified as separate units. The average maximum pool depth was 4.2 feet, average residual depth of 3 feet, with all of the pools greater than 3 feet deep (Figure 47). Substrate in pools was sand with gravel.

Figure 47: Maximum Pool Depths in Reach 9

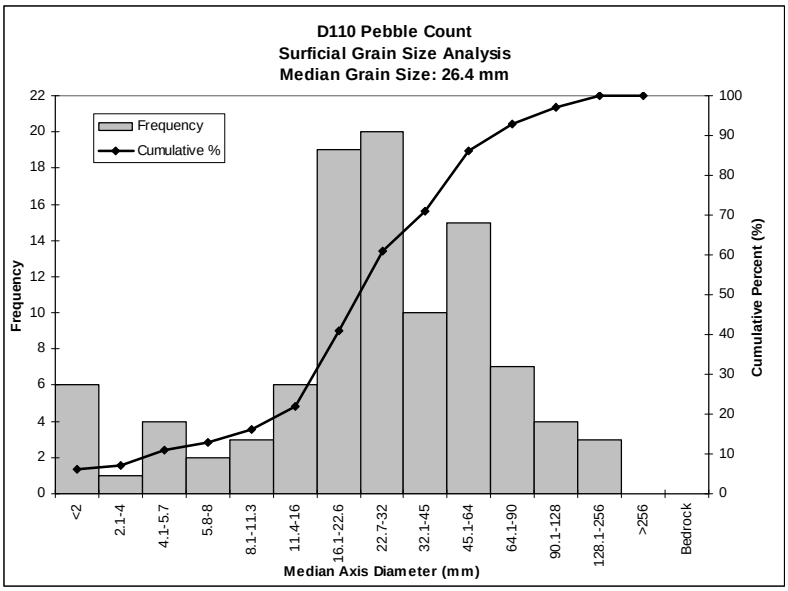


Riffles & Flatwaters

There were five riffles and five flatwaters in Reach 9. The average riffle depth was 0.9 feet, and the average flatwater depth was 1.5 feet. Substrate in riffles was gravel and small cobble, and in flatwaters it was gravel with small cobble and sand. One pebble count was conducted in a riffle near the upstream end of the reach.

The bed material in the riffle near the upstream extent of the reach ranges from sand to large cobbles but is primarily composed of coarse to very coarse gravel with a median grain size of 26 mm (Figure 48). The majority of the sediment fell within the coarse to very coarse gravel category. 81% of the sediment sampled was within desirable size classes for coho spawning (11.4 to 128mm), and 36% was within the desirable size classes for juvenile rearing (32 to 128 mm). 6% of the samples were fine sediments or sand.

Figure 48: Grain size distribution for a riffle near the upstream extent of reach 9 (habitat unit #110).



Side-Channels

No side channels were observed in Reach 9.

Alcoves

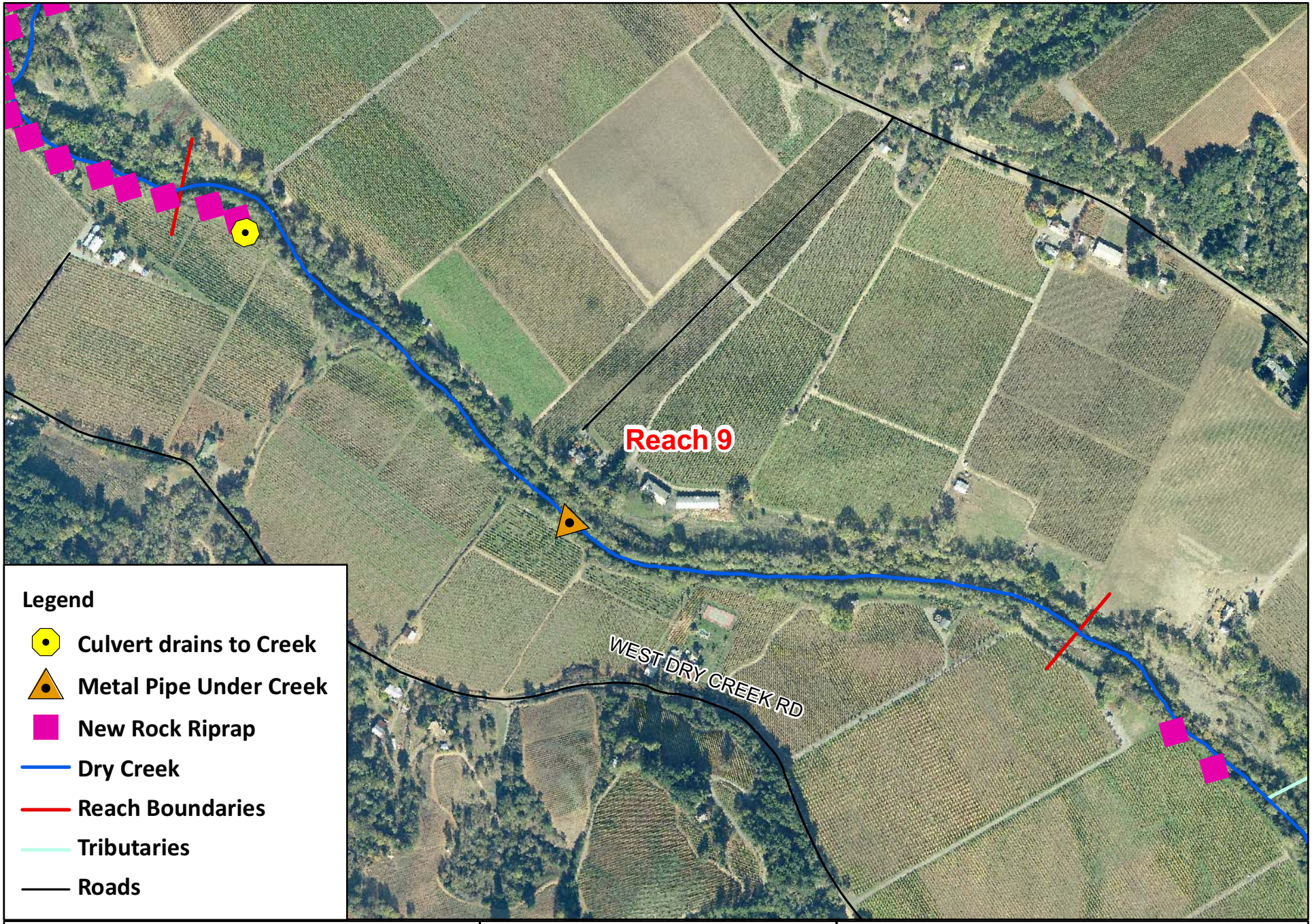
One alcove was measured in Reach 9. It was 53 feet long, 12 feet wide, with a maximum depth of 1.5 feet. Substrate was fine sediment with sand.

Instream Cover & Woody Debris

There were 193 pieces of wood per mile counted in Reach 9 (Table 9). A total of 155 pieces were counted. Of the 9 pieces of large wood (>20” diameter), 8 were counted in pools. The highest density of instream wood was in the mainstem pool, followed by scour pools and riffles. Although cover was provided by terrestrial vegetation and small woody debris in all habitat types, with some additional cover provided by root masses in riffles and flatwaters, and by riprap boulders in one pool. Only the alcove had abundant aquatic vegetation and high percent cover and shelter ratings. Edge habitat was only present in 4 out of a total of 13 habitat units.

Table 9: Instream woody debris, cover, and edge habitat frequency for Reach 9.

	wood pieces/mile				instream cover		
	small 6" - 12"	med 12" - 20"	large >20"	total	% cover	shelter rating	% units with edge habitat
Scour Pools	159.8	33.5	12.9	206.3	28%	85	33%
Riffles	161.5	34.0	8.5	204.1	18%	55	20%
Flatwaters	143.3	17.1	10.2	170.5	16%	47	40%
Alcove	99.6	0.0	0.0	99.6	90%	270	0%
	mainstem pieces/mile			192.8			



N W E S

0 500 1,000 Feet

DRY CREEK
Reach 9 Features

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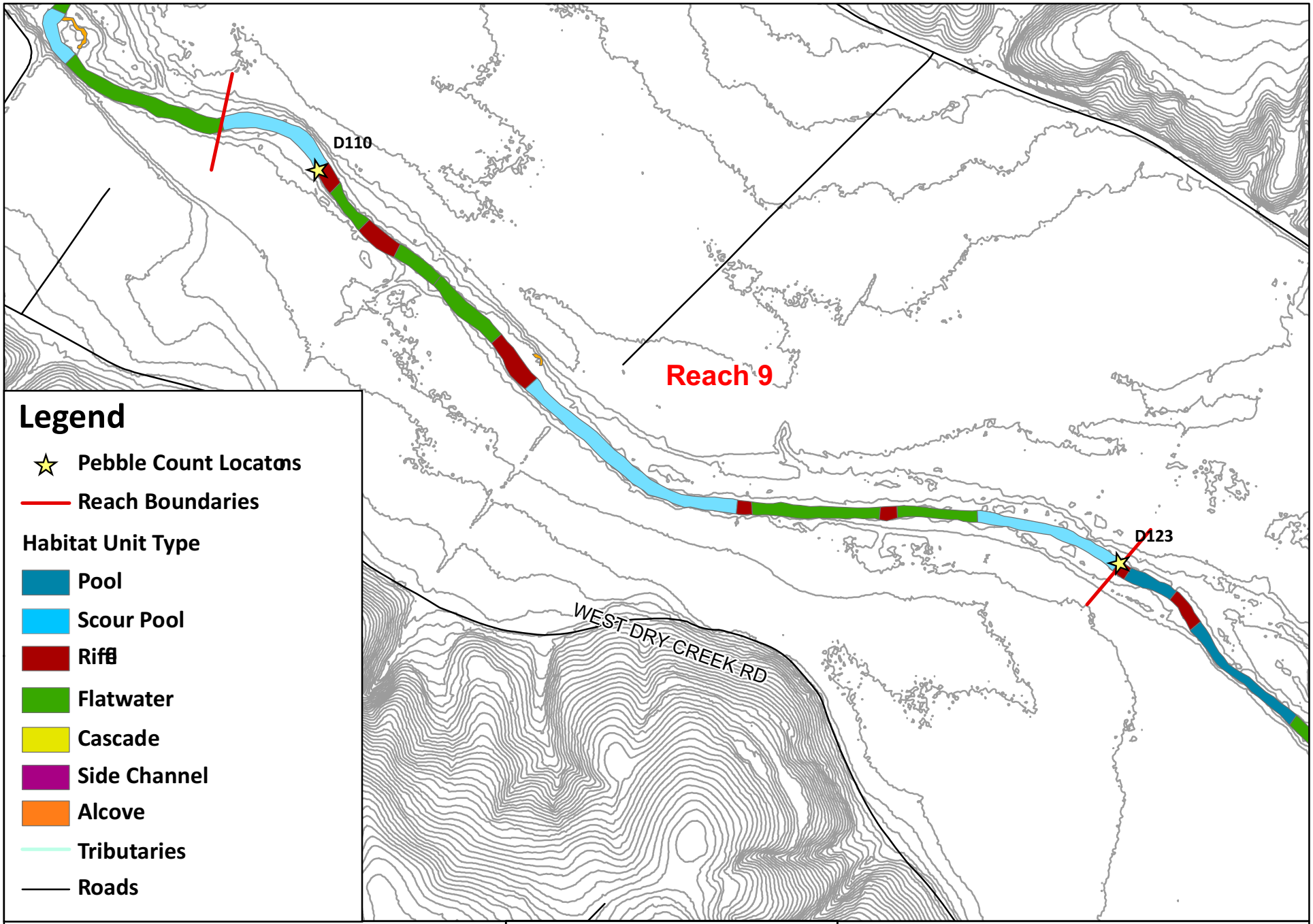

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S

0 500 1,000 Feet

DRY CREEK
Reach 9 Habitat Units

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Reach 9 - Channel Position Map

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REACH 10 (RM 9.8 to RM 10.3) **Bank stabilization structures, with native sourced boulders**

This reach contains significant length of stabilized streambank. From the start of Reach 10 at river mile 9.8, boulder riprap lines the right[7] bank for 0.3 miles upstream. At river mile 10.1, the tall, eroding left bank is covered with dead grapevines (Figure 49). The right bank at this site has a wide floodplain. Last, at river mile 10.3, I-beam and chainlink fence stabilization structures have been built along the left bank for 250 feet.

Reach 10 is a single-thread channel that extends upstream to where the east lineament intersects Dry Creek about 150 ft downstream of the inflow from an unnamed tributary. This reach is short but contains one large meander bend. Since the dam was built, the channel has narrowed substantially and the meander bend has migrated or avulsed to the opposite side of the riparian corridor. Despite channel modifications that have been built to try to stop bank erosion, the meander bend has continued to migrate southward in the last 25 years.

Figure 49: (upper row) vegetated islands in the middle of a riffle, recruiting small woody debris and creating a small scour pool, (lower left) native green boulder, (lower right) dead grapevine dump to stabilize the bank.

The channel change that has occurred has resulted in a large elevated bar on the right bank that is about 400 ft wide and 500 ft long as well as off-channel pools and backwater channels. The off-channel pools and backwater channels are fed by hyporheic flows and

[7] In the individual reach summaries, right and left bank designation defined as looking downstream.

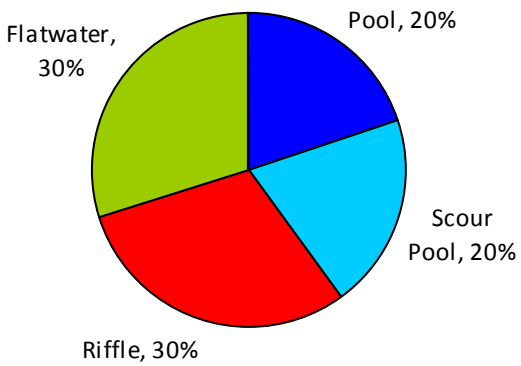
contain numerous salmonids. These areas may provide good analogs for enhancing habitat elsewhere. The large bar provides significant space for enhancing habitat, though this may require a large amount of excavation as the old channels are 6 to 7 ft above the bed.

Also in Reach 10, large, possibly native sourced boulders were observed in the stream, lime-green rocks w/white veins, 3'x3' boulders in substrate at river mile 10.2.

Habitat Classification

The channel in this reach was composed of 30% flatwaters, 20% pools, 20% scour pools, and 30% riffles by relative frequency (Figure 50). There were three riffles in the reach ranging from 70 to 150 ft in length representing only 12% of the reach on a length basis. The average wetted width during the survey was similar to reach 9 (48 ft), but the active channel was wider (78 ft) and the flood prone width was narrower (87 ft). The average active channel depth was 2.4 ft. The total mainstem length of Reach 10 is 0.6 miles.

Figure 50: Proportion of Habitat Types by Relative Frequency in Reach 10

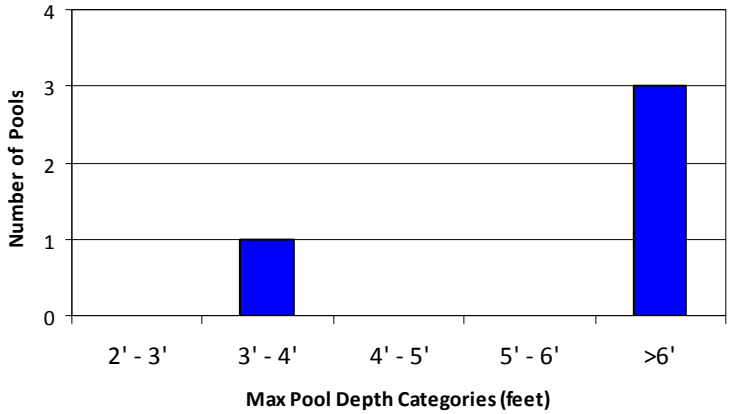


With a low entrenchment ratio (1.1) and a high active channel width:depth ratio (32), the reach resembles an F4-type channel, plane-bed reach with ample flatwater habitat and deep pools.

Pools

There are four pools in Reach 10, two of which are scour pools. All of the pools have a maximum depth of greater than 3 feet, with average maximum depth of 6.3 feet and average residual depth of 5 feet (Figure 51). Substrate in pools is gravel with sand, and some small cobble.

Figure 51: Maximum Pool Depths in Reach 10.



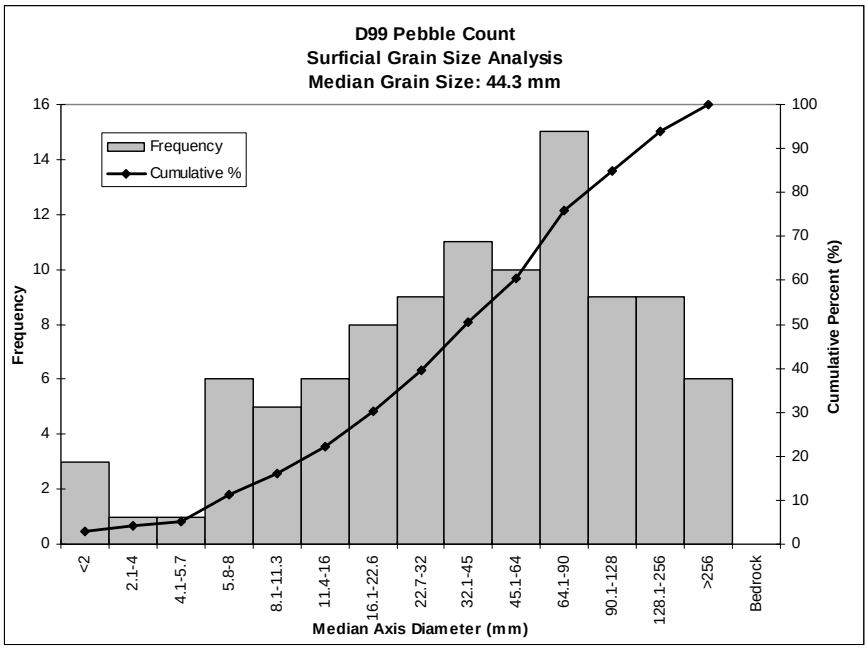
Riffles & Flatwaters

Three riffles and three flatwaters were in Reach 10. The average riffle depth was 1.1, while the average flatwater depth was 1.9 feet. Substrate in riffles was small cobble, with gravel and some large cobble. In flatwaters substrate was gravel with small cobble and sand. Algal mats grow on the substrate in some flatwaters.

The bed material in a riffle in the middle of the reach ranges from sand to small boulders but is primarily composed of very coarse gravel and small cobble. In this riffle, there were two mid-channel bar/islands with living willows and alders that have recruited a small woody debris jam. One island has formed a 15'x20' scour pool within the riffle. The median grain size for this riffle is very coarse gravel at 44 mm (Figure 52). 69% of the sediments were within ideal spawning sizes, and 45% were within ideal juvenile rearing sizes. 3% were fine sediment or sand. This riffle had a higher proportion of large cobbles and small boulders than any other.

Bed material may not be transported through this reach as easily as further downstream. The bed material in this reach is generally larger than downstream and there is evidence of aggradation: the bases of alders near the channel are buried by gravels and cobbles. The ability of the reach to transport bed material will need to be determined before attempting habitat enhancement.

Figure 52: Grain size distribution for a riffle in the middle of reach 10 (habitat unit #99).



Side-Channels

One riffle-dominated side channel in Reach 10 was measured, with a length of 70 feet, a width of 7 feet, and an average depth of 0.3 feet (Figure 53). Substrate was gravel, with small cobble.

Figure 53: (left) side channel, (right) alcove habitat.

Alcoves

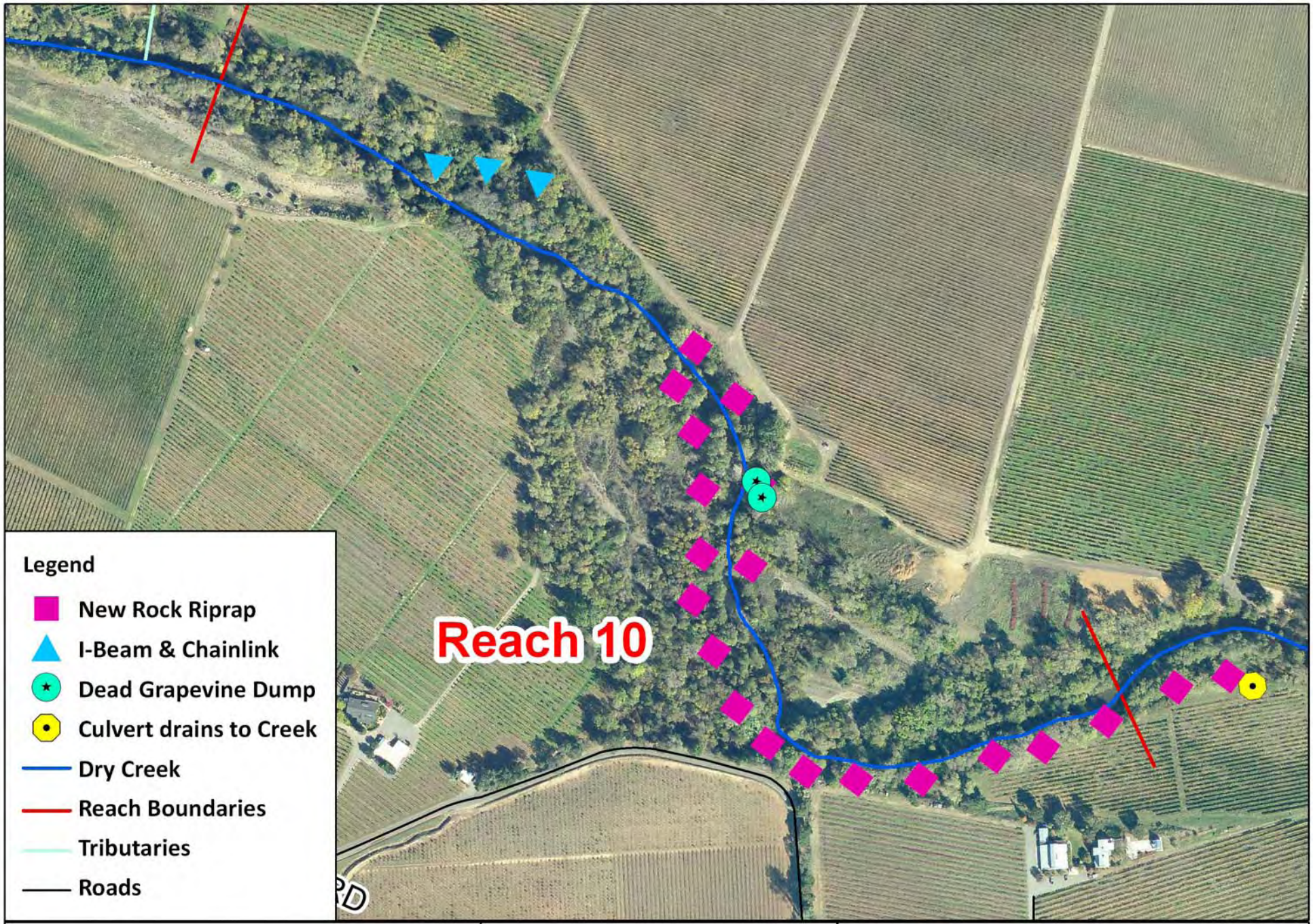
Three alcoves were observed in Reach 10. Water temperature measured in one alcove was 60° F, while Dry Creek water was 56° F. Several juvenile salmonids were seen in this alcove. Another alcove was 350 feet long, and resembled a side channel with no outlet. The water temperature in this series of small pools was also 60° F. Many small fish, frogs, and lizards were observed. This long alcove may serve as a template for enhancement or construction of additional alcoves. The average maximum depth of the alcoves was 2.6 feet, with substrate consisting of sand, gravels, fine sediment, and some small cobble.

Instream Cover & Woody Debris

In Reach 10, there were 362 pieces of wood per mile. A total of 235 pieces of wood were counted, 209 of these in the mainstem (Table 10). The highest wood densities by length were in scour pools, riffles, alcoves, and pools. Out of nine large wood pieces (>20" diameter), 7 were in pools. Only side channels and alcoves had significant percent cover and shelter rating (>40% and >100, respectively). Cover was primarily provided by small woody debris and terrestrial vegetation, and by aquatic vegetation in alcoves. There were few units with edge habitat present in Reach 10, with only two out of the two mainstem habitat pools, and all of the three alcoves providing edge habitat.

Table 10: Instream woody debris, cover, and edge habitat frequency for Reach 10.

	wood pieces/mile				instream cover		
	small 6" - 12"	med 12" - 20"	large >20"	total	% cover	shelter rating	% units with edge habitat
Pools	229.0	60.6	13.5	303.1	28%	83	100%
Scour Pools	355.7	125.5	34.9	516.1	33%	98	0%
Riffles	402.7	119.3	14.9	536.9	20%	60	0%
Flatwaters	201.1	41.1	4.6	246.9	22%	65	0%
Side-Channels				0.0	50%	100	0%
Alcoves	188.6	138.3		326.9	86%	258	100%
	mainstem pieces/mile			361.8			



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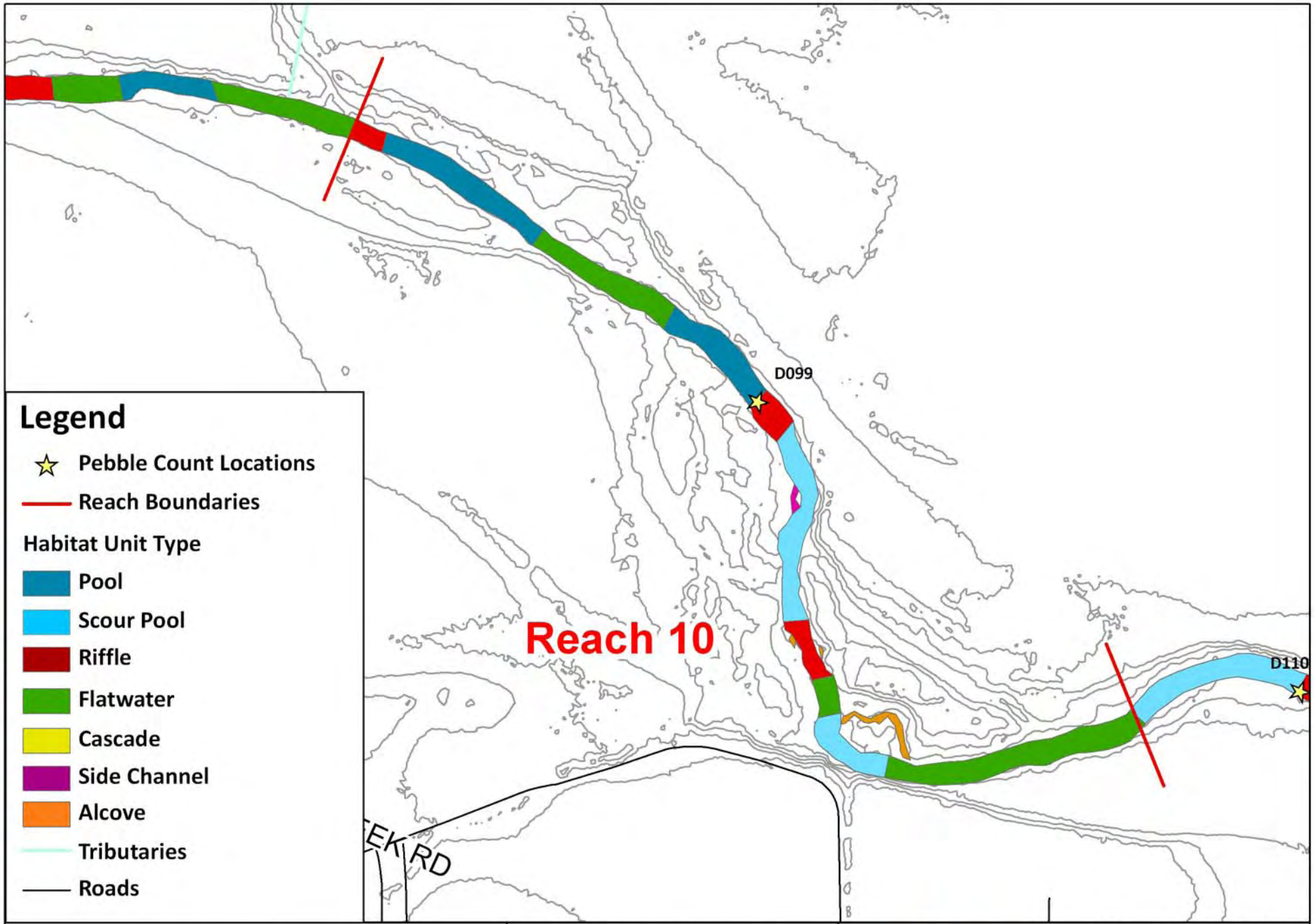

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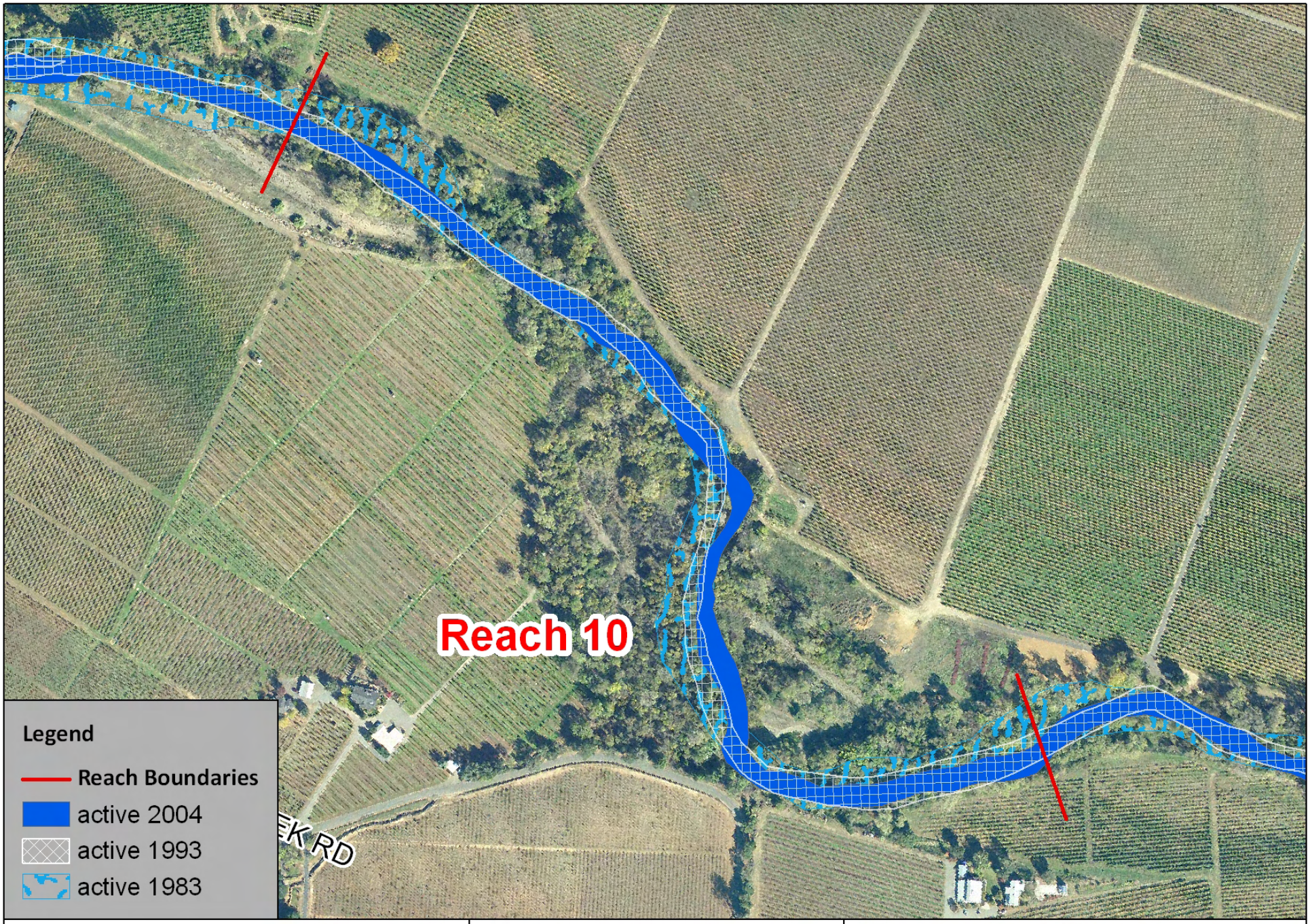

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REACH 11 (RM 10.3 to RM 11.0) **Yoakim Bridge to Pena Creek**

Reach 11 contains several notable features (Figure 54). First, the upper boundary of Reach 11 is the confluence of Pena Creek with Dry Creek. The mouth of Pena Creek remains watered in the summertime, as serves as a 100 foot by 25 foot-wide alcove. The Pena Creek inlet was also hopping with hundreds of small frogs at the time of the survey. The Pena Creek watershed is the largest of the tributaries in the study area (22.3 mi^2) and contributes substantial quantities of flow and sediment to Dry Creek.

Reach 11 flows under Yoakim Bridge at river mile 10.7. A flow gage that operated in the past is located on Yoakim Bridge. Concrete and concrete chunks 200 feet downstream of the bridge along the left[8] bank and across the channel cause a small cascade in the mainstem. At river mile 10.45, an intermittent stream enters on the left bank of Dry Creek. A car body is partially buried in the left bank of this tributary, and vegetation has been cleared from all of the banks.

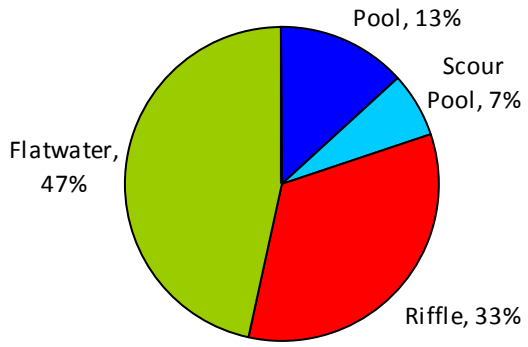
Figure 54: (upper left) A large gravel bar in Pena Creek 100 feet upstream from its confluence with Dry Creek, (upper right) an invasive grass (*Arundo donax*) grows on the right bank just downstream from Pena Creek, (lower left) small, intermittent stream with cleared banks, (lower right) Pebble count being conducted in a riffle in Reach 11.

[8] In the individual reach summaries, right and left bank designation defined as looking downstream.

The channel in reach 11 is single-thread with little sinuosity. Although the channel has narrowed, there has been little channel change since the 1940s except in the middle of the reach around Yoakim Bridge.

Habitat Classification

Figure 55: Proportion of Habitat Types by Relative Frequency in Reach 11



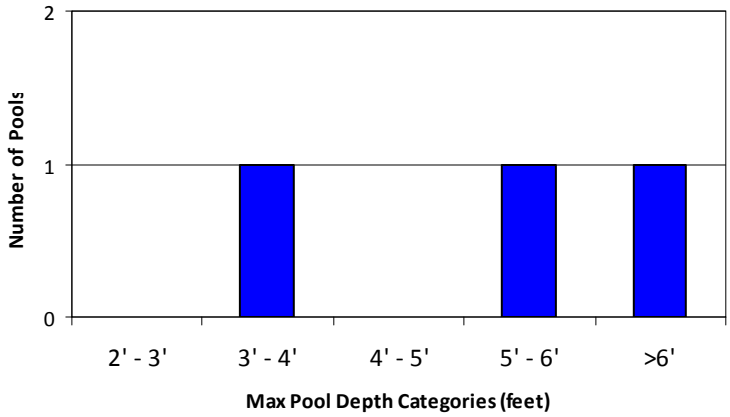
The channel in reach 11 is primarily composed of flatwaters (47%) and riffles (33%) but also contains a few pools and scour pools (20% combined), on a relative frequency basis (Figure 55). The five riffles in this reach ranging from 50 to 330 ft in length comprise 21% of the reach on a length basis. The channel geometry is similar to reach 10; the average wetted width during the survey was 47 ft. The average active channel depth in the riffles was 2.6 ft. The active channel and flood prone widths are narrower than in Reach 10 at 57 and 78 ft respectively. The total length of this reach is 0.7 miles.

The high active channel width:depth ratio of 22 and the low entrenchment ratio of 1.4 cause this channel to resemble an F4 channel type. The abundant flatwaters and deep pools resemble a plane-bed channel morphology.

Pools

There were three pools in Reach 11, one of which was a scour pool. All of the pools had a maximum depth of greater than 3 feet, with an average maximum depth of 5.1 feet (Figure 56). The average residual pool depth was 4.3 ft, and the average pool crest depth was 1.6 ft. Substrate in pools was gravel with sand, and some small cobble.

Figure 56: Maximum Pool Depths in Reach 11.

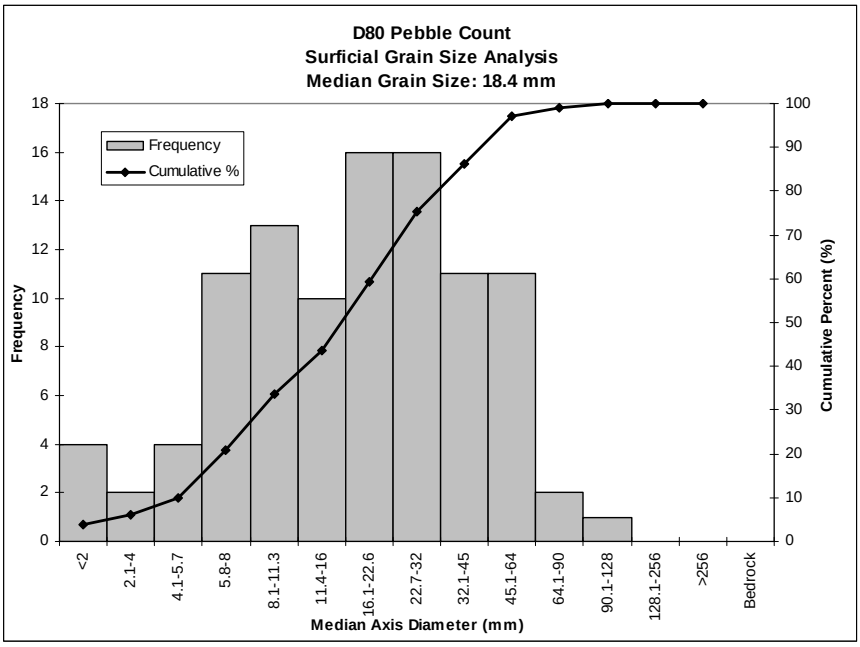


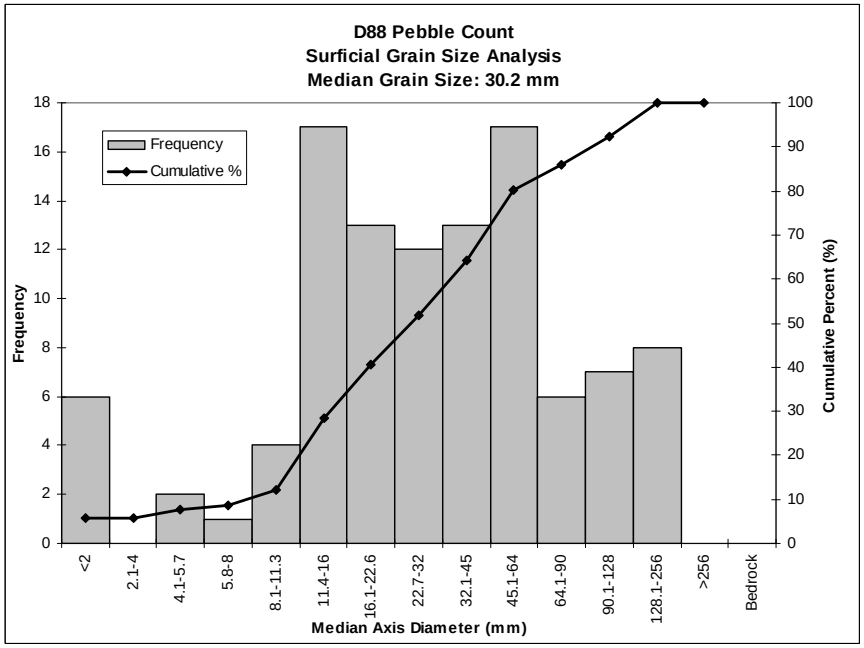
Riffles & Flatwaters

There were five riffles and six flatwaters in Reach 11. The flatwaters were extremely long, with two over 600 feet long, and another over 300 feet long. The average riffle depth was 1.0, and the average flatwater depth was 1.8 feet. Substrate in both riffles and flatwaters was predominantly gravel with small cobble.

The bed material in riffles downstream from Pena Creek and downstream from Yoakim Bridge ranges from sand to large cobbles but is primarily composed of coarse to very coarse gravel with median grain sizes of 18 and 30 mm respectively (Figure 57). 73% was within ideal spawning gravel sizes, 33% within ideal fry rearing size classes, and 5% of the samples were fine sediment or sand.

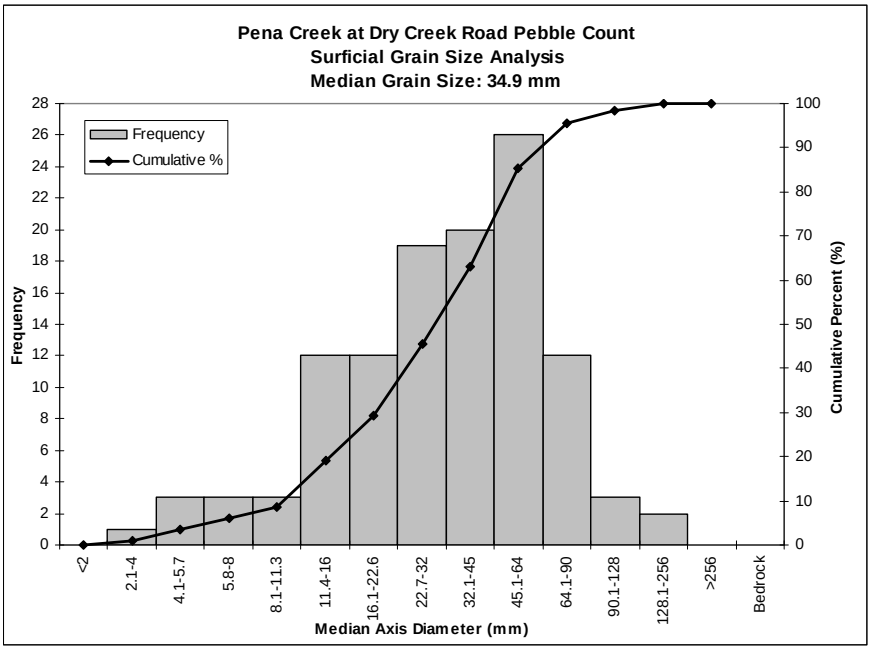
Figure 57: Grain size distribution for riffles downstream from Pena Creek (habitat unit #80) and downstream from Yoakim Bridge (habitat unit #88).

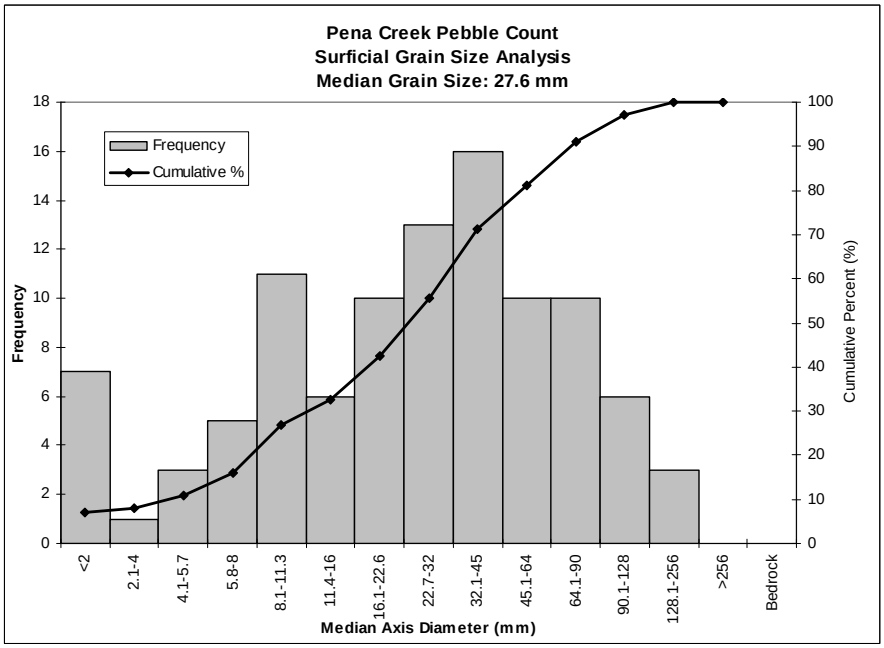




The bed material of Pena Creek was analyzed at the mouth and near the Dry Creek Road bridge about 1 mile upstream from the confluence with Dry Creek. At both locations, the Pena Creek bed material is primarily coarse to very coarse gravel. The median grain size decreases from 35 mm at the bridge to 28 mm near the mouth (Figure 58). This bed material is similar to the Dry Creek bed material downstream of Pena Creek.

Figure 58: Grain size distribution for Pena Creek at the Dry Creek Road bridge and near the confluence with Dry Creek.





Side-Channels

One, 100 foot long side channel was located on the left bank upstream from Yoakim Bridge. It was 25 feet wide, with an average depth of 1 foot. Substrate was gravel with small cobble.

Alcoves

The primary alcove in Reach 11 was the inlet at the mouth of Pena Creek. The maximum depth of this alcove was 2.3 feet. Substrate was gravel with fine sediment. Just downstream of Pena Creek, there were two very small alcoves that were less than a channel-width long. One was on the left bank in the flatwater, and another 10' long alcove was located on the right bank of the first riffle.

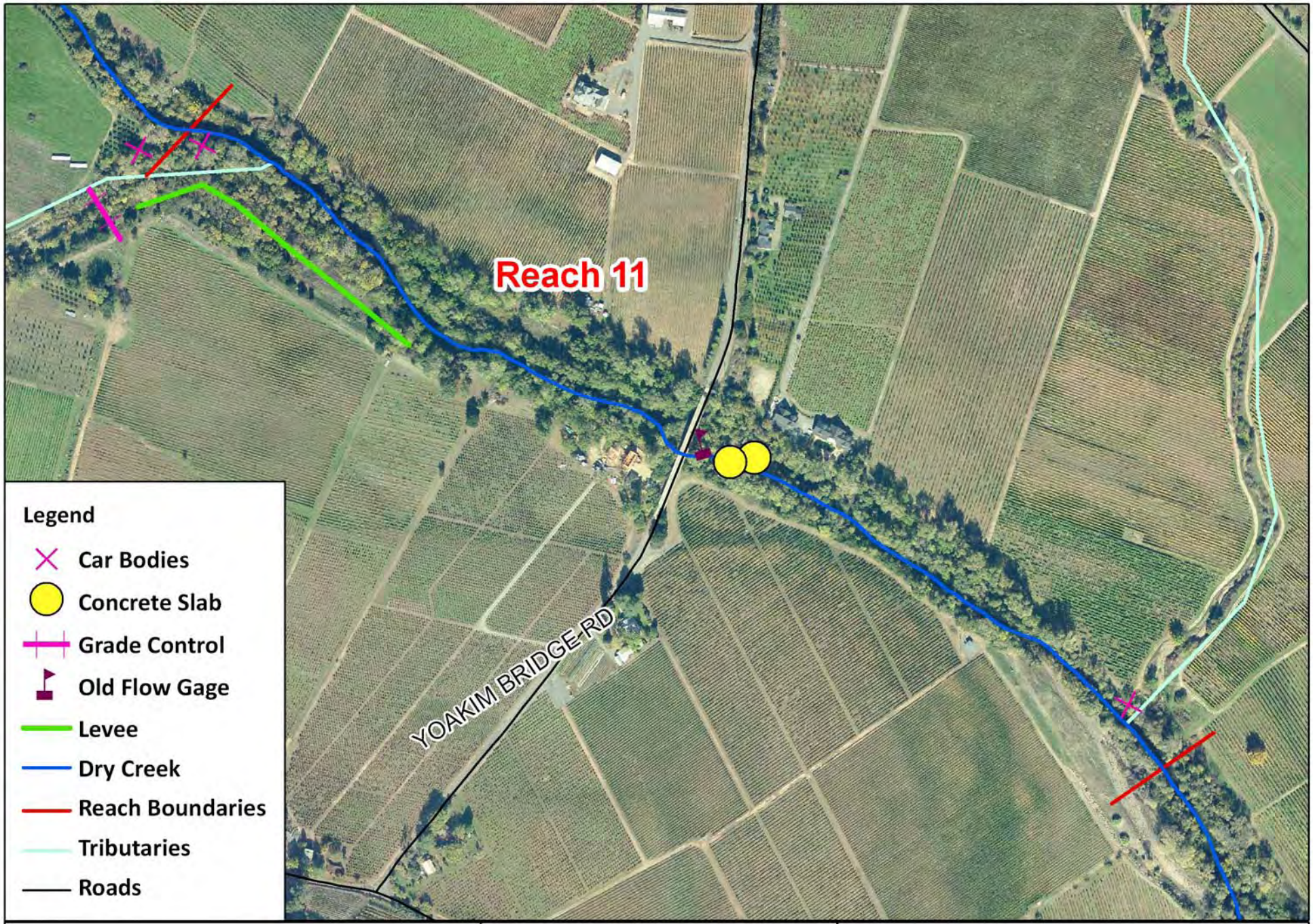
Figure 59: (left) glide habitat in Reach 11, (right) a deep pool with overhanging willows.

Instream Cover & Woody Debris

In Reach 11, there were 269 pieces of wood per mile. A total of 196 pieces of wood were counted, 47% of them in pools (Table 11). However, this number is likely an underestimate for these deeper pools, because woody debris could have been hidden under profuse willow thickets overhanging deeper, dark waters. Regardless, the highest density of wood was recorded in pools, although 6 out of the 12 large wood pieces (>20" diameter) were recorded in flatwaters. The highest levels of instream cover were also found in pools. Most of the cover was provided by woody debris and terrestrial vegetation, with some root masses. There was very little edge habitat in Reach 11, most of it associated with scour pools, and some present at the inlet of Pena Creek.

Table 11: Instream woody debris, cover, and edge habitat frequency for Reach 11.

	wood pieces/mile				instream cover		
	small 6" - 12"	med 12" - 20"	large >20"	total	% cover	shelter rating	% units with edge habitat
Pools	302.0	201.4	22.4	525.8	38%	113	0%
Scour Pools	330.0	132.0	0.0	462.0	20%	60	100%
Riffles	79.0	52.7	19.8	151.4	10%	29	0%
Flatwaters	183.7	52.5	15.3	251.4	19%	58	0%
Side-Channels	105.6			105.6	5%	15	0%
Alcoves	105.6			105.6	10%	20	100%
	mainstem pieces/mile			269.0			



0 400 800 Feet

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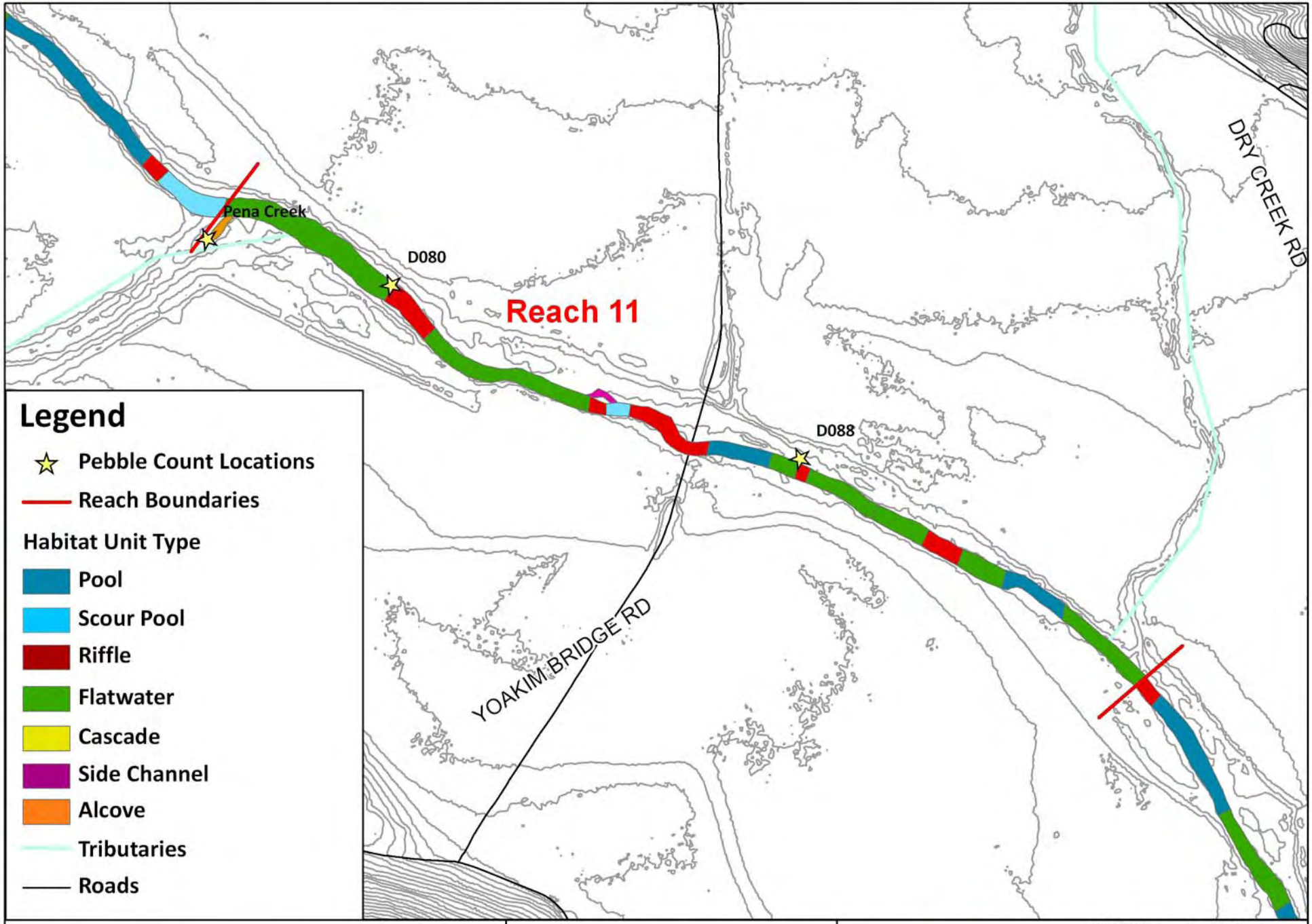

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REACH 12 (RM 11.0 to RM 11.7) **Pena Creek to Dutcher Creek**

Reach 12 is a single-thread channel extending from the Pena Creek confluence upstream to below the Dutcher Creek confluence. In addition to Dutcher and Pena creeks, an unnamed tributary flows into Dry Creek on the left[9] bank about half way through the reach at river mile 11.6. The active channel has narrowed substantially through the photo record, but there has been little lateral channel change since the dam was built, except for slight migrations immediately downstream from the unnamed tributary.

Figure 60: (upper left) pump in Dry Creek at river mile 11.75, (upper right) tributary at river mile 11.6, (lower left) straight bermed streambank along left bank, (lower right) gravel bar at river mile 11.75.

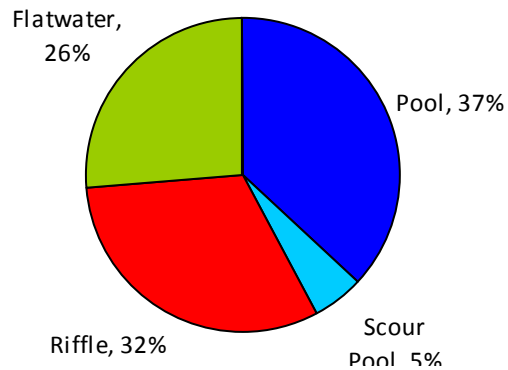
At river mile 11.65, a gravel bar forms along the left bank. Riprap bank stabilization covers the streambanks for about 800 feet throughout Reach 12. Riprap boulders have tumbled into the creek from these bank protection measures and provide some cover. A fault lineament runs along the left bank for the lower half of Reach 12.

[9] In the individual reach summaries, right and left bank designation defined as looking downstream.

Habitat Classification

By relative frequency, Reach 12 is primarily composed of pools (42%) but also contains riffles (32%) and flatwaters (26%, Figure 61). Side channels and alcoves represent 8% of the wetted channel area. There are six riffles that range in length from 50 to 230 ft and represent 19% of the mainstem on a length basis. The two riffles near the upstream reach boundary appear to have significant riprap materials as part of the substrate.

Figure 61: Proportion of Habitat Types by Relative Frequency in Reach 12

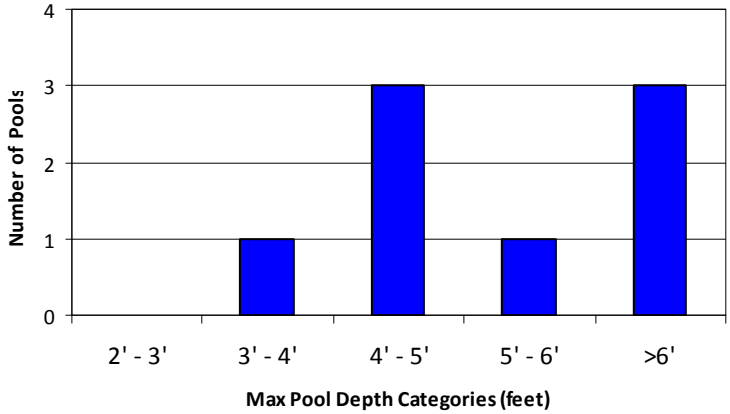


The average wetted channel width in Reach 12 was 46.0 feet, similar to Reach 11. The average active channel width was 54.0 feet, with an active channel depth of 2.6 feet, and a floodprone width of 93.0 feet. The entrenchment ratio was 1.7, and the active channel width:depth ratio was 21.

Pools

There were 8 pools in Reach 12, one of which was a scour pool. All of the pools had a maximum depth greater than 3 feet (Figure 62). Two pools had a maximum depth over 7 feet. The average maximum pool depth was 5.5 feet (stdev=2.0). The average residual depth was 3.9 ft., and the average pool crest depth was 1.5 ft. Substrate in pools was gravel with small cobble and sand, with a few boulders derived from riprap bank protection.

Figure 62: Maximum Pool Depths in Reach 12.

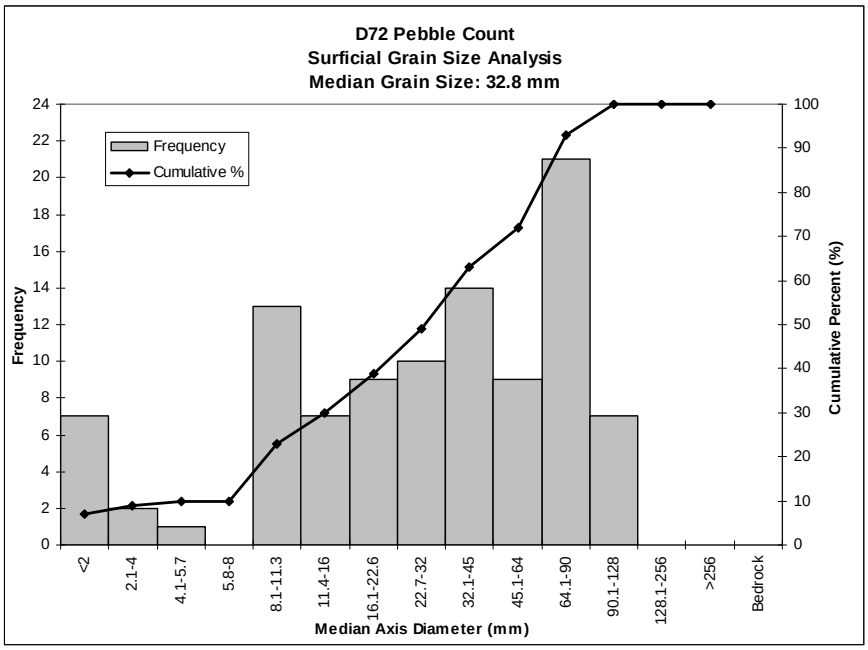


Riffles & Flatwaters

There were 6 riffles and 5 flatwaters in Reach 12. The average riffle depth was 1.4 feet, and the average flatwater depth was 2.0 feet. Substrate in riffles and flatwaters was gravel with small cobble, and some boulders associated with riprap banks.

The material in the riffle in the middle of the reach below the unnamed tributary ranges from sand to small cobbles with fairly even percentages of medium, coarse and very coarse gravel and small cobbles. The median grain size is coarse gravel at 33 mm. 77% were within ideal sizes for coho spawning (11.4 to 128mm), and 51% were within ideal sizes for juvenile rearing (32 to 128mm). 7% of the samples were fine sediments or sand.

Figure 63: Grain size distribution for a riffle in the middle of reach 12 downstream of an unnamed tributary (habitat unit #72).



Side-Channels

There were three side channels in Reach 12, two were pool dominated, and one was comprised of a single riffle. The side channel pools were 90 and 120 feet long, 12 and 32 feet wide, and 2.1 and 3.2 feet deep. Substrate in the pools was gravel with sand. The longer side channel pool resembled a straight canal, similar to the long alcove unit in this reach. The side channel riffle was 140 feet long, by 15 feet wide, with an average depth of 1.1 feet. Substrate in the side channel riffle was gravel with small cobble.

Alcoves

There was one alcove in Reach 12. It was 300 feet long, 25 feet wide, and had a maximum depth of 2.5 feet. Substrate was gravel with fine sediment. In addition, two

small off-channel pools were observed on the left bank gravel bar that forms river mile 11.75. Each pool was 10 feet by 10 feet in area.

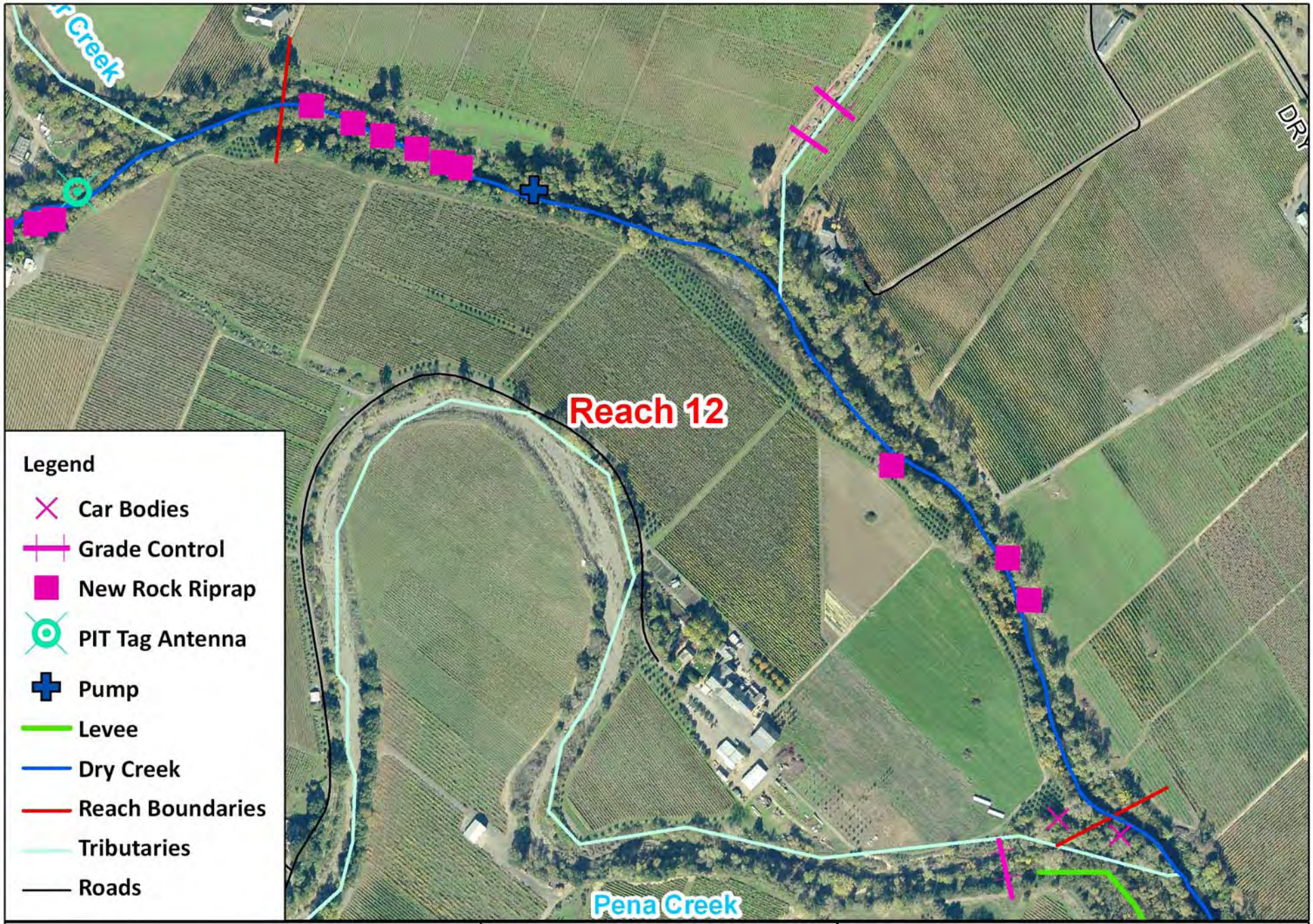
Instream Cover & Woody Debris

161 pieces of wood were categorized in Reach 12. Of these, 44% were in pools (Table 12). The highest densities of woody debris were found in side channels and in scour pools. Only three large pieces of wood were observed in Reach 12, one of which was in a side channel. Overall, cover was provided by overhanging vegetation and woody debris (Figure 64). Some cover was provided by boulders associated with bank stabilization measures, and boulders in riffles, root masses provided some limited instream cover. Edge habitat was associated with four out of the eight pools in Reach 12, and with a side channel and an alcove.

Figure 64: (left) green tunnel of riparian vegetation, (right) vegetation providing instream cover.

Table 12: Instream woody debris, cover, and edge habitat frequency for Reach 12.

	wood pieces/mile				instream cover		
	small 6" - 12"	med 12" - 20"	large >20"	total	% cover	shelter rating	% units with edge habitat
Pools	110.6	34.9	0.0	145.5	25%	68	57%
Scour Pools	142.2	121.8	0.0	264.0	25%	75	0%
Riffles	142.9	30.1	7.5	180.5	20%	53	0%
Flatwaters	170.1	34.0	5.7	209.8	28%	83	0%
Side-Channels	301.7	105.6	15.1	422.4	20%	60	33%
Alcoves	140.8	17.6	0.0	158.4	95%	285	100%
	mainstem pieces/mile			176.6			



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Reach 12 Features

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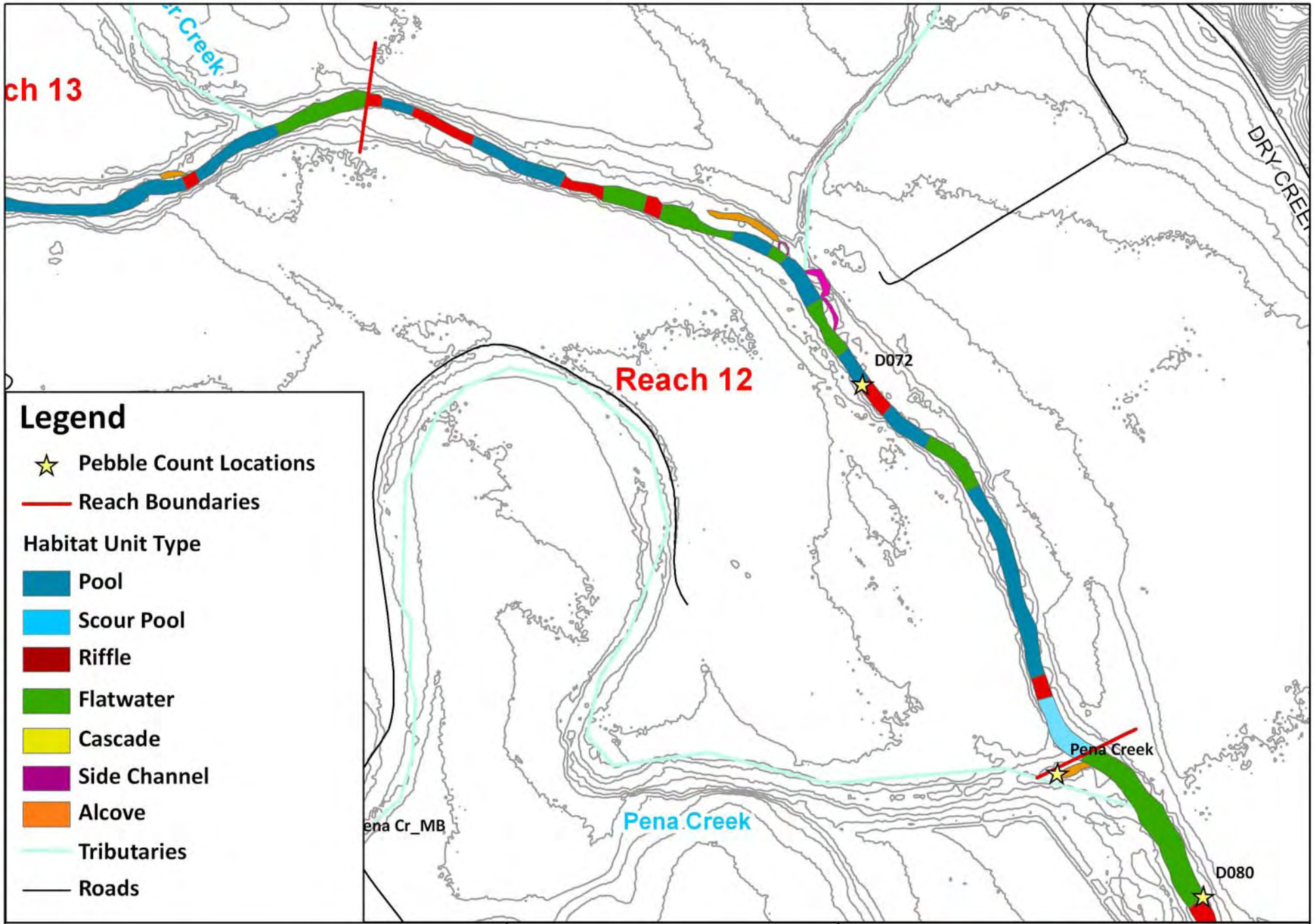

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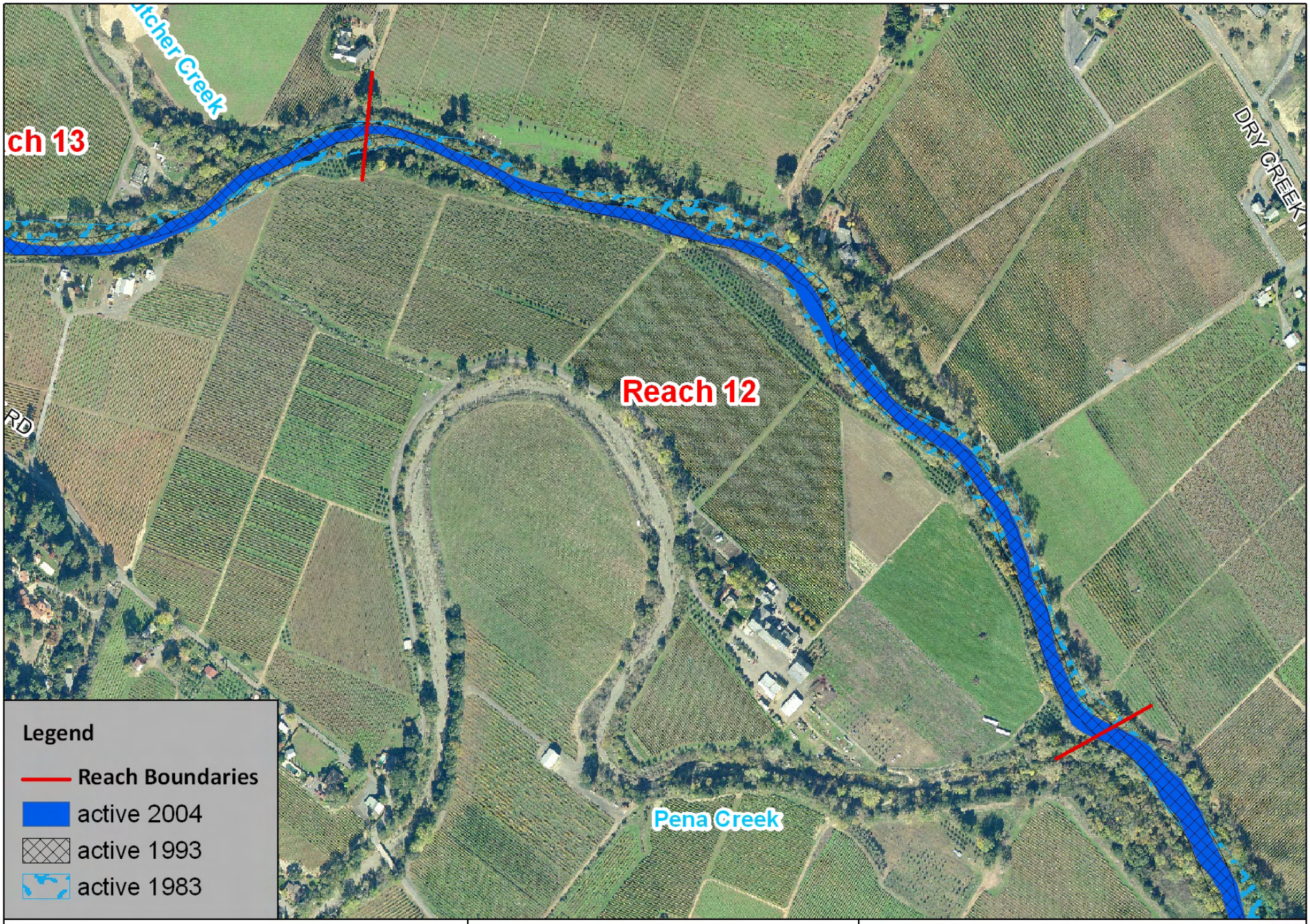

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DRY CREEK
Reach 12 - Channel Position Map

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REACH 13 (RM 11.7 to RM 12.6**) Dutcher Creek to above Fall Creek**

Reach 13 extends from 0.05 miles below the Dutcher Creek tributary junction upstream to approximately river mile 12.6. Dutcher Creek enters Dry Creek on the left[10] bank at river mile 12, and Fall Creek flows into Dry Creek on the right bank at river mile 12.4. Upstream of Fall Creek, the channel planform and location has remained relatively stable since the dam was built. Downstream from Fall Creek slight channel migration since the dam was built has occurred. At the upstream extent of the reach, trees near previous channel boundaries are about 26 years old, the approximate date of dam construction. Trees close to the current channel are about 14 years old, indicating that narrowing and vegetation encroachment along the active channel margins has occurred.

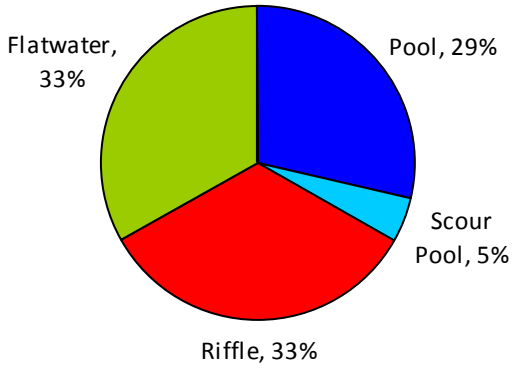
A pit tag recording station at river mile 12.05 creates a short riffle. A pump was observed on the left bank at river mile 12.1, with boulder riprap on the opposite bank along the pool unit. A short section of riprap armored the left bank at the top of the reach.

Figure 65: (left) Pump in Dry Creek, (right) Pit-tag antennae spans Dry Creek.

Habitat Classification

The channel in reach 13 alternates primarily between pools (34%) and flatwaters (33%) on a relative frequency basis (Figure 66). Seven riffles make up 33% of the reach by relative frequency, 21% of the channel on a length basis, and range from 40 to 400 ft in length. The channel banks are steep, so the average wetted and active channel widths are similar at slightly more than 40 ft wide. The flood prone width is 62 ft. The average active channel depth in the riffles is 2.3 ft. Terraces in reach 13 are approximately 10 ft above the channel bed.

Figure 66: Proportion of Habitat Types by Relative Frequency in Reach 13



Reach 13 resembles an F4 Rosgen channel type

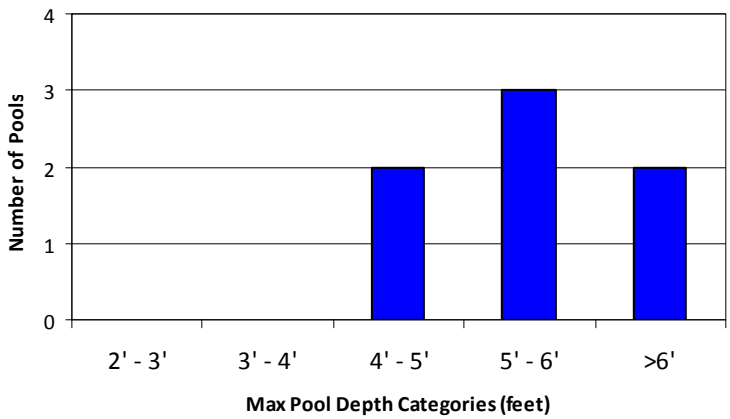
[10] In the individual reach summaries, right and left bank designation defined as looking downstream.

with an entrenchment ratio of 1.5 and a active channel width:depth ratio of 17.6. This reach has a plan-bed channel verging on pool-riffle morphology.

Pools

All of the eight pools measured in Reach 13 were greater than three feet deep (Figure 67). The average pool depth was 5.7 feet (stdev1.5). The average residual pool depth was 3.8 ft, and the average pool crest depth was 2.0 ft. Substrate in pools was gravel with cobbles and some sand.

Figure 67: Maximum Pool Depths in Reach 13.

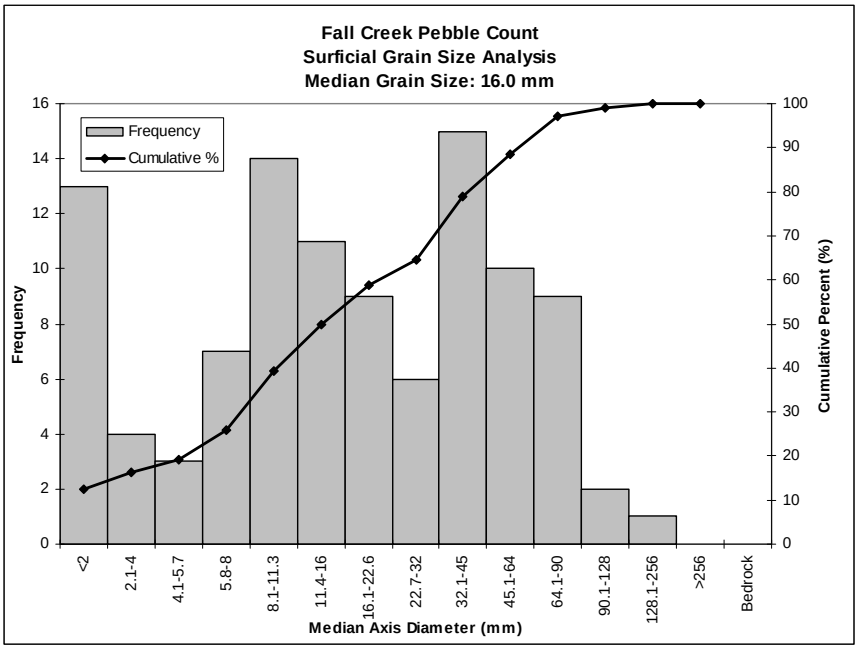


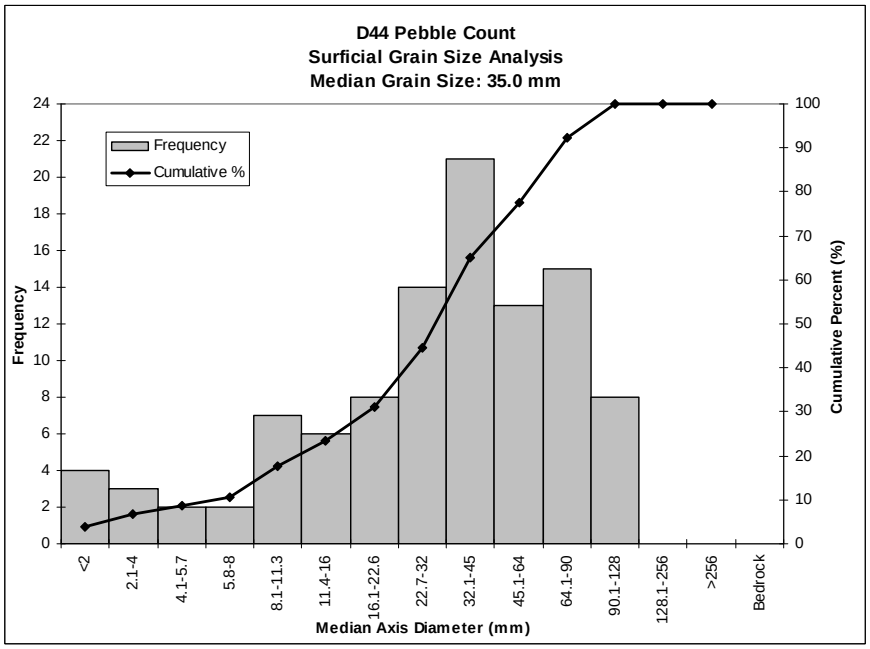
Riffles

Water depths in the riffles and flatwaters were 1.2 ft and 2.2 ft respectively during the survey. The bed material in reach 13 is primarily gravel with some small and large cobbles throughout the reach. Material in the riffle immediately downstream from the Fall Creek confluence ranges from sand to small cobbles but is primarily composed of coarse gravel to small cobble. The median grain size for this riffle is 35 mm (Figure 68). 83% of the sediments are within ideal spawning sizes, and 55% are within ideal fry rearing sizes. 4% of the samples were fine sediments or sand.

The bed material of Fall Creek is smaller (median grain size of 16 mm) than that found in Dry Creek.

Figure 68: Grain size distribution for the channel bed of Fall Creek and for a riffle on Dry Creek downstream of the Fall Creek inflow (habitat unit #44).





Side-Channels
No side channels were observed in Reach 13.

Alcoves
Three alcoves in Reach 13 measured 60, 80, and 90 feet long, 10, 18, and 12 feet wide, with maximum depths of 2.4, 2.5, and 1.6 feet. Substrate in the alcoves was fine sediment, sand, and gravel.

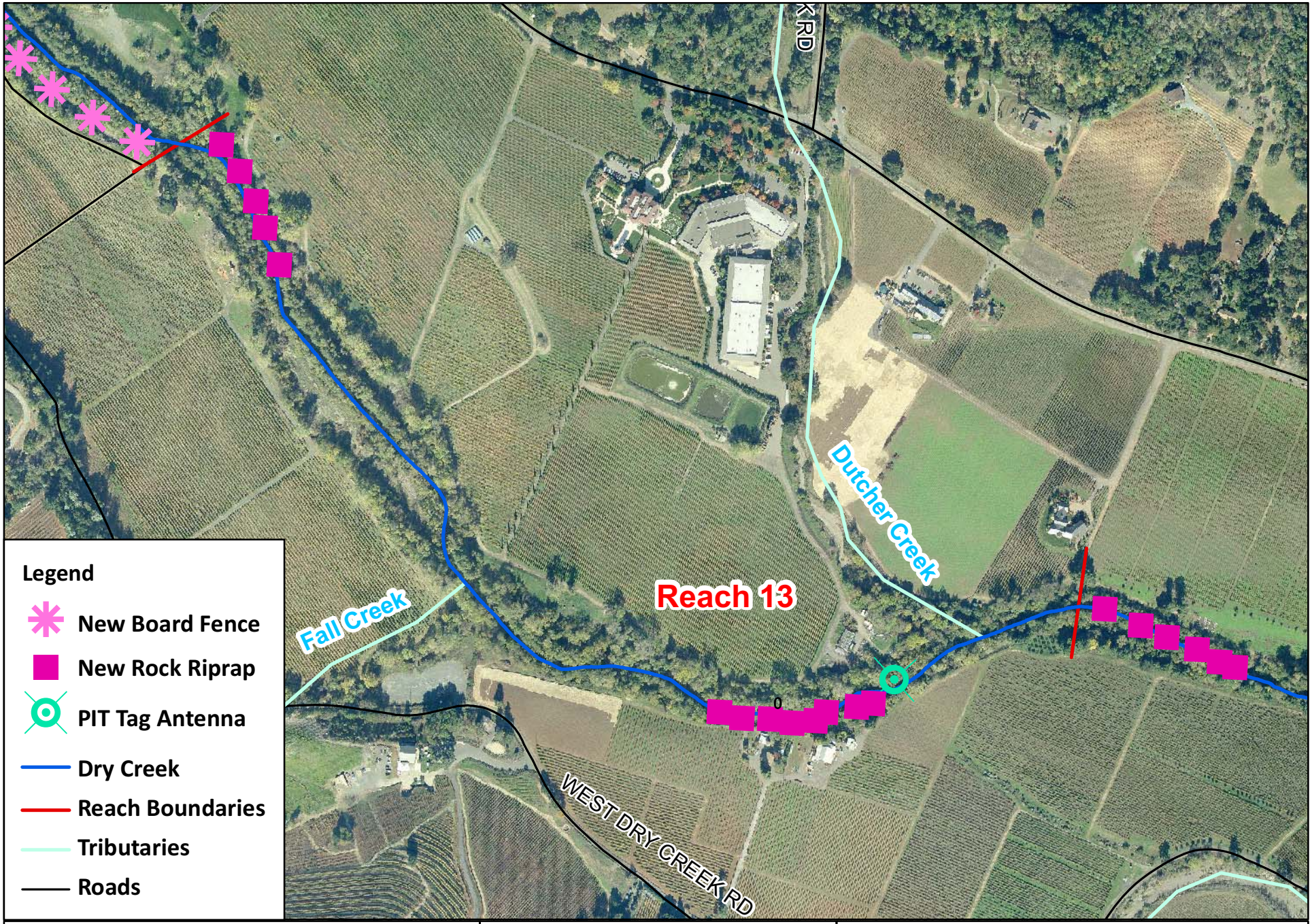
Instream Cover & Woody Debris

Overall, wood density in this reach of Dry Creek was 160 pieces per mile. A total of 141 pieces were counted, with 86 counted in pools. The highest densities of wood were in pools and alcoves. Of the six large pieces >20" diameter, three were located in pools. Instream cover was mainly provided by terrestrial vegetation and small woody debris, with some root mass cover provided in riffles. Aquatic vegetation with small woody debris provided abundant cover in alcoves (Figure 69). Edge habitat was observed in four pools, a riffle, a flatwater, and two alcoves.

Figure 69: Alcoves in Reach 13 with abundant cover provided by aquatic vegetation.

Table 13: Instream woody debris, cover, and edge habitat frequency for Reach 13.

	wood pieces/mile				instream cover		
	small 6" - 12"	med 12" - 20"	large >20"	total	% cover	shelter rating	% units with edge habitat
Pools	124.7	41.6	5.9	172.2	26%	78	50%
Scour Pools	303.0	86.6	21.6	411.1	35%	105	100%
Riffles	88.1	11.7	0.0	99.8	8%	17	14%
Flatwaters	91.7	40.4	7.3	139.4	22%	60	14%
Alcoves	91.8	91.8	23.0	206.6	87%	260	67%
	mainstem pieces/mile			159.9			



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DRY CREEK
Reach 13 Features

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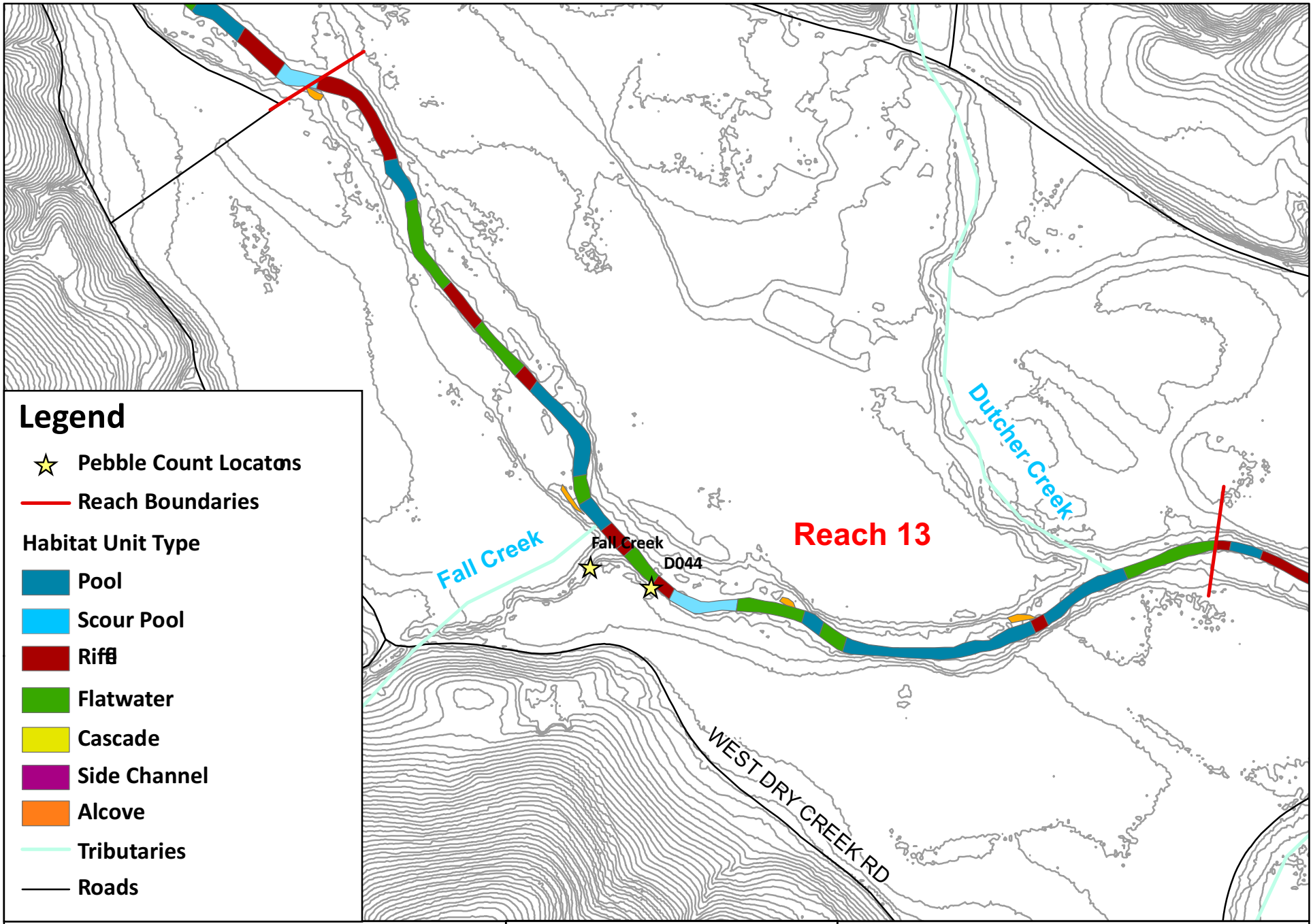

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DRY CREEK
Reach 13 Habitat Units

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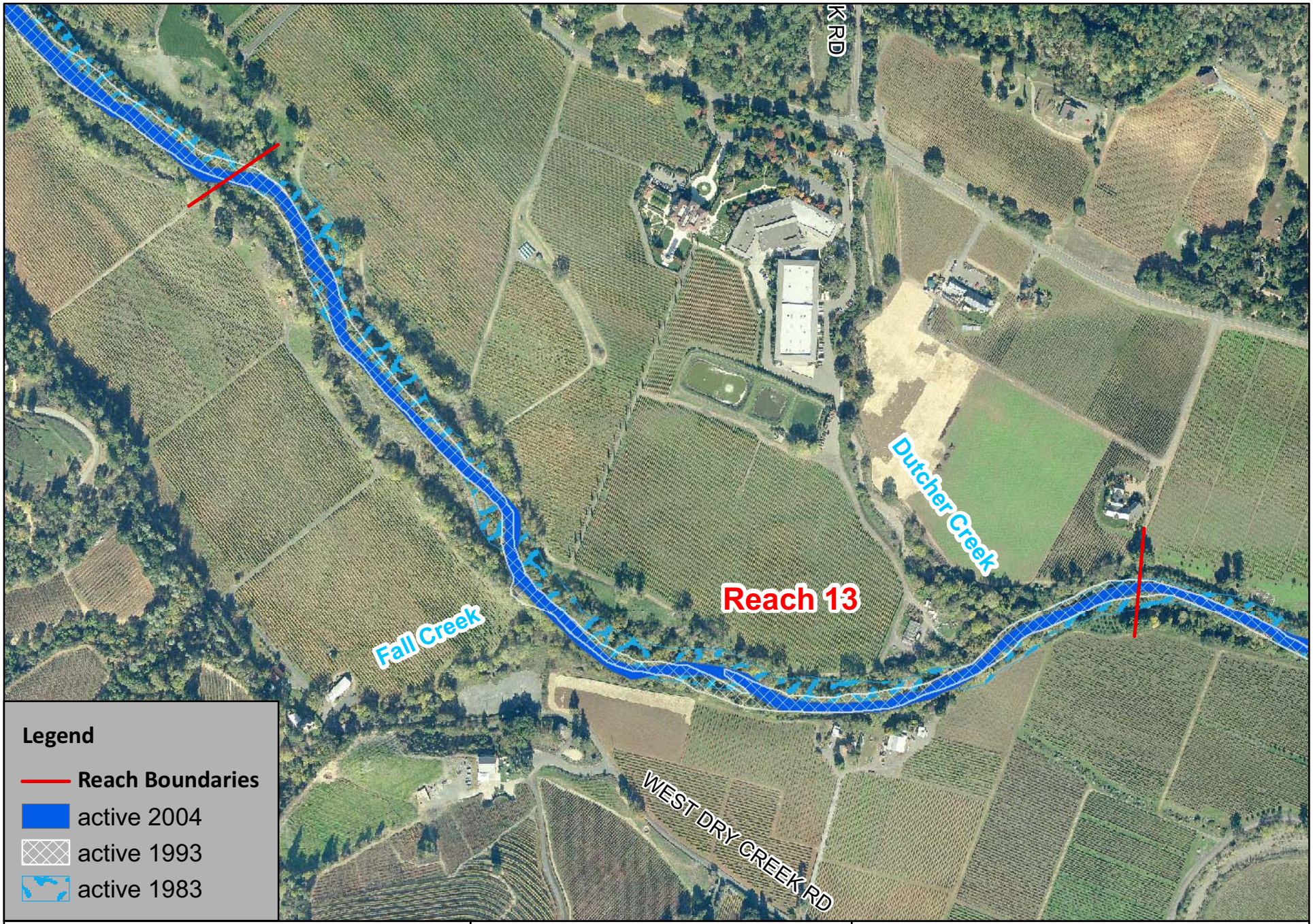

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DRY CREEK
Reach 13 - Channel Position Map

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REACH 14 (RM 12.6 to RM 13.3) **Schoolhouse Creek**

Reach 14 is a single-thread channel extending upstream to the Schoolhouse Creek confluence. The channel is slightly less entrenched than reach 13 and has migrated laterally slightly prior to, and since, dam construction. The air photo record suggests that the channel has generally narrowed over time as incision occurred.

Board fence bank protection was constructed along the lower 500 feet of the right[11] bank of Reach 14. Riprap boulder bank armor was installed along the banks near the upstream end of the reach for about 1,200 feet. Some litter was observed in Reach 14, including a ¾" black pipe on the left bank that disappears into the floodplain forest at river mile 12.9, and tires in the center of a flatwater at river mile 13.3 at the top of the reach.

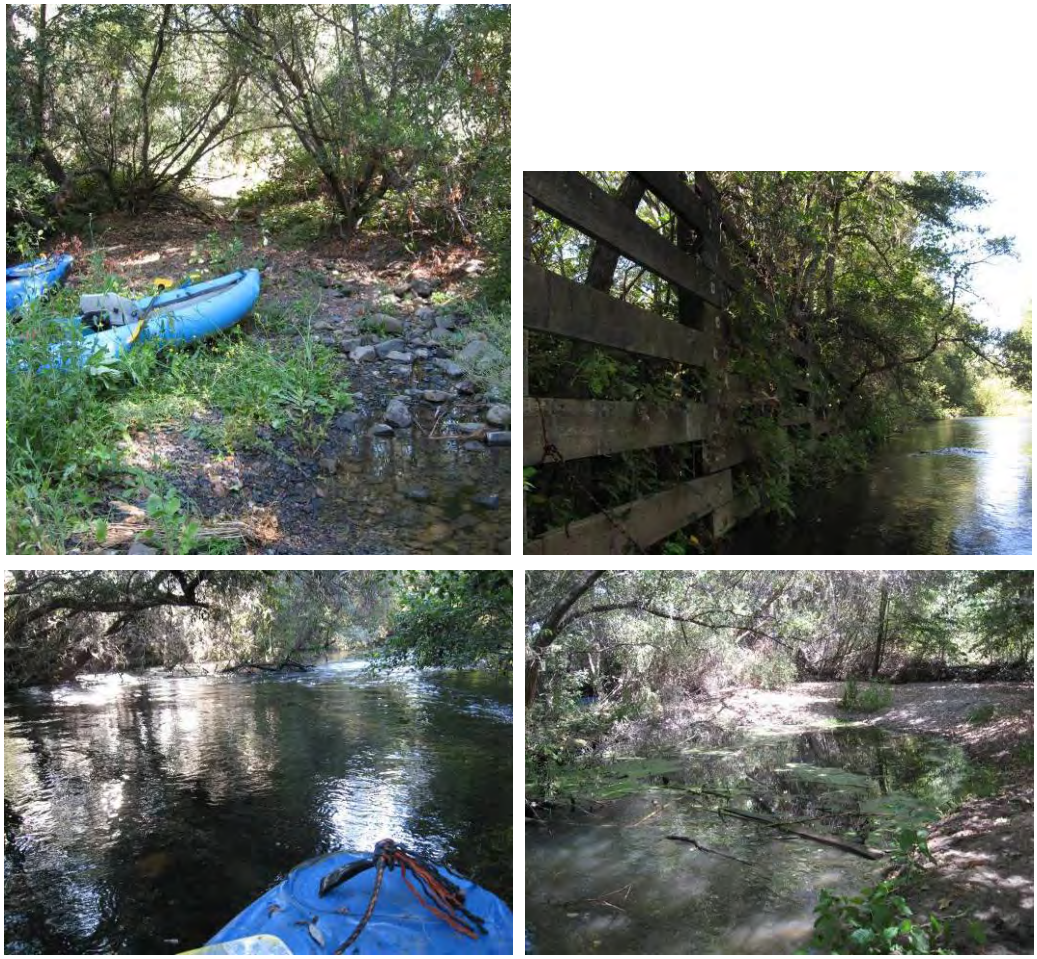


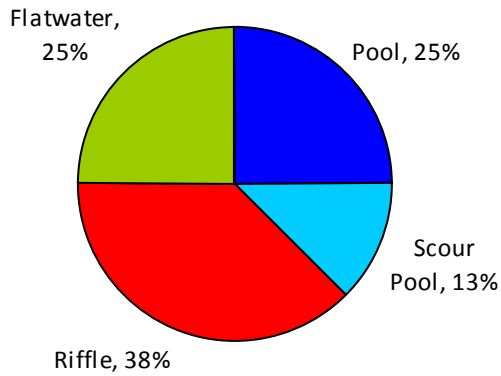
Figure 70: (upper left) mouth of Schoolhouse Creek, (upper right) board fence along the right bank, (lower left) deep pools with interacting live tree cover, (lower right) alcove habitat with aquatic vegetation.

[11] In the individual reach summaries, right and left bank designation defined as looking downstream.

Habitat Classification

The channel in reach 14 alternates between pools (38%), riffles (38%) and flatwaters (25%) on a relative frequency basis (Figure 71). There are nine riffles throughout the reach ranging in length from 50 to 300 ft making up 32% of the total reach on a length basis. The channel is wider than in the more confined reach 13, with an average wetted width of 48 ft during the survey and active channel and flood prone widths of 65 and 139 ft respectively. The average active channel depth of the riffles was 2.6 ft.

Figure 71: Proportion of Habitat Types by Relative Frequency in Reach 14

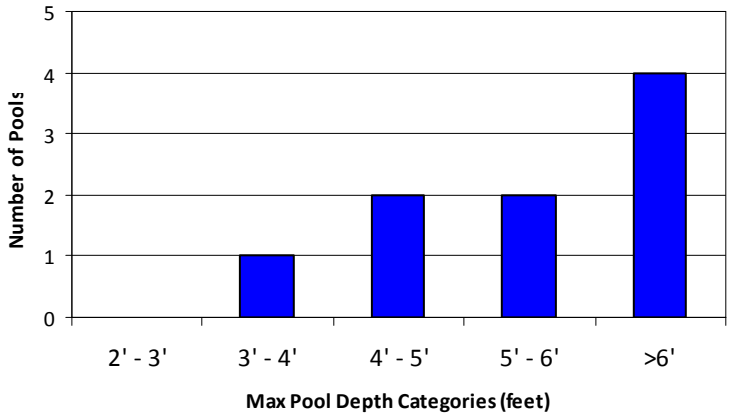


This portion of channel resembles an F4 Rosgen channel type, with a active channel width:depth ratio of 25 and an entrenchment ratio of 2.1. The reach has characteristics of both plane-bed and pool riffle morphology.

Pools

There were 9 pools in Reach 14, 3 of these were scour pools. All of the pools had a maximum depth greater than 3 feet, eith average maximum pool depth of 5.7 feet (Figure 72). The average residual pool depth was 4.4 feet, and the average pool crest depth was 1.4 ft. Substrate in the pools consisted of gravel with sand, with some small cobble.

Figure 72: Maximum Pools Depths in Reach 14.

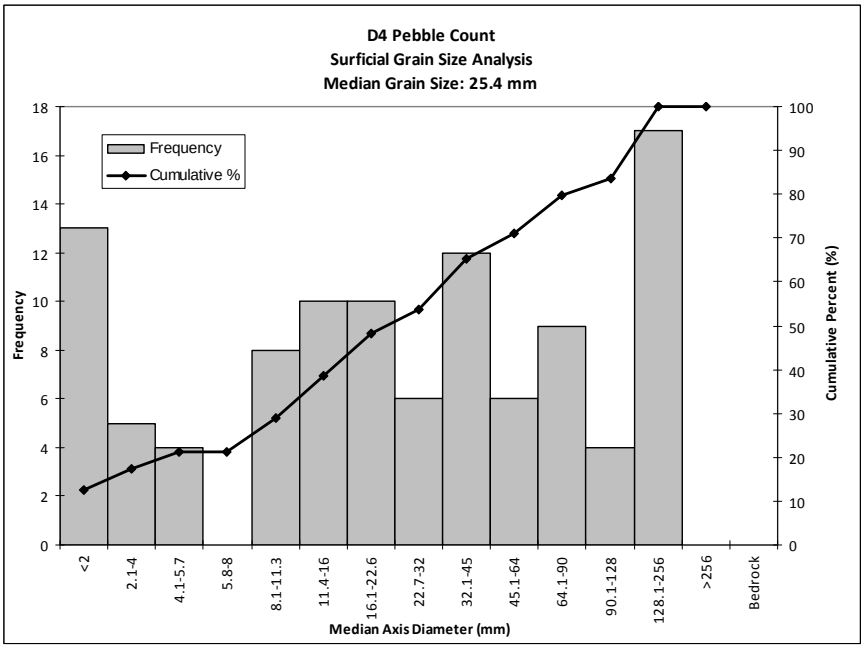


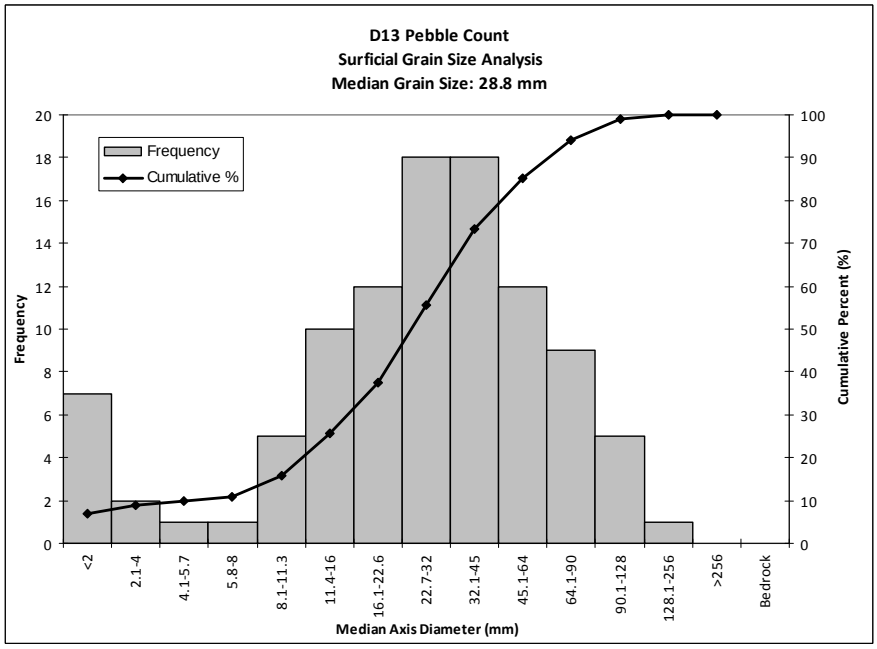
Riffles & Flatwaters

There were 9 riffles and 6 flatwaters in Reach 14. The average riffle depth was 1.1 feet, and the average flatwater depth was 2.3 feet. Substrate in riffles and flatwaters was gravel and small cobble. The bed material of two riffles were sampled, one at the upstream extent of the reach and the second approximately 0.25 miles downstream. The upstream riffle was primarily composed of medium to very coarse gravel with a median grain size

of 25 mm. The downstream riffle was primarily composed of coarse to very coarse gravel with a median grain size of 29 mm.

Figure 73: Grain size distribution for two riffles in reach 14 (habitat units #4 and #13).





Side-Channels

One side channel, dominated by flatwater habitat, was observed in Reach 14. Dimensions were 118 feet long, by 15 feet wide, and an average of 1.1 feet deep. Substrate was gravel with sand.

Alcoves

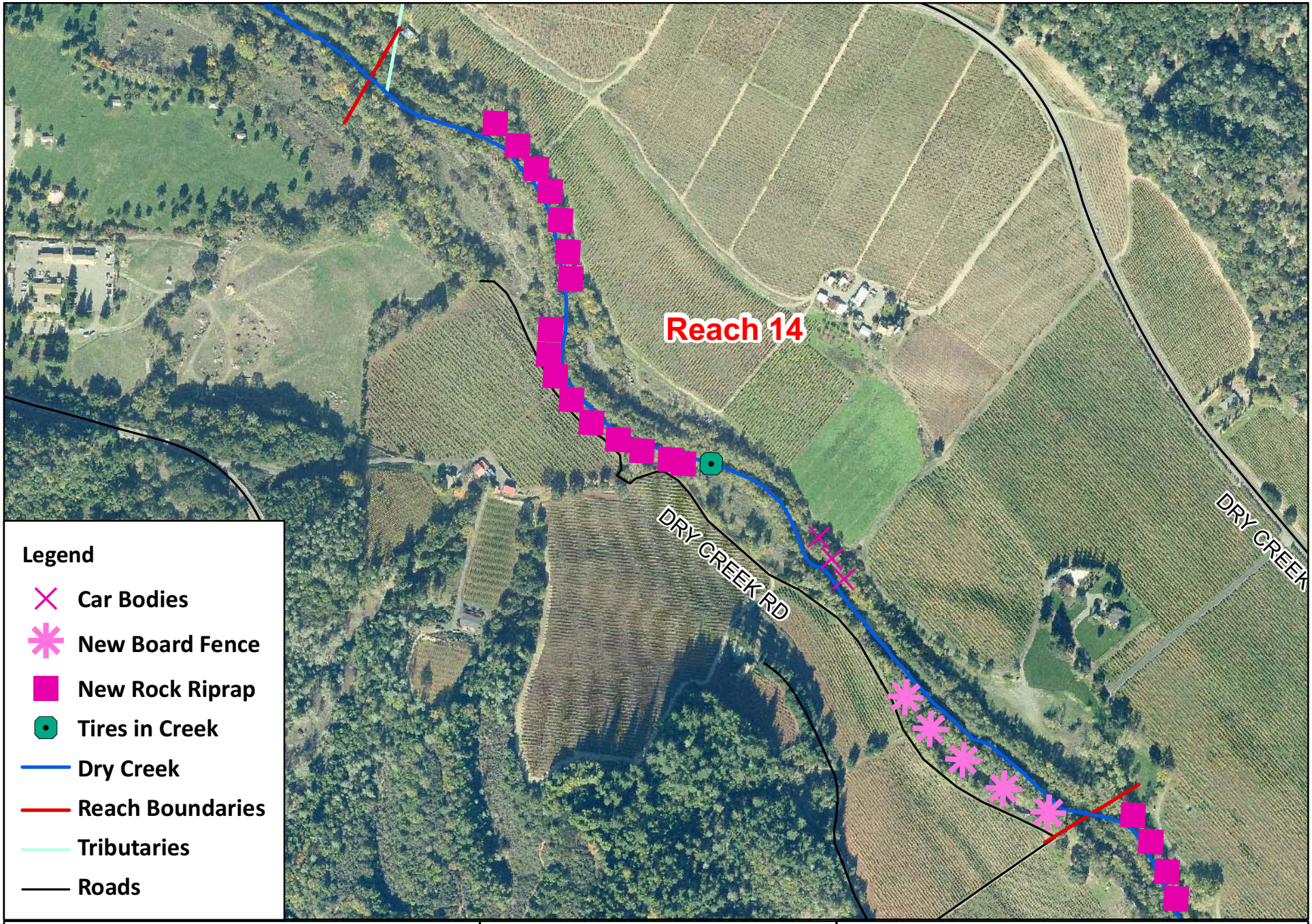
Three alcoves were measured in Reach 14. The alcoves were 58 and 38 feet long, 20 and 25 feet wide, with maximum depths of 1.5 and 5.4 feet. Substrate in the alcoves was fine sediment, with gravel and sand.

Instream Cover & Woody Debris

121 pieces of wood per mile were counted in Reach 14, with a total of 93 pieces counted in the reach (Table 14). There were no large pieces of wood observed, and 53 of the pieces were counted in pools. The highest densities of wood were found in pools and alcoves. Very low instream cover was present in Reach 14, provided by terrestrial vegetation and small woody debris, and less so by root masses and aquatic vegetation. Edge habitat was observed in one pool, three flatwaters, and the side channel.

Table 14: Instream woody debris, cover, and edge habitat frequency for Reach 14.

	small 6" - 12"	med 12" - 20"	large >20"	total	% cover	shelter rating	% units with edge habitat
Pools	135.7	72.4		208.1	23%	66	17%
Scour Pools	57.4	23.0		80.3	20%	47	0%
Riffles	62.8	16.7		79.6	20%	50	0%
Flatwaters	54.1	27.0		81.1	18%	50	50%
Side-Channels					30%	90	100%
Alcoves	110.0	55.0		165.0	28%	69	0%
	mainstem pieces/mile			117.0			



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DRY CREEK
Reach 13 Features

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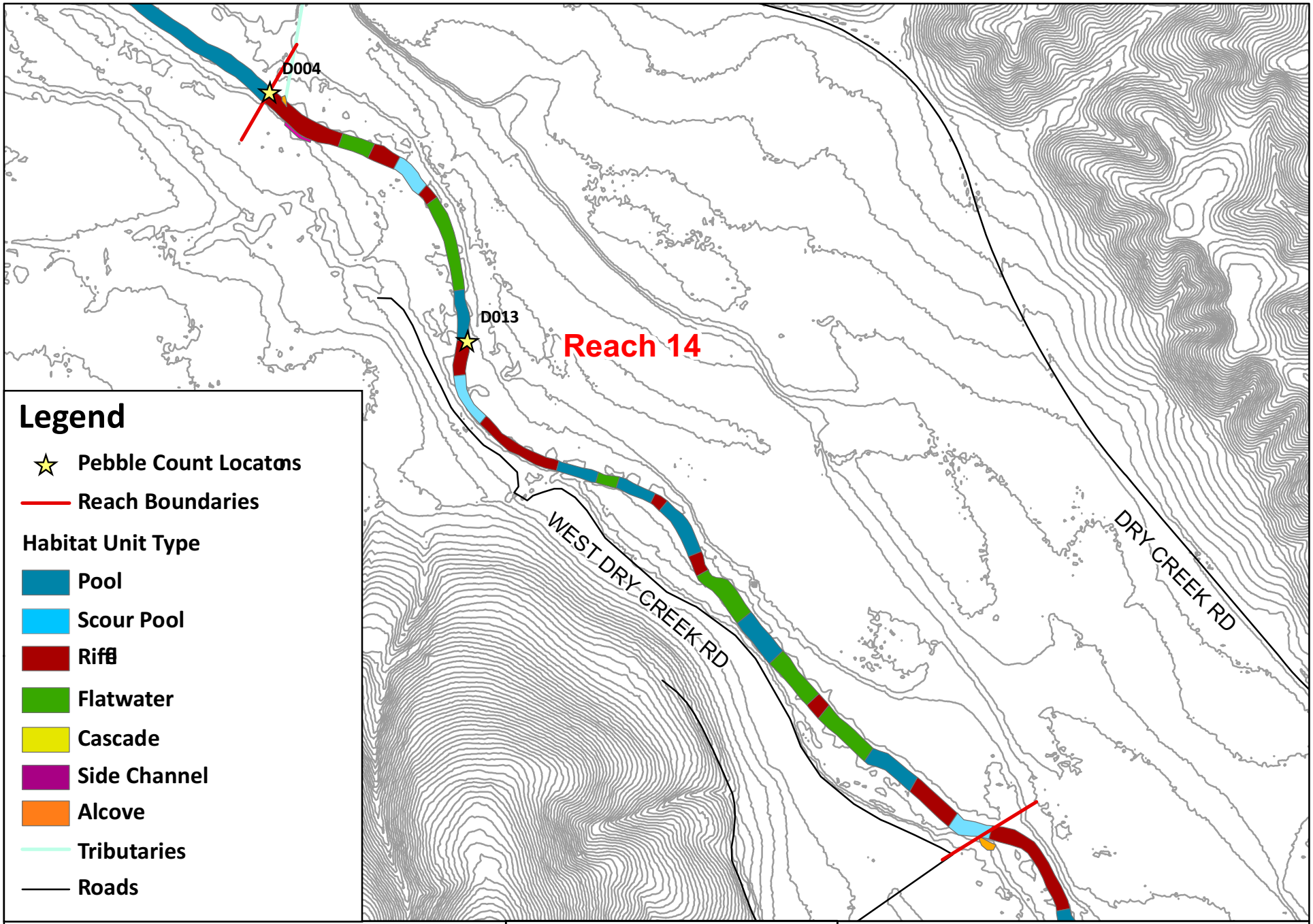

DRY CREEK
Reach 14 Habitat Units

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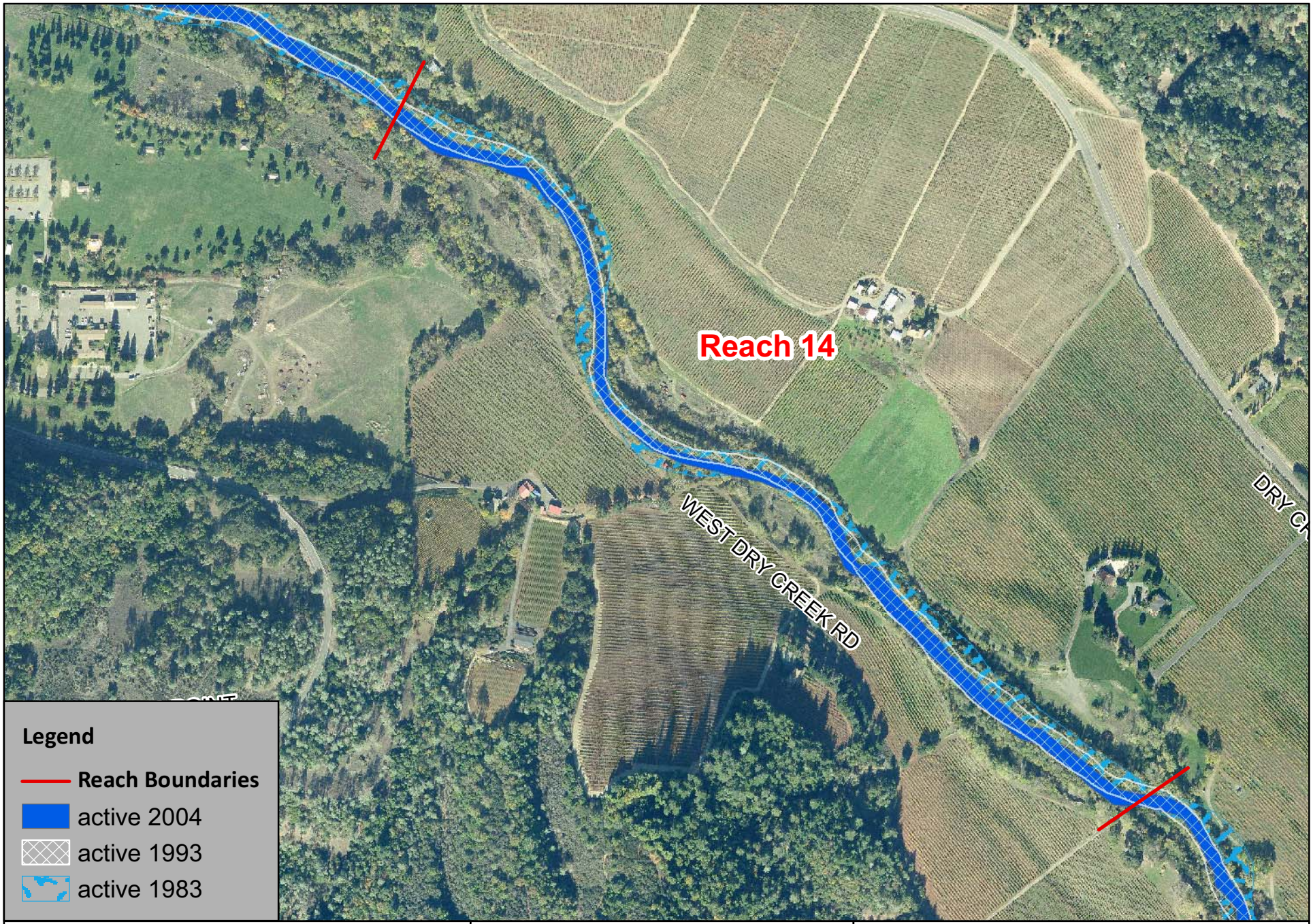

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DRY CREEK
Reach 14 - Channel Position Map

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REACH 15 (RM 13.3 to RM 13.6) **Schoolhouse Creek to Bord Bridge**

Reach 15 is a single-thread channel extending upstream from Schoolhouse Creek to the Bord Bridge. The channel here has a very low sinuosity and has experienced little channel change within the air photo record except for narrowing over time. The riparian corridor is narrow.

At the Bord Bridge, a boulder revetment associated with the bridge armors the right[12] bank. Higher on this bank, there is evidence of an older wood revetment. The high canopy cover in this reach is provided by California bay, willow, alder, and cottonwood. Himalayan blackberries and other exotics were present on both banks, but overstory vegetation dominates. An old board fence with metal mesh and cable covers part of the right bank along a pool unit. In general the banks were steeper on the right, and with a more gradual floodplain on the left bank.

Figure 74: (upper left) the riffle under Bord Bridge, (upper right) canopy cover, (lower left) deep, slow pool unit downstream, , (lower right) the long pool.

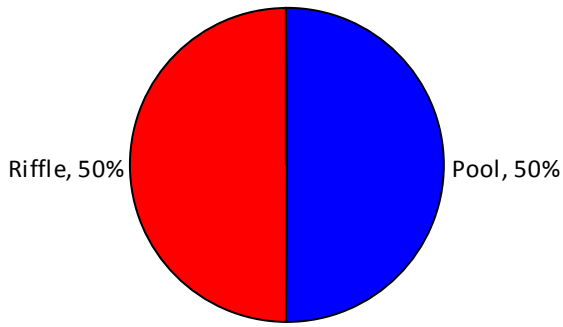
[12] In the individual reach summaries, right and left bank designation defined as looking downstream.

Habitat Classification

Reach 15 consists of a 48 foot long riffle and an extremely long, 1630 foot pool (Figure 75). This is the first stream channel habitat downstream of the dam outlet influence. The wetted channel width of the riffle was 23.0 feet, and the wetted width of the long pool was 55.0 feet.

Channel dimensions were measured at the riffle under the Bord Bridge. The active channel width was 45.0 feet, the average active channel depth was 2.9 feet, and the floodprone width with 126.0 feet. This riffle resembles a C4 channel type due to its moderate entrenchment ratio of 2.8 and its moderate width:depth ratio of 15.

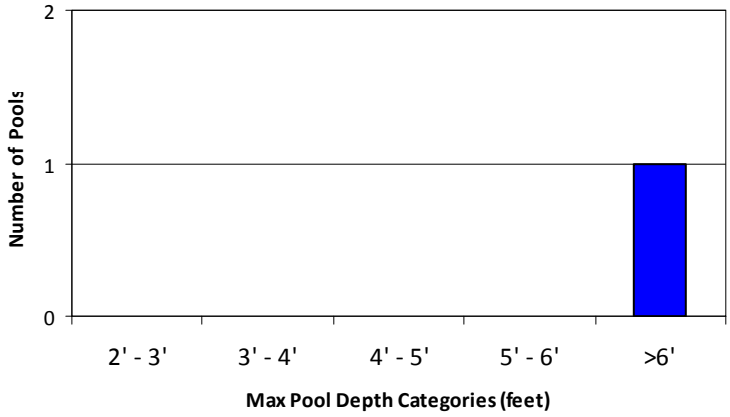
Figure 75: Proportion of Habitat Types by Relative Frequency in Reach 15



Pool

The single, very long pool in Reach 15 had a maximum depth of 7.0 feet. The residual depth was 4.5 feet, with a pool crest depth of 2.5 feet. Substrate in this pool was gravel with small cobble.

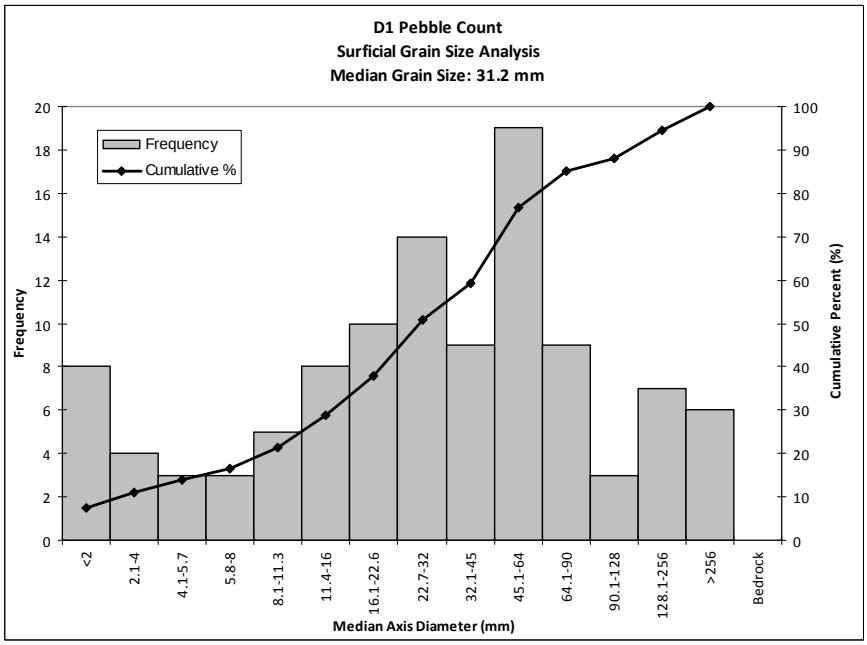
Figure 76: Maximum Pool Depth in Reach 15.



Riffle

The short, 48 foot long riffle had an average depth of 1.0 foot. The bed material is primarily gravel with some small cobbles. The material in the riffle is primarily coarse to very coarse gravel but ranges from sand to small boulders. The median grain size for this riffle is 31 mm (Figure 77). 67% was within ideal spawning sizes for coho and steelhead (11.4 to 128mm), and 37% was within ideal juvenile rearing sediment sizes (32mm to 128mm). 7% of the samples were sand or fine sediments.

Figure 77: Grain size distribution for the riffle below Bord Bridge in reach 15 (habitat unit #1).



Side-Channels

No side channels were observed in Reach 15.

Alcoves

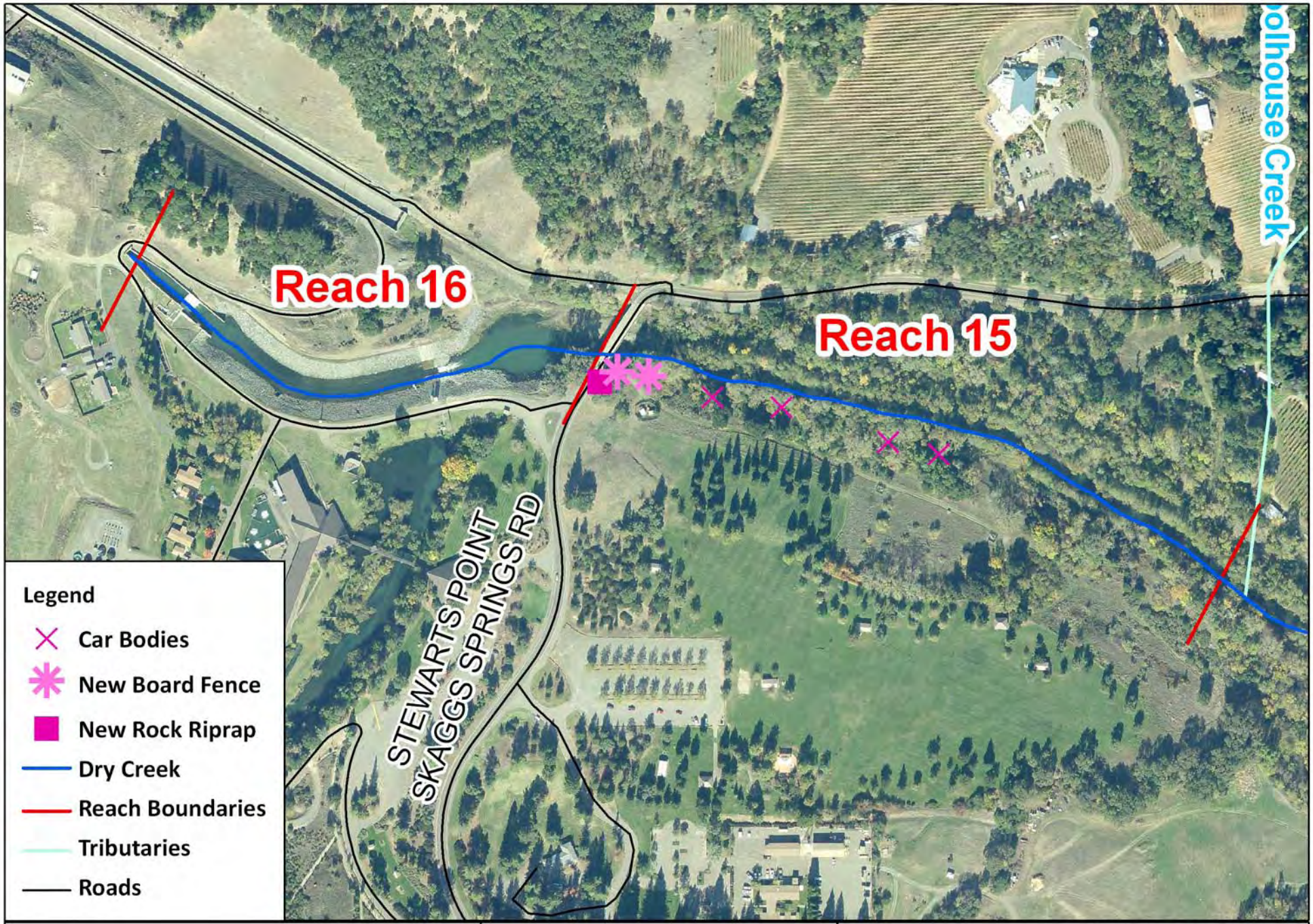
One alcove was observed in Reach 15. It was 45 feet long and 27 feet wide, with a maximum depth of 3.0 feet. Substrate in the alcove was fine sediment with sand.

Instream Cover & Woody Debris

There were 63 pieces of wood per mile in Reach 15. A total of 20 pieces of wood were counted, with no large pieces of wood observed (Table 15). 19 of the 20 pieces were found in the long pool, but the density of wood pieces in the riffle was much higher. Cover was provided in the pool by terrestrial vegetation, with additional cover provided by aquatic vegetation. In the riffle, a modicum of cover was provided by terrestrial vegetation and boulders associated with the bridge riprap bank armoring. In the alcove, cover was provided by aquatic vegetation with some overhanging vegetation. Edge habitat was observed only along the margins of the riffle in Reach 15.

Table 15: Instream woody debris, cover, and edge habitat frequency for Reach 15.

	wood pieces/mile				instream cover		
	small 6" - 12"	med 12" - 20"	large >20"	total	% cover	shelter rating	% units with edge habitat
Pool	38.9	22.7	0.0	61.5	30%	90	0%
Riffle	110.0	0	0	110.0	7%	7	100%
Alcove	0	0	0	0	80%	240	0%
	mainstem pieces/mile			62.9			



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DRY CREEK
Reach 15 Features

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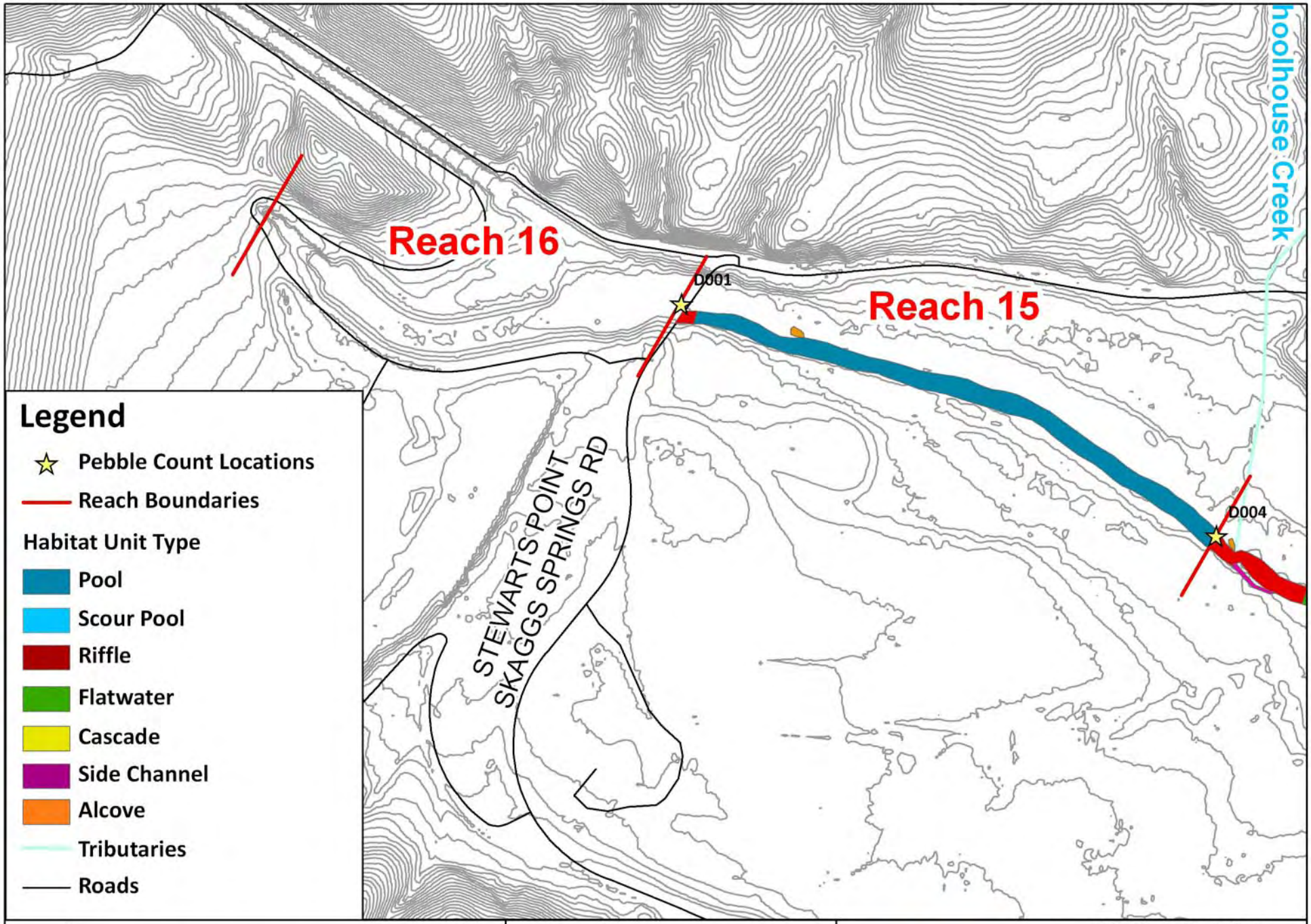

DRY CREEK
Reach 15 Habitat Units

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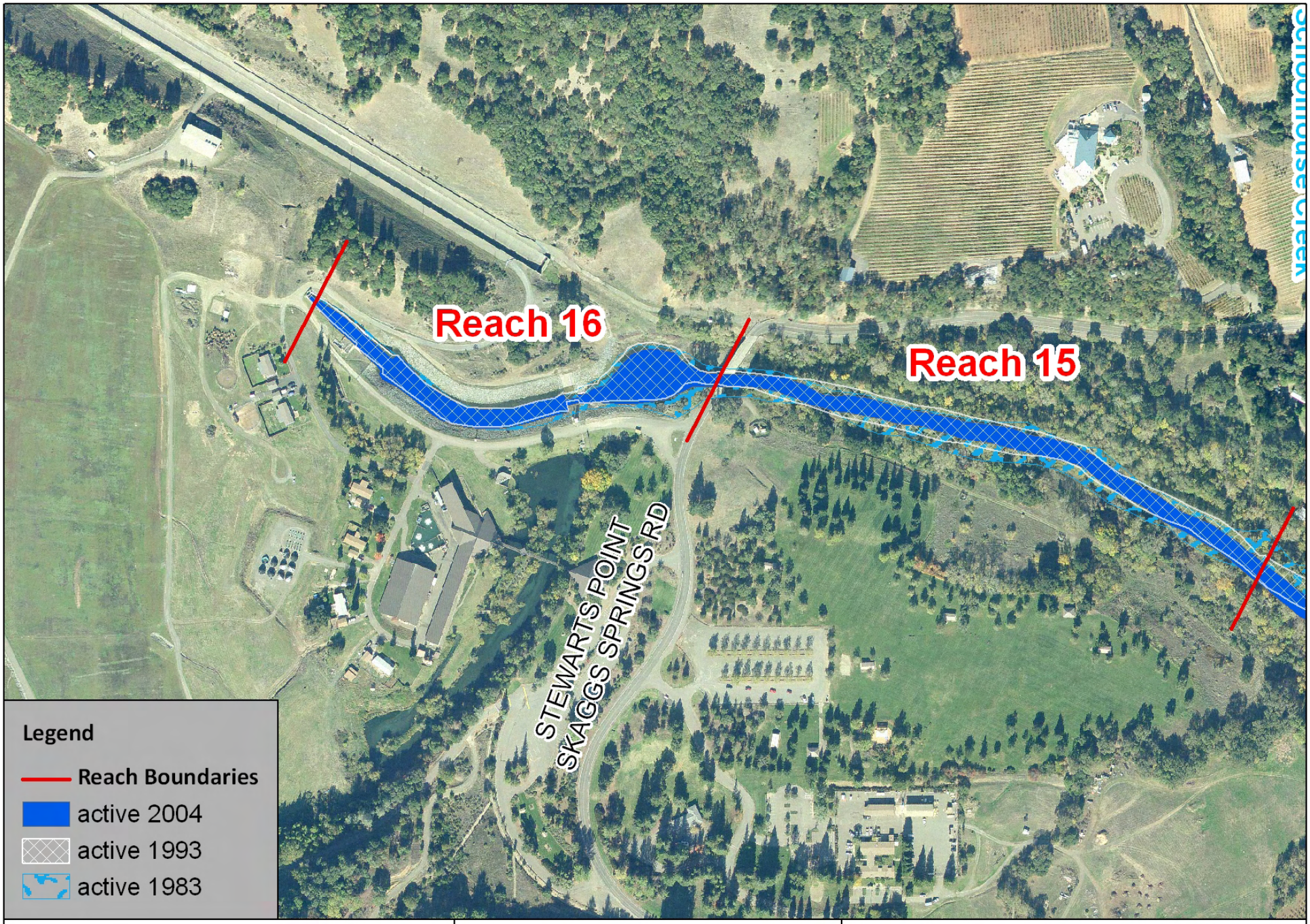

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DRY CREEK
Reach 15 - Channel Position Map

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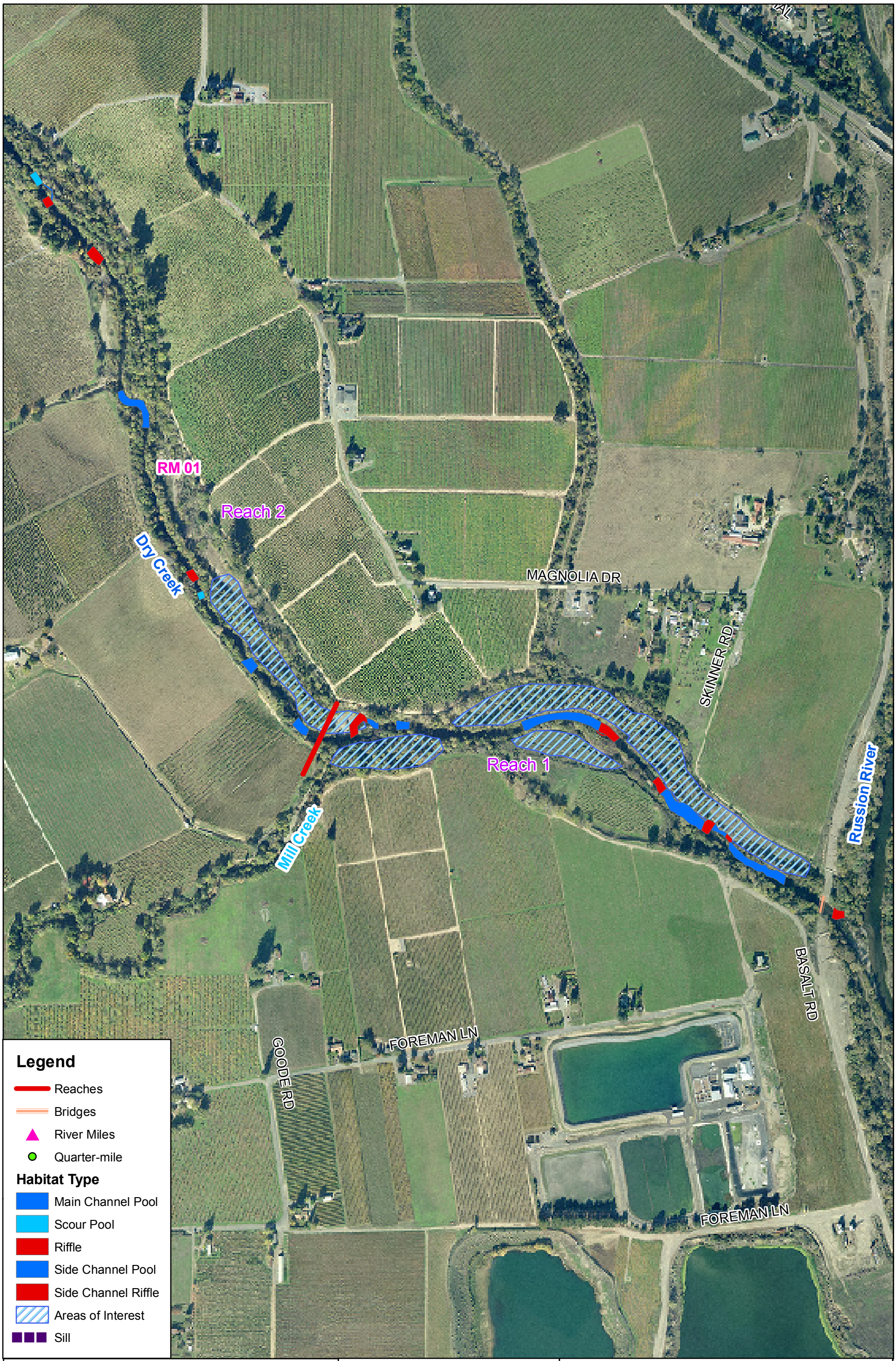
REACH 16 (RM 13.6 to RM 13.9) **Bord Bridge to dam spillway pool**

Reach 16 extends upstream from Bord Bridge to a flow measuring flume immediately below Warm Springs Dam. From the outlet of the dam, water flows through a constructed channel and over two drop structures before spilling into a deep pool (>12 feet deep) immediately upstream of the Bord bridge. Boulder revetments cover both banks within this constructed channel.

Figure 78: (left) looking upstream at the deep pool downstream of the measuring flume structure, (right) preparing to launch from the measuring flume structure.

9 APPENDIX B – PRELIMINARY ENHANCEMENT OPPORTUNITIES FIGURES



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0 0.1 0.2 Miles

DRY CREEK
Habitat Restoration
Sheet 1 of 10

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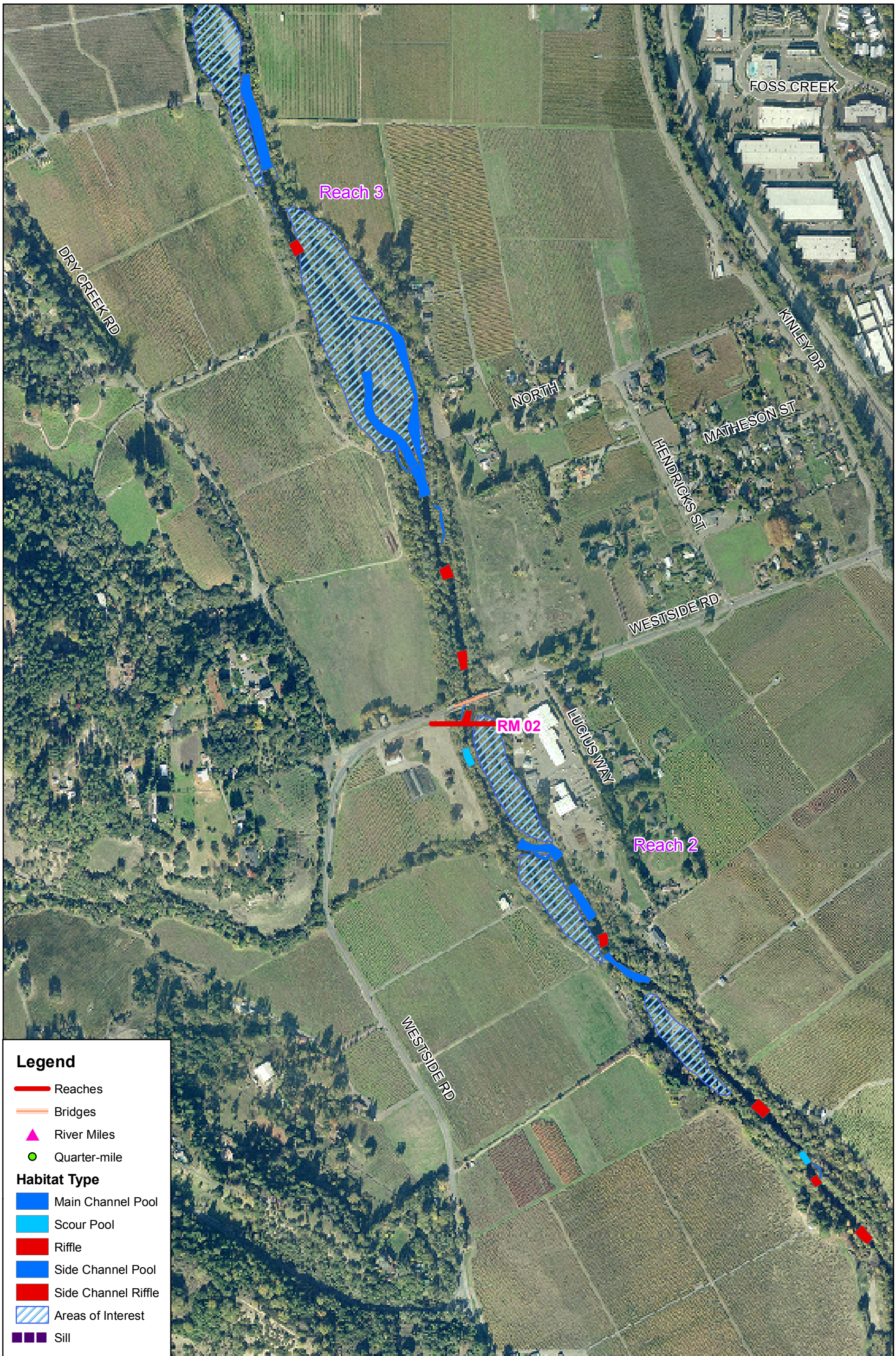

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DRY CREEK
Habitat Restoration
Sheet 2 of 10

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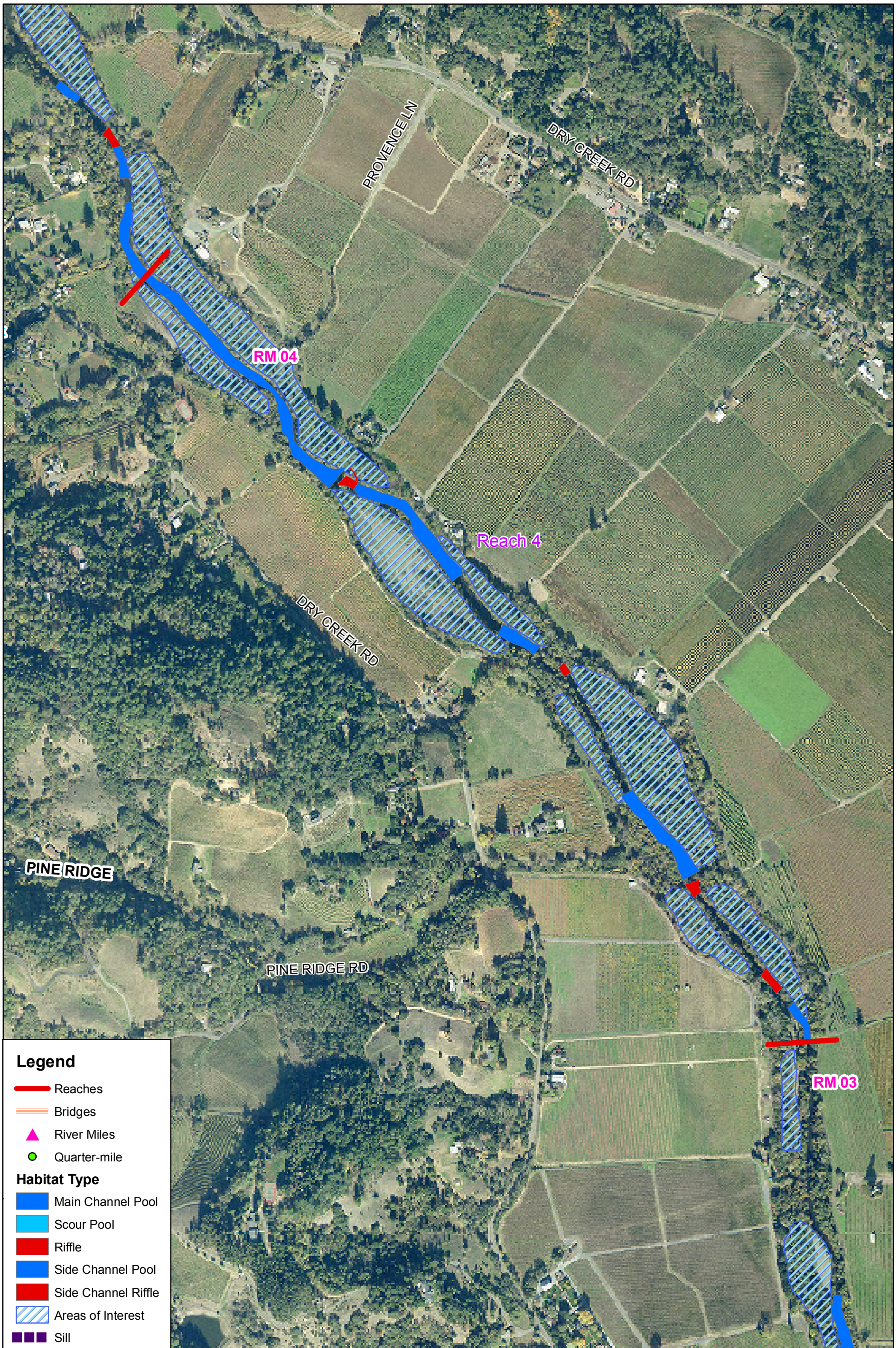

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DRY CREEK
Habitat Restoration
Sheet 3 of 10

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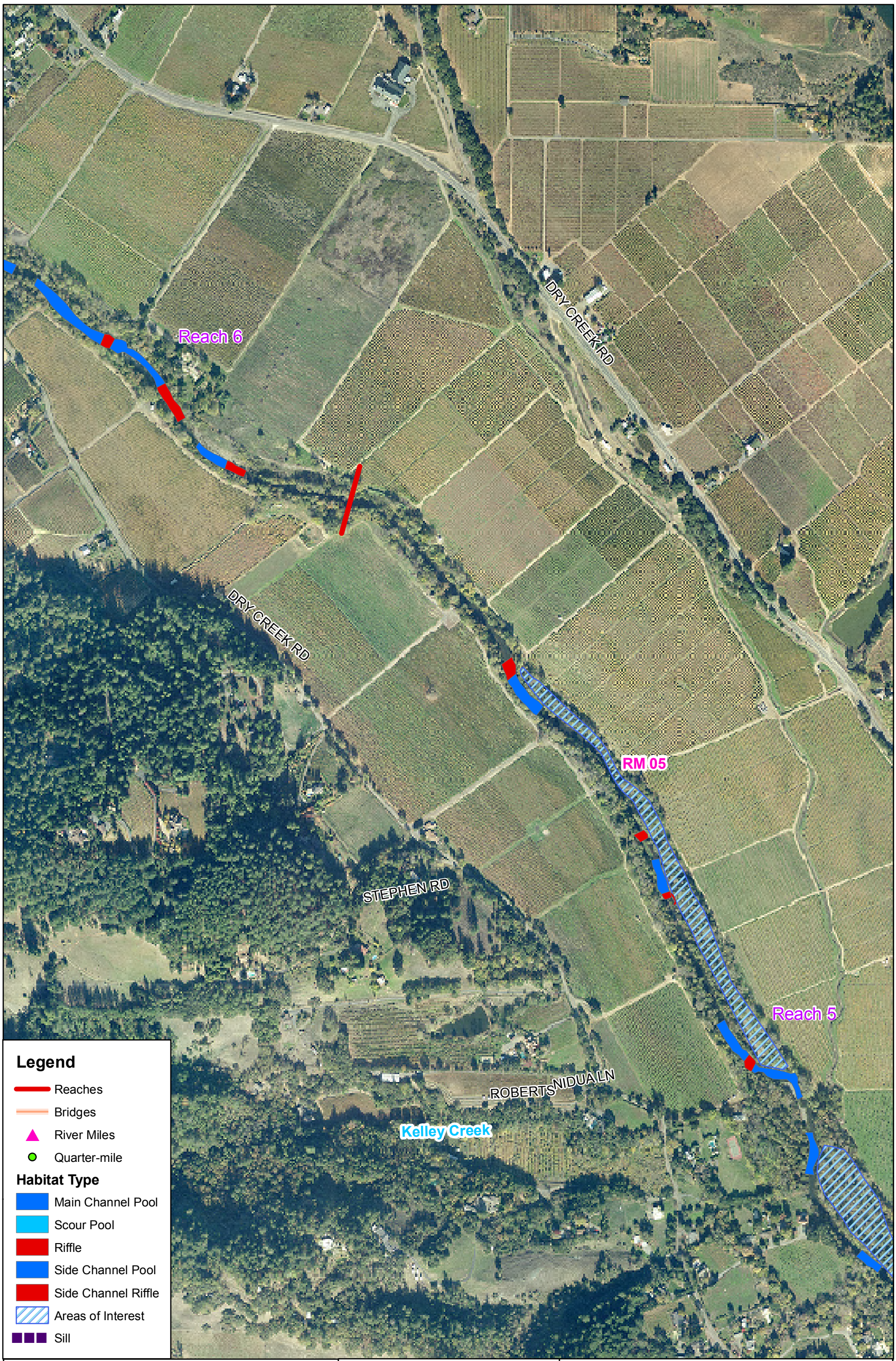

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DRY CREEK
Habitat Restoration
Sheet 4 of 10

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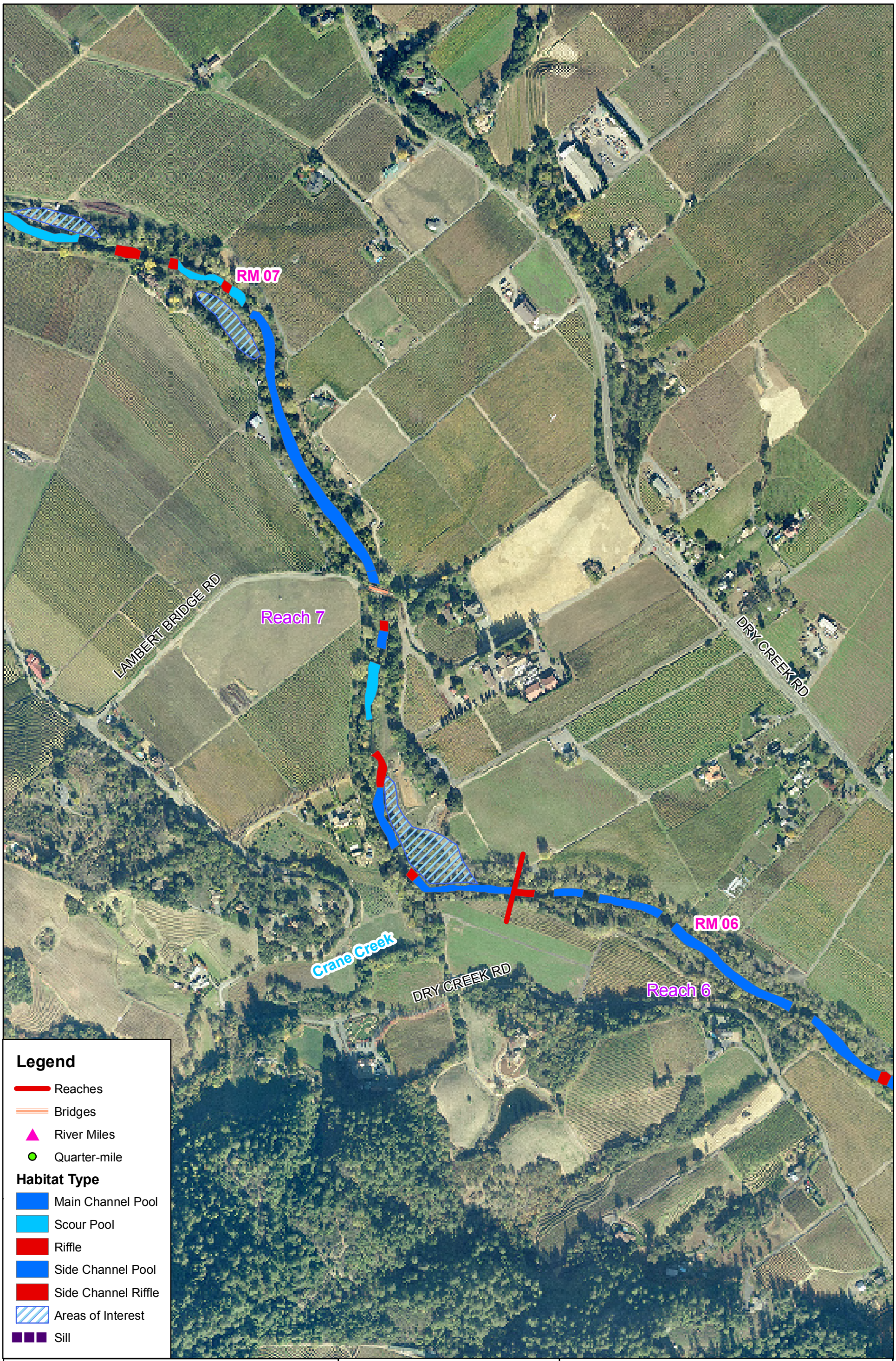

DRY CREEK
Habitat Restoration
Sheet 5 of 10

inter·fluve inc.
1020 Wasco St., Suite 1
Hood River, OR 97031
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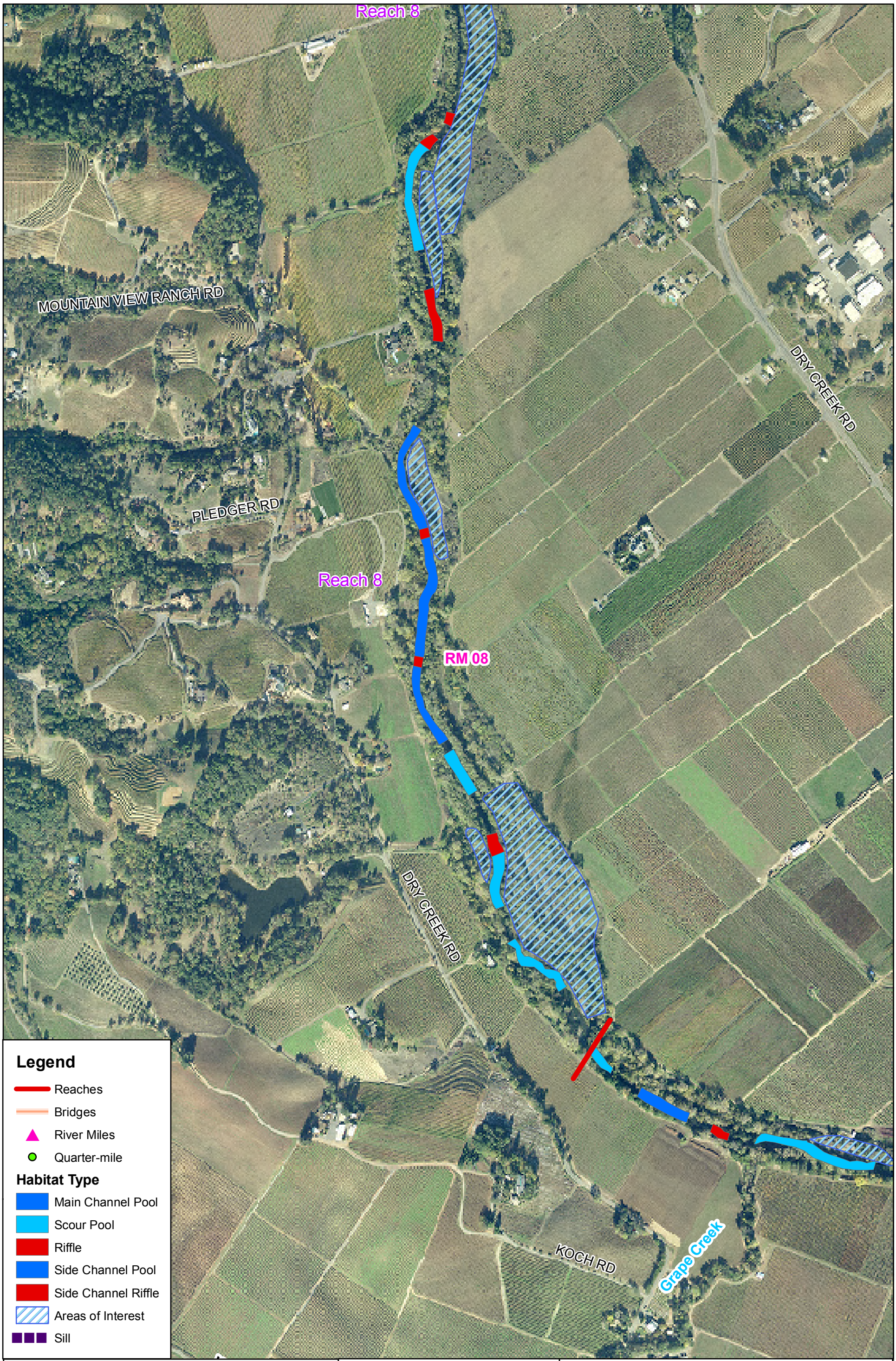
www.interfluve.com



N W E S

0 500 1,000 Feet

0 0.1 0.2 Miles

DRY CREEK
Habitat Restoration
Sheet 6 of 10

inter·fluve inc.

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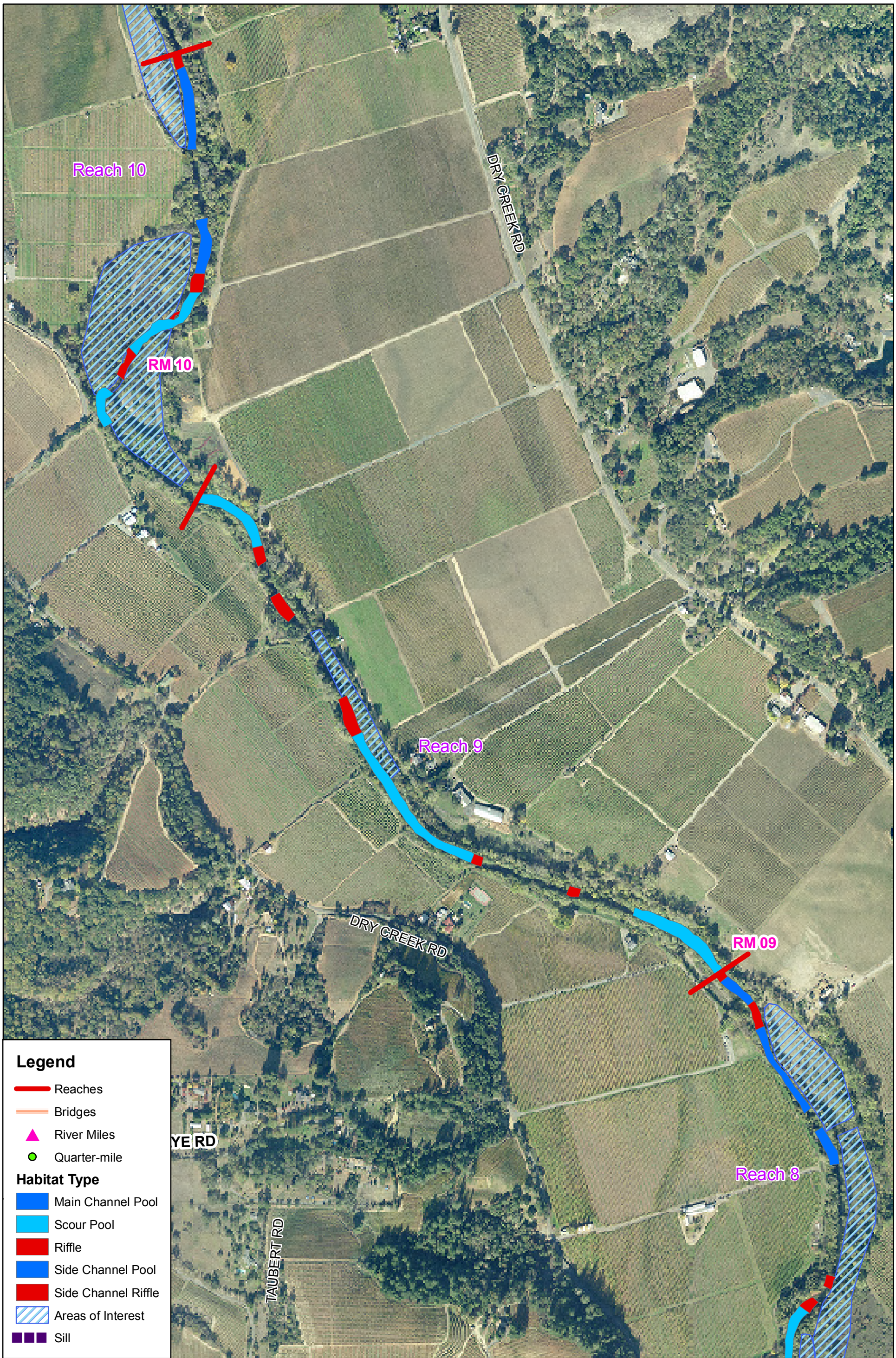
www.interfluve.com



N W E S

0 500 1,000 Feet

0 0.1 0.2 Miles

DRY CREEK
Habitat Restoration
Sheet 7 of 10

inter·fluve inc.

1020 Wasco St., Suite 1
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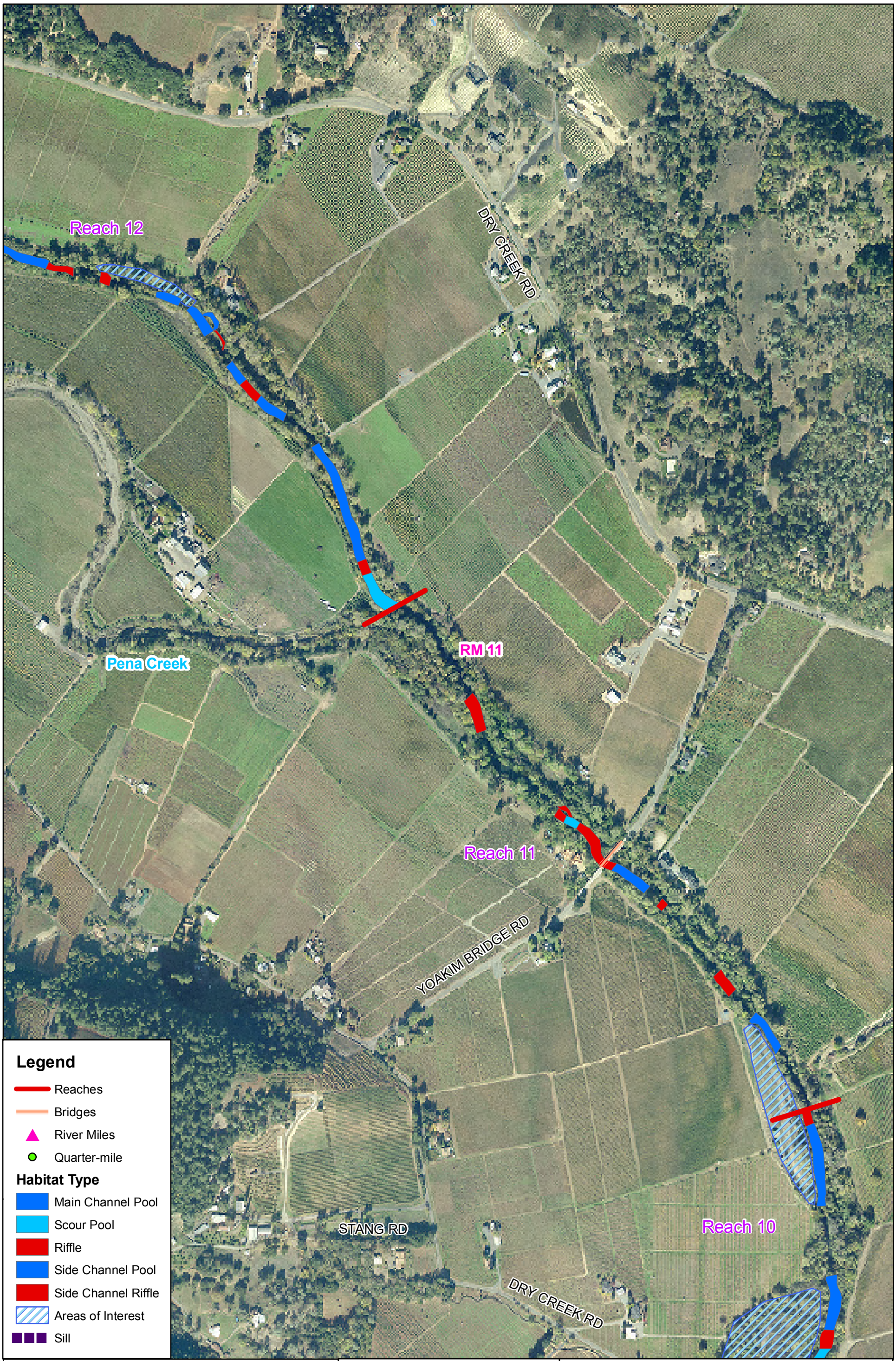

N W E S

0 500 1,000 Feet

0 0.1 0.2 Miles

DRY CREEK
Habitat Restoration
Sheet 8 of 10

inter·fluve inc.

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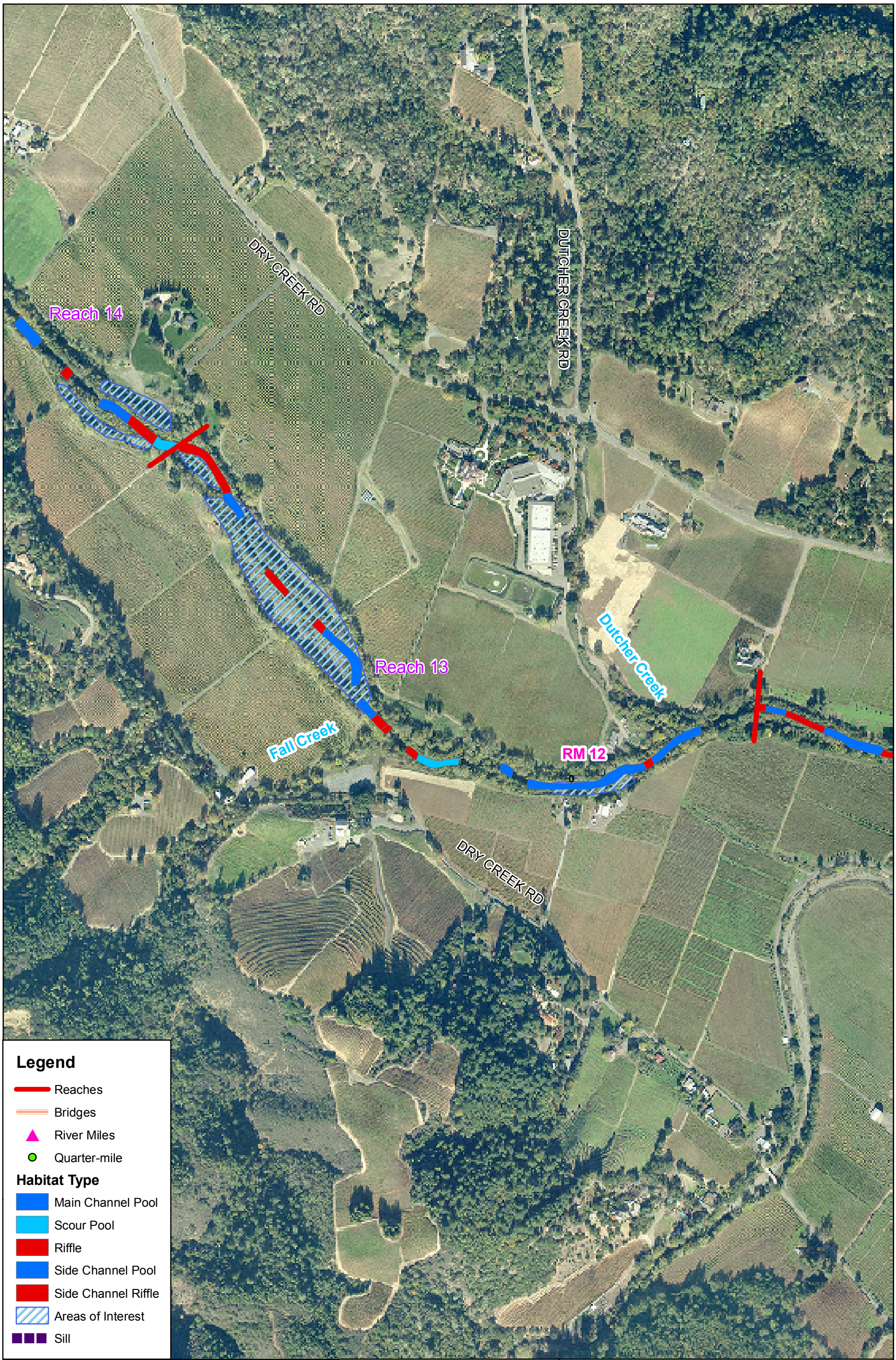

N W E S

0 500 1,000 Feet

0 0.1 0.2 Miles

DRY CREEK
Habitat Restoration
Sheet 9 of 10

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1020 Wasco St., Suite 1
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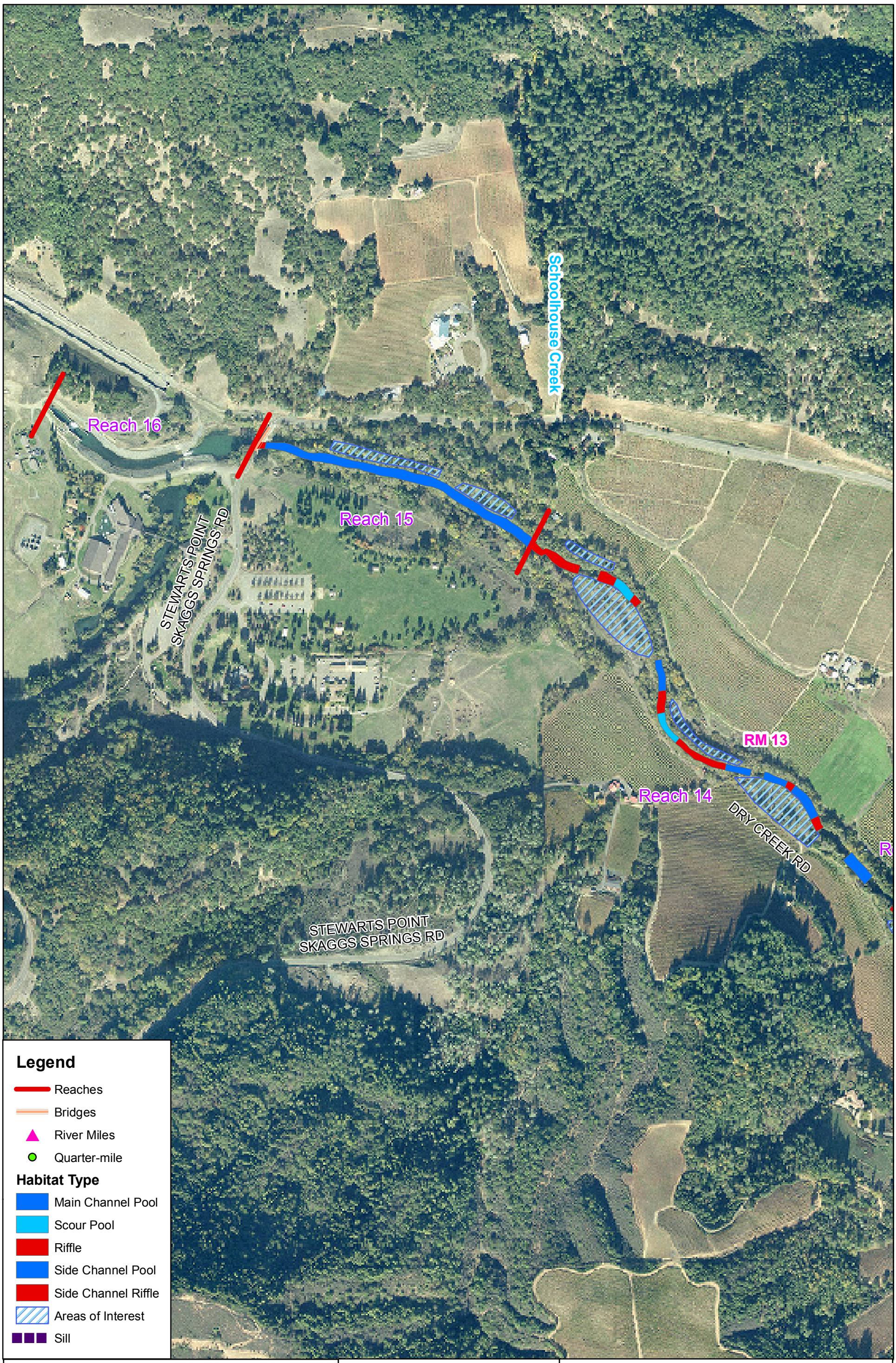

N W E S

0 500 1,000 Feet

0 0.1 0.2 Miles

DRY CREEK
Habitat Restoration
Sheet 10 of 10

inter·fluve inc.

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10 APPENDIX C - HABITAT SURVEY DATA SHEETS

FISHERY HABITAT INVENTORY DATA

inter-fluve, inc.

STREAM Dry Creek

OBSERVOR(S) **RJ & NN** DATE 8/26/2009

Stream Discharge

SAMP #	UNIT			DIMENSIONS						WOOD						SHELTER				SUBSTRATE		Nth UNIT MEASURES								
				STA bgn	Length	Avg Wet Width (O)	Pool Max D	Avg D /PTC	Edge Present	DEAD S	DEAD M	DEAD L	ALIVE S	ALIVE M	ALIVE L	% Cover	1	2	Complex. Code	1	2	Wet Width (M) 1	Wet Width (M) 2	Wet Width (M) 3	Riffle BF Width	Riffle BF Avg Depth 1	Riffle BF Avg Depth 2	Riffle BF Avg Depth 3	Riffle FPW	Peb Ct (Y/N)
	Rch.	No.	Type																											
1	15	1	R	D01	48	23		2	*				1			7	TV	Bo	1	G	SC	33			45	2.8	2.8	3.2	126	Y
2	15	2	P	D02	1630	55	7	2.5		2	4		10	3		3000%	TV	AV	3	G	SC	57								N
3	15	3	A	D03	45	27	3									8000%	AV	TV	3	F	S	52								
4	14	1	R	D04	312	55		1.7					1			15	TV	SWD	2	SC	G				88	3.4	2.4	2.1	113	Y
5	14	2	A	D05	38	20	1.5						2			5	TV	SWD	2	F	G									
6	14	3	SC/F	D06	108	15		1.1	*							30	TV	AV	3	G	S									
7	14	4	F	D07	114	43		2	*				3			20	TV	SWD	3	SC	S	42								
8	14	5	R	D08	100	38		1.5			1		4			35	SWD	TV	3	SC	G									
9	14	6	SP	D09	132	40	5.8	1					3	1		25	TV	SWD	3	SC	G	33								
10	14	7	R	D10	50	38		1.2								20	TV	RM	3	G	SC									
11	14	8	F	D11	332	44		3.5		1	1		1			20	TV	SWD	3	G	S									
12	14	9	P	D12	180	50	7	1.5			1		4			15	TV	SWD	3	G	S									
13	14	1	R	D13	126	53		1		3				1		10	TV	SWD	2	G	SC	43			54	2	2.6	3.6	180	Y
14	14	2	SP	D14	185	38	6	1.3		1						15	TV	RM	2	G	S	38								
15	14	3	R	D15	315	40		0.9					1			10	TV	RM	2	G	SC									
16	14	4	P	D16	145	43	5.5	2			1			1		15	TV	SWD	2	G	SC									
17	14	5	F	D17	80	45		2		1	1		2			15	SWD	TV	3	G	SC									
18	14	6	P	D18	132	48	3.5	1.1		1			2			15	TV	RM	3	G	S									
19	14	7	R	D19	50	38		1					2	1		30	SWD	TV	3	G	SC									
20	14	8	P	D20	206	60	8	1.2		5	2		5	6		30	SWD	TV	3	G	S									
21	14	9	R	D21	60	50		0.7					1			20	TV	SWD	2	G	SC	49			53	2	2.7	2.9	124	N
22	14	10	F	D22	231	60		2	*	1	1		1	3		20	TV	SWD	3	G	SC	65								
23	14	11	P	D23	180	60	4	1.3	*	1	2		7	2		40	TV	AV	3	G	S									
24	14	12	F	D24	197	57		2.2	*				2			20	TV	SWD	3	G	SC									
25	14	13	R	D25	60	53		1					1			30	SWD	TV	3	SC	G									
26	14	14	F	D26	218	48		2								10	TV	RM	2	SC	G									

Habitat Unit Types

P - Main Channel Pool
SP - Scour Pool
A - Alcove/Backwater/SideChannel Pool
SC/Type - Side Channel with Unit Type
R - Riffle
F - Flatwater (Glide/Run)
C - Cascade

LWD Size Classes

S >6" but <12"
M >12" by <20"
L >20"

CDFD Shelter Types

RM
SWD
LWD Root Mass
TV <12" Woody Debris
AV >12" Woody Debris
BC Terrestrial Vegetation
BO Aquatic Vegetation
BD Bubble Curtain
UC Boulders
Bedrock Ledge
Undercut Bank

0 No Shelter

1 1 to 5 boulders
bare undercut bank / bedrock ledge
single piece large wood (LWD

2 1 to 2 pieces LWD associated with SWD
> 6 boulders / 50 feet
stable 12" undercut bank w/ rootmass
single RW lacking complexity
branches in/near water
limited submersed veg fish cover
bubble curtain

3 Combination of cover types (at least two)
LWD/boulders/rootwads
3 or more LWD w? SWD
3 or more boulders w/ LWD/SWD
bubble curtain w/ LWD/boulders
stable > 12" undercut bank w/ rootmass/LWD
extensive submersed veg fish cover

Substrate

F fines, D<0.0625 mm
S sand, 0.0625mm<D<2mm
G gravel, 2mm<D<64mm
SC small cobble, 64mm<D<128mm
LC large cobble, 128mm<D<256mm
B boulders, 256 mm<D
W bedrock

FISHERY HABITAT INVENTORY DATA

inter-fluve, inc.

STREAM **Dry Creek**

OBSERVOR(S) **RJ & NN** DATE 8/26/2009

Stream Discharge

SAMP #	UNIT			DIMENSIONS						WOOD						SHELTER				SUBSTRATE		Nth UNIT MEASURES								
				STA	Length	Avg Wet	Pool	Avg D	Edge	DEAD			ALIVE			%	1	2	Complex.	1	2	Wet Width (M)			Riffle BF	Riffle BF Avg Depth			Riffle	Peb Ct
	Rch.	No.	Type	bgn		Width (O)	Max D	/PTC	Present	S	M	L	S	M	L	Cover			Code			1	2	3	Width	1	2	3	FPW	(Y/N)
27	14	15	P	D27	192	53	7.2	1.4		3	1		2			25	TV	AV	3	G	SC									
28	14	16	R	D28	188	50		0.9		2				1		7	SWD	TV	3	G	SC									
29	14	17	SP	D29	143	50	4.4	1.2		1				1		20	TV	AV	2	G	S	45								
30	14	18	A	D30	58	25	5.4				1					50	AV	SWD	3	F	S									
31	13	19	R	D31	405	39		1.6		4						5	Bo	RM	2	SC	G									
32	13	20	P	D32	159	43	4.4	2		2	1		2	1		20	TV	SWD	3	G	SC									
33	13	21	F	D33	336	40		2.2								15	TV	RM	2	G	SC									
34	13	22	R	D34	180	40		1.1					1			10	TV	RM	2	SC	LC	40								
35	13	23	F	D35	218	45		2.5					1			5	TV	RM	2	SC	LC									
36	13	24	R	D36	65	40		1.7		1			1			10	TV	RM	2	SC	G									
37	13	25	P	D37	394	43	5	1.9		2	1		5	3	1	20	SWD	TV	3	SC	LC									
38	13	26	F	D38	70	45		2.1			1		1	2	1	20	SWD	TV	3	SC	LC									
39	13	27	P	D39	139	38	5.3	1.3								35	LWD	SWD	3	G	SC									
40	13	28	A	D40	90	12	1.6		*	2	2					80	AV	SWD	3	S	G									
41	13	29	R	D41	84	45		0.7	*				1			5	RM	TV	2	G	SC									

P - Main Channel Pool
SP - Scour Pool
A - Alcove/Backwater/SideChannel Pool
SC/Type - Side Channel with Unit Type
R - Riffle
F - Flatwater (Glide/Run)
C - Cascade

LWD Size Classes
S >6" but <12"
M >12" by <20"
L >20"

CDFD Shelter Types
RM Root Mass
SWD <12" Woody Debris
LWD >12" Woody Debris
TV Terrestrial Vegetation
AV Aquatic Vegetation
BC Bubble Curtain
BO Boulders
BD Bedrock Ledge
UC Undercut Bank

0 No Shelter

1 1 to 5 boulders
bare undercut bank / bedrock ledge
single piece large wood (LWD

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limited submersed veg fish cover
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extensive submersed veg fish cover

F fines, D<0.0625 mm
S sand, 0.0625mm<D<2mm
G gravel, 2mm<D<64mm
SC gravel, 2mm<D<64mm
LC large cobble, 128mm<D<256mm
B boulders, 256 mm<D
W bedrock

PAGE 1 of

FISHERY HABITAT INVENTORY DATA

inter-fluve, inc.

STREAM **Dry Creek**

OBSERVOR(S) **RJ & NN** DATE 8/27/2009

Stream Discharge

SAMP #	UNIT			DIMENSIONS						WOOD						SHELTER				SUBSTRATE		Nth UNIT MEASURES								
				STA	Length	Avg Wet	Pool	Avg D	Edge	DEAD			ALIVE			%	1	2	Complex.	1	2	Wet Width (M)			Riffle BF	Riffle BF Avg Depth			Riffle	Peb Ct
	Rch.	No.	Type	bgn		Width (O)	Max D	/PTC	Present	S	M	L	S	M	L	Cover			Code			1	2	3	Width	1	2	3	FPW	(Y/N)
42	13	1	R	D42	40	37		0.9		2			3			8	SWD	TV	3	G	SC									
43	13	2	F	D43	136	46	3	1.4		2	1		4	2		20	SWD	TV	3	G	SC	50	49	49						
44	13	3	R	D44	70	36		1.2			1		1			10	TV	SWD	3	G	SC	39	37	38	41	2.1	1.9	3	62	Y
45	13	4	SP	D45	244	35	5.7	2.1	*	8	3		6	1	1	35	SWD	TV	3	G	S									
46	13	5	F	D46	239	38		3		3	1		4	2		30	TV	SWD	3	G	SC									
47	13	6	A	D47	60	10	2.4			1				1	1	100	AV	TV	3	F	S									
48	13	7	P	D48	77	50	4	1.5	*	1			1	1		25	TV	SWD	3	G	S	58	53	45						
49	13	8	F	D49	100	55		1.8					2	1		35	TV	SWD	3	G	S									
50	13	9	P	D50	681	50	8	2	*	12	3	1	2	1		30	TV	SWD	3	SC	G									
51	13	10	R	D51	55	33		1.2		1				1		5	TV	SWD	2	G	SC									
52	13	11	A	D52	80	18	2.5		*	1				1		80	AV	TV	3	G	F									
53	13	12	P	D53	328	55	7.5	3	*	7	2		8	1		25	TV	SWD	3	S	G									
54	13	13	F	D54	340	60		2.4	*	2		1	6	1		30	SWD	TV	3	G	SC									
55	12	14	R	D55	50	58		1.8					3			20	TV	SWD	2	SC	G	54	53	56	60	3.1	3.3	2.7	130	N
56	12	15	P	D56	114	35	4.5	2.3		3			1	1		40	BO	RM	3	B	S	35	37	40	ely hp-rap from along LB					
57	12	16	R	D57	235	42		2.5		4	1					60	BO	RM	3	B	SC									
58	12	17	P	D58	350	45	7.8	1.2	*	3						30	TV	AV	3	S	SC									
59	12	18	R	D59	153	45		1.3		1	1		1			10	RM	SWD	3	G	SC									
60	12	19	F	D60	153	60	4	2.5		4	1		3			25	TS	AV	3	G	SC									
61	12	20	R	D61	54	53		1.1		1			1			10	TV	SWD	2	G	SC									
62	12	21	F	D62	277	35		2		4	1		3	1		20	SWD	TV	3	G	SC									
63	12	22	P	D63	141	40	6.5	1.5		5	2		2	2		25	TV	SWD	3	G	SC									
64	12	23	F	D64	59	35		1.6		3	1	1				38	SWD	TV	3	G	SC	27	28	29						
65	12	24	A	D65	300	25	2.5		*	5	1		3			95	AV	TV	3	G	F									
66	12	25	SC/F	D66	90	12	2.1	0.9		3				2		40	SWD	TV	3	G	S									

Habitat Unit Types

P - Main Channel Pool
SP - Scour Pool
A - Alcove/Backwater/SideChannel Pool
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R - Riffle
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C - Cascade

LWD Size Classes

S >6" but <12"
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L >20"

CDFD Shelter Types

RM Root Mass
SWD <12" Woody Debris
LWD >12" Woody Debris
TV Terrestrial Vegetation
AV Aquatic Vegetation
BC Bubble Curtain
BO Boulders
BD Bedrock Ledge
UC Undercut Bank

Combination of cover types (at least two)
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bubble curtain w/ LWD/boulders
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extensive submersed veg fish cover

limited submersed veg fish cover
bubble curtain

Substrate

F fines, D<0.0625 mm
S sand, 0.0625mm<D<2mm
G gravel, 2mm<D<64mm
SC small cobble, 64mm<D<128mm
LC large cobble, 128mm<D<256mm
B boulders, 256 mm<D
W bedrock

PAGE 2 of

FISHERY HABITAT INVENTORY DATA

inter-fluve, inc.

STREAM **Dry Creek**

OBSERVOR(S) **RJ & NN** DATE 8/27/2009

Stream Discharge

SAMP #	UNIT			DIMENSIONS						WOOD						SHELTER				SUBSTRATE		Nth UNIT MEASURES								
				STA	Length	Avg Wet	Pool	Avg D	Edge	DEAD			ALIVE			%	1	2	Complex.	1	2	Wet Width (M)			Riffle BF	Riffle BF Avg Depth			Riffle	Peb Ct
	Rch.	No.	Type	bgn		Width (O)	Max D	/PTC	Present	S	M	L	S	M	L	Cover			Code			1	2	3	Width	1	2	3	FPW	(Y/N)
67	12	1	P	D67	187	43	4	1.5					1			20	TV	SDW	3	G	SC									
68	12	2	F	D68	205	28		1.8		9	2		2			35	TV	SDW	3	G	SC	29	27	27						
69	12	3	SC/P	D69	120	32	3.2	0.8	*	8	2	1	1	3		15	SWD	AV	3	G	S									
70	12	4	SC/R	D70	140	15		1.1		5			3			5	SWD	RM	3	G	SC									
71	12	5	P	D71	129	43	3.5	1.2	*	2			1			5	TV	SDW	2	G	SC									
72	12	6	R	D72	130	44		1		3			1			5	SWD	RM	3	G	SC	46	38	40	48	1.7	2.3	2.2	56	Y
73	12	7	P	D73	183	50	4.5	1.9	*				2			5	TV	SDW	2	G	S									
74	12	8	F	D74	237	45		2		2						20	TV	SDW	3	G	SC									
75	12	9	P	D75	710	57	7.2	1.1	*	9	5		9	2		50	TV	SDW	3	G	S	70	68	65						
76	12	10	R	D76	80	56		0.8		2	2	1	2			15	SWD	TV	3	G	SC									
77	12	11	SP	D77	260	60	5.8	1.6			4		7	2		25	TV	SDW	3	G	SC									
78	11	1	F	D78	670	46		1.3		8	4	2	3			20	TV	SDW	3	G	SC	47	49	65						
79	11	2	A	D79	100	25	2.3		*	2						10	TV	SDW	2	G	F									
80	11	3	R	D80	216	63		0.6		2	4	2	3	1		10	SWD	TV	3	G	SC	65	67	77	68	2.3	2	3.2	74	Y
81	11	4	F	D81	637	55	5.8	1.5		17	4	2	5	1	1	15	TV	SDW	3	G	G									
82	11	5	R	D82	60	45		1								10				G	SC									
83	11	6	SC/R	D83	100	25		1		1			1			5	TV	RM	3	G	SC									
84	11	7	SP	D84	80	40	3.1	1	*	5	2					20	SWD	TV	3	G	S									
85	11	8	R	D85	335	55		1.1		2	1		1	1		10	TV	SDW	3	SC	G									

P - Main Channel Pool
SP - Scour Pool
A - Alcove/Backwater/SideChannel Pool
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LWD Size Classes
S >6" but <12"
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CDFD Shelter Types
RM
SWD Root Mass
LWD <12" Woody Debris
TV >12" Woody Debris
AV Terrestrial Vegetation
BC Aquatic Vegetation
BO Bubble Curtain
BD Boulders
UC Bedrock Ledge
Undercut Bank

0 No Shelter

1 1 to 5 boulders
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F fines, D<0.0625 mm
S sand, 0.0625mm<D<2mm
G gravel, 2mm<D<64mm
SC gravel, 2mm<D<64mm
LC large cobble, 128mm<D<256mm
B boulders, 256 mm<D
W bedrock

PAGE 1 of

FISHERY HABITAT INVENTORY DATA

inter-fluve, inc.

STREAM **Dry Creek**

OBSERVOR(S) **RJ & NN** DATE 8/28/2009

Stream Discharge

SAMP #	UNIT			DIMENSIONS						WOOD						SHELTER				SUBSTRATE		Nth UNIT MEASURES								
										DEAD			ALIVE									Wet Width (M)				Riffle BF Avg Depth				
	Rch.	No.	Type	STA bgn	Length	Avg Wet Width (O)	Pool Max D	Avg D /PTC	Edge Present	S	M	L	S	M	L	% Cover	1	2	Complex. Code	1	2	1	2	3	Riffle BF Width	1	2	3	Riffle FPW	Peb Ct (Y/N)
86	11	1	P	D86	226	43	5.2	1.7		12	7	2	3	2		35	SWD	TV	3	G	SC	35	35	35						
87	11	2	F	D87	95	38		1.7		2			2			20	SWD	TV	3	G	SC									
88	11	3	R	D88	50	40	4.2	1		1		1		1		8	SWD	TV	3	G	SC	41	41	42	45	2.4	2.6	3	82	Y
89	11	4	F	D89	269	45	2.5	1		20	5	1	8	4		25	SWD	LWD	3	G	S									
90	11	5	F	D90	202	40		2.3		3	3	1				20	TV	SWD	3	G	SC									
91	11	6	R	D91	141	43		1.5		2			1			10	TV	SWD	3	G	SC									
92	11	7	F	D92	175	47		2.6		4	2		2	1		30	TV	RM	3	G	SC	45	45	50						
93	11	1	P	D93	246	48	7	2		6			6	9		40	SWD	TV	3	S	G	43	44	43						
94	11	2	F	D94	367	50		2		9			1			5	TV	SWD	3	G	SC									
95	10	3	R	D95	86	48		1.3		6	1		1			15	SWD	TV	3	G	SC									
96	10	4	P	D96	467	45	3.4	1.1	*	9	2		6	2	1	25	TV	SWD	3	G	S									
97	10	5	F	D97	390	50		2.1		12	1		3			15	TV	SWD	3	G	S									
98	10	6	P	D98	317	52	8.4	1.4	*	15	3	1	4	2		30	TV	SWD	3	S	G									
99	10	7	R	D99	108	70		0.7		15	4		2	1		25	SWD	TV	3	LC	SC	71	60	69	78	2	2.5	2.8	87	Y
100	10	8	SP	D100	531	55	7	1.4		38	12	5	3	1		30	SWD	LWD	3	G	SC	48	54	52						
101	10	9	SC/R	D101	70	7		0.3								50	TV		2	G	SC									
102	10	10	R	D102	160	32		1.4		2	2		1		1	20	TV	SWD	3	SC	G									
103	10	11	A	D103	35	15	2.3		*	1	2					90	AV	TV	3	SC	S									
104	10	12	A	D104	35	20	3.2		*	1						98	AV	RM	3	F	G									
105	10	13	F	D105	98	40				5	2		3	3		30	TV	SWD	3	G	SC									
106	10	14	SP	D106	226	44	6.5	1.6		9	5		1			35	SWD	TV	3	G	S									
107	10	15	A	D107	350	15	2.3		*	10	8		3	1		70	AV	TV	3	G	S									
108	10	16	F	D108	667	40		1.6		19	3	1	2			20	SWD	TV	3	G	SC	42	45	41						

Habitat Unit Types

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SC/Type - Side Channel with Unit Type
R - Riffle
F - Flatwater (Glide/Run)
C - Cascade

LWD Size Classes

S >6" but <12"
M >12" by <20"
L >20"

CDFD Shelter Types

RM
SWD Root Mass
LWD <12" Woody Debris
TV >12" Woody Debris
AV Terrestrial Vegetation
BC Aquatic Vegetation
BO Bubble Curtain
BD Boulders
UC Bedrock Ledge
Undercut Bank

Instream Shelter Complexity

0 No Shelter

1 1 to 5 boulders
bare undercut bank / bedrock ledge
single piece large wood (LWD

2 1 to 2 pieces LWD associated with SWD
> 6 boulders / 50 feet
stable 12" undercut bank w/ rootmass
single RW lacking complexity
branches in/near water
limited submersed veg fish cover
bubble curtain

3 Combination of cover types (at least two)
LWD/boulders/rootwads
3 or more LWD w? SWD
3 or more boulders w/ LWD/SWD
bubble curtain w/ LWD/boulders
stable > 12" undercut bank w/ rootmass/LWD
extensive submersed veg fish cover

Substrate

F fines, D<0.0625 mm
S gravel, 2mm<D<64mm
G gravel, 2mm<D<64mm
SC small cobble, 64mm<D<128mm
LC large cobble, 128mm<D<256mm
B boulders, 256 mm<D
W bedrock

PAGE 2 of

FISHERY HABITAT INVENTORY DATA

STREAM **Dry Creek**

OBSERVOR(S) **RJ & NN** DATE 8/28/2009

Stream Discharge

SAMP #	UNIT			DIMENSIONS						WOOD						SHELTER				SUBSTRATE		Nth UNIT MEASURES								
				STA	Length	Avg Wet	Pool	Avg D	Edge	DEAD			ALIVE			%	1	2	Complex.	1	2	Wet Width (M)			Riffle BF	Riffle BF Avg Depth			Riffle	Peb Ct
	Rch.	No.	Type	bgn		Width (O)	Max D	/PTC	Present	S	M	L	S	M	L	Cover			Code			1	2	3	Width	1	2	3	FPW	(Y/N)
109	9	1	SP	D109	469	40	3.4	0.9	*	17	5		2			30	SWD	BO	3	G	S	52	55	45						Y
110	9	2	R	D110	104	56		1.1		1			2			10	TV	SWD	3	G	SC	50	51	49	57	2.3	2.6	3.4	95	
111	9	3	F	D111	191	50	2.6	1.3		3	1	1	1		1	15	TV	SWD	3	S	G									
112	9	4	R	D112	168	53		1.1	*	7	3	1	2			25	SWD	TV	3	G	SC									
113	9	5	F	D113	200	54	2.6	1.6		18	1	1				20	SWD	TV	3	S	G									
114	9	6	F	D114	330	49		1.5		7	1		1	1		20	TV	SWD	3	G	SC									
115	9	7	R	D115	**224**	45		1			1					7	TV	RM	3	SC	G									
116	9	8	SP	D116	984	45	4.2	1.5		25	1	1	2	1	1	25	TV	SWD	3	S	G	49	51	59						
117	9	9	A	D117	53	12	1.5			1						90	AV	SWD	3	F	S									
118	9	10	R	D118	60	55		0.7		1			1			20	TV	SWD	3	SC	G									
119	9	11	F	D119	504	63		1.5	*	4			2			8	TV	RM	3	G	S									
120	9	12	R	D120	65	57		0.7		4			1			30	TV	SWD	3	SC	G									
121	9	13	F	D121	323	46		1.5	*	5	1		1			15	TV	SWD	3	S	G									
122	9	14	SP	D122	595	51	5	1.3		8	4	2	8	2	1	30	TV	SWD	3	S	G									
123	8	1	R	D123	50	40		1		3						10	SWD	RM	3	G	SC	42	41	41	64	3.8	2.4	1.4	77	Y
124	8	2	P	D124	200	45	4	1.5	*	7						8	TV	SWD	3	G	S	51	50	52						
125	8	3	R	D125	149	33		1.2	*							25	TV		2	G	SC									
126	8	4	P	D126	547	40	7	1.2		16	2	1	5	1	1	50	BO	TV	3	S	G									
127	8	5	F	D127	121	38		1.5		3						20	TV	SWD	3	G	SC									
128	8	6	P	D128	220	40	3.5	1.5		1				2		15	TV	SWD	3	G	S									
129	8	7	F	D129	160	41		1.5								3	TV	TV	1	G	S									
130	8	8	F	D130	67	44	3	1.4	*	6			1			20	SWD	TV	3	G	S									
131	8	9	F	D131	295	47		1.2		3		1	2			20	TV	SWD	3	G	SC	58	57	55						
132	8	10	F	D132	105	55	2.2	1.2	*	2	1					15	TV	SWD	3	G	S									
133	8	11	R	D133	72	45		1.1		6			1			20	TV	SWD	3	G	SC									
134	8	12	F	D134	95	48	2.1	1.5		3						25	TV	SWD	3	G	SC									
135	8	13	R	D135	85	38		0.8	*							50	TV		3	G	SC									
136	8	14	SP	D136	612	45	5	1.1		19	3	1	7	2	1	17	SWD	TV	3	G	S									

Habitat Unit Types

P - Main Channel Pool
SP - Scour Pool
A - Alcove/Backwater/SideChannel Pool
SC/Type - Side Channel with Unit Type
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F - Flatwater (Glide/Run)
C - Cascade

LWD Size Classes

S >6" but <12"
M >12" by <20"
L >20"

CDFD Shelter Types

RM Root Mass
SWD <12" Woody Debris
LWD >12" Woody Debris
TV Terrestrial Vegetation
AV Aquatic Vegetation
BC Bubble Curtain
BO Boulders
BD Bedrock Ledge
UC Undercut Bank

Instream Shelter Complexity

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Substrate

F fines, D<0.0625 mm
S gravel, 2mm<D<64mm
G gravel, 2mm<D<64mm
SC small cobble, 64mm<D<128mm
LC large cobble, 128mm<D<256mm
B boulders, 256 mm<D
W bedrock

PAGE _____ of _____

FISHERY HABITAT INVENTORY DATA

inter-fluve, inc.

STREAM **Dry Creek**

OBSERVOR(S) **RJ, NN, JM** DATE 8/28/09 & 8/29/09

Stream Discharge _____

SAMP #	UNIT			DIMENSIONS						WOOD						SHELTER				SUBSTRATE		Nth UNIT MEASURES								
				STA	Length	Avg Wet	Pool	Avg D	Edge	DEAD			ALIVE			%	1	2	Complex.	1	2	Wet Width (M)			Riffle BF	Riffle BF Avg Depth			Riffle	Peb Ct
	Rch.	No.	Type	bgn		Width (O)	Max D	/PTC	Present	S	M	L	S	M	L	Cover			Code			1	2	3	Width	1	2	3	FPW	(Y/N)
137	8	15	F	D137	223	55		1.4	*	5	1					10	SWD	RM	3	G	SC									
138	8	16	R	D138	298	50		0.8		5						8	TV	RM	3	G	SC									
139	8	17	F	D139	424	48	2.7	1.3		12	3		3	1		28	TV	SWD	3	G	SC	58	50	53						
140	8	18	F	D140	77	49		1.3		4		1				25	TV	SWD	3	G	SC									
141	8	19	P	D141	616	45	4.2	1.4	*	9	3	1	6	3		18	TV	SWD	3	G	SC									
142	8	20	R	D142	53	49		1.1		4			1			20	SWD	TV	3	G	SC	49	48	49	53	3	2.2	1.8	64	N
143	8	21	P	D143	678	50	5.5	1.5	*	18	2	1	7	4		23	SWD	TV	3	S	G	57	48	48						
144	8	22	R	D144	60	45		0.9	*	1			1			8	TV	SWD	2	G	SC									
145	8	23	P	D145	470	53	3.6	1.4	*	7	1		6	1		18	SWD	BO	3	G	B									
146	8	24	F	D146	52	35		1.6			1					5	TV	RM	1	G	SC									
147	8	25	SP	D147	277	58	3.8	1.3	*	8	3			1		15	TV	SWD	3	G	S									
148	8	26	F	D148	253	58		1.2	*	3						12	TV	SWD	2	G	SC									
149	8	27	R	D149	100	35		1.1								5	TV	RM	1	G	SC									
150	8	28	SP	D150	323	48	6.8	1.3		15	3		1	2		20	SWD	RM	3	G	S	37	44	42						
151	8	29	F	D151	196	50		1.6		2						18	TV	SWD	2	G	S									
152	8	30	SP	D152	425	48	4	1.3	*	15	4		1	1		15	SWD	TV	3	G	SC									
153	8	31	A	D153	110	15	2		*	7	2		3	2		30	SWD	TV	3	G	G									
154	8	32	F	D154	389	45		1.6	*	4	6					8	TV	SWD	2	G	SC									
155	7	33	SP	D155	80	48	4.5	1.4	*	6	2		1			40	SWD	RM	3	G	S									
156	7	34	F	D156	202	58		1.9	*	5	1		2			20	SWD	BO	3	G	SC	44	64	49						
157	7	35	P	D157	313	45	5	1.6	*	6		1	1	1		40	BD	SWD	3	G	W									
158	7	36	F	D158	148	45		1.1	*	3						15	BO	SWD	3	G	S									
159	7	37	A	D159	320	15	2.1		*	4	1		4			35	TV	SWD	3	S	F									
160	7	38	R	D160	108	40		1		3					1	5	RM	TV	2	G	SC									
161	7	39	F	D161	107	40	2.7	1.1			1					3	RM	SWD	2	G	SC									

P - Main Channel Pool
SP - Scour Pool
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SC/Type - Side Channel with Unit Type
R - Riffle
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LWD Size Classes
S >6" but <12"
M >12" by <20"
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CDFD Shelter Types
RM Root Mass
SWD <12" Woody Debris
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BC Bubble Curtain
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F fines, D<0.0625 mm
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LC large cobble, 128mm<D<256mm
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W bedrock

PAGE _____ of _____

FISHERY HABITAT INVENTORY DATA

inter-fluve, inc.

STREAM **Dry Creek**

OBSERVOR(S) **RJ, NN, JM** DATE 8/29/2009

Stream Discharge _____

SAMP #	UNIT			DIMENSIONS						WOOD						SHELTER				SUBSTRATE		Nth UNIT MEASURES								
				STA	Length	Avg Wet	Pool	Avg D	Edge	DEAD			ALIVE			%	1	2	Complex.	1	2	Wet Width (M)			Riffle BF	Riffle BF Avg Depth			Riffle	Peb Ct
	Rch.	No.	Type	bgn		Width (O)	Max D	/PTC	Present	S	M	L	S	M	L	Cover			Code			1	2	3	Width	1	2	3	FPW	(Y/N)
162	7	1	F	D162	50	30		1.2								2	RW	TV	1	G	SC	30	42	38						
163	7	2	SP	D163	721	33	4	1.3		12			5	4		25	TV	SWD	3	S	G									
164	7	3	A	D164	30	12	2.5		*	2						5	RM	TV	2	G	S									
165	7	4	A	D165	400	5	1		*							10	TV		1	G	S									
166	7	5	F	D166	222	55		1		4			3			10	TV	SWD	3	G	S	59	63	54						
167	7	6	R	D167	145	63		1.1	*	8	3		4			15	SWD	TV	3	G	SC	66	59	57	77	1.9	2.8	2.5	82	Y
168	7	7	F	D168	171	54		1.3					1			15	TV	RM	3	G	S									
169	7	8	R	D169	50	57		0.8			1					8	TV	RM	2	G	SC									
170	7	9	SP	D170	283	40	3.8	0.8	*	5	1	3	1	3		12	TV	SWD	3	G	S									
171	7	1	R	D171	55	48		1.1	*	2	1					23	TV	SWD	3	G	SC	52	52	50	62	3.8	2.7	3.7	84	Y
172	7	2	SP	D172	116	49	3.8	1.3		2	2		1	1		20	TV	SWD	3	G	S									
173	7	3	F	D173	64	42		1.4	*	3	2		1	1		15	TV	SWD	3	G	S									
174	7	4	P	D174	1654	60	4.3	1.3	*	28	7	1	24	8		20	TV	SWD	3	G	S	61	60	63						
175	7	5	P	D175	80	50	3.9	1.3	*	1						90	BD	BO	3	G	S									

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PAGE _____ of _____

FISHERY HABITAT INVENTORY DATA

inter-fluve, inc.

STREAM **Dry Creek**

OBSERVOR(S) **NN & JM** DATE 8/29/09 & 8/30/09

Stream Discharge _____

SAMP #	UNIT			DIMENSIONS						WOOD						SHELTER				SUBSTRATE		Nth UNIT MEASURES								
										DEAD			ALIVE									Wet Width (M)			Riffle BF	Riffle BF Avg Depth			Riffle	Peb Ct
	Rch.	No.	Type	STA bgn	Length	Avg Wet Width (O)	Pool Max D	Avg D /PTC	Edge Present	S	M	L	S	M	L	% Cover	1	2	Complex. Code	1	2	1	2	3	Width	1	2	3	FPW	(Y/N)
176	7	1	C	D176	75	55		1.1	*							95	BD	BO	3	W	B									
177	7	2	F	D177	100	55	2.9	1.5		1			1			15	RM	SWD	2	G	SC									
178	7	3	R	D178	60	45		1								90	BD	BO	3	W	B									
179	7	4	P	D179	99	50	6	1.5					1			50	BO	BD	2	B	S	54	55	53						
180	7	5	F	D180	100	40		1.6								5	RM		1	G	SC									
181	7	6	SC/F	D181	75	10		0.9	*	2	1					50	BD	SWD	2	W	S									
182	7	7	SP	D182	330	55	4.5	1.4		8			7			15	TV	SWD	3	G	SC									
183	7	8	A	D183	40	20	3.4	0.9		2						70	TV	SWD	2	G	SC									
184	7	9	SC/F	D184	550	23		0.8		10	2		3			30	TV	SWD	2	G	SC									
187	7	12	A	D187	40	18	2.7	0.7	*				1			40	TV	BO	2	G	SC									
188	7	13	SC/R	D188	30	35		0.6								40	TV		2	G	S									
189	7	14	F	D189	60	40		2		1			1			60	BD	TV	3	W	G									
190	7	15	F	D190	110	50	2.7	1.6	*	1			1			30	BD	TV	3	G	W	51	44	48						
191	7	16	R	D191	216	30		0.9		2						5	TV	SWD	1	G	SC	28	35	39	32	2.1	2.4	2.3	84	Y
192	7	17	A	D192	50	12	0.4		*	2						30	TV	SWD	2	G	SC									
193	7	1	P	D193	361	55	5.9	2		12	3		3	2		25	TV	SWD	3	G	SC	53	46	58						
194	7	2	A	D194	60	8	0.9		*	2		1				80	TV	SWD	3	F	G									
195	7	3	F	D195	152	48		1.5		1	1					12	TV	SWD	2	G	SC									
196	7	4	R	D196	60	45		1		1					1	5	TV	LWD	2	G	SC	53	53	49	63	2	1.7	2.3	74	Y
197	7	5	P	D197	580	55	7.4	1.2		10	4		9	3		22	TV	SWD	3	G	S									
198	7	6	A	D198	60	15	2.7			6			1	1		40	TV	SWD	3	G	S									
199	6	7	R	D199	100	50		0.8		6	1					20	TV	SWD	3	G	SC									Y
200	6	8	F	D200	100	52		2	*	1						30	TV	SWD	2	G	SC									
201	6	9	P	D201	194	50	8	1.4		9			4		1	45	TV	SWD	3	G	S									
202	6	10	F	D202	80	35		2.2	*	1						5	TV	RM	2	G	SC									
203	6	11	P	D203	373	55	5.8	1.8		13	2		3	2	3	45	TV	SWD	3	S	G	51	55	58						

Habitat Unit Types

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S >6" but <12"
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RM Root Mass
SWD <12" Woody Debris
LWD >12" Woody Debris
TV Terrestrial Vegetation
AV Aquatic Vegetation
BC Bubble Curtain
BO Boulders
BD Bedrock Ledge
UC Undercut Bank

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3 or more LWD w? SWD
3 or more boulders w/ LWD/SWD
bubble curtain w/ LWD/boulders
stable > 12" undercut bank w/ rootmass/LWD
extensive submersed veg fish cover

Substrate

F fines, D<0.0625 mm
S sand, 0.0625mm<D<2mm
G gravel, 2mm<D<64mm
SC small cobble, 64mm<D<128mm
LC large cobble, 128mm<D<256mm
B boulders, 256 mm<D
W bedrock

PAGE _____ of _____

FISHERY HABITAT INVENTORY DATA

inter-fluve, inc.

STREAM **Dry Creek**

OBSERVOR(S) **NN & JM** DATE 8/30/2009

Stream Discharge _____

SAMP #	UNIT			DIMENSIONS						WOOD						SHELTER				SUBSTRATE		Nth UNIT MEASURES								
				STA	Length	Avg Wet	Pool	Avg D	Edge	DEAD			ALIVE			%	1	2	Complex.	1	2	Wet Width (M)			Riffle BF	Riffle BF Avg Depth			Riffle	Peb Ct
	Rch.	No.	Type	bgn		Width (O)	Max D	/PTC	Present	S	M	L	S	M	L	Cover			Code			1	2	3	Width	1	2	3	FPW	(Y/N)
204	6	14	F	D204	100	50		1.4		16	2	2	2	3	3	12	LWD	TV	3	G	SC									
205	6	15	P	D205	810	50	3.3	1.2	*	5		1	5	2	1	18	TV	SWD	3	G	S									
206	6	16	F	D206	100	55		1		7	3			2		10	TV	SWD	3	G	SC									
207	6	17	P	D207	541	52	3.8	1.5	*	9	3	1	4	2	1	30	LWD	TV	3	G	S									
208	6	18	R	D208	60	48		0.9								2	TV		1	G	SC									
209	6	19	P	D209	372	50	5.6	1.2		2						30	TV	SWD	2	G	SC	42	42	50						
210	6	20	R	D210	228	45		1.1		1		1				30	TV	SWD	2	G	SC									
211	6	21	F	D211	167	45		1.5	*	4			5			30	TV	SWD	3	G	SC									
212	6	22	P	D212	198	48	6.7	1.9		1			3	1		40	TV	SWD	3	S	G									
213	6	23	R	D213	120	45		0.7							1	10	TV	RM	2	G	SC									
214	6	24	F	D214	270	48	2.9	1.6					3			18	TV	RM	3	G	SC									
215	6	25	F	D215	343	48		1.5		2	3		4	3		15	TV	SWD	3	G	S									
216	5	1	F	D216	753	50	3.2	1.6	*	18	2	3	10	3	2	35	TV	SWD	3	G	S	51	56	60						
217	5	2	F	D217	275	55		1.6			1		2			30	TV	SWD	3	G	SC									
218	5	3	F	D218	269	50	2.6	1.6		2	1		4			30	TV	SWD	2	G	S									
219	5	4	R	D219	90	52		1		1						12	TV	SWD	3	G	SC	64	63	57	73	1.8	1.9	2	88	Y
220	5	5	P	D220	247	55	6.2	1.5	*	10	2	2	3		1	20	TV	SWD	3	G	S									
221	5	6	F	D221	526	52		1.6	*	15	5		2	2		18	TV	SWD	3	G	SC									
222	5	7	F	D222	148	55	3	1.7		4			1	1		30	SWD	TV	3	G	S									
223	5	8	F	D223	223	55		1.4		17	2	1	2			25	SWD	RM	3	G	S									
224	5	9	R	D224	50	35		1		2						15	TV	SWD	2	G	SC									
225	5	10	F	D225	80	35	3	1.6		4	1		1			20	SWD	TV	3	G	SC	35	33	33						
226	5	11	F	D226	50	35		1.6		1	1					5	SWD	TV	1	G	SC									
227	5	12	P	D227	195	40	4	1.4		3	1		2			10	TV	SWD	2	G	S									

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inter-fluve, inc.

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OBSERVOR(S) **NN & JM** DATE 8/30/2009 & 8/31/

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	Rch.	No.	Type	bgn		Width (O)	Max D	/PTC	Present	S	M	L	S	M	L	Cover			Code			1	2	3	Width	1	2	3	FPW	(Y/N)
228	5	1	R	D228	45	40		1.2		2			1	1		40	SWD	TV	3											Y
229	5	2	SC/R	D229	60	12		0.5	*	1			2			20	TV	SWD	2	G	SC									
230	5	3	F	D230	209	47	3.5	1.6	*	3			6			40	TV	SWD	3	G	S	52	46	46						
231	5	4	F	D231	88	48		1.5		2	1	1				35	TV	SWD	3	G	S									
232	5	5	F	D232	161	50	2.3	1.5		3				1		40	TV	SWD	2	G	S									
233	5	6	F	D233	292	53		1.5		6	1	2				25	TV	SWD	3	G	SC									
234	5	7	P	D234	255	45	4	1.7	*	2	1		4			20	TV	SWD	3	G	S									
235	5	8	R	D235	60	38		1			1					5	TV	SWD	1	G	SC	37	48	33	65	1.3	1.3	2.4	85	
236	5	9	P	D236	260	40	5.4	1.6		13	1	1	4	2	1	40	SWD	TV	3	G	S									
237	5	10	A	D237	45	5	0.5		*	1	1		2			70	AV	SWD	3	F										
238	5	11	F	D238	203	35		1.7		1						15	TV	SWD	2	G	SC	37	42	33						
239	5	12	P	D239	241	52	3.8	1.5		7	1	1	3			20	TV	SWD	3	G	S									
240	5	13	F	D240	48	50		1.1	*							20	TV		2	G	SC									
241	5	14	F	D241	331	55	2.7	1.8		13	3	1	1	2		35	TV	SWD	3	G	S									
242	5	15	F	D242	167	55		1.5	*	1	1		1			30	TV	SWD	2	G	S									
243	5	16	P	D243	148	58	5.5	1.4					7			20	TV	SWD	3	G	S	56	57	57						
244	5	17	A	D244	60	10	1.5		*							40	TV			G	F									
245	5	18	F	D245	233	65		1.5	*	4			3			25	TV	SWD	3	G	S									
246	5	19	R	D246	114	48		0.9		1				1		10	TV	RM	2	G	SC									
247	5	20	P	D247	183	50	5	1.6	*	3			2	1		20	TV	SWD	2	G	S									
248	5	21	F	D248	135	48		0.9		4			1			15	TV	SWD	3	G	S									
249	5	22	P	D249	444	55	5.2	1.1	*	15	3	2	6	3	2	25	TV	SWD	3	G	S									
250	4	1	P	D250	1618	60	6.2	1.6	*	39	18	1	11	11	2	25	TV	SWD	3	G	S	58	64	67						
251	4	2	A	D251	45	5		1.2	*	2			1			50	TV	RM	3	F	G									
252	4	3	A	D252	500	35	3		*	10	3	2		3		25	SWD	AV	3	F	S									
253	4	4	C	D253	30	120		0.9								50	BO	TV	2	B	SC									
254	4	5	A	D254	30	18	2		*							3	RM	TV	1	G	S									
255	4	6	A	D255	60	20	2.1		*	1						3	RM	SWD	1	G	S									

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FISHERY HABITAT INVENTORY DATA

inter-fluve, inc.

STREAM **Dry Creek**

OBSERVOR(S) **NN & JM** DATE 8/31/2009

Stream Discharge _____

SAMP #	UNIT			DIMENSIONS						WOOD						SHELTER				SUBSTRATE		Nth UNIT MEASURES								
				STA	Length	Avg Wet	Pool	Avg D	Edge	DEAD			ALIVE			%	1	2	Complex.	1	2	Wet Width (M)			Riffle BF	Riffle BF Avg Depth			Riffle	Peb Ct
	Rch.	No.	Type	bgn		Width (O)	Max D	/PTC	Present	S	M	L	S	M	L	Cover			Code			1	2	3	Width	1	2	3	FPW	(Y/N)
256	4	7	R	D256	80	30		1.5		2				1		3	SWD	RM	2	G	SC									Y
257	4	8	SC/R	D257	40	12		0.5	*	4			1			15	SWD	RM	2	G	SC									
258	4	9	SC/F	D258	60	12		0.7	*	1				1		5	RM	SWD	1	G	S									
259	4	10	P	D259	805	65	5.5	1.7		13	3	2	4	3		30	TV	SWD	3	S	G									
260	4	11	F	D260	378	60		1.1	*	2			4			10	TV	AV	2	S	G									
261	4	12	P	D261	239	58	5.2	1.7	*	12	2		2	2		35	TV	SWD	3	G	S									
262	4	13	F	D262	172	30		1.4		1			1	1		5	RM	SWD	1	G	SC									
263	4	14	A	D263	100	30	2.8			2			1			30	AV	TV	3	F	S									
264	4	15	A	D264	50	25	1.5									70	AV	TV	2	F	S									
265	4	16	SC/F	D265	250	30		1.5		5	2	2	2	3		15	TV	SWD	3	G	SC									
266	4	17	R	D266	50	30		1.2		1	1	1	1	1		10	SWD	TV	2	G	SC									
267	4	18	F	D267	80	40		1.7	*	2						8	TV	SWD	2	G	S									
268	4	19	F	D268	249	58	2.5	1.1	*	4			2		1	25	TV	SWD	3	G	S	44	65	64						
269	4	20	A	D269	40	6	0.5		*	2						90	AV	TV	3	F	G									
270	4	21	F	D270	417	60		1.2	*	3	1		1	2		30	TV	SWD	3	G	S									
271	4	22	P	D271	588	53	4.8	1.7	*	4			7	1	1	40	TV	SWD	3	G	S									
272	4	23	A	D272	50	8	0.8		*				4			70	TV	SWD	3	G	S									
273	4	24	F	D273	40	60		0.9	*						1	10	RM	TV	2	G	S									
274	4	25	R	D274	70	40		1		2			1			8	RM	SWD	2	G	S	45	42	49	52	3.1	2.6	2.5	112	
275	4	26	F	D275	60	43		1.3								5	RM	TV	1	G	S									
276	4	27	F	D276	188	52	2.9	1.4	*	1			4			12	TV	SWD	3	G	S									
277	4	28	F	D277	337	55		1.4	*	3			3	1		18	TV	SWD	3	G	S	68	53	40						
278	4	29	R	D278	144	43		1		1	1		3			25	TV	SWD	3	G	SC									
279	4	30	F	D279	101	40		1.3		1			2	1	1	40	TV	SWD	3	G	S									
280	4	31	P	D280	238	40	4.6	1.5		3	1	1	1	3		60	TV	SWD	3	G	S									

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FISHERY HABITAT INVENTORY DATA

inter-fluve, inc.

STREAM **Dry Creek**

OBSERVOR(S) **JM & NN** DATE 8/31/2009

Stream Discharge _____

SAMP #	UNIT			DIMENSIONS						WOOD						SHELTER				SUBSTRATE		Nth UNIT MEASURES								
										DEAD			ALIVE									Wet Width (M)			Riffle BF	Riffle BF Avg Depth			Riffle	Peb Ct
	Rch.	No.	Type	STA bgn	Length	Avg Wet Width (O)	Pool Max D	Avg D /PTC	Edge Present	S	M	L	S	M	L	% Cover	1	2	Complex. Code	1	2	1	2	3	Width	1	2	3	FPW	(Y/N)
281	3	1	F	D281	1244	40		1.6	*	4	1	1	7	3		40	TV	SWD	3	G	S	47	37	39						
282	3	2	F	D282	133	40	3.3	1.4					2	1		30	TV	SWD	3	G	S									
283	3	3	F	D283	91	38		1.4	*	2			3			28	TV	SWD	3	G	S									
284	3	4	P	D284	554	50	4	1.5		2	1		6	2	1	40	TV	SWD	3	G	S									
285	3	5	SC/P	D285	70	15	0.8		*				2	1		70	TV	SWD	3	F	S									
286	3	6	F	D286	434	53		1.4	*	3	1		8	3	4	35	TV	SWD	3	G	S									
287	3	7	SC/P	D287	100	25	2.9		*	1	1		1	2	1	80	AV	TV	3	F	S									
288	3	8	SC/P	D288	80		1.9				1		2			25	TV	SWD	3	S	G									
289	3	9	R	D289	80	55		0.9	*	2						10	TV	RM	2	G	SC	79	56	44	86	2.2	2	1.6	95	Y
290	3	10	F	D290	132	48	3.3	1.5		1			1	1	1	10	TV	LWD	3	G	S									
291	3	11	F	D291	128	50		1	*	4			1	1		40	TV	SWD	3	G	S	56	42	39						
292	3	12	F	D292	384	48	2.6	1.5		1						50	TV	SWD	3	G	S									
293	3	13	F	D293	81	55		1.2	*				1			35	TV	AV	3	G	S									
294	3	14	P	D294	625	45	6.1	1		7	1		5		1	15	TV	SWD	2	G	S									
295	3	1	P	D295	185	60	3.7	1.4		6	2	1	5			25	SWD	TV	3	G	S									
296	3	2	SC/P	D296	150	10	0.8		*			2		1	1	70	TV	SWD	3	S	F									
297	3	3	SC/P	D297	1073	35	2.5		*	3	2	1	2	3	4	90	AV	LWD	3	F	S									
298	3	4	A	D298	100	12	0.8		*	3	1		1			80	AV	TV	3	F	S									
299	3	5	SC/F	D299	165	18		0.8	*	6	3		2	1	1	45	SWD	TV	3	G	S									
300	3	6	F	D300	418	50		1.1	*	29	5	1	8	6	2	30	SWD	LWD	3	G	S									
301	3	7	SC/P	D301	250	22	3.6			6			3			25	SWD	TV	3	F	S									
302	3	8	A	D302	200	10	1.3		*	1						95	AV	TV	3	F	S									
303	3	9	R	D303	75	48		1.3			1					2	SWD		1	G	SC									
304	3	10	F	D304	412	58		1.7	*	8	1	1		4		15	TV	SWD	3	G	S	68	68	67						
305	3	11	R	D305	110	48		1.1		2	1	1	1			8	RM	SWD	3	G	SC	45	48	44	78	1	1.6	1.9	125	Y
306	3	12	F	D306	240	38	3.1	1.7				1				12	TV	BO	3	G	S									
307	3	13	A	D307	40	8	0.3		*	3			4			70	TV	SWD	3	F	G									
																SWD														

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LWD/boulders/rootwads
3 or more LWD w? SWD
3 or more boulders w/ LWD/SWD
bubble curtain w/ LWD/boulders
stable > 12" undercut bank w/ rootmass/LWD
extensive submersed veg fish cover

F fines, D<0.0625 mm
S sand, 0.0625mm<D<2mm
G gravel, 2mm<D<64mm
SC gravel, 2mm<D<64mm
LC large cobble, 128mm<D<256mm
B boulders, 256 mm<D
W bedrock

PAGE _____ of _____

FISHERY HABITAT INVENTORY DATA

inter-fluve, inc.

STREAM **Dry Creek**

OBSERVOR(S) **JM & NN** DATE 9/1/2009 REACH 2: Small pools in glides & small glides in pools

Stream Discharge _____

SAMP #	UNIT			DIMENSIONS						WOOD						SHELTER				SUBSTRATE		Nth UNIT MEASURES								
				STA	Length	Avg Wet	Pool	Avg D	Edge	DEAD			ALIVE			%	1	2	Complex.	1	2	Wet Width (M)			Riffle BF	Riffle BF Avg Depth			Riffle	Peb Ct
	Rch.	No.	Type	bgn		Width (O)	Max D	/PTC	Present	S	M	L	S	M	L	Cover			Code			1	2	3	Width	1	2	3	FPW	(Y/N)
308	3	1	R	D308	70	35		1.2						1		7	TV	SWD	2	G	SC									
309	2	2	F	D309	138	53		1.4		1			1			13	TV	SWD	3	G	SC									
310	3	3	A	D310	1500	15	3.2		*	13	2	5	1			90	AV	TV	3	F	S									
311	3	4	SC/P	D311	110	6	0.9		*	1						95	TV	AV	3	S	F									
312	2	5	SP	D312	106	52	3.8	1.5	*	2	1		1			20	TV	SWD	3	G	S									
313	2	6	F	D313	514	45		1.8		4	3		7	2		30	TV	SWD	3	G	S	39	39	40						
314	2	7	P	D314	260	55	3.5	1.4					2	2		33	TV	SWD	3	G	S									
315	2	8	A	D315	60	12	2.6		*	1			2			20	TV	AV	3	F	S									
316	2	9	SC/P	D316	90	10	3.2			10	2		4	1	1	90	SWD	AV	3	G	S									
317	2	10	F	D317	163	48		1.6	*	1						8	TV	SWD	2	G	SC	52	45	41						
318	2	11	P	D318	230	48	3.9	1.4	*	2			5	1		35	TV	SWD	3	G	S									
319	2	12	F	D319	101	45		1.3						1		25	TV	SWD	2	G	S									
320	2	13	R	D320	70	42		1.2	*							8	TV		2	G	SC	43	46	44	72	0.8	2.1	1.8	190	Y
321	2	14	F	D321	50	45		1.7					2			15	TV	SWD	2	G	S									
322	2	15	A	D322	250	12	0.8		*	6	4			1		98	AV	SWD	3	F	S									
323	2	16	P	D323	297	28	3.6	1.5		2	1		1			45	TV	SWD	3	G	S									
324	2	17	A	D324	45	8	0.8		*	1						25	TV	SWD	2	F	G									
325	2	18	F	D325	924	40		1.7		15	6		10	9	1	45	SWD	TV	3	G	SC									
326	2	19	R	D326	90	45		0.8		2	1		2	1		25	SWD	TV	3	G	SC									
327	2	20	F	D327	290	45		1.6		1						12	TV	SWD	2	G	SC									
328	2	21	SP	D328	80	55	4.1	1.4								10	RM	TV	2	G	S									
329	2	22	F	D329	80	50		1.2		1			1			12	TV	SWD	2	G	S	58	55	56						
330	2	23	A	D330	50	12	3.5		*	1						70	TV	SWD	3	F	S									
331	2	24	R	D331	60	50		0.5		1			1		1	10	TV	SWD	3	G	S									
332	2	25	SC/P	D332	100	4		0.3	*							80	TV		2	G	SC									
333	2	26	F	D333	328	45		1.2		1			1		1	23	TV	SWD	3	G	SC									
334	2	27	R	D334	90	45		1		1			1	1		12	TV	SWD	3	G	SC									
335	2	28	F	D335	149	45		1.6					1			20	TV	SWD	2	G	SC									
336	2	29	F	D336	60	40	3.3	1.5	*		1					50	LWD	TV	3	G	S									
337	2	30	F	D337	82	45		0.9	*	2			2	2	1	15	TV	RM	3	G	S	45	51	51						
338	2	31	F	D338	127	35	2.4	1.3		4	1					40	TV	SWD	3	G	S									

P - Main Channel Pool
SP - Scour Pool
A - Alcove/Backwater/SideChannel Pool
SC/Type - Side Channel with Unit Type
R - Riffle
F - Flatwater (Glide/Run)
C - Cascade

LWD Size Classes
S >6" but <12"
M >12" by <20"
L >20"

CDFD Shelter Types
RM Root Mass
SWD <12" Woody Debris
LWD >12" Woody Debris
TV Terrestrial Vegetation
AV Aquatic Vegetation
BC Bubble Curtain
BO Boulders
BD Bedrock Ledge
UC Undercut Bank

0 No Shelter

1 1 to 5 boulders
bare undercut bank / bedrock led
single piece large wood (LWD

2 1 to 2 pieces LWD associated with SWD
> 6 boulders / 50 feet
stable 12" undercut bank w/ rootmass
single RW lacking complexity
branches in/near water
limited submersed veg fish cover
bubble curtain

Combination of cover types (at least two)
LWD/boulders/rootwads
3 or more LWD w? SWD

3 3 or more boulders w/ LWD/SWD
bubble curtain w/ LWD/boulders
stable > 12" undercut bank w/ rootmass/LWD
extensive submersed veg fish cover

F fines, D<0.0625 mm
S sand, 0.0625mm<D<2mm
G gravel, 2mm<D<64mm
SC gravel, 2mm<D<64mm
LC large cobble, 128mm<D<256mm
B boulders, 256 mm<D
W bedrock

PAGE _____ of _____

FISHERY HABITAT INVENTORY DATA

inter-fluve, inc.

STREAM **Dry Creek**

OBSERVOR(S) **JM & NN** DATE 9/1/2009

Stream Discharge _____

SAMP #	UNIT			DIMENSIONS						WOOD						SHELTER				SUBSTRATE		Nth UNIT MEASURES								
				STA	Length	Avg Wet	Pool	Avg D	Edge	DEAD			ALIVE			%	1	2	Complex.	1	2	Wet Width (M)			Riffle BF	Riffle BF Avg Depth			Riffle	Peb Ct
	Rch.	No.	Type	bgn		Width (O)	Max D	/PTC	Present	S	M	L	S	M	L	Cover			Code			1	2	3	Width	1	2	3	FPW	(Y/N)
339	2	32	F	D339	368	45		1		1			3	1	1	25	TV	SWD	3	G	SC									
340	2	33	P	D340	280	40	5.8	1.9	*	6	5	3		4		25	TV	LWD	3	G	S									
341	2	34	A	D341	90	12	1.7		*	2			1			85	AV	TV	3	F	G									
342	2	35	F	D342	260	45		1.3		2	2		1	3		35	TV	LWD	3	G	SC									
343	2	36	F	D343	187	45	3.2	1.6		2	3		2	2		35	TV	LWD	3	G	S	40	41	43						
344	2	37	F	D344	147	42		1.5					2			32	TV	SWD	3	G	S									
345	2	38	F	D345	100	45	2.3	1.8		1				1	1	25	TV	SWD	3	G	S									
346	2	39	F	D346	175	50		1.6		2	1	1	3			28	TV	SWD	3	G	S									
347	2	40	R	D347	70	50		1.1	*				1	1	1	30	TV	SWD	3	G	S	58	64	43	64	1.6	2	1.9	90	N
348	2	41	SC/F	D348	150	6		0.5	*	1			1			60	TV	SWD	3	G	S									
349	2	42	F	D349	60	38		1.3								30	TV	RM	2	G	S									
350	2	43	SP	D350	40	40	5.4	1.5					1	1		50	LWD	TV	2	G	S									
351	2	44	F	D351	433	50		1.4	*				5	3		40	TV	BO	3	G	S	56	58	50						
352	2	45	P	D352	70	45	5	1.2		3						15	SWD	TV	3	G	S									
353	2	46	A	D353	40	12	2.3		*							70	AV	TV	3	S	F									
354	2	47	F	D354	373	48		1.6		5	3		10		1	35	TV	SWD	3	G	S									
355	2	48	P	D355	94	52	4	1.7	*							20	BO	TV	3	G	S									
356	2	49	F	D356	50	50		1.8								20	TV	BO	2	G	S									

P - Main Channel Pool
SP - Scour Pool
A - Alcove/Backwater/SideChannel Pool
SC/Type - Side Channel with Unit Type
R - Riffle
F - Flatwater (Glide/Run)
C - Cascade

LWD Size Classes
S >6" but <12"
M >12" by <20"
L >20"

CDFD Shelter Types
RM Root Mass
SWD <12" Woody Debris
LWD >12" Woody Debris
TV Terrestrial Vegetation
AV Aquatic Vegetation
BC Bubble Curtain
BO Boulders
BD Bedrock Ledge
UC Undercut Bank

0 No Shelter

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bare undercut bank / bedrock ledge
single piece large wood (LWD

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single RW lacking complexity
branches in/near water
limited submersed veg fish cover
bubble curtain

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F fines, D<0.0625 mm
S sand, 0.0625mm<D<2mm
G gravel, 2mm<D<64mm
SC gravel, 2mm<D<64mm
LC large cobble, 128mm<D<256mm
B boulders, 256 mm<D
W bedrock

PAGE _____ of _____

FISHERY HABITAT INVENTORY DATA

inter-fluve, inc.

STREAM **Dry Creek**

OBSERVOR(S) **JM & NN** DATE 9/1/2009

Stream Discharge _____

SAMP #	UNIT			DIMENSIONS						WOOD						SHELTER				SUBSTRATE		Nth UNIT MEASURES								
				STA	Length	Avg Wet	Pool	Avg D	Edge	DEAD			ALIVE			%	1	2	Complex.	1	2	Wet Width (M)			Riffle BF	Riffle BF Avg Depth			Riffle	Peb Ct
	Rch.	No.	Type	bgn		Width (O)	Max D	/PTC	Present	S	M	L	S	M	L	Cover			Code			1	2	3	Width	1	2	3	FPW	(Y/N)
357	1	1	F	D357	190.5	40	3.5	1.6								10	TV		1	G	SC									
358	1	2	R	D358	141	45		1								2	TV		1	G	SC	39	38	52	43	2.9	2.1	1.4	145	Y
359	1	3	P	D359	70	45	4	1.2					1			40	TV	SWD	2	G	S									
360	1	4	F	D360	111	50		1	*					1	2	20	TV	SWD	3	G	S									
361	1	5	A	D361	60	7	1.2		*	1						60	TV	AV	3	F	G									
362	1	6	P	D362	76	48	3.5	1.1					2	1	1	30	TV	SWD	2	G	S									
363	1	7	A	D363	70	8	0.8		*	2						80	TV	AV	3	F	G									
364	1	8	F	D364	648	65		1.3	*	5		1	4	2		35	TV	SWD	3	G	S	56	64	52						
365	1	9	P	D365	459	55	3.5	1.3		12	1		4	1		28	TV	SWD	3	G	S									
366	1	10	R	D366	125	58		1								15	TV	RM	2	G	S									
367	1	11	SC/R	D367	60	17		0.3	*							1	TV		1	G	S									
368	1	12	F	D368	106	50		1.5	*							15	TV	RM	2	G	S									
369	1	13	F	D369	203	50	2.8	1.7								15	TV	RM	2	G	S	45	48	49						
370	1	14	R	D370	83	42		0.9		1	1					15	TV	AV	3	G	SC									
371	1	15	P	D371	304	55	5.4	1.3	*	5	3					18	TV	SWD	3	G	S									
372	1	16	R	D372	60	38		1.1								1	TV		1	G	SC									
373	1	17	SC/F	D373	110	15		0.9	*				1			40	TV	SWD	2	G	S									
374	1	18	SC/R	D374	40	18		0.6	*							2	TV		1	G	SC									
375	1	19	P	D375	86	25	4.1	1.2								25	TV	RM	2	G	S									
376	1	20	R	D376	45	20		1.5			1					5	TV	LWD	2	G	SC									
377	1	21	P	D377	395	55	3.3	1.3	*	1		3	1	3		12	RM	SWD	3	G	S	62	52	54						
378	1	22	F	D378	331	55		1.3					1			18	TV	SWD	2	G	S									
379	1	23	A	D379	50	8	0.2		*							55	TV	AV	3	G	F									
380	1	24	R	D380	70	35		1.2								10	BC		1	G	SC	41	45	32	82	1.8	2.3	2	130	N
381	1	25	F	D381	105	35		1.3							1	5	TV	LWD	2	G	SC									
382	1	26	A	D382	40	8	1.6					1				50	AV	RM	3	G	S									
383	MOUTH OF DRY CREEK																													

P - Main Channel Pool
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SC/Type - Side Channel with Unit Type
R - Riffle
F - Flatwater (Glide/Run)
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LWD Size Classes
S >6" but <12"
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L >20"

CDFD Shelter Types
RM Root Mass
SWD <12" Woody Debris
LWD >12" Woody Debris
TV Terrestrial Vegetation
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BC Bubble Curtain
BO Boulders
BD Bedrock Ledge
UC Undercut Bank

0 No Shelter

1 1 to 5 boulders
bare undercut bank / bedrock ledge
single piece large wood (LWD

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single RW lacking complexity
branches in/near water
limited submersed veg fish cover
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3 or more boulders w/ LWD/SWD
bubble curtain w/ LWD/boulders
stable > 12" undercut bank w/ rootmass/LWD
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F fines, D<0.0625 mm
S sand, 0.0625mm<D<2mm
G gravel, 2mm<D<64mm
SC gravel, 2mm<D<64mm
LC large cobble, 128mm<D<256mm
B boulders, 256 mm<D
W bedrock

12 APPENDIX D - PEBBLE COUNT DATA SHEETS

Location (Stream, Reach, Description)

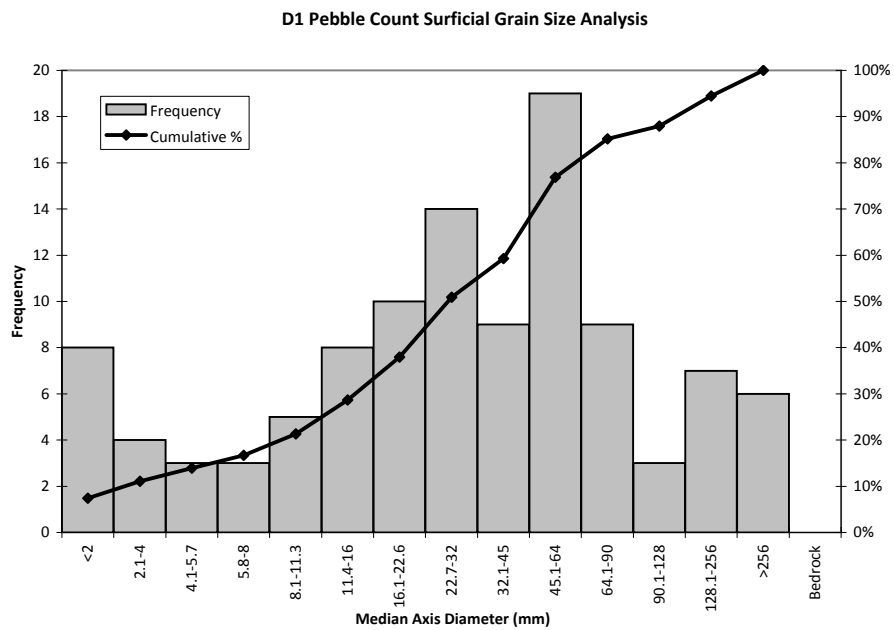
Sediment Grain Size Analysis

Dry	Stream	**8/26/2009**	Date
15	Reach	N. Nelson & G. Johnston	Personnel
	Location		Latitude
1	Identifier / Unit		Longitude
Riffle	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
Surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	8	7.4%
Very Fine Gravel	2.1-4	4	11.1%
Fine Gravel	4.1-5.7	3	13.9%
Fine Gravel	5.8-8	3	16.7%
Medium Gravel	8.1-11.3	5	21.3%
Medium Gravel	11.4-16	8	28.7%
Coarse Gravel	16.1-22.6	10	38.0%
Coarse Gravel	22.7-32	14	50.9%
Very Coarse Gravel	32.1-45	9	59.3%
Very Coarse Gravel	45.1-64	19	76.9%
Small Cobble	64.1-90	9	85.2%
Small Cobble	90.1-128	3	88.0%
Large Cobble	128.1-256	7	94.4%
Small Boulders	>256	6	100.0%
Bedrock	Bedrock	0	100.0%
	Total	108	



Location (Stream, Reach, Description)

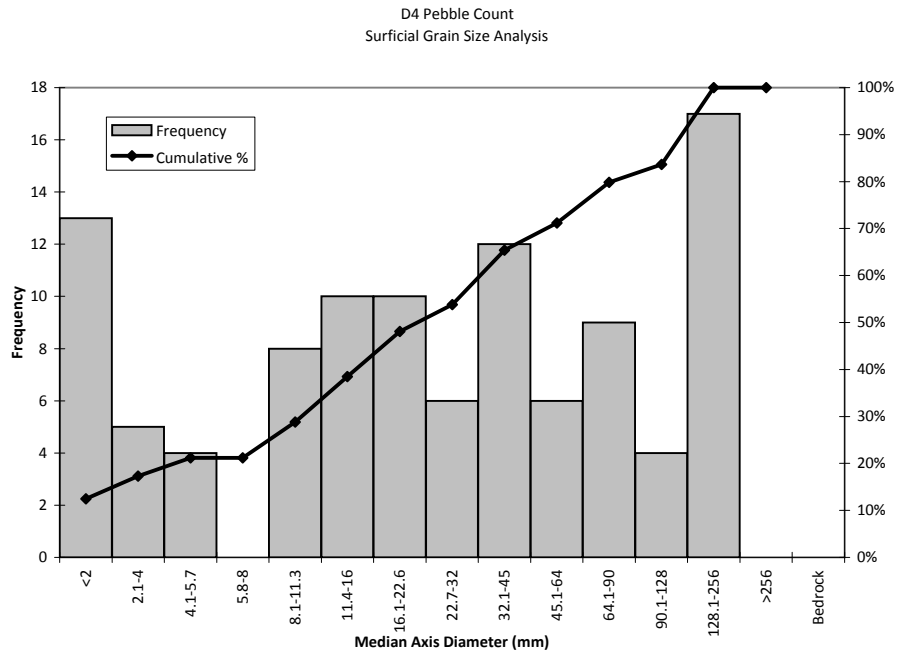
Sediment Grain Size Analysis

Dry	Stream	**8/26/2009**	Date
14	Reach	N. Nelson & G. Johnston	Personnel
	Location		Latitude
4	Identifier / Unit		Longitude
Riffle	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
Surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:
Riffle at the top of Reach 20 below Schoolhouse Trib.

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	13	12.5%
Very Fine Gravel	2.1-4	5	17.3%
Fine Gravel	4.1-5.7	4	21.2%
Fine Gravel	5.8-8	0	21.2%
Medium Gravel	8.1-11.3	8	28.8%
Medium Gravel	11.4-16	10	38.5%
Coarse Gravel	16.1-22.6	10	48.1%
Coarse Gravel	22.7-32	6	53.8%
Very Coarse Gravel	32.1-45	12	65.4%
Very Coarse Gravel	45.1-64	6	71.2%
Small Cobble	64.1-90	9	79.8%
Small Cobble	90.1-128	4	83.7%
Large Cobble	128.1-256	17	100.0%
Small Boulders	>256	0	100.0%
Bedrock	Bedrock	0	100.0%
	Total	104	



Location (Stream, Reach, Description)

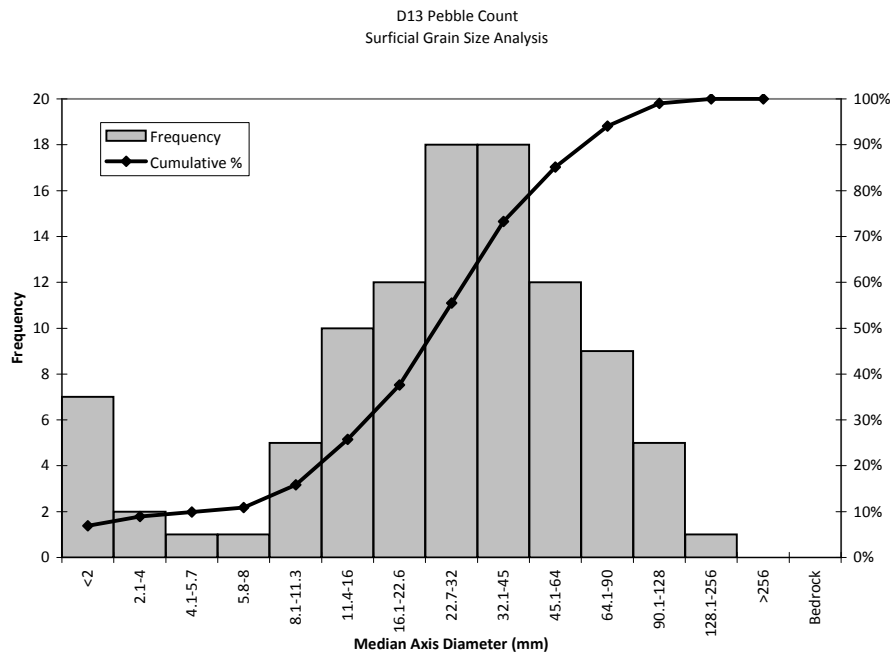
Sediment Grain Size Analysis

Dry	Stream	**8/26/2009**	Date
14	Reach	N. Nelson & G. Johnston	Personnel
	Location		Latitude
13	Identifier / Unit		Longitude
Riffle	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
Surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	7	6.9%
Very Fine Gravel	2.1-4	2	8.9%
Fine Gravel	4.1-5.7	1	9.9%
Fine Gravel	5.8-8	1	10.9%
Medium Gravel	8.1-11.3	5	15.8%
Medium Gravel	11.4-16	10	25.7%
Coarse Gravel	16.1-22.6	12	37.6%
Coarse Gravel	22.7-32	18	55.4%
Very Coarse Gravel	32.1-45	18	73.3%
Very Coarse Gravel	45.1-64	12	85.1%
Small Cobble	64.1-90	9	94.1%
Small Cobble	90.1-128	5	99.0%
Large Cobble	128.1-256	1	100.0%
Small Boulders	>256	0	100.0%
Bedrock	Bedrock	0	100.0%
	Total	101	



Location (Stream, Reach, Description)

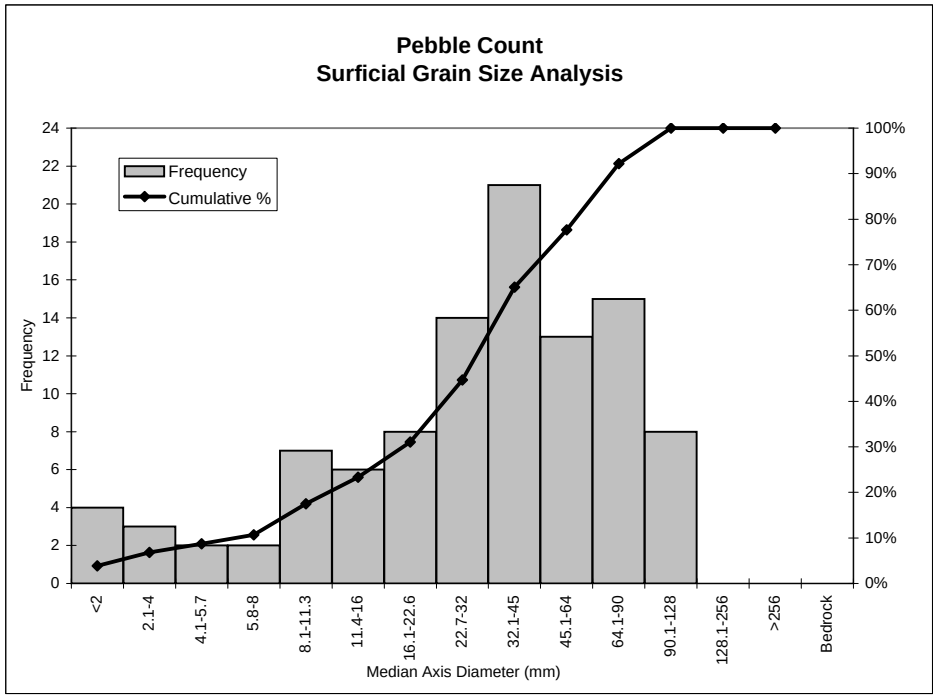
Sediment Grain Size Analysis

Dry	Stream	**8/27/2009**	Date
13	Reach		Personnel
	Location		Latitude
D44	Identifier / Unit		Longitude
Riffle	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
Surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:
Riffle in R18 just d/s of whre Fall Ck enters Dry Ck at GPS # D44

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	4	3.9%
Very Fine Gravel	2.1-4	3	6.8%
Fine Gravel	4.1-5.7	2	8.7%
Fine Gravel	5.8-8	2	10.7%
Medium Gravel	8.1-11.3	7	17.5%
Medium Gravel	11.4-16	6	23.3%
Coarse Gravel	16.1-22.6	8	31.1%
Coarse Gravel	22.7-32	14	44.7%
Very Coarse Gravel	32.1-45	21	65.0%
Very Coarse Gravel	45.1-64	13	77.7%
Small Cobble	64.1-90	15	92.2%
Small Cobble	90.1-128	8	100.0%
Large Cobble	128.1-256	0	100.0%
Small Boulders	>256	0	100.0%
Bedrock	Bedrock	0	100.0%
	Total	103	



Location (Stream, Reach, Description)

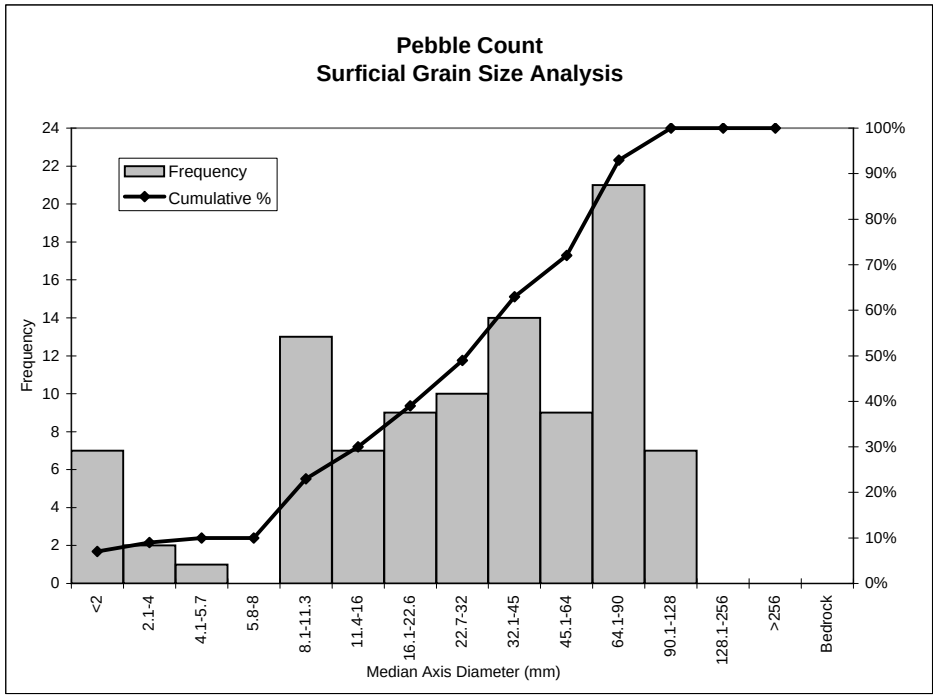
Sediment Grain Size Analysis

Dry	Stream	**8/27/2009**	Date
12	Reach		Personnel
	Location		Latitude
D72	Identifier / Unit		Longitude
Riffle	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
Surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:
Dry Creek at D72 in Reach 17 u/s of Pena Ck.

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	7	7.0%
Very Fine Gravel	2.1-4	2	9.0%
Fine Gravel	4.1-5.7	1	10.0%
Fine Gravel	5.8-8	0	10.0%
Medium Gravel	8.1-11.3	13	23.0%
Medium Gravel	11.4-16	7	30.0%
Coarse Gravel	16.1-22.6	9	39.0%
Coarse Gravel	22.7-32	10	49.0%
Very Coarse Gravel	32.1-45	14	63.0%
Very Coarse Gravel	45.1-64	9	72.0%
Small Cobble	64.1-90	21	93.0%
Small Cobble	90.1-128	7	100.0%
Large Cobble	128.1-256	0	100.0%
Small Boulders	>256	0	100.0%
Bedrock	Bedrock	0	100.0%
	Total	100	



Location (Stream, Reach, Description)

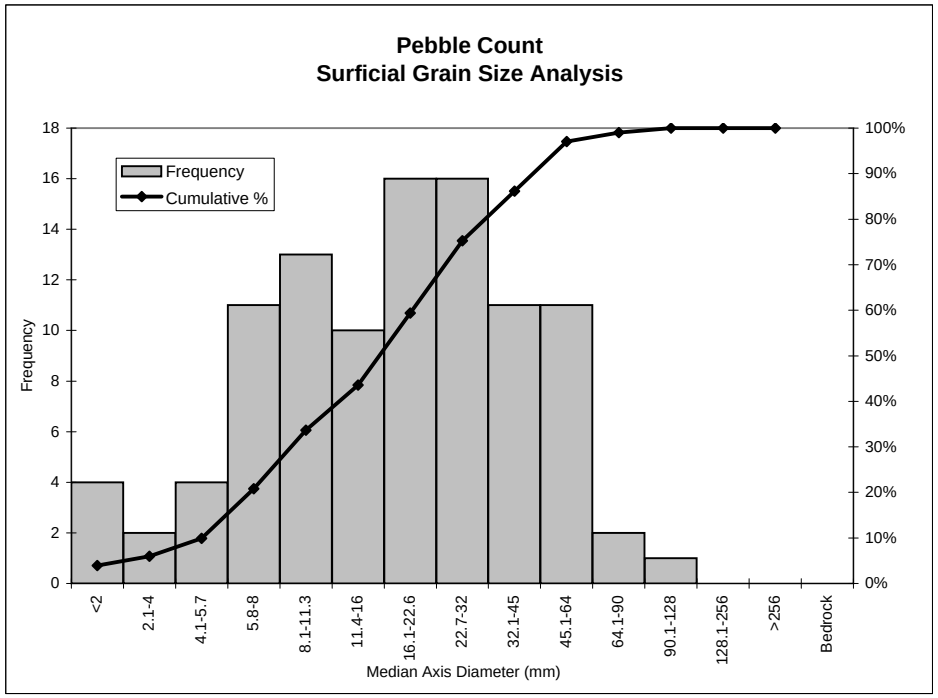
Sediment Grain Size Analysis

Dry	Stream	**8/27/2009**	Date
111	Reach		Personnel
	Location		Latitude
D80	Identifier / Unit		Longitude
Riffle	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
Surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:
Dry Creek, Reach 16, D80 Riffle d/s of Pena Ck.

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	4	4.0%
Very Fine Gravel	2.1-4	2	5.9%
Fine Gravel	4.1-5.7	4	9.9%
Fine Gravel	5.8-8	11	20.8%
Medium Gravel	8.1-11.3	13	33.7%
Medium Gravel	11.4-16	10	43.6%
Coarse Gravel	16.1-22.6	16	59.4%
Coarse Gravel	22.7-32	16	75.2%
Very Coarse Gravel	32.1-45	11	86.1%
Very Coarse Gravel	45.1-64	11	97.0%
Small Cobble	64.1-90	2	99.0%
Small Cobble	90.1-128	1	100.0%
Large Cobble	128.1-256	0	100.0%
Small Boulders	>256	0	100.0%
Bedrock	Bedrock	0	100.0%
	Total	101	



Location (Stream, Reach, Description)

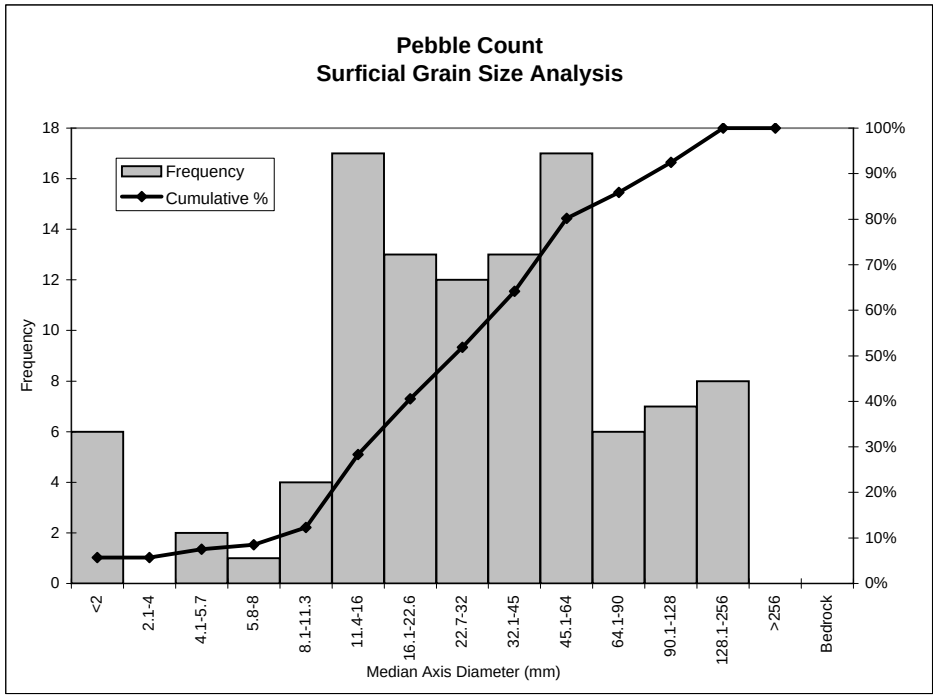
Sediment Grain Size Analysis

Dry	Stream	**8/28/2009**	Date
11	Reach		Personnel
	Location		Latitude
D88	Identifier / Unit		Longitude
Riffle	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
Surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	6	5.7%
Very Fine Gravel	2.1-4	0	5.7%
Fine Gravel	4.1-5.7	2	7.5%
Fine Gravel	5.8-8	1	8.5%
Medium Gravel	8.1-11.3	4	12.3%
Medium Gravel	11.4-16	17	28.3%
Coarse Gravel	16.1-22.6	13	40.6%
Coarse Gravel	22.7-32	12	51.9%
Very Coarse Gravel	32.1-45	13	64.2%
Very Coarse Gravel	45.1-64	17	80.2%
Small Cobble	64.1-90	6	85.8%
Small Cobble	90.1-128	7	92.5%
Large Cobble	128.1-256	8	100.0%
Small Boulders	>256	0	100.0%
Bedrock	Bedrock	0	100.0%
	Total	106	



Location (Stream, Reach, Description)

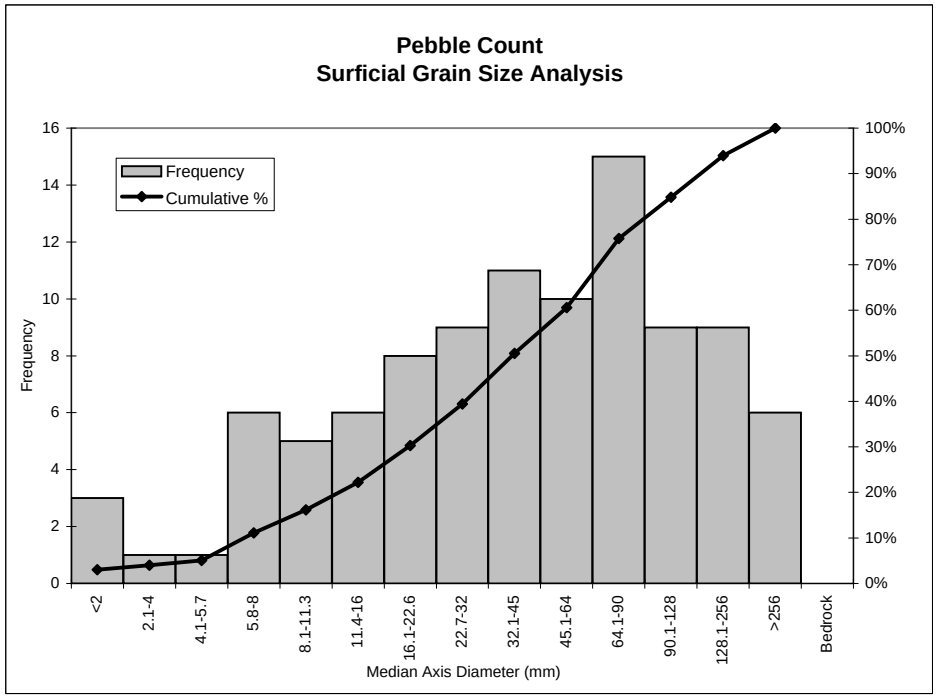
Sediment Grain Size Analysis

Dry	Stream	**8/29/2009**	Date
10	Reach		Personnel
	Location		Latitude
D99	Identifier / Unit		Longitude
Riffle	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
Surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:
w/ small mid-channel bars

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	3	3.0%
Very Fine Gravel	2.1-4	1	4.0%
Fine Gravel	4.1-5.7	1	5.1%
Fine Gravel	5.8-8	6	11.1%
Medium Gravel	8.1-11.3	5	16.2%
Medium Gravel	11.4-16	6	22.2%
Coarse Gravel	16.1-22.6	8	30.3%
Coarse Gravel	22.7-32	9	39.4%
Very Coarse Gravel	32.1-45	11	50.5%
Very Coarse Gravel	45.1-64	10	60.6%
Small Cobble	64.1-90	15	75.8%
Small Cobble	90.1-128	9	84.8%
Large Cobble	128.1-256	9	93.9%
Small Boulders	>256	6	100.0%
Bedrock	Bedrock	0	100.0%
	Total	99	



Location (Stream, Reach, Description)

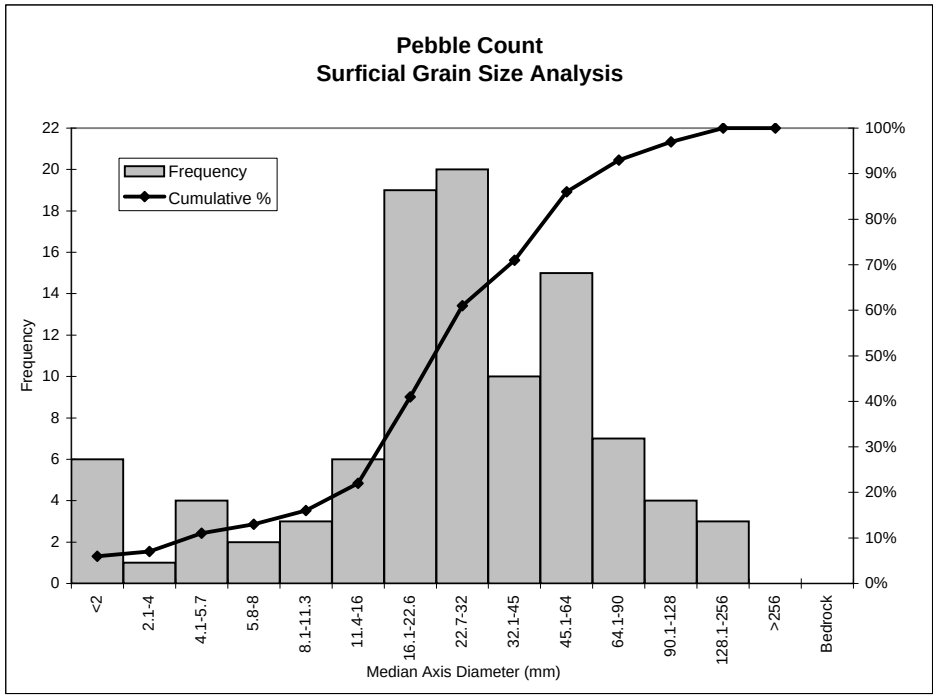
Sediment Grain Size Analysis

Dry	Stream	**8/28/2009**	Date
9	Reach		Personnel
	Location		Latitude
D110	Identifier / Unit		Longitude
Riffle	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
Surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	6	6.0%
Very Fine Gravel	2.1-4	1	7.0%
Fine Gravel	4.1-5.7	4	11.0%
Fine Gravel	5.8-8	2	13.0%
Medium Gravel	8.1-11.3	3	16.0%
Medium Gravel	11.4-16	6	22.0%
Coarse Gravel	16.1-22.6	19	41.0%
Coarse Gravel	22.7-32	20	61.0%
Very Coarse Gravel	32.1-45	10	71.0%
Very Coarse Gravel	45.1-64	15	86.0%
Small Cobble	64.1-90	7	93.0%
Small Cobble	90.1-128	4	97.0%
Large Cobble	128.1-256	3	100.0%
Small Boulders	>256	0	100.0%
Bedrock	Bedrock	0	100.0%
	Total	100	



Location (Stream, Reach, Description)

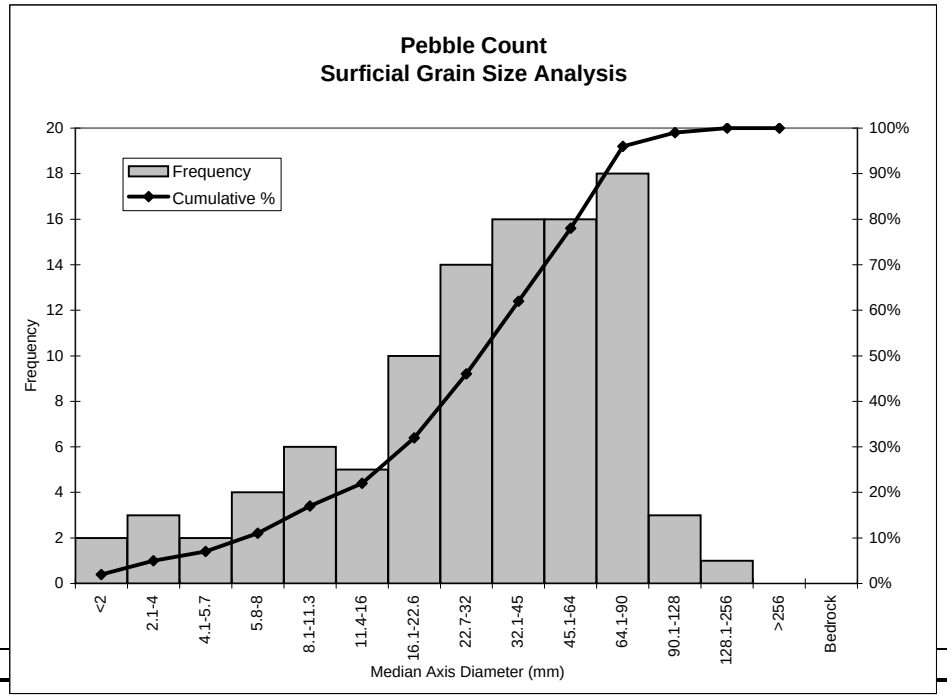
Sediment Grain Size Analysis

Dry	Stream	**8/28/2009**	Date
8	Reach		Personnel
	Location		Latitude
D123	Identifier / Unit		Longitude
Riffle	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
Surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	2	2.0%
Very Fine Gravel	2.1-4	3	5.0%
Fine Gravel	4.1-5.7	2	7.0%
Fine Gravel	5.8-8	4	11.0%
Medium Gravel	8.1-11.3	6	17.0%
Medium Gravel	11.4-16	5	22.0%
Coarse Gravel	16.1-22.6	10	32.0%
Coarse Gravel	22.7-32	14	46.0%
Very Coarse Gravel	32.1-45	16	62.0%
Very Coarse Gravel	45.1-64	16	78.0%
Small Cobble	64.1-90	18	96.0%
Small Cobble	90.1-128	3	99.0%
Large Cobble	128.1-256	1	100.0%
Small Boulders	>256	0	100.0%
Bedrock	Bedrock	0	100.0%
	Total	100	



Location (Stream, Reach, Description)

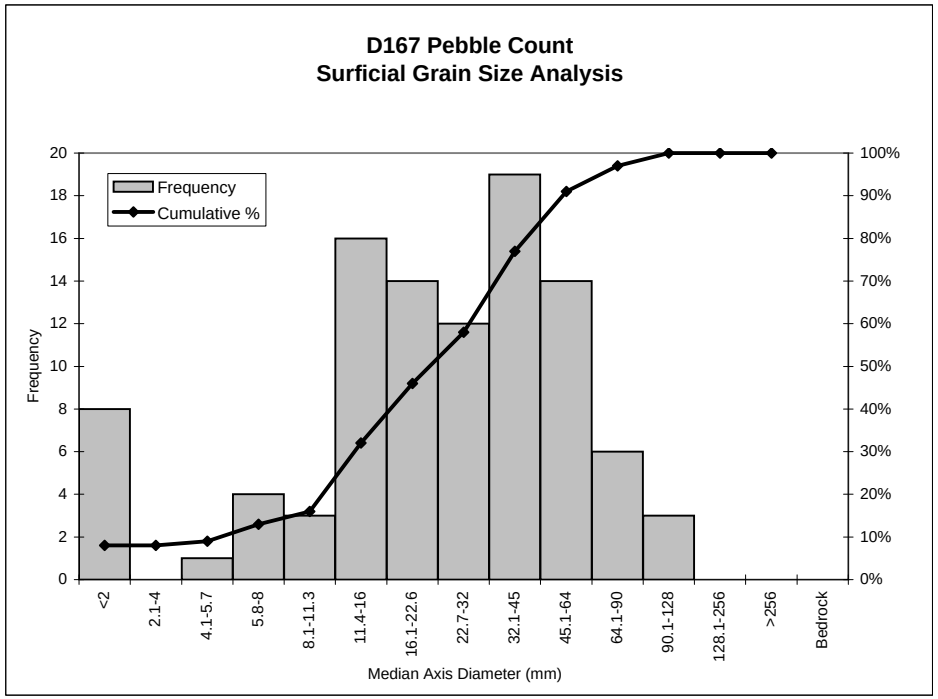
Sediment Grain Size Analysis

Dry	Stream	**8/29/2009**	Date
7	Reach		Personnel
	Location		Latitude
167	Identifier / Unit		Longitude
Riffle	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
Surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	8	8.0%
Very Fine Gravel	2.1-4	0	8.0%
Fine Gravel	4.1-5.7	1	9.0%
Fine Gravel	5.8-8	4	13.0%
Medium Gravel	8.1-11.3	3	16.0%
Medium Gravel	11.4-16	16	32.0%
Coarse Gravel	16.1-22.6	14	46.0%
Coarse Gravel	22.7-32	12	58.0%
Very Coarse Gravel	32.1-45	19	77.0%
Very Coarse Gravel	45.1-64	14	91.0%
Small Cobble	64.1-90	6	97.0%
Small Cobble	90.1-128	3	100.0%
Large Cobble	128.1-256	0	100.0%
Small Boulders	>256	0	100.0%
Bedrock	Bedrock	0	100.0%
	Total	100	



Location (Stream, Reach, Description)

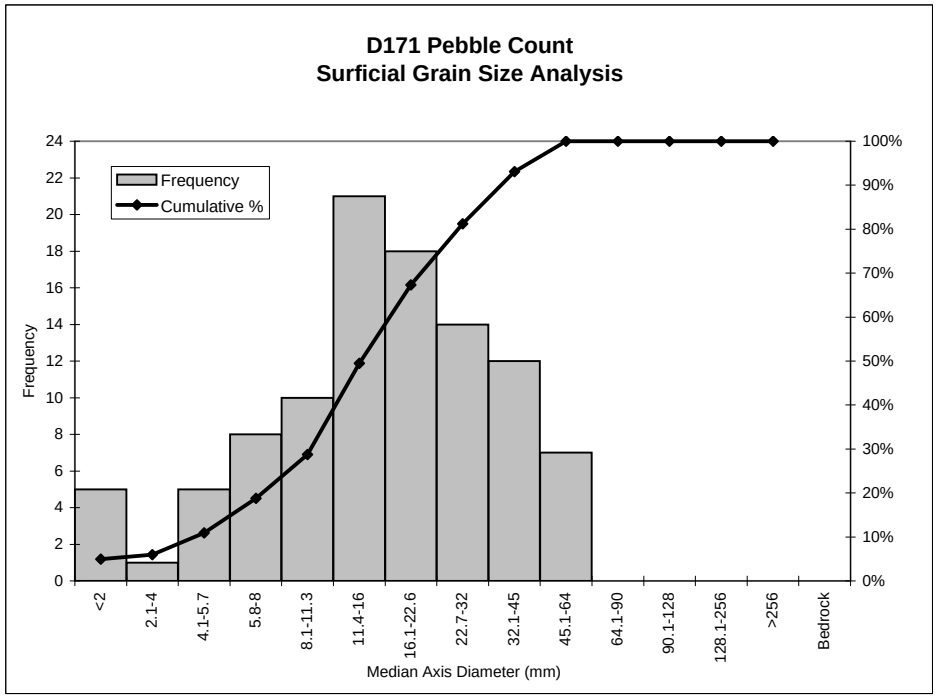
Sediment Grain Size Analysis

Dry	Stream	**8/29/2009**	Date
7 7	Reach		Personnel
	Location		Latitude
171	Identifier / Unit		Longitude
Riffle	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
Surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	5	5.0%
Very Fine Gravel	2.1-4	1	5.9%
Fine Gravel	4.1-5.7	5	10.9%
Fine Gravel	5.8-8	8	18.8%
Medium Gravel	8.1-11.3	10	28.7%
Medium Gravel	11.4-16	21	49.5%
Coarse Gravel	16.1-22.6	18	67.3%
Coarse Gravel	22.7-32	14	81.2%
Very Coarse Gravel	32.1-45	12	93.1%
Very Coarse Gravel	45.1-64	7	100.0%
Small Cobble	64.1-90	0	100.0%
Small Cobble	90.1-128	0	100.0%
Large Cobble	128.1-256	0	100.0%
Small Boulders	>256	0	100.0%
Bedrock	Bedrock	0	100.0%
	Total	101	



Location (Stream, Reach, Description)

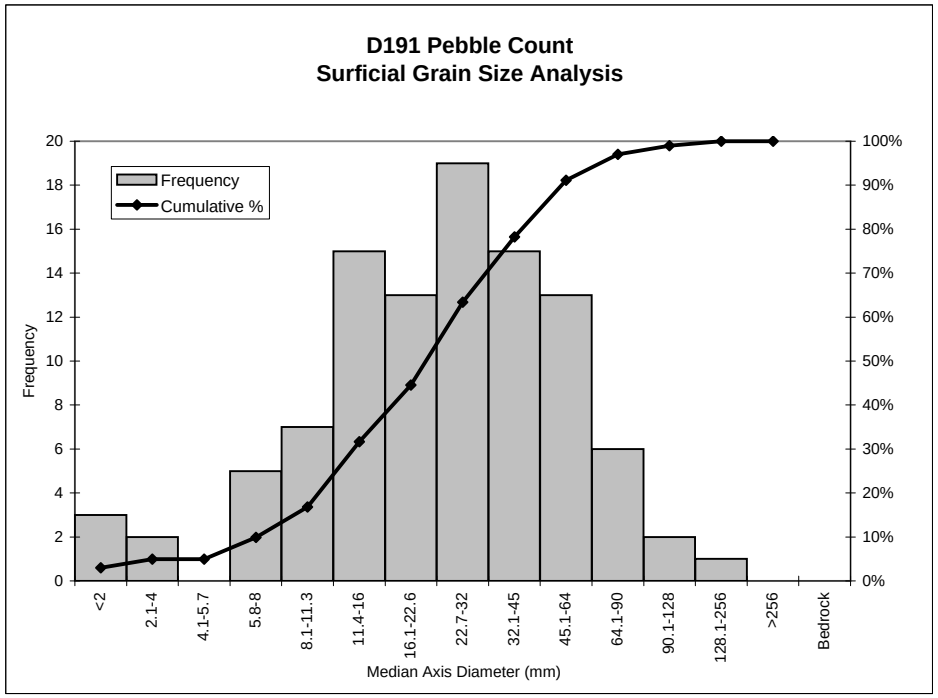
Sediment Grain Size Analysis

Dry	Stream		Date
7	Reach		Personnel
	Location		Latitude
191	Identifier / Unit		Longitude
Riffle	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
Surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	3	3.0%
Very Fine Gravel	2.1-4	2	5.0%
Fine Gravel	4.1-5.7	0	5.0%
Fine Gravel	5.8-8	5	9.9%
Medium Gravel	8.1-11.3	7	16.8%
Medium Gravel	11.4-16	15	31.7%
Coarse Gravel	16.1-22.6	13	44.6%
Coarse Gravel	22.7-32	19	63.4%
Very Coarse Gravel	32.1-45	15	78.2%
Very Coarse Gravel	45.1-64	13	91.1%
Small Cobble	64.1-90	6	97.0%
Small Cobble	90.1-128	2	99.0%
Large Cobble	128.1-256	1	100.0%
Small Boulders	>256	0	100.0%
Bedrock	Bedrock	0	100.0%
	Total	101	



Location (Stream, Reach, Description)

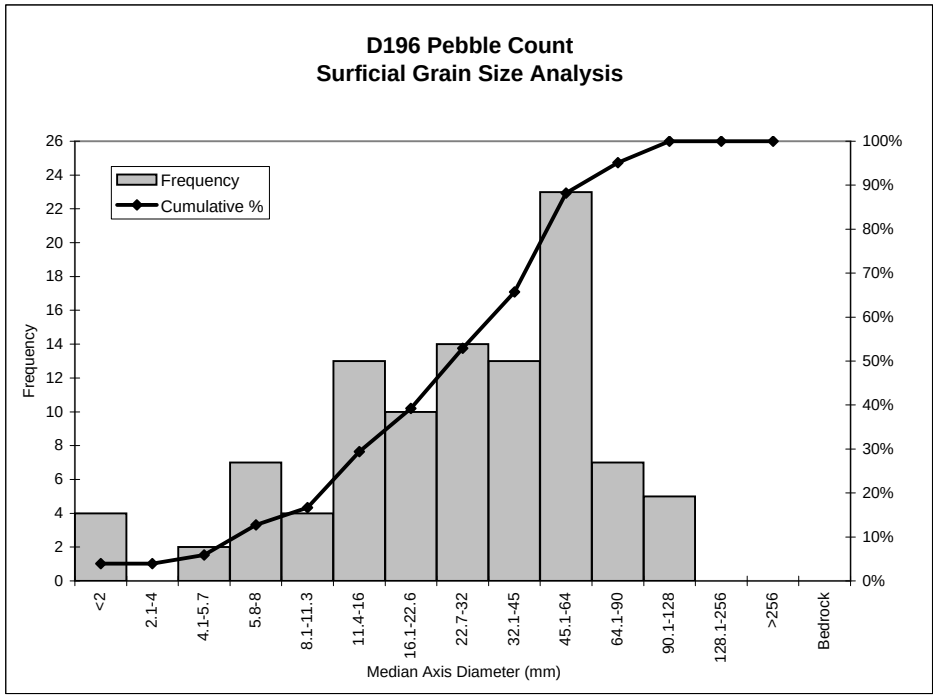
Sediment Grain Size Analysis

Dry	Stream	**8/30/2009**	Date
7	Reach	N. Nelson & J. Mullen	Personnel
	Location		Latitude
D196	Identifier / Unit		Longitude
Riffle	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
Surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	4	3.9%
Very Fine Gravel	2.1-4	0	3.9%
Fine Gravel	4.1-5.7	2	5.9%
Fine Gravel	5.8-8	7	12.7%
Medium Gravel	8.1-11.3	4	16.7%
Medium Gravel	11.4-16	13	29.4%
Coarse Gravel	16.1-22.6	10	39.2%
Coarse Gravel	22.7-32	14	52.9%
Very Coarse Gravel	32.1-45	13	65.7%
Very Coarse Gravel	45.1-64	23	88.2%
Small Cobble	64.1-90	7	95.1%
Small Cobble	90.1-128	5	100.0%
Large Cobble	128.1-256	0	100.0%
Small Boulders	>256	0	100.0%
Bedrock	Bedrock	0	100.0%
	Total	102	



Location (Stream, Reach, Description)

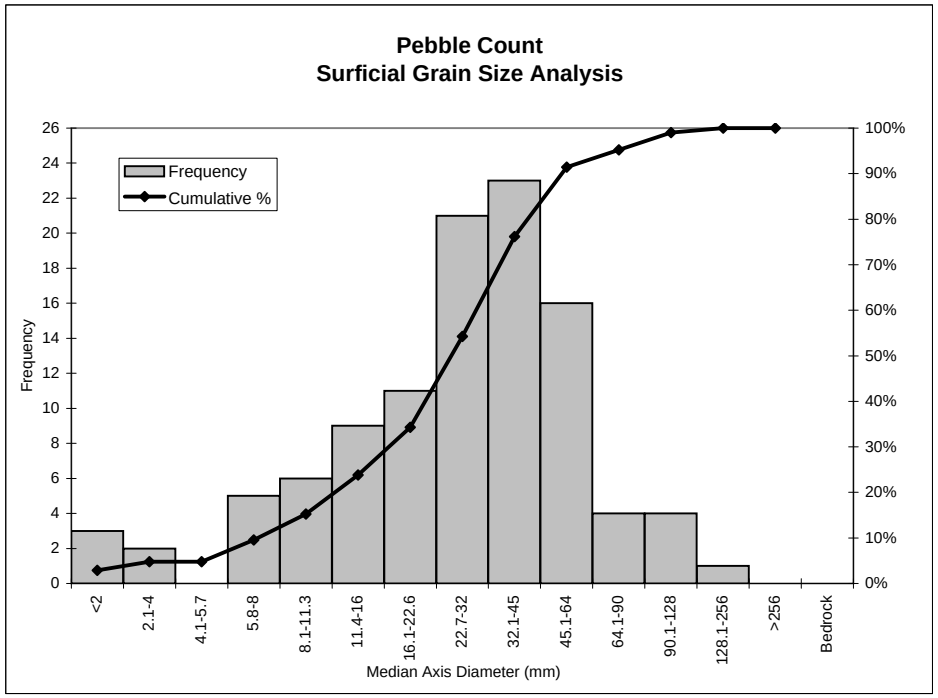
Sediment Grain Size Analysis

Dry	Stream	**8/31/2009**	Date
6	Reach	N. Nelson & J. Mullen	Personnel
	Location		Latitude
199	Identifier / Unit		Longitude
Riffle	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
Surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:
Riffle D/S of Crane Creek

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	3	2.9%
Very Fine Gravel	2.1-4	2	4.8%
Fine Gravel	4.1-5.7	0	4.8%
Fine Gravel	5.8-8	5	9.5%
Medium Gravel	8.1-11.3	6	15.2%
Medium Gravel	11.4-16	9	23.8%
Coarse Gravel	16.1-22.6	11	34.3%
Coarse Gravel	22.7-32	21	54.3%
Very Coarse Gravel	32.1-45	23	76.2%
Very Coarse Gravel	45.1-64	16	91.4%
Small Cobble	64.1-90	4	95.2%
Small Cobble	90.1-128	4	99.0%
Large Cobble	128.1-256	1	100.0%
Small Boulders	>256	0	100.0%
Bedrock	Bedrock	0	100.0%
	Total	105	



Location (Stream, Reach, Description)

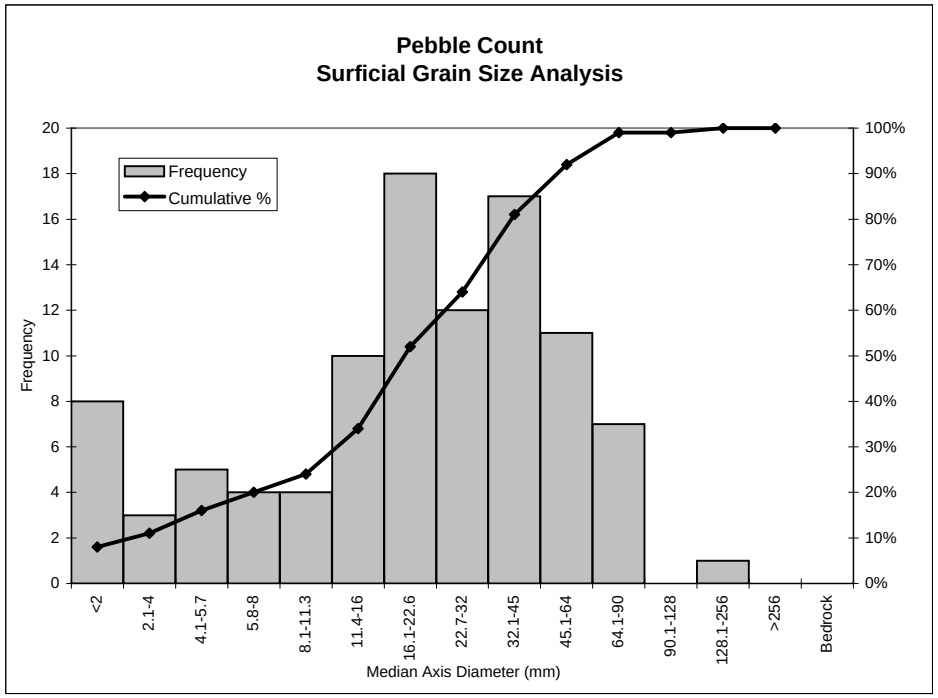
Sediment Grain Size Analysis

Dry	Stream	**8/30/2009**	Date
5	Reach	N. Nelson & J. Mullen	Personnel
	Location		Latitude
D219	Identifier / Unit		Longitude
Riffle	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
Surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	8	8.0%
Very Fine Gravel	2.1-4	3	11.0%
Fine Gravel	4.1-5.7	5	16.0%
Fine Gravel	5.8-8	4	20.0%
Medium Gravel	8.1-11.3	4	24.0%
Medium Gravel	11.4-16	10	34.0%
Coarse Gravel	16.1-22.6	18	52.0%
Coarse Gravel	22.7-32	12	64.0%
Very Coarse Gravel	32.1-45	17	81.0%
Very Coarse Gravel	45.1-64	11	92.0%
Small Cobble	64.1-90	7	99.0%
Small Cobble	90.1-128	0	99.0%
Large Cobble	128.1-256	1	100.0%
Small Boulders	>256	0	100.0%
Bedrock	Bedrock	0	100.0%
	Total	100	



Location (Stream, Reach, Description)

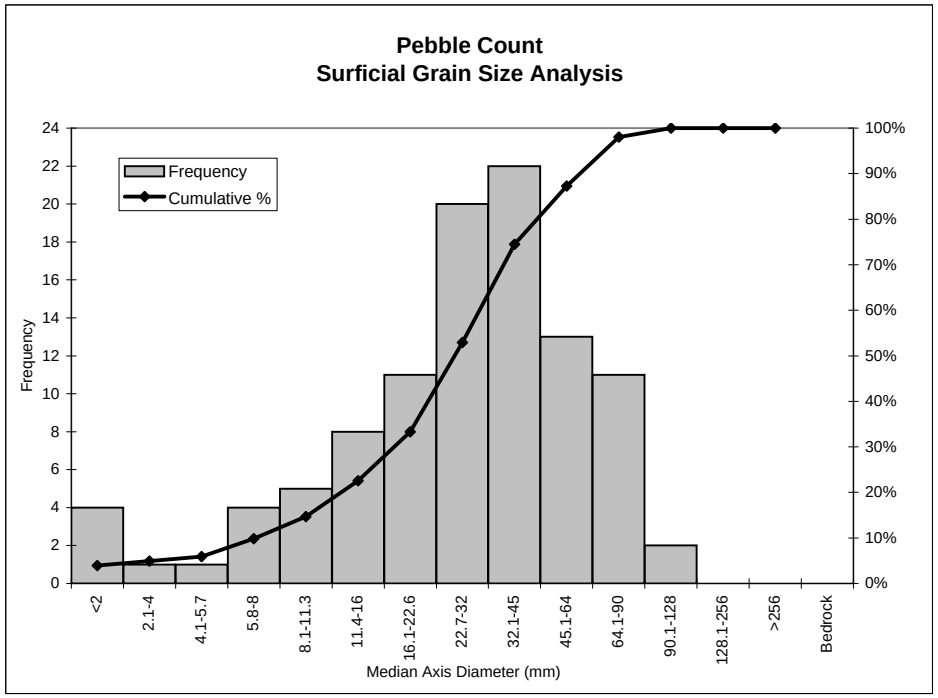
Sediment Grain Size Analysis

Dry	Stream	**8/30/2009**	Date
5	Reach	N. Nelson & J. Mullen	Personnel
	Location		Latitude
D228	Identifier / Unit		Longitude
Riffle	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
Surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	4	3.9%
Very Fine Gravel	2.1-4	1	4.9%
Fine Gravel	4.1-5.7	1	5.9%
Fine Gravel	5.8-8	4	9.8%
Medium Gravel	8.1-11.3	5	14.7%
Medium Gravel	11.4-16	8	22.5%
Coarse Gravel	16.1-22.6	11	33.3%
Coarse Gravel	22.7-32	20	52.9%
Very Coarse Gravel	32.1-45	22	74.5%
Very Coarse Gravel	45.1-64	13	87.3%
Small Cobble	64.1-90	11	98.0%
Small Cobble	90.1-128	2	100.0%
Large Cobble	128.1-256	0	100.0%
Small Boulders	>256	0	100.0%
Bedrock	Bedrock	0	100.0%
	Total	102	



Location (Stream, Reach, Description)

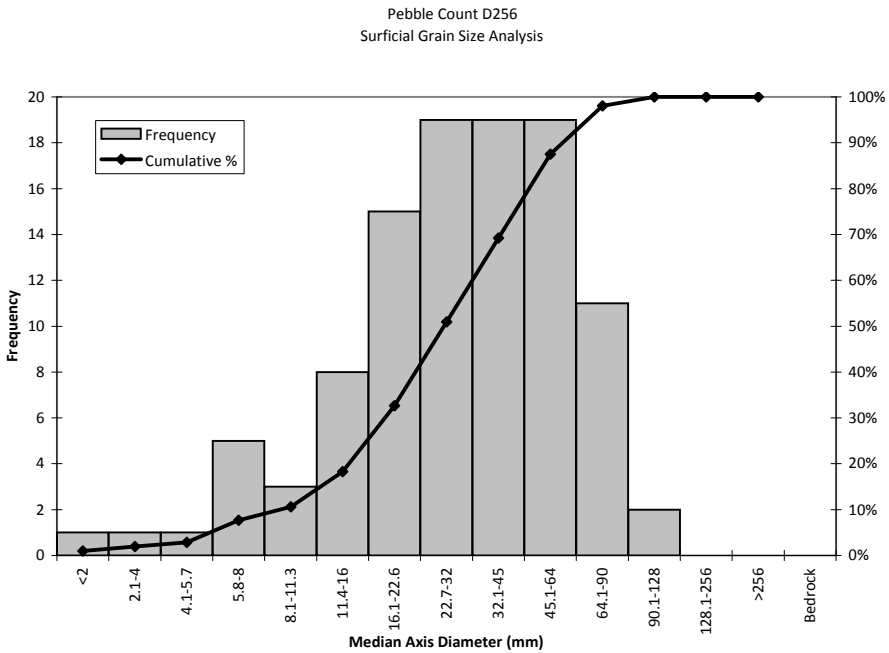
Sediment Grain Size Analysis

Dry	Stream	Dry Creek	**8/31/2009**	Date
4	Reach	5	N. Nelson & J. Mullen	Personnel
	Location			Latitude
256	Identifier / Unit			Longitude
Riffle	Longitudinal Description (Pool, Riffle, Bend, Crossing)			Northing
Surficial	Sample Type: Armor Layer or Subarmor			Easting
	Approximate Depth of Flow at Thalweg (ft)			Waypoint

Notes:

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	1	1.0%
Very Fine Gravel	2.1-4	1	1.9%
Fine Gravel	4.1-5.7	1	2.9%
Fine Gravel	5.8-8	5	7.7%
Medium Gravel	8.1-11.3	3	10.6%
Medium Gravel	11.4-16	8	18.3%
Coarse Gravel	16.1-22.6	15	32.7%
Coarse Gravel	22.7-32	19	51.0%
Very Coarse Gravel	32.1-45	19	69.2%
Very Coarse Gravel	45.1-64	19	87.5%
Small Cobble	64.1-90	11	98.1%
Small Cobble	90.1-128	2	100.0%
Large Cobble	128.1-256	0	100.0%
Small Boulders	>256	0	100.0%
Bedrock	Bedrock	0	100.0%
	Total	104	



Location (Stream, Reach, Description)

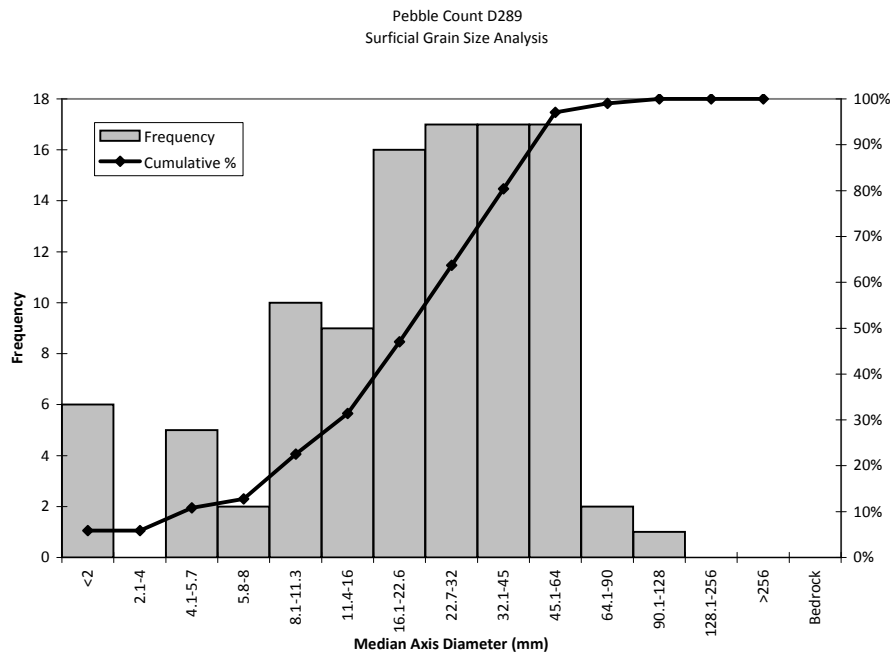
Sediment Grain Size Analysis

Dry	Stream	**8/31/2009**	Date
3	Reach	N. Nelson & J. Mullen	Personnel
	Location		Latitude
D289	Identifier / Unit		Longitude
Riffle	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
Surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	6	5.9%
Very Fine Gravel	2.1-4	0	5.9%
Fine Gravel	4.1-5.7	5	10.8%
Fine Gravel	5.8-8	2	12.7%
Medium Gravel	8.1-11.3	10	22.5%
Medium Gravel	11.4-16	9	31.4%
Coarse Gravel	16.1-22.6	16	47.1%
Coarse Gravel	22.7-32	17	63.7%
Very Coarse Gravel	32.1-45	17	80.4%
Very Coarse Gravel	45.1-64	17	97.1%
Small Cobble	64.1-90	2	99.0%
Small Cobble	90.1-128	1	100.0%
Large Cobble	128.1-256	0	100.0%
Small Boulders	>256	0	100.0%
Bedrock	Bedrock	0	100.0%
	Total	102	



Location (Stream, Reach, Description)

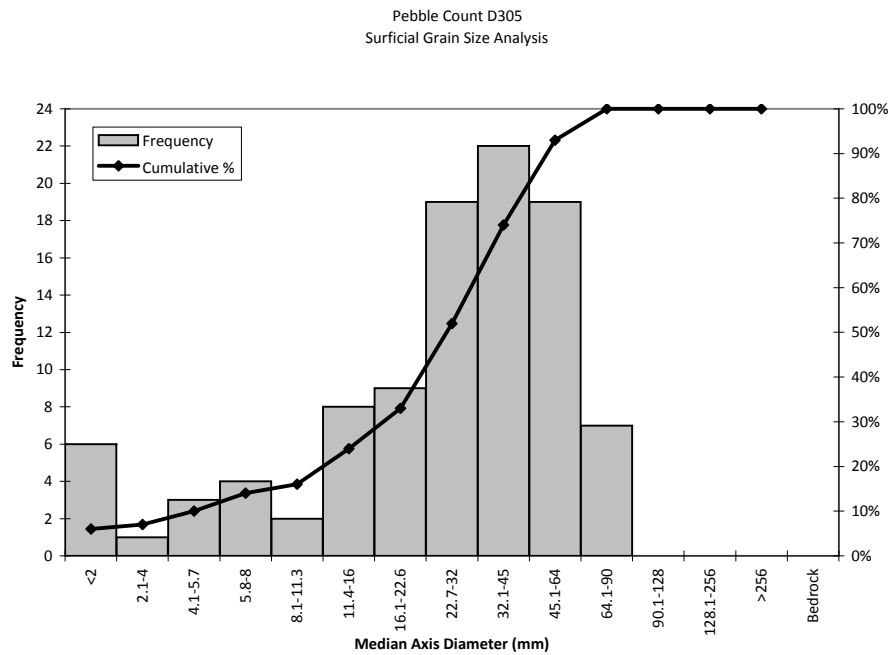
Sediment Grain Size Analysis

Dry	Stream	**9/1/2009**	Date
3	Reach	N. Nelson & J. Mullen	Personnel
	Location		Latitude
D305	Identifier / Unit		Longitude
Riffle	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
Surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	6	6.0%
Very Fine Gravel	2.1-4	1	7.0%
Fine Gravel	4.1-5.7	3	10.0%
Fine Gravel	5.8-8	4	14.0%
Medium Gravel	8.1-11.3	2	16.0%
Medium Gravel	11.4-16	8	24.0%
Coarse Gravel	16.1-22.6	9	33.0%
Coarse Gravel	22.7-32	19	52.0%
Very Coarse Gravel	32.1-45	22	74.0%
Very Coarse Gravel	45.1-64	19	93.0%
Small Cobble	64.1-90	7	100.0%
Small Cobble	90.1-128	0	100.0%
Large Cobble	128.1-256	0	100.0%
Small Boulders	>256	0	100.0%
Bedrock	Bedrock	0	100.0%
	Total	100	



Location (Stream, Reach, Description)

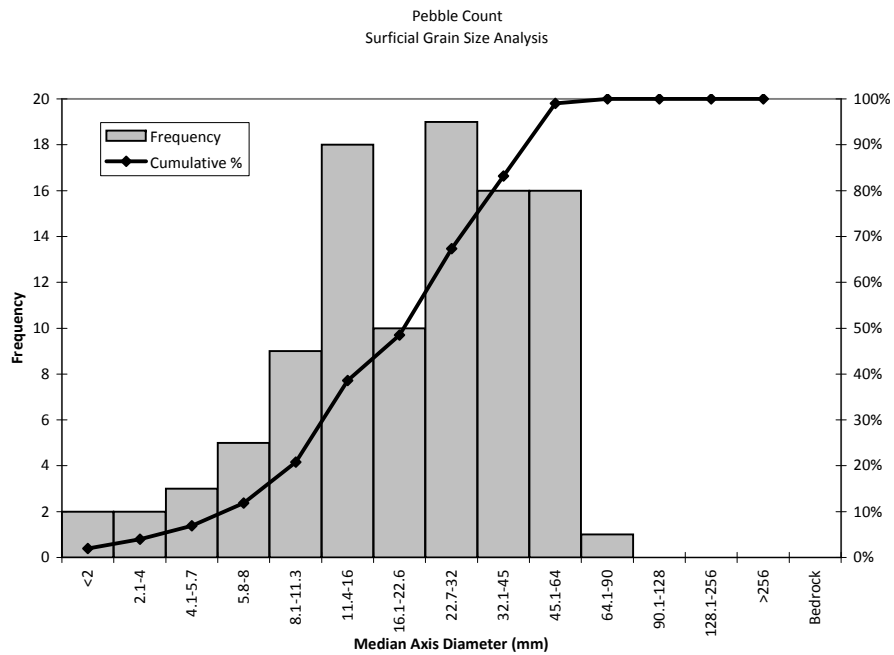
Sediment Grain Size Analysis

Dry	Stream	**9/1/2009**	Date
2	Reach	N. Nelson	Personnel
	Location		Latitude
320	Identifier / Unit		Longitude
Riffle	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
Surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	2	2.0%
Very Fine Gravel	2.1-4	2	4.0%
Fine Gravel	4.1-5.7	3	6.9%
Fine Gravel	5.8-8	5	11.9%
Medium Gravel	8.1-11.3	9	20.8%
Medium Gravel	11.4-16	18	38.6%
Coarse Gravel	16.1-22.6	10	48.5%
Coarse Gravel	22.7-32	19	67.3%
Very Coarse Gravel	32.1-45	16	83.2%
Very Coarse Gravel	45.1-64	16	99.0%
Small Cobble	64.1-90	1	100.0%
Small Cobble	90.1-128	0	100.0%
Large Cobble	128.1-256	0	100.0%
Small Boulders	>256	0	100.0%
Bedrock	Bedrock	0	100.0%
	Total	101	



Location (Stream, Reach, Description)

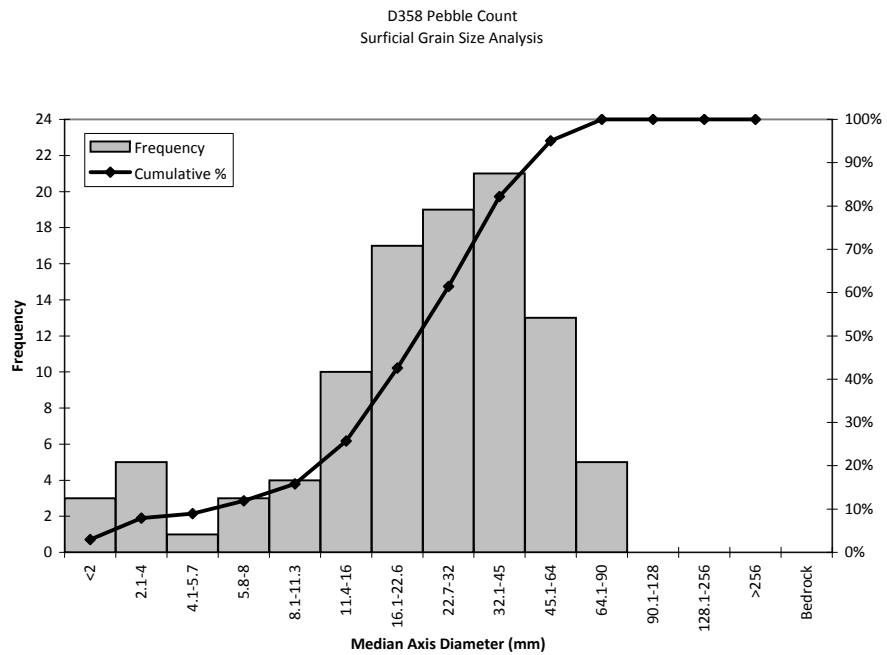
Sediment Grain Size Analysis

Dry	Stream	**9/1/2009**	Date
1	Reach	N. Nelson	Personnel
	Location		Latitude
358	Identifier / Unit		Longitude
Riffle	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
Surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:
Riffle below Mill Creek

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	3	3.0%
Very Fine Gravel	2.1-4	5	7.9%
Fine Gravel	4.1-5.7	1	8.9%
Fine Gravel	5.8-8	3	11.9%
Medium Gravel	8.1-11.3	4	15.8%
Medium Gravel	11.4-16	10	25.7%
Coarse Gravel	16.1-22.6	17	42.6%
Coarse Gravel	22.7-32	19	61.4%
Very Coarse Gravel	32.1-45	21	82.2%
Very Coarse Gravel	45.1-64	13	95.0%
Small Cobble	64.1-90	5	100.0%
Small Cobble	90.1-128	0	100.0%
Large Cobble	128.1-256	0	100.0%
Small Boulders	>256	0	100.0%
Bedrock	Bedrock	0	100.0%
	Total	101	



Location (Stream, Reach, Description)

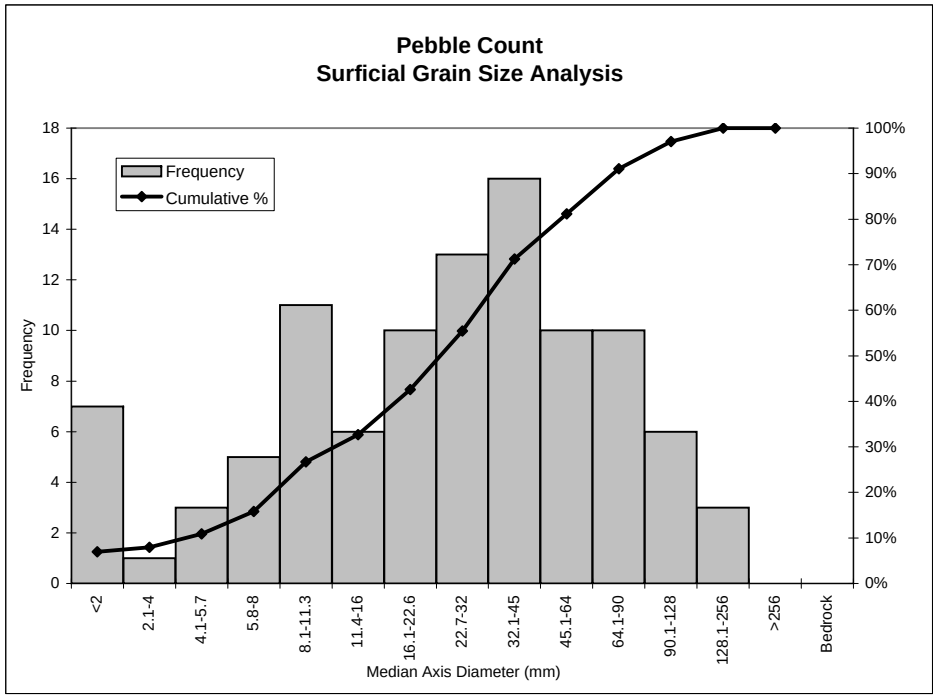
Sediment Grain Size Analysis

Pena	Stream	**8/27/2009**	Date
	Reach	Brunfelt	Personnel
	Location		Latitude
	Identifier / Unit		Longitude
	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:
Trib to Dry Creek that enters at reach break between R17 and R16 at D78

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	7	6.9%
Very Fine Gravel	2.1-4	1	7.9%
Fine Gravel	4.1-5.7	3	10.9%
Fine Gravel	5.8-8	5	15.8%
Medium Gravel	8.1-11.3	11	26.7%
Medium Gravel	11.4-16	6	32.7%
Coarse Gravel	16.1-22.6	10	42.6%
Coarse Gravel	22.7-32	13	55.4%
Very Coarse Gravel	32.1-45	16	71.3%
Very Coarse Gravel	45.1-64	10	81.2%
Small Cobble	64.1-90	10	91.1%
Small Cobble	90.1-128	6	97.0%
Large Cobble	128.1-256	3	100.0%
Small Boulders	>256	0	100.0%
Bedrock	Bedrock	0	100.0%
	Total	101	



Location (Stream, Reach, Description)

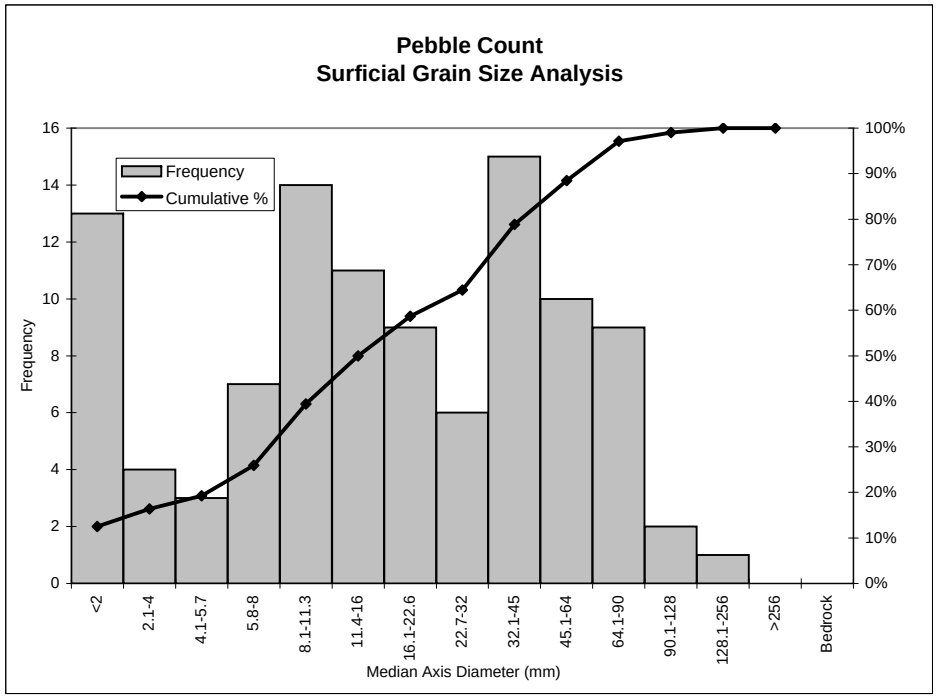
Sediment Grain Size Analysis

Fall	Stream	**8/27/2009**	Date
	Reach	Brunfelt	Personnel
	Location		Latitude
	Identifier / Unit		Longitude
	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:
Tributary to Dry Creek enters at GPS D42 at the v/s end of R18

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	13	12.5%
Very Fine Gravel	2.1-4	4	16.3%
Fine Gravel	4.1-5.7	3	19.2%
Fine Gravel	5.8-8	7	26.0%
Medium Gravel	8.1-11.3	14	39.4%
Medium Gravel	11.4-16	11	50.0%
Coarse Gravel	16.1-22.6	9	58.7%
Coarse Gravel	22.7-32	6	64.4%
Very Coarse Gravel	32.1-45	15	78.8%
Very Coarse Gravel	45.1-64	10	88.5%
Small Cobble	64.1-90	9	97.1%
Small Cobble	90.1-128	2	99.0%
Large Cobble	128.1-256	1	100.0%
Small Boulders	>256	0	100.0%
Bedrock	Bedrock	0	100.0%
	Total	104	



Location (Stream, Reach, Description)

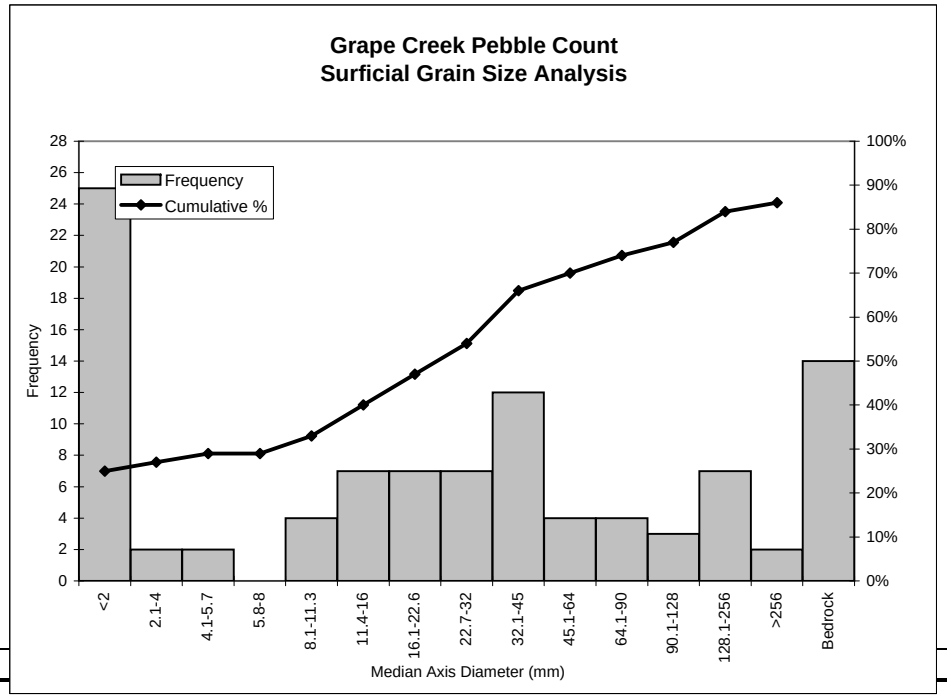
Sediment Grain Size Analysis

Grape	Stream	**8/29/2009**	Date
	Reach	Brunfelt	Personnel
	Location		Latitude
	Identifier / Unit		Longitude
	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	25	25.0%
Very Fine Gravel	2.1-4	2	27.0%
Fine Gravel	4.1-5.7	2	29.0%
Fine Gravel	5.8-8	0	29.0%
Medium Gravel	8.1-11.3	4	33.0%
Medium Gravel	11.4-16	7	40.0%
Coarse Gravel	16.1-22.6	7	47.0%
Coarse Gravel	22.7-32	7	54.0%
Very Coarse Gravel	32.1-45	12	66.0%
Very Coarse Gravel	45.1-64	4	70.0%
Small Cobble	64.1-90	4	74.0%
Small Cobble	90.1-128	3	77.0%
Large Cobble	128.1-256	7	84.0%
Small Boulders	>256	2	86.0%
Bedrock	Bedrock	14	100.0%
	Total	100	



Location (Stream, Reach, Description)

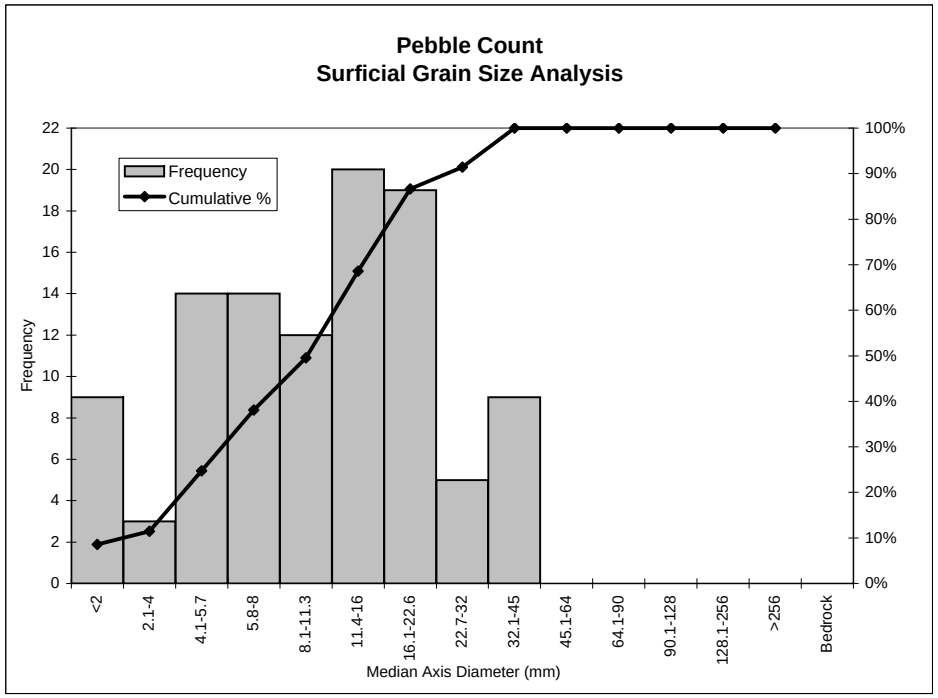
Sediment Grain Size Analysis

Kelly	Stream	**8/30/2009**	Date
	Reach	N. Nelson & J. Mullen	Personnel
	Location		Latitude
	Identifier / Unit		Longitude
	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:
Kelly Creek is in the middle of unit #242

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	9	8.6%
Very Fine Gravel	2.1-4	3	11.4%
Fine Gravel	4.1-5.7	14	24.8%
Fine Gravel	5.8-8	14	38.1%
Medium Gravel	8.1-11.3	12	49.5%
Medium Gravel	11.4-16	20	68.6%
Coarse Gravel	16.1-22.6	19	86.7%
Coarse Gravel	22.7-32	5	91.4%
Very Coarse Gravel	32.1-45	9	100.0%
Very Coarse Gravel	45.1-64	0	100.0%
Small Cobble	64.1-90	0	100.0%
Small Cobble	90.1-128	0	100.0%
Large Cobble	128.1-256	0	100.0%
Small Boulders	>256	0	100.0%
Bedrock	Bedrock	0	100.0%
	Total	105	



Location (Stream, Reach, Description)

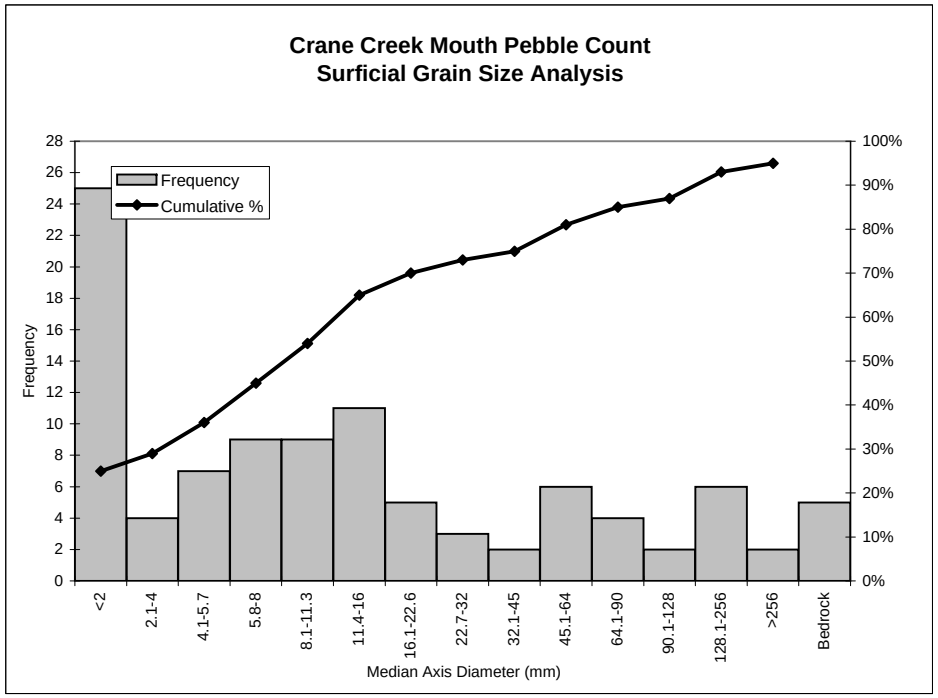
Sediment Grain Size Analysis

Crane	Stream	**8/31/2009**	Date
	Reach	N. Nelson & J. Mullen	Personnel
	Location		Latitude
	Identifier / Unit		Longitude
	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	25	25.0%
Very Fine Gravel	2.1-4	4	29.0%
Fine Gravel	4.1-5.7	7	36.0%
Fine Gravel	5.8-8	9	45.0%
Medium Gravel	8.1-11.3	9	54.0%
Medium Gravel	11.4-16	11	65.0%
Coarse Gravel	16.1-22.6	5	70.0%
Coarse Gravel	22.7-32	3	73.0%
Very Coarse Gravel	32.1-45	2	75.0%
Very Coarse Gravel	45.1-64	6	81.0%
Small Cobble	64.1-90	4	85.0%
Small Cobble	90.1-128	2	87.0%
Large Cobble	128.1-256	6	93.0%
Small Boulders	>256	2	95.0%
Bedrock	Bedrock	5	100.0%
	Total	100	



Location (Stream, Reach, Description)

Sediment Grain Size Analysis

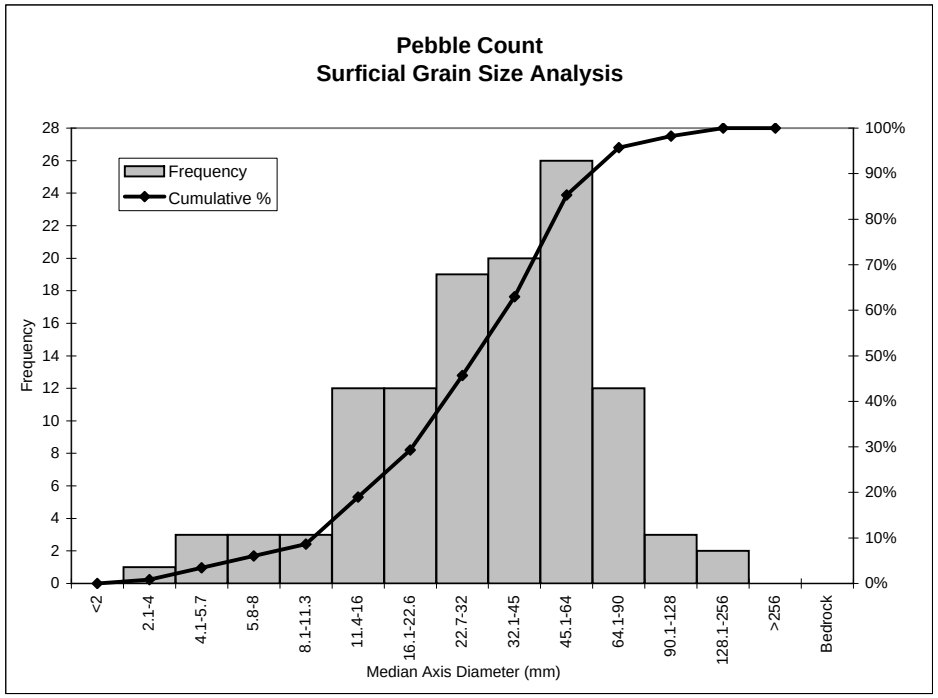
Pena Ck	Stream	**8/31/2009**	Date
	Reach	N. Nelson & J. Mullen	Personnel
near bridge	Location		Latitude
	Identifier / Unit		Longitude
	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:

Pebble count taken under and upstream ~ 60 feet
Very simiar size distrubution to what sampled all the way down below Mill C
Mill Creek, little larger w/ some 128 mm. due to slope?

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	0	.0%
Very Fine Gravel	2.1-4	1	.9%
Fine Gravel	4.1-5.7	3	3.4%
Fine Gravel	5.8-8	3	6.0%
Medium Gravel	8.1-11.3	3	8.6%
Medium Gravel	11.4-16	12	19.0%
Coarse Gravel	16.1-22.6	12	29.3%
Coarse Gravel	22.7-32	19	45.7%
Very Coarse Gravel	32.1-45	20	62.9%
Very Coarse Gravel	45.1-64	26	85.3%
Small Cobble	64.1-90	12	95.7%
Small Cobble	90.1-128	3	98.3%
Large Cobble	128.1-256	2	100.0%
Small Boulders	>256	0	100.0%
Bedrock	Bedrock	0	100.0%
	Total	116	



Location (Stream, Reach, Description)

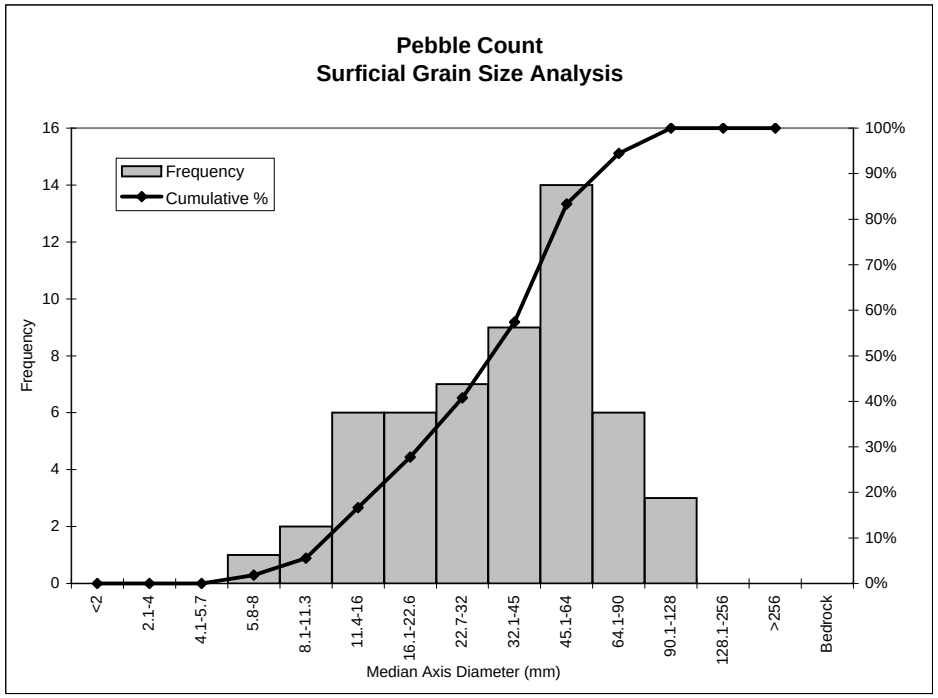
Sediment Grain Size Analysis

Dry Creek	Stream	**8/28/2009**	Date
	Reach	Brunfelt	Personnel
Dp 28	Location		Latitude
	Identifier / Unit		Longitude
	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:
In yellow book, no Reach number.
Pool filled with Pea Gravel

Pebble Count Data

Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	0	.0%
Very Fine Gravel	2.1-4	0	.0%
Fine Gravel	4.1-5.7	0	.0%
Fine Gravel	5.8-8	1	1.9%
Medium Gravel	8.1-11.3	2	5.6%
Medium Gravel	11.4-16	6	16.7%
Coarse Gravel	16.1-22.6	6	27.8%
Coarse Gravel	22.7-32	7	40.7%
Very Coarse Gravel	32.1-45	9	57.4%
Very Coarse Gravel	45.1-64	14	83.3%
Small Cobble	64.1-90	6	94.4%
Small Cobble	90.1-128	3	100.0%
Large Cobble	128.1-256	0	100.0%
Small Boulders	>256	0	100.0%
Bedrock	Bedrock	0	100.0%
	Total	54	



Location (Stream, Reach, Description)

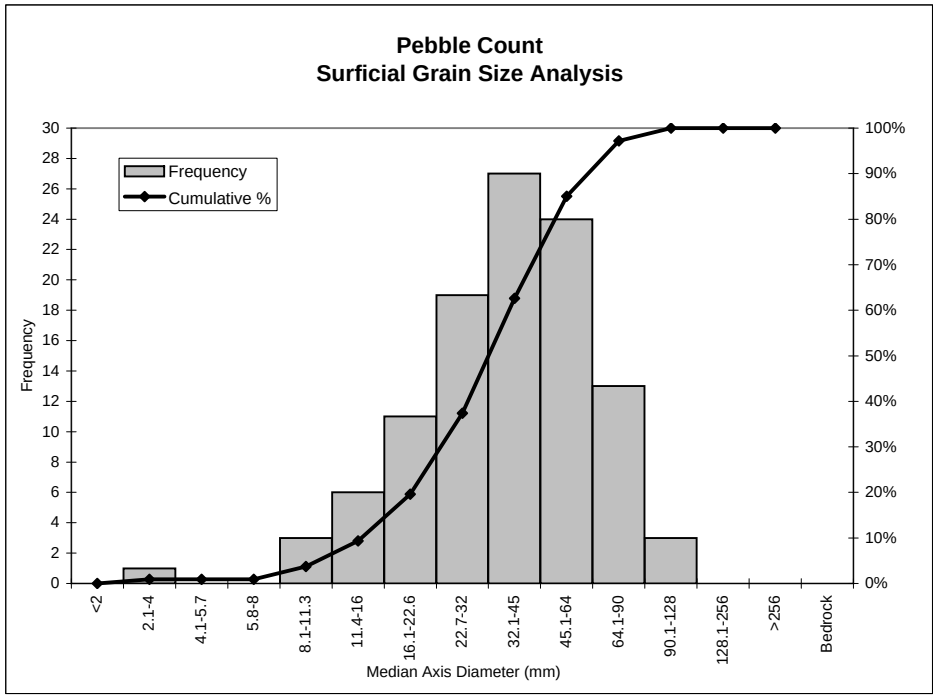
Sediment Grain Size Analysis

Dry Creek	Stream	**8/28/2009**	Date
1	Reach	Brunfelt	Personnel
below Mill Creek	Location		Latitude
	Identifier / Unit		Longitude
	Longitudinal Description (Pool, Riffle, Bend, Crossing)		Northing
surficial	Sample Type: Armor Layer or Subarmor		Easting
	Approximate Depth of Flow at Thalweg (ft)		Waypoint

Notes:
Below Mill Creek

Pebble Count Data

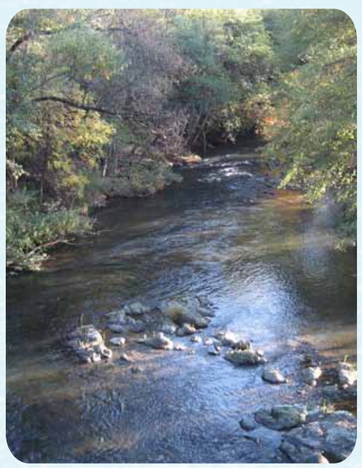
Class (Wentworth)	*Size Class mm*	*Frequency*	*Cumulative %*
Sand	<2	0	.0%
Very Fine Gravel	2.1-4	1	.9%
Fine Gravel	4.1-5.7	0	.9%
Fine Gravel	5.8-8	0	.9%
Medium Gravel	8.1-11.3	3	3.7%
Medium Gravel	11.4-16	6	9.3%
Coarse Gravel	16.1-22.6	11	19.6%
Coarse Gravel	22.7-32	19	37.4%
Very Coarse Gravel	32.1-45	27	62.6%
Very Coarse Gravel	45.1-64	24	85.0%
Small Cobble	64.1-90	13	97.2%
Small Cobble	90.1-128	3	100.0%
Large Cobble	128.1-256	0	100.0%
Small Boulders	>256	0	100.0%
Bedrock	Bedrock	0	100.0%
	Total	107	



Appendix D-2

Dry Creek Conceptual design

DRAFT



Dry Creek

Habitat Enhancement Demonstration Projects

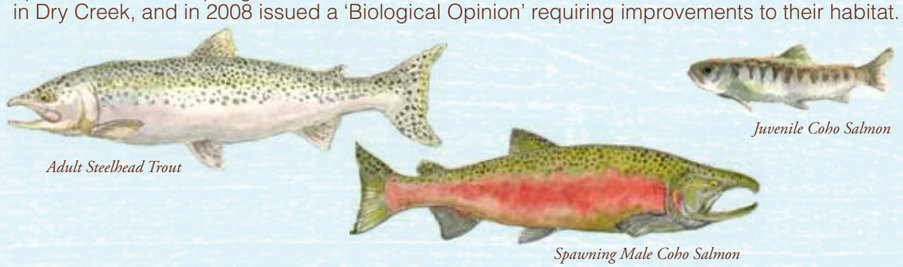
Concept Designs

Introduction

Dry Creek meanders through a pastoral landscape to where it meets the Russian River near the town of Healdsburg in Sonoma County, California. The fertile land along its banks has long been used for agriculture, and that tradition continues today. The Dry Creek Valley is renowned for producing some of the world's finest wines.

The waters of Dry Creek flow 14 miles from the Warm Springs Dam to the mouth of the Russian River. The dam is operated by the Army Corps of Engineers to control floods and for recreation, and by the Sonoma County Water Agency to supply potable water to 600,000 consumers in Sonoma and northern Marin Counties.

Dry Creek is home to native threatened and endangered fish, including coho salmon, Chinook salmon, and steelhead trout. The National Marine Fisheries Service has determined that the operation of Warm Springs Dam could threaten the survival of coho salmon and steelhead trout in Dry Creek, and in 2008 issued a 'Biological Opinion' requiring improvements to their habitat.



Adult Steelhead Trout

Juvenile Coho Salmon

Spawning Male Coho Salmon

These fish are most vulnerable in their juvenile phase as they prepare to swim out to the ocean as small, young fish called 'smolts.' In order to thrive, they need slow water and diverse habitat in summer, and places to rest and take refuge during the high flow dam releases that occur in winter. All of these crucial habitat elements are in short supply in the Dry Creek of current times. This booklet discusses a conceptual plan to re-create these rare habitats.

The Biological Opinion lays out a timeline for the habitat work, which will ultimately result in over six miles of habitat enhancement in Dry Creek by 2020. A group of cooperating landowners in the Dry Creek Valley has come together with the Sonoma County Water Agency to begin planning the implementation of the first phase of these enhancements. This will be accomplished through a series of 'demonstration' projects within a 1.1 mile length of Dry Creek in the middle of the valley, extending from the mouth of Grape Creek downstream to the mouth of Crane Creek. Construction of the demonstration projects is scheduled to begin in 2011.

Implementation of the demonstration projects is an important first step in the longer-term process of improving habitat conditions in Dry Creek. This series of projects provides an opportunity to showcase fish habitat enhancement approaches that may be used elsewhere in Dry Creek over the next decade.

The following pages summarize the enhancement approaches that will be implemented along the 1.1 mile "Demonstration Reach" of Dry Creek. To start, we'll describe the current conditions in Dry Creek and why suitable habitat for juvenile coho and steelhead is lacking. In subsequent pages, we'll describe the proposed enhancements – first in general, and then in site-specific detail.

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Questions & Answers ..... 19 - 20

Dry Creek Today

Conditions that exist in Dry Creek today have resulted from 150 years of settlement, land use and stream management in the area. Historically, Dry Creek was nearly dry or had very low streamflow in the summer, and in the winter, would flood dramatically, though infrequently. The name 'Dry Creek' comes from those times.

Beginning in the 1850s, many of the forested areas of the upper valley were cut, which increased the rate at which water, soil and gravel were delivered to the valley. This caused the creek bed to cut down into the valley bottom through a stream process called 'incision.' During the 1900s, construction of dams and gravel mining on the Russian River indirectly accelerated the incision of Dry Creek's stream bed, which in turn caused many streambanks to erode. The creek bed between the two streambanks was generally bare gravel and sand, as the creek continued to nearly dry out each year.

Pre-dam image of Dry Creek.

In the 1970s and 1980s, Warm Springs Dam was constructed at the junction of Dry Creek and Warm Springs Creek. Its operation began in 1984 to provide flood control in the winter, and to store water year-round for municipal, domestic and industrial uses.

Warm Springs Dam.

The dam has affected Dry Creek in many ways. First, it has reduced the severity of floods. However, high flow periods now typically last longer than before the dam was constructed, and the stream flows at a much higher level through the summer. The dam also blocks gravel and cobbles from flowing to the lower valley. With smaller floods and higher summer flows, many areas of the streambed that had been bare now support dense vegetation.

Stream conditions in Dry Creek today are similar to what can be seen in many other streams that have been incised or confined between levees and streambank revetments. This confinement impairs the natural formation of essential fish habitat. The result in Dry Creek is that pools, runs and glides are quite long for a stream its size. These areas also have swifter velocities and poor habitat quality, resulting in a stressful environment for young coho salmon and steelhead when they are at their most vulnerable.

Deep, swift, long pool with dense vegetation.

Riffle habitats, which are important fish food production areas of the stream, are only present in a proportionally small area. The dense vegetative growth, which often provides many benefits to a stream, is no longer pruned by annual flood events. This lack of pruning further confines streamflow and contributes to reduced quality of fish habitat. Though many areas that had been subject to erosion have stabilized, other areas are still vulnerable to streambank erosion. This includes places where the stream flows up against tall streambanks, or breaks through the vegetative growth into bare areas.

Bank erosion on Dry Creek.

DRAFT

Improving Dry Creek: The Enhancement Toolbox

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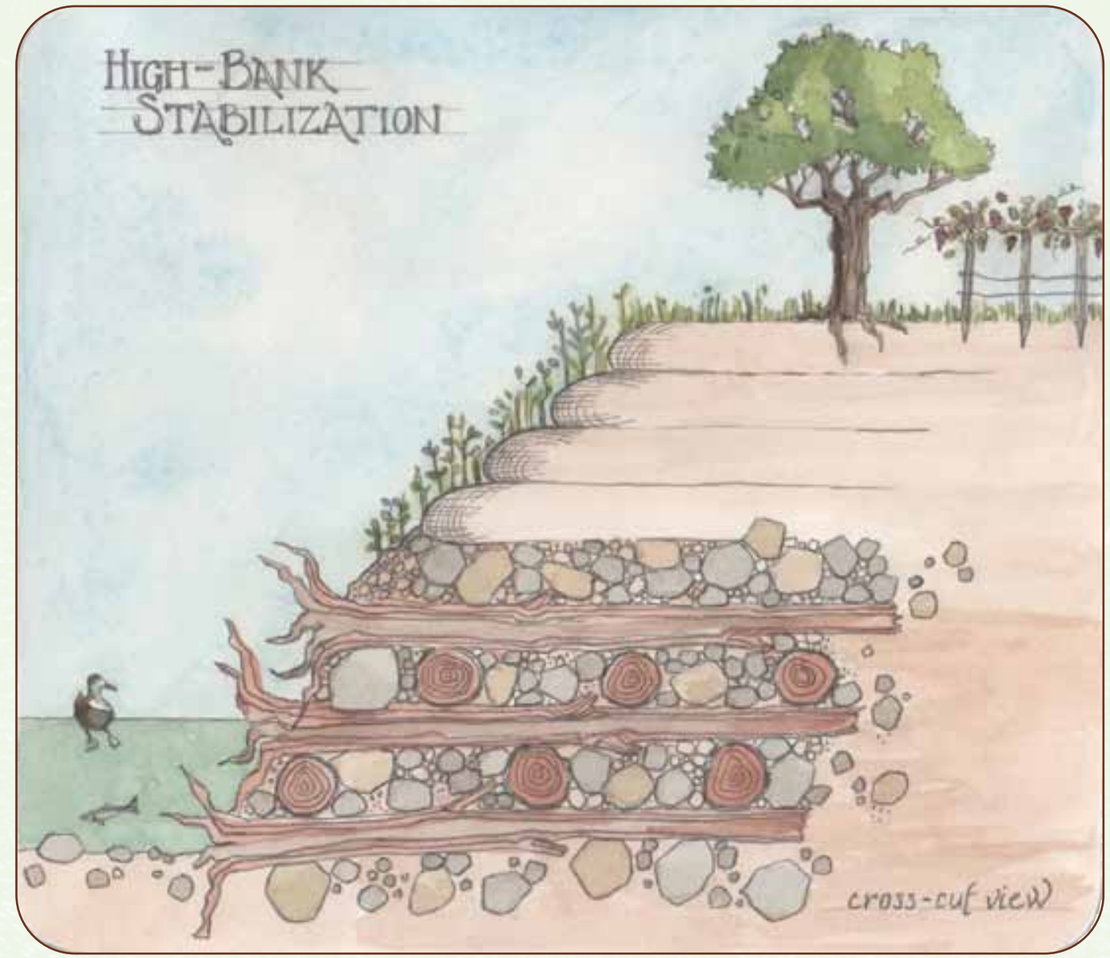
Enhancements in the Demonstration Reach will emphasize natural stream characteristics, or geomorphology, which refers to the manner in which water and sediment combine to create habitat features friendly to fish. By using enhancement practices that emulate natural geomorphic conditions, the benefits provided to young coho and steelhead and their longevity are optimized.

The following illustrations describe typical enhancement practices – the 'tools' in the enhancement 'toolbox.' These may be repeated in isolation at several locations, or in varying combinations, depending on the geomorphic conditions specific to of each site. In subsequent pages, we'll show how these 'tools' would be applied to the demonstration reach.

Streambank Stabilization

This solution is applied in areas of bank erosion to retain valuable property and to enhance the habitat characteristics along the edge of the stream. Two similar, yet slightly different approaches will be used on Dry Creek:

1. For low streambanks (less than six to seven feet tall), eroding materials will be excavated and the streambank rebuilt with a combination of logs, boulders, cobbles and soil. The area is then planted with native riparian vegetation. This forms a very durable, habitat-friendly streambank.



2. For high streambanks (greater than seven feet tall), the base of the streambank will be rebuilt in a manner similar to what was described for low streambanks. The upper part of the streambank will also be rebuilt with a technique that encapsulates soil in strong fabric blankets made from coconut fiber. Native plants are planted right through the fabric. After three to five years, the blankets decompose and the native vegetation takes over the role of stabilizing the upper part of the streambank. This approach also forms a very durable, habitat-friendly streambank that serves to protect valuable property.

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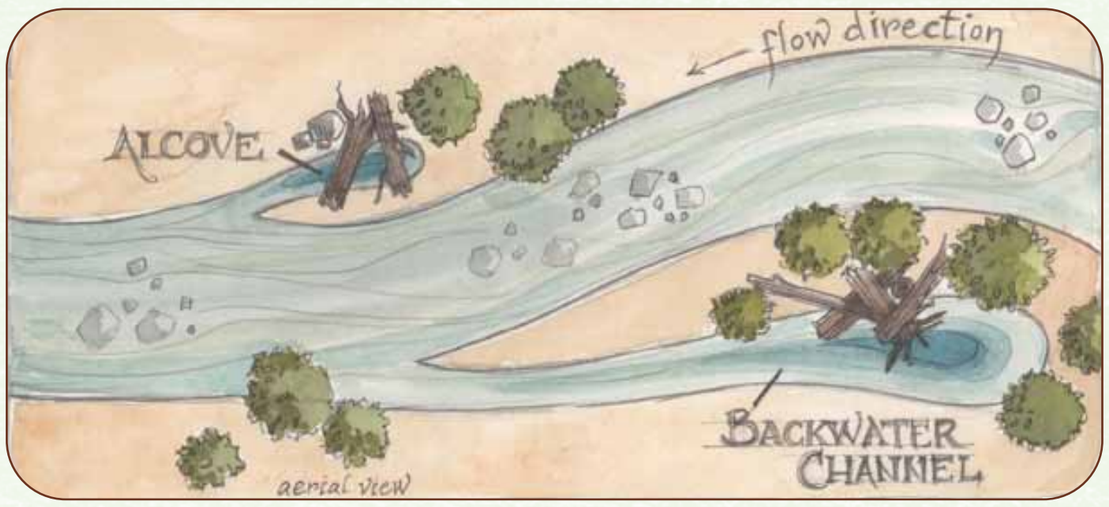
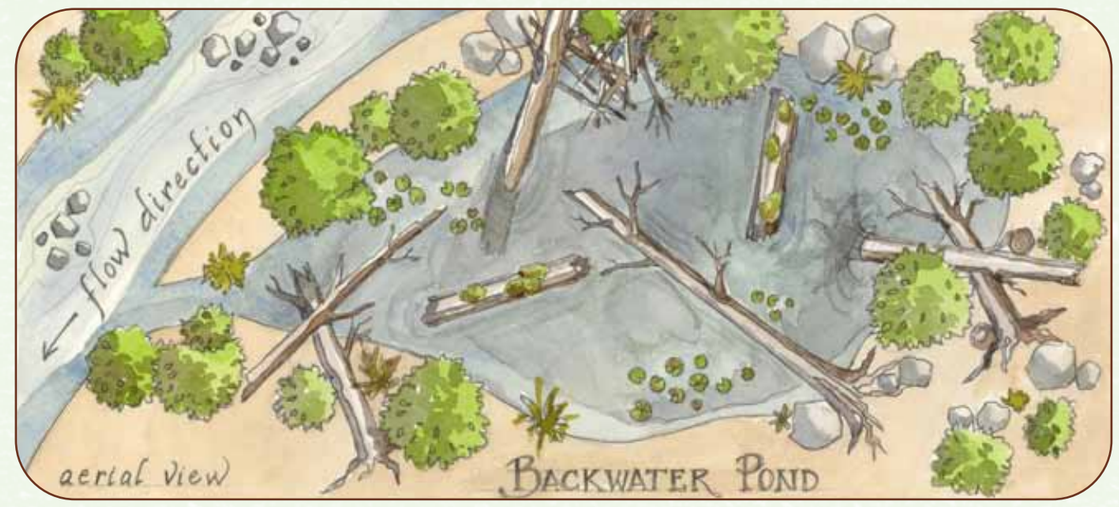
Backwater Channels, Alcoves, & Ponds

Backwater channels, alcoves and ponds are areas off to the side of the stream that in summer connect to the main stream only at their downstream end. During this time, water backs into these areas, and has very low or no current. In addition to still waters, logs that protrude into or float on the water, in combination with floating and submerged vegetation, and surrounding tall vegetation make these areas very attractive to young fish, particularly coho salmon. They use these areas to search for food, to rest and to avoid predators. During winter periods, these backwater areas will continue to have quiet water despite occasional flows moving through them. In Dry Creek, this type of habitat will be primarily constructed in wider areas of the creek. Construction of these areas will include excavation to form the channel, pool or ponds, and include placement of logs at appropriate locations, planting of aquatic vegetation and management of surrounding vegetation.





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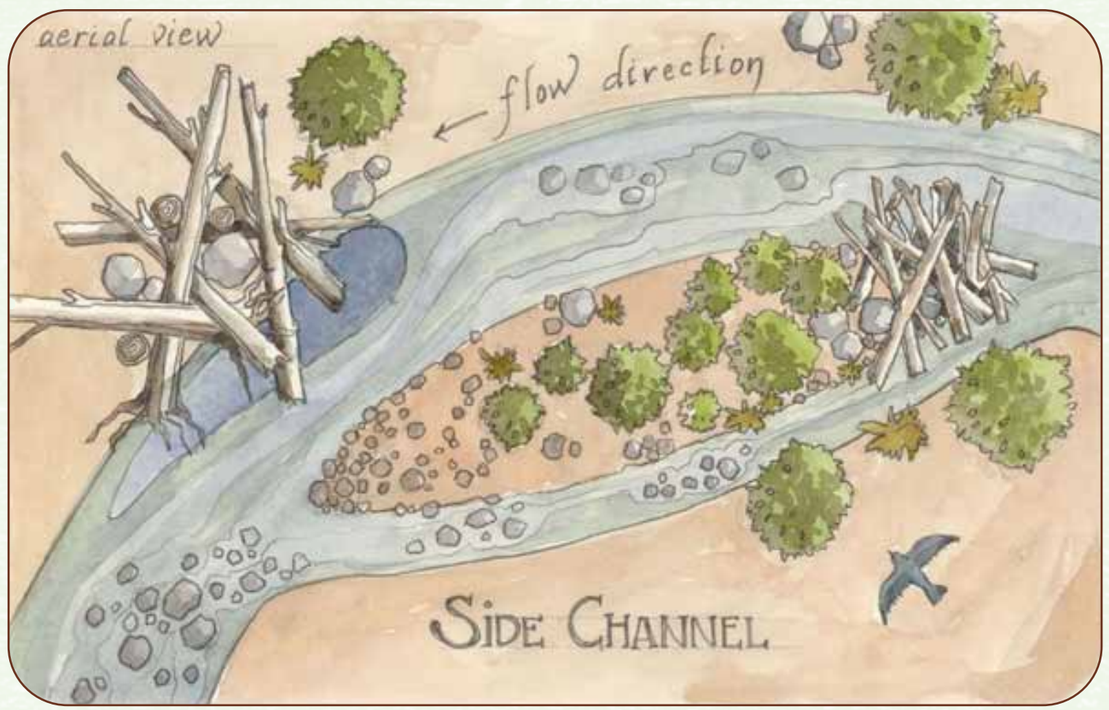
Side Channels

Side channels run parallel to the main stream and connect to the main stream at both ends, even during the summer. The flow of the stream is split between the two channels. This serves to reduce the stream current, which in combination with pools and logs in the water, make these areas attractive to coho salmon and steelhead trout. The fish use these areas to search for food, to rest and to avoid predators. In Dry Creek, this type of habitat will also be primarily constructed in wider areas of the creek. In some of these areas, old abandoned channels may be excavated to provide enhanced side channels. Construction of these areas will entail excavation to form the channel and pools, placement of logs at appropriate locations, and management of the surrounding vegetation.



Log Jams

A log jam is an accumulation of logs that may be constructed in an area where it would be beneficial to initiate or stabilize a turn or fork in the channel. The log jam serves to anchor the stream's location by being an immobile object along one or both banks, acting similar to a bridge abutment or a natural bedrock outcrop. Deep pools may form next to log jams through the interaction of the logs and flowing water, creating excellent fish habitat. To create a log jam, an area is excavated and then logs are stacked and knit together with boulders and "snags" (trunks of dead trees that remain standing vertical to the horizon). This combination stabilizes the log jam during floods.

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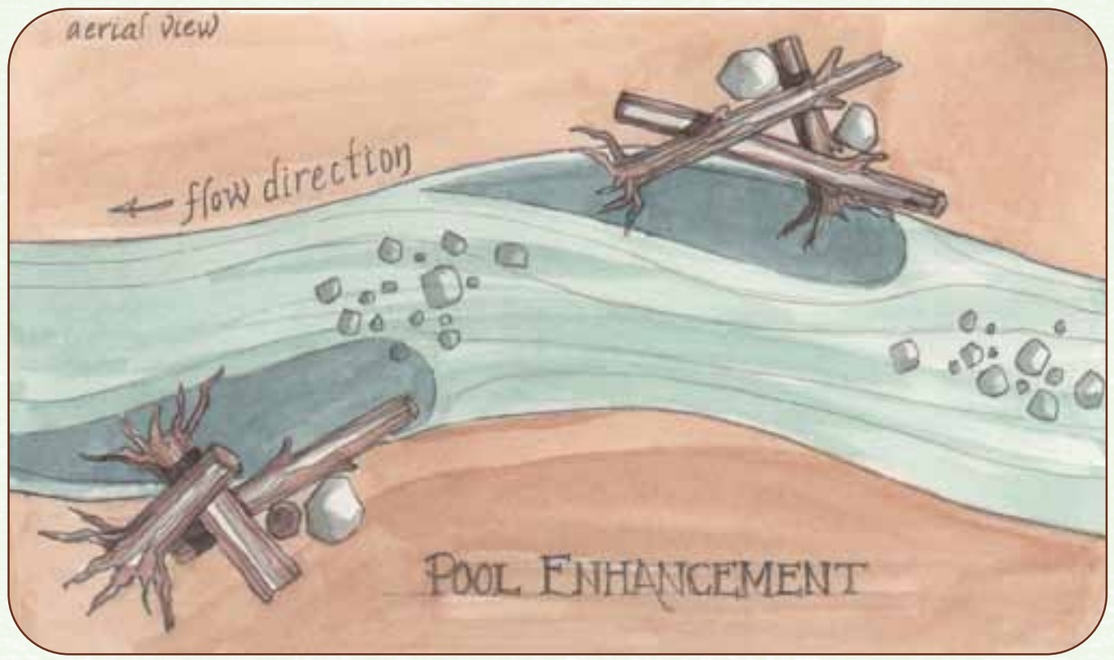
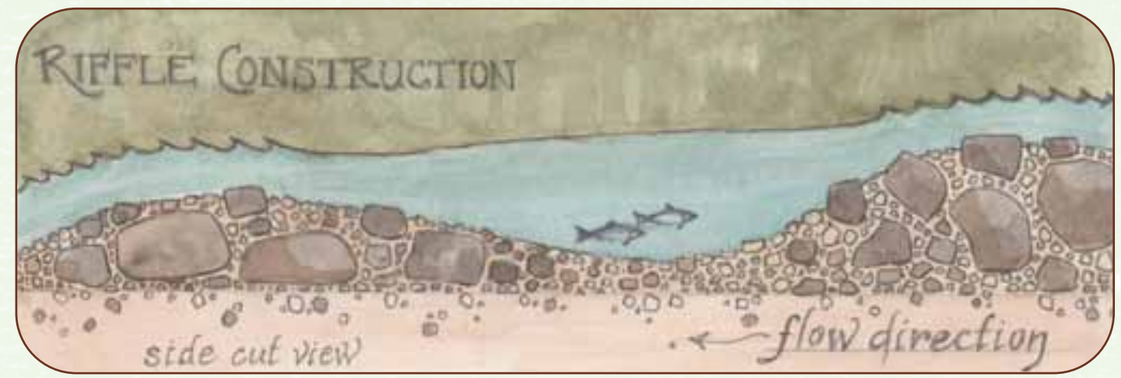
Pool Enhancement

Pools are deeper areas of the stream. In a healthy stream, pools provide key habitat for young fish because currents are slow, the flow patterns are diverse, and fish can hide beneath logs that project into the water. Pool enhancement in Dry Creek will act to increase the variety of habitat for young fish, and create areas that have sheltered currents that young fish prefer. This will be accomplished through selective grading of existing pool features and the installation of logs in the water.



Riffle Construction

Riffles are areas where the streambed is steeper and the current is swift. Riffles play a key role in controlling the elevation of the streambed and releasing the stream's energy to slow the current flowing through adjoining pools. They also serve as the stream's grocery store, as much of the food produced in a stream comes from these places. Construction of riffles in Dry Creek will improve the quality of the adjoining pools for fish and stabilize the stream bed while providing the fish with a wider variety of things to eat. Riffles are constructed by building mounds of small boulders, cobbles, gravel and sand across the stream.



Riparian Vegetation Management

Dry Creek has extensive vegetative growth along the channel, which includes many non-native or invasive weed species. In some areas, overly dense stands of vegetation impair stream function by channelizing the flow of the creek and acting like a levee, which forces energy into the creek bed, and results in pools that are too long, with water that moves too swiftly. Riparian vegetation management will include selective thinning of existing vegetation, removal of invasive weeds, and in some cases, replanting of native vegetation.

The Demonstration Reach

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The 1.1 mile Demonstration Reach is located in the middle of the Dry Creek Valley, extending from the mouth of Grape Creek downstream to the mouth of Crane Creek (see photo 1, below). The landowners along this stretch of the creek have joined forces to begin planning the first phase of habitat enhancement on Dry Creek.

Implementation of habitat enhancement in this reach is an important first step in the longer-term process of improving habitat conditions in Dry Creek. This series of projects provides an opportunity to improve habitat while also showcasing a range of fish habitat enhancement approaches that may be used elsewhere in Dry Creek over the next decade. Construction of the demonstration projects is scheduled to begin in 2011.

In this document, the Demonstration Reach has been divided into 5 'sub-reaches' according to common characteristics (see photo 2, next page). The reaches are labeled according to their distance, in miles, above the mouth of Dry Creek. This distance is commonly referred to as 'river miles.' In the following pages, we'll show the proposed enhancements for each reach in site-specific detail.

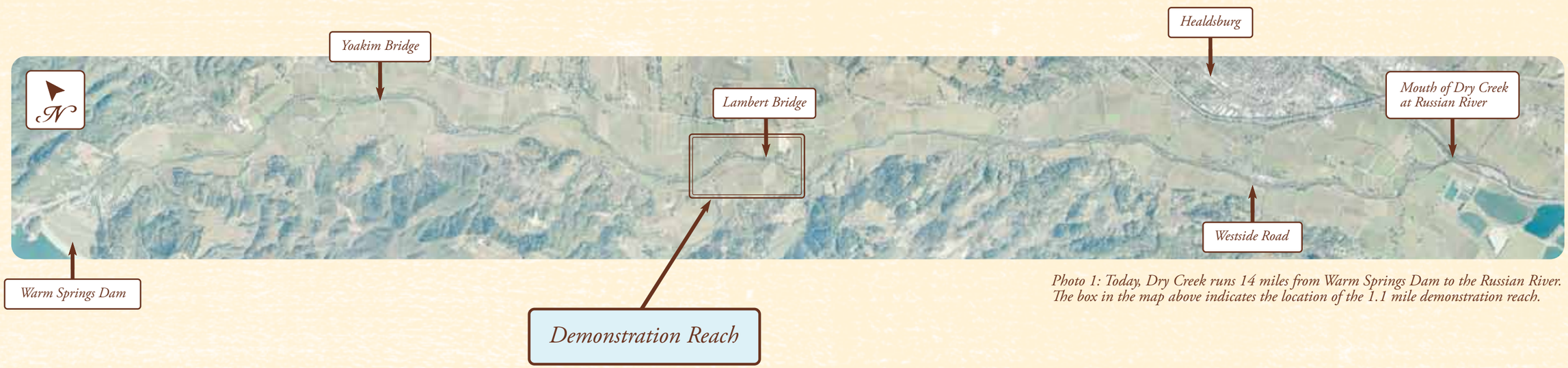


Photo 1: Today, Dry Creek runs 14 miles from Warm Springs Dam to the Russian River. The box in the map above indicates the location of the 1.1 mile demonstration reach.

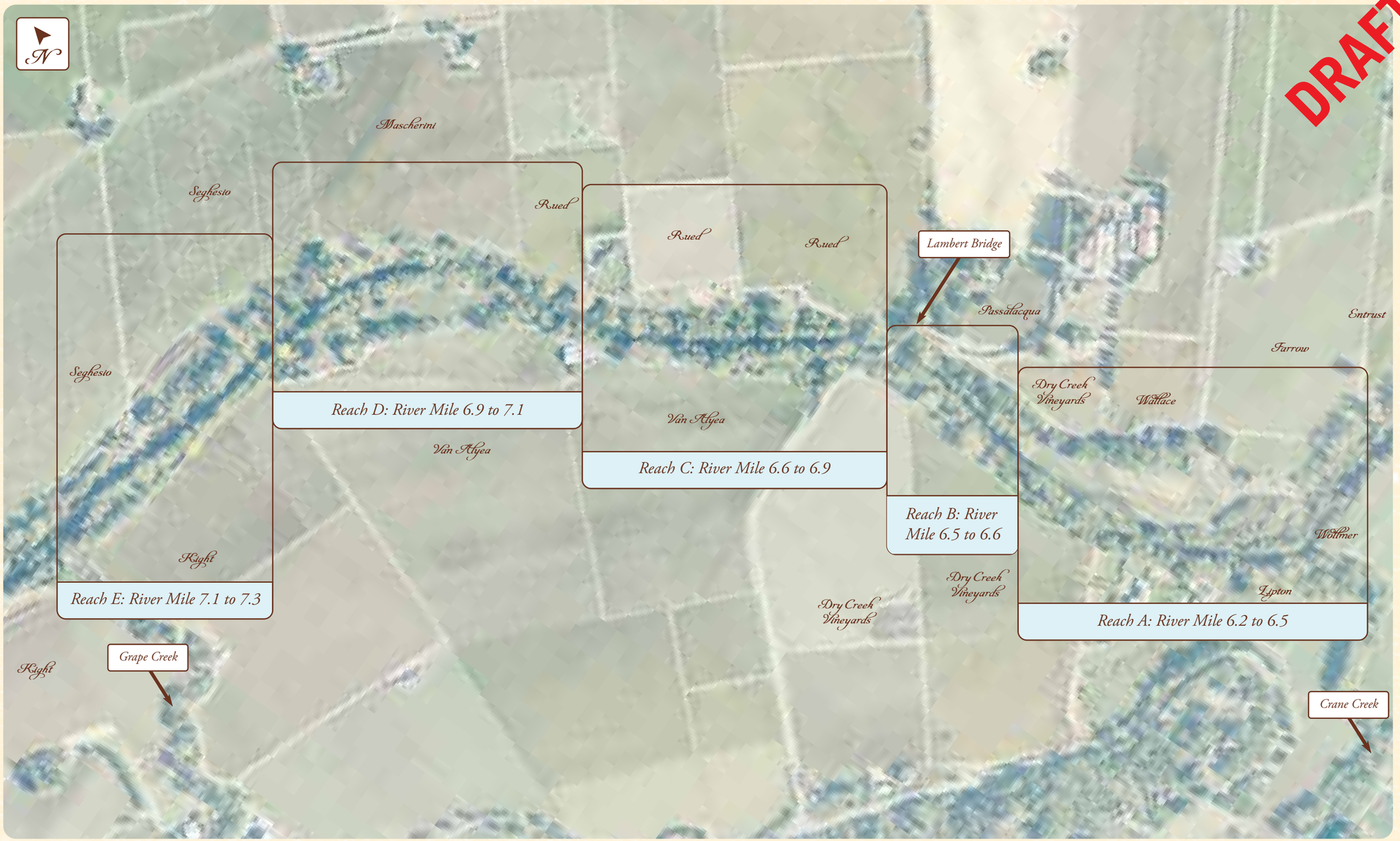


Photo #2: The 5 demonstration project sub-reaches.

Reach A

River Mile 6.2 to 6.5

This is one of the more complex and dynamic sub-reaches in the Demonstration Reach. It includes a series of riffles, glides and pools, one side channel that flows in the winter, and a large area where the creek used to flow and now only flows during very high winter floods. Crane Creek flows into a deep pool near the downstream end of the reach, and there is one area that is actively eroding. This sub-reach has a number of significant enhancement opportunities, including backwater and side channels, log jams, riffle construction, streambank stabilization and riparian vegetation management. The symbols below appear on the "Proposed Enhancement" photo (next page) to show which of the enhancements might be utilized and where. Enhancement solutions are described in detail on pages 3 through 6.

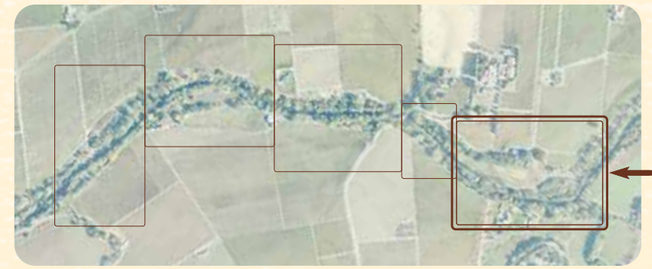
Streambank Stabilization

Riffle Construction

Backwater Channels

Log Jams

Riparian Vegetation Management



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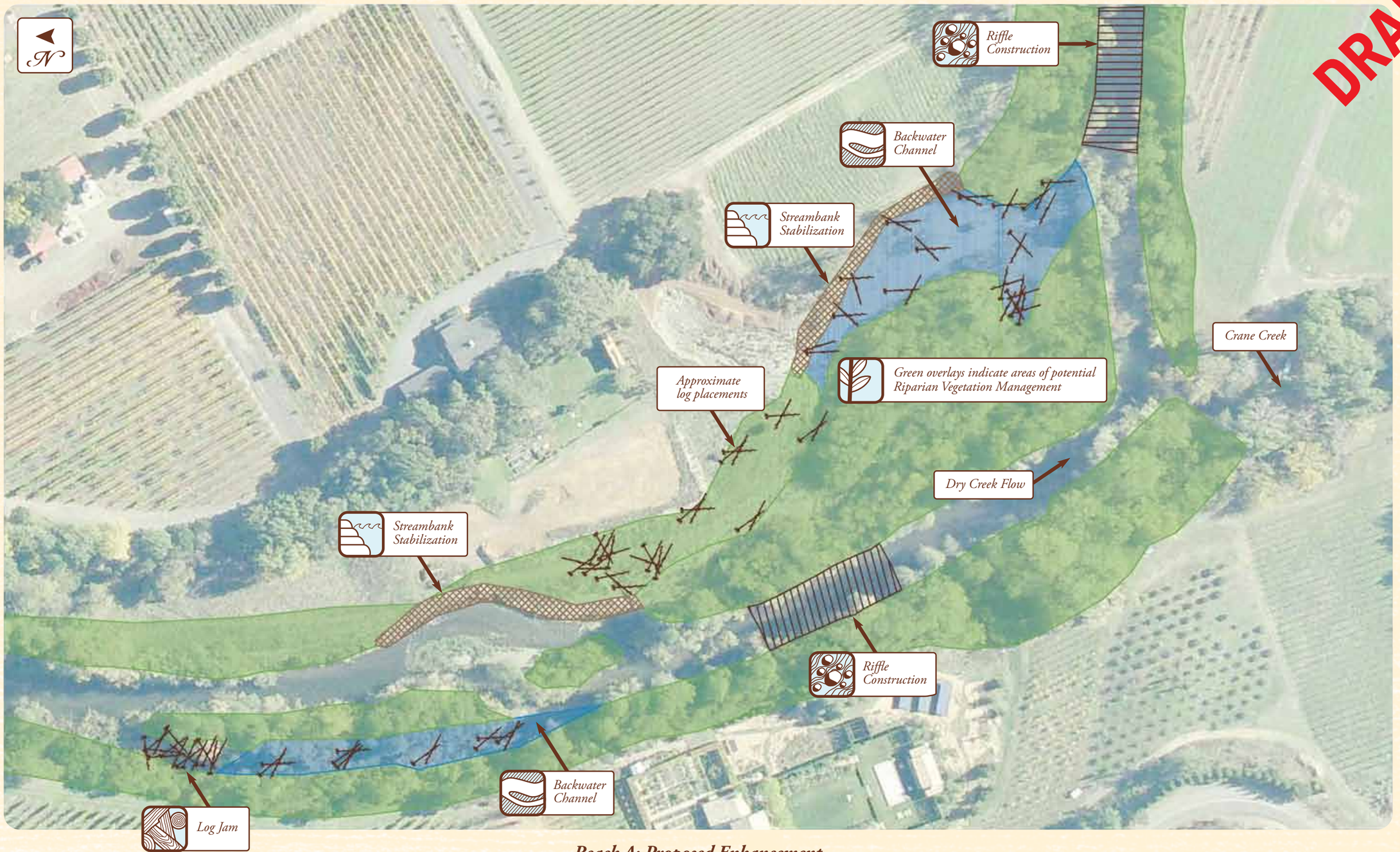
Reach A: Existing Condition

Scale: 1 inch equals 150 feet



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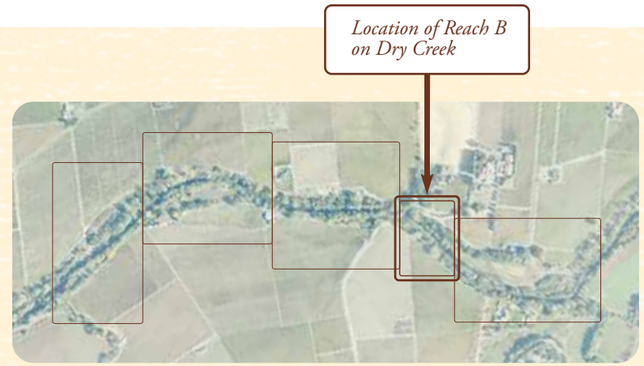
Reach A: Proposed Enhancement

Scale: 1 inch equals 100 feet

Reach B



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River Mile 6.5 to 6.6

This short sub-reach is immediately downstream of Lambert Bridge. In this area, the stream is confined and includes a small bedrock cascade and other bedrock outcrops, a short riffle, two glides and two pools. Enhancement opportunities in this subreach are limited to riparian vegetation management. The symbols below appear on the "Proposed Enhancement" photo (next page) to show where the enhancement might be utilized. Enhancement solutions are described in detail on pages 3 through 6.

Riparian Vegetation Management

Reach B: Existing Condition

Scale: 1 inch equals 150 feet

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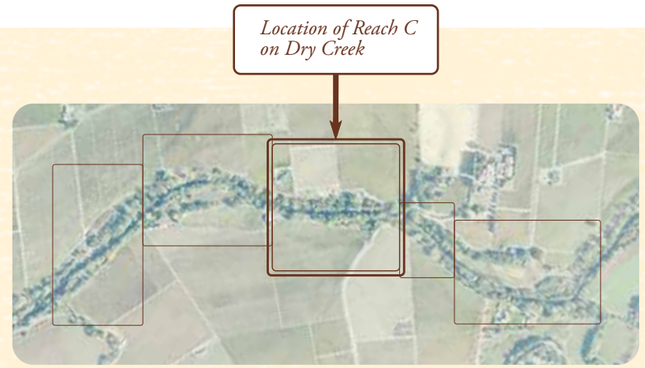
Reach B: Proposed Enhancement

Scale: 1 inch equals 100 feet

Reach C



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River Mile 6.6 to 6.9

This sub-reach is immediately upstream of Lambert Bridge. In this area, the stream is confined and includes a bedrock outcrop and one long pool. Enhancement opportunities in this subreach include riffle construction, pool enhancement, and riparian vegetation management. The symbols below appear on the "Proposed Enhancement" photo (next page) to show which of the enhancements might be utilized and where. Enhancement solutions are described in detail on pages 3 through 6.

Riffle Construction

Pool Enhancement

Riparian Vegetation Management

Reach C: Existing Condition

Scale: 1 inch equals 150 feet

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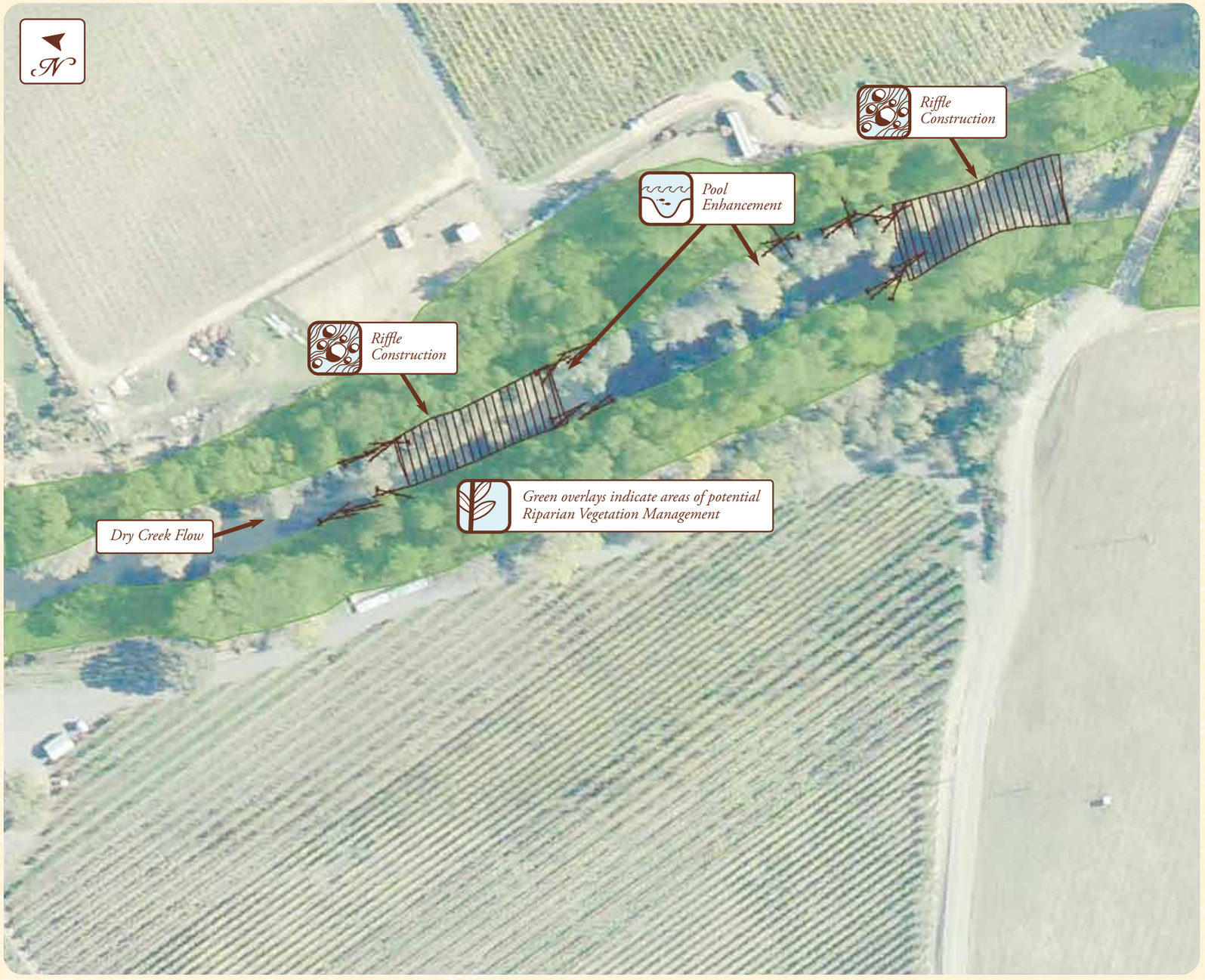
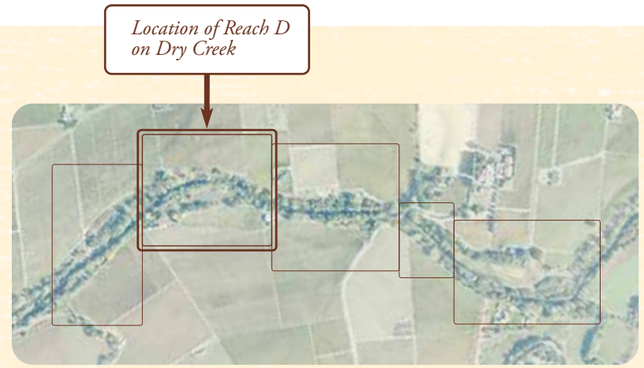


Reach C: Proposed Enhancement

Scale: 1 inch equals 100 feet

Reach D



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River Mile 6.9 to 7.1

This is one of the wider sub-reaches in the Demonstration Reach. It includes a series of short riffles, glides and pools, the beginning of a long pool that connects to Reach C, and a large area where the creek used to flow and now only flows during very high winter floods. The northeast bank has eroded and one area along that bank is actively eroding. This sub-reach has a number of significant enhancement opportunities, including a backwater channel or pond, pool enhancement, riffle construction, high streambank enhancement and riparian vegetation management. The symbols below appear on the "Proposed Enhancement" photo (next page) to show which of the enhancements might be utilized and where. Enhancement solutions are described in detail on pages 3 through 6.

Streambank Stabilization

Riffle Construction

Backwater Channels

Pool Enhancement

Riparian Vegetation Management

Reach D: Existing Condition
Scale: 1 inch equals 150 feet

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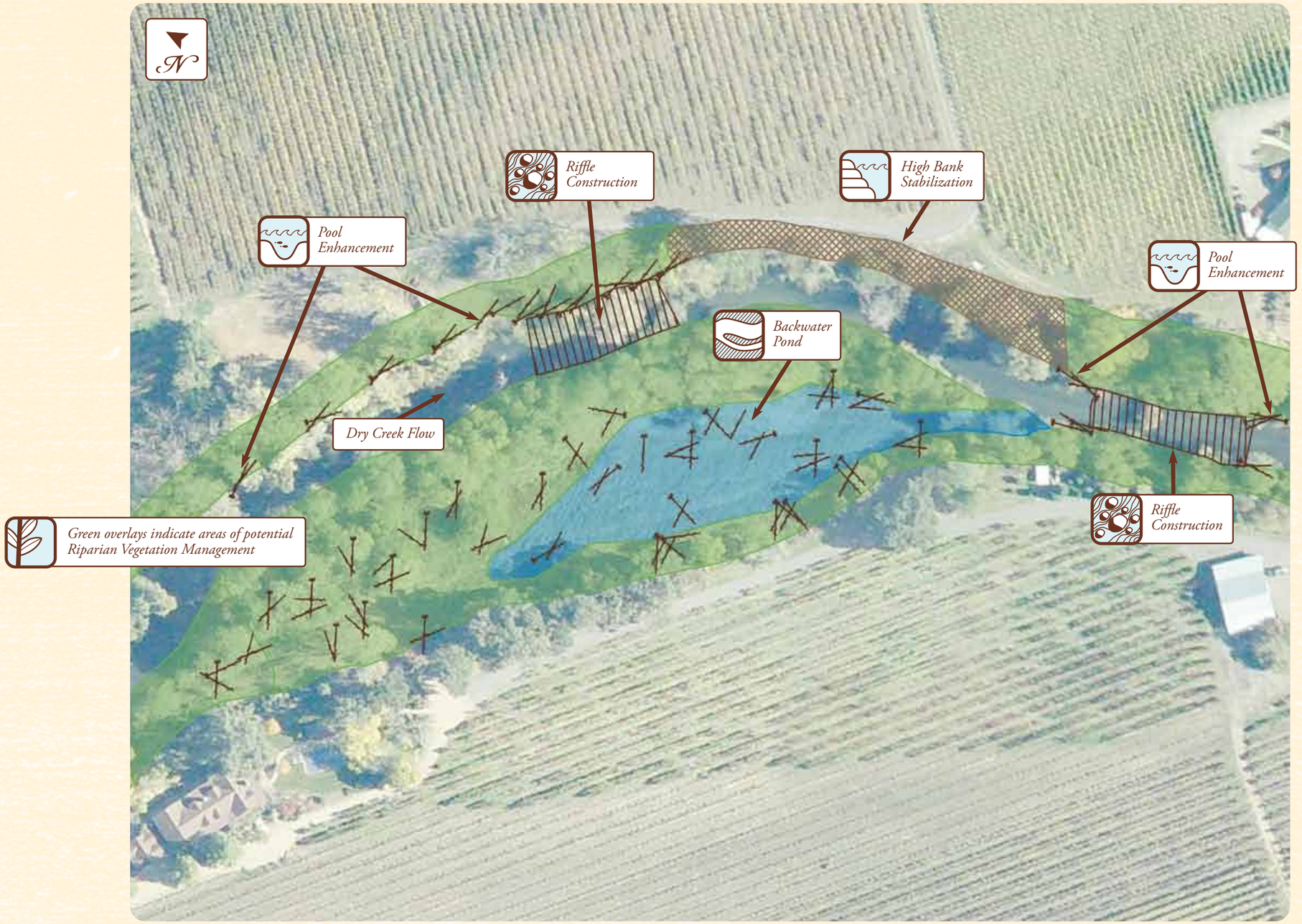
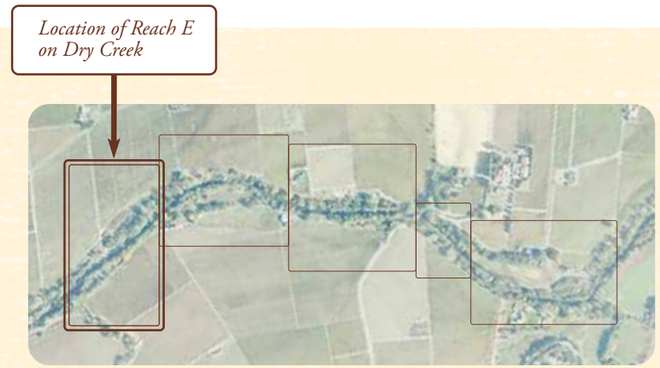


Reach D: Proposed Enhancement

Scale: 1 inch equals 100 feet

Reach E



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River Mile 7.1 to 7.3

Grape Creek enters this moderately confined sub-reach into a pool at the upstream end. It includes a series of short riffles, glides and long pools, and three side channels that flow during the winter. The area near the mouth of Grape Creek shifted during the winter of 2009-2010, with one side channel filling with gravel, and another side channel being created. This sub-reach has enhancement opportunities that include a backwater channel, log jams, riffle construction, pool enhancement, and riparian vegetation management. The symbols below appear on the "Proposed Enhancement" photo (next page) to show which of the enhancements might be utilized and where. Enhancement solutions are described in detail on pages 3 through 6.

Backwater Channels

Riffle Construction

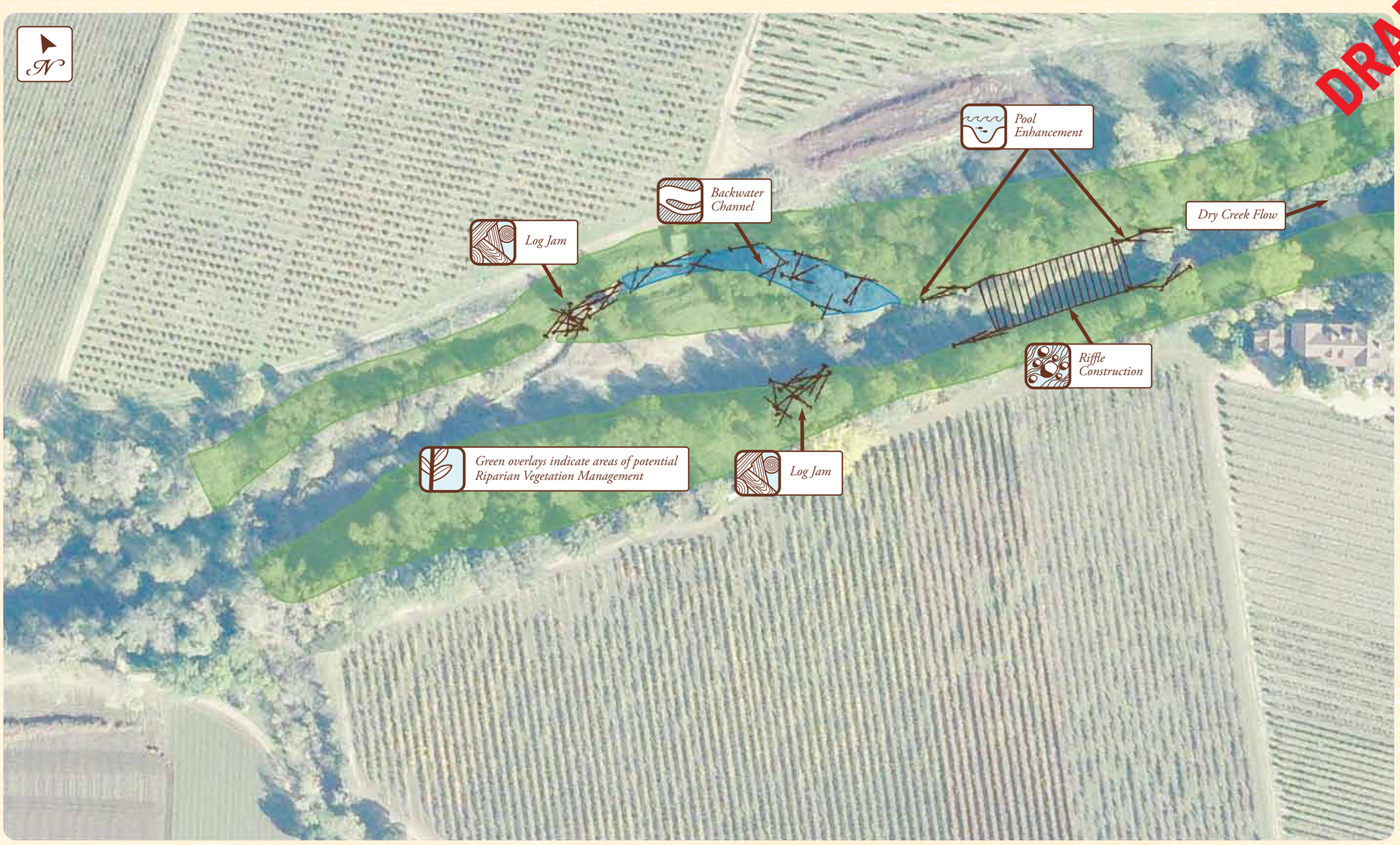
Log Jams

Pool Enhancement

Riparian Vegetation Management

Reach E: Existing Condition

Scale: 1 inch equals 150 feet



Reach E: Proposed Enhancement

Scale: 1 inch equals 100 feet

Questions & Answers

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How will the enhancement work benefit the property holders along Dry Creek?

Enhancement work completed in the demonstration reach will benefit landowners who live along Dry Creek as well as fish and other wildlife that share the habitat. It will also benefit the function of the stream itself. Actively eroding stream banks and stream beds will be stabilized where they threaten valuable property; overly-dense vegetation will be thinned – thereby reducing noxious weed species; and routine inspection and maintenance will be performed by the agency as needed or requested.

How will the enhancement work benefit the greater Dry Creek community and the extended communities of Sonoma and Marin counties?

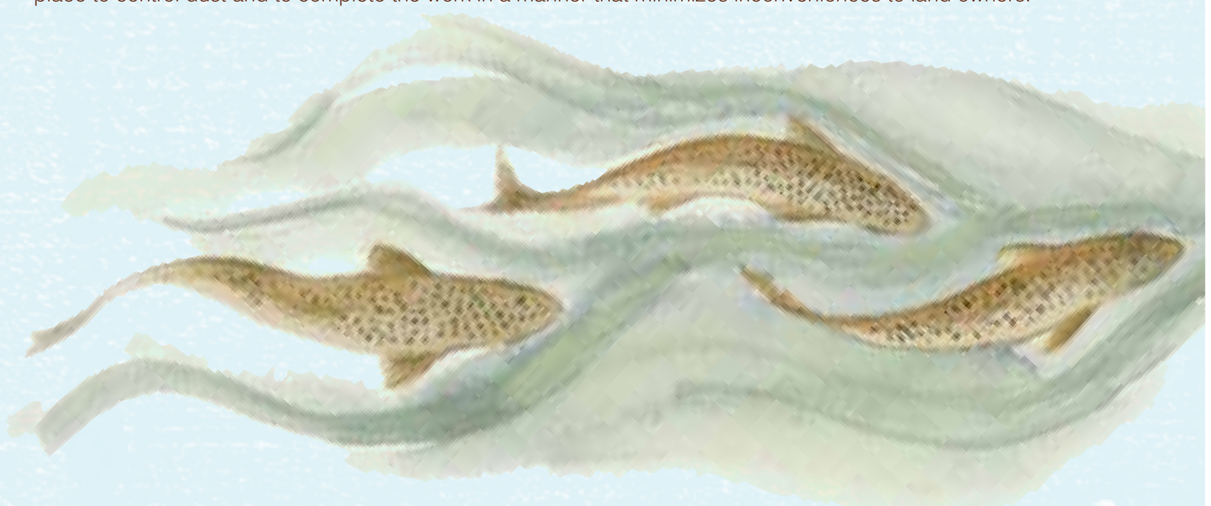
The enhancement work in the creek provides the means to implement the terms of the Biological Opinion, and is less intrusive to the lives and livelihoods of the Dry Creek Community than other alternatives. It also ensures Sonoma County Water Agency's ability to convey water down Dry Creek to the 600,000 customers who depend on its delivery.

The demonstration projects only cover a mile of Dry Creek. Is there a plan to restore the entire Dry Creek? And if so, when is that slated to happen? And how long will it take?

The Biological Opinion requires that 6 miles of Dry Creek be enhanced to provide an overall balance of suitable habitat within the 14 mile length below the dam. The work will occur in phases, with one mile of enhancement to be completed by 2014, and two additional miles of enhancement done by 2017. If the first three miles of enhancement have been successful, the final three miles of enhancement will be completed by 2020.

What will it be like while enhancement work is going on?

The intensity of the work will vary with each site. In some areas, the work will be completed with a combination of heavy construction equipment – such as bulldozers, backhoes and dump trucks – and a team of individuals experienced in enhancement construction. In these areas, the stream will be temporarily diverted around active construction zones. In other areas, where work consists solely of vegetation management, the task will be primarily accomplished by skilled labor. *In every case*, crews will be conscientious about keeping impacts to a minimum, and measures will be in place to control dust and to complete the work in a manner that minimizes inconveniences to land owners.



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During the restoration effort, what precautionary measures will be taken to ensure fish, other wildlife, and native plants in the area aren't harmed?

During periods when work is being done, the stream will be diverted around the work zone and aquatic life within the construction zone will be relocated to safe areas. Stringent control measures will be employed to prevent degradation of sensitive areas. Terrestrial wildlife and birds naturally tend to migrate away from a work zone, but they readily return to occupy enhanced areas once the work is complete. Work in the stream is done only during certain time periods to keep impacts on fish and other aquatic wildlife to a minimum.

How long will it take before the restoration activity is complete?

Construction on the demonstration projects will start in the summer of 2011. Depending on the final designs for the work, remaining items may be completed by the summer of 2012.

How long will it take before the creek looks "recovered" and evidence of the enhancement work is no longer visible?

The enhancement work will provide renewed habitat for fish and wildlife immediately following construction. As stream-side zones re-vegetate, signs of the work will begin to fade – usually within the first few years after project completion. In three to five years, evidence of the work will be very hard to see.

How much will it cost and who is paying for it?

The final composition of the demonstration projects has not been determined, so a detailed cost estimate is not currently available. The preliminary planning budget for the work is $7.25 million. Once a project plan has been selected and finalized, a detailed cost estimate will be prepared. Funding for the work will come from a variety of sources, and will include ratepayers, state and federal grants, and existing tax revenues that can be designated for this purpose.

Who will make sure it's implemented?

The Sonoma County Water Agency and the Army Corps of Engineers are leading the effort to implement the enhancement work. The National Marine Fisheries Service and the California Department of Fish and Game are responsible for verifying that the work completed meets the expectations of the Biological Opinion.

Who will make sure the projects are maintained?

The Sonoma County Water Agency will be working with each landowner to develop long-term agreements specifically tailored to the details of each property. These agreements will specify how maintenance will be accomplished. Project maintenance will ultimately be the responsibility of the Water Agency.

How can the public get involved?

Please visit http://www.scwa.ca.gov/rrifr/ to learn more about the Biological Opinion, the enhancement work, and how to get involved.

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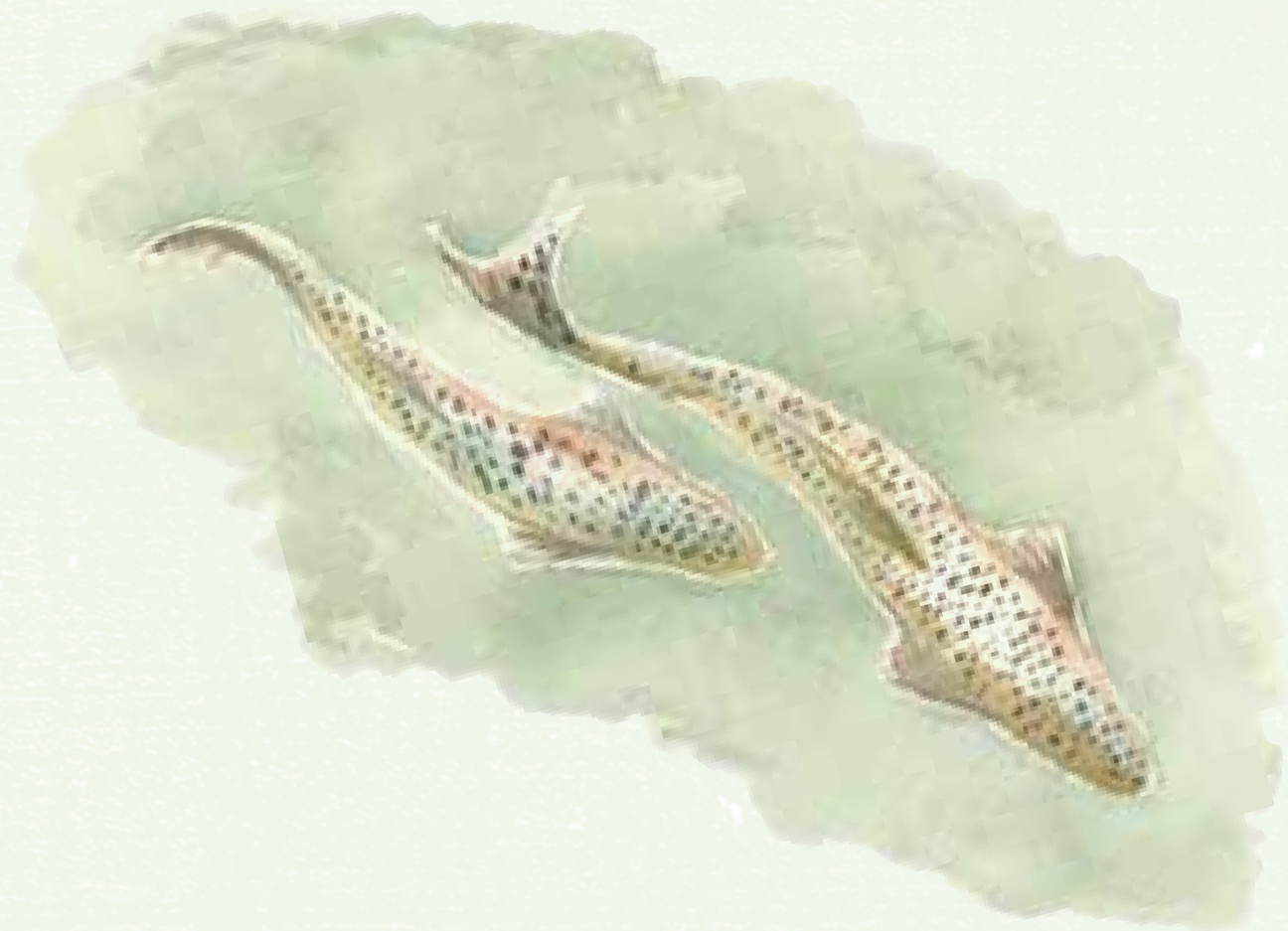

SONOMA COUNTY WATER AGENCY

RRIFR
Russian River Instream Flow and Restoration

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Appendix D-3

Evaluation of Dry Creek Pipe line criteria

EVALUATION METHODOLOGY

Dry Creek Bypass Pipeline Feasibility Study *November 11, 2009*

Purpose

This technical memorandum outlines the methodology that will be used to evaluate the Dry Creek bypass pipeline alternatives. This memorandum will present the criteria first used to screen the options then used to rank and compare alternatives.

Facilities Screening and Criteria Evaluation Process

A two step evaluation process was developed to evaluate the bypass pipeline alternatives. Each alternative consists of an inlet facility, pipeline route, and outlet facility. The first step will be to screen options for the location and construction of the inlet facility, pipeline segments, and the outlet facility options. After the screening process, complete alternatives for the bypass pipeline will be developed and evaluated using a common set of evaluation criteria, see Figure 1. The screening and criteria evaluation process is as follows:

1. Screen individual options for the inlet facility, pipeline segments, and outlet facility.
2. Combine the screened inlet, pipeline segment, and outlet options into complete alternatives consisting of an inlet, route, and outlet.
3. Evaluate the alternatives (inlet, route, and outlet) based on a set of common evaluation criteria.

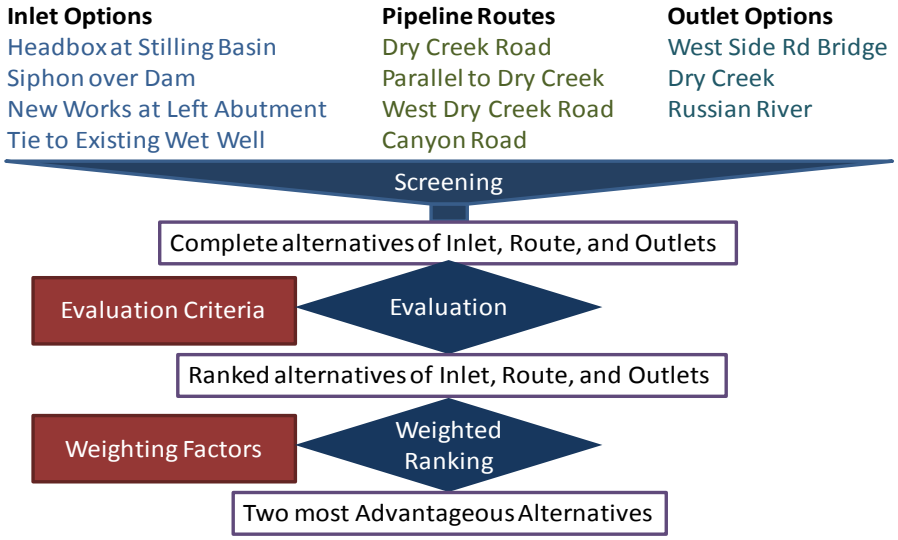

Figure 1. Evaluation Process Flow Chart

Screening Criteria

The screening criteria that will be applied to each project element (i.e., inlet facility, pipeline route, and outlet facility) are listed in Table 1. These criteria will be applied to the facility options to identify fatal flaws and eliminate undesirable and infeasible options. The intent of this effort is to carry forward into the evaluation process the most viable options as feasible alternatives.

Table 1. Summary of Screening Criteria

Inlet Facility	Pipeline Route	Outlet Facility
Design and Construction	Alignment Length	Proximity to the Confluence with Dry Creek and the Russian River
Operability	Topography	Proximity to Pipeline Terminus

Inlet Screening Criteria

Four inlet options have been identified (see Figure 2):

1. Head Box - Construction of a head box at the existing outfall structure. Both the east and west sides of the outfall structure are being considered to accommodate the pipeline route.
2. Siphon - Construction of a piping system over the dam operated by either a siphon or a pump station.
3. New Inlet - Construction of new inlet works through the west abutment of the dam.
4. Integrated Facility - Partner with the U.S. Army Corps of Engineers (Corps) on the construction of an emergency water supply to the fish hatchery. Both a common pipeline and separate pipelines through the dam are being considered.

The inlet options will be screened to confirm both the feasibility of construction and the facility operability, as described below.

Design and Construction

The design and construction criteria include identifying fatal flaw design constraints and unrealistic or extremely difficult construction procedures. Fatal flaw design constraints include a specific design requirement that cannot be achieved through physical law. The construction procedures for this project are generally controlled by geotechnical conditions, tunnel and pipe installation procedures, and dam operation. Geotechnical considerations include soil stability during tunneling operations, potential damage to the grout curtain associated with the dam, and damage to the foundation and embankment due to subsidence resulting from tunneling operations. Tunnel and pipe construction are common practice for projects of this nature, however, the various options presented above present various levels of difficulty with regard to constructability and can be weighed accordingly. The final consideration for the screening process is the ability to coordinate normal dam operation. It is extremely difficult or unrealistic to modify the water surface elevation as a result of construction requirements. As such, all

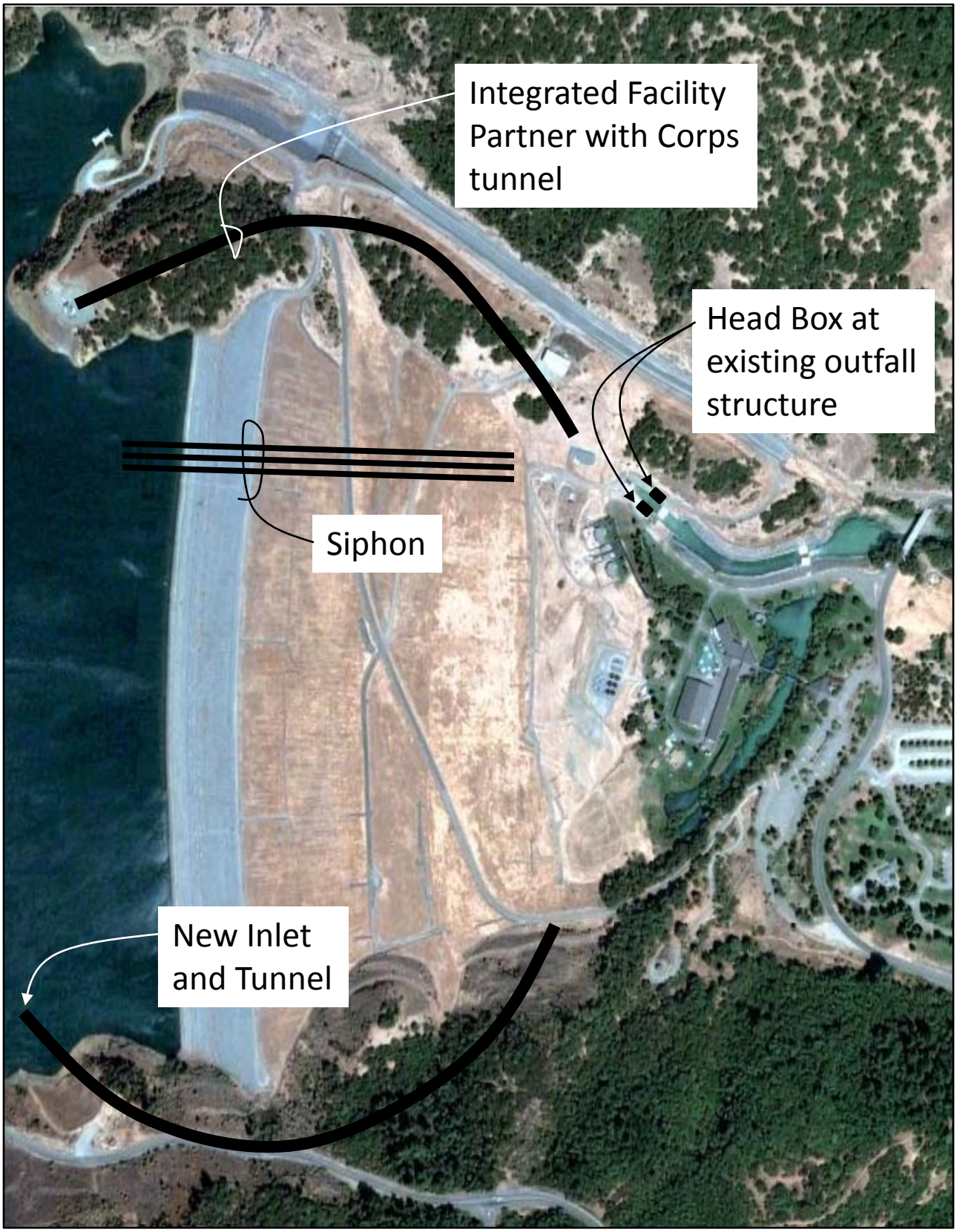

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Figure 2
Preliminary Inlet Works Options
Dry Creek Pipeline Feasibility Study

SONOMA COUNTY WATER AGENCY

construction activities associated with the water side of the dam must be considered as in-water work. The following chart describes the rating criteria that will be applied to each option for Design and Construction.

Rating	Criteria
Best	All factors are acceptable for design and construction procedures.
Satisfactory	All factors of design, geotechnical, tunnel and pipe installation, and construction during normal dam operation are acceptable, but one or more factors may be difficult.
Unacceptable	Geotechnical, tunnel and pipe installation, and construction conflicts with normal dam operation and causes an unacceptable condition.

Operability

When designing a water conveyance system it is important to characterize certain critical factors which have an affect on the systems ability to function or operate as required. The critical factors utilized to determine the level of facility operability are system capacity, available pressure head, and operational complexity. System capacity is the ability of the system to efficiently provide and maintain the required volume of water to the outlet works pipeline. When considering each option, system capacity becomes more complex when integrating the proposed inlet works facilities into the existing structures at the dam.

In addition to system capacity it is necessary to provide and maintain the required pressure head needed to convey the required water to the outlet works. Pressure head is a function of water surface elevation. Each option presents different methods to achieve the required elevation which vary in complexity. Similar to system capacity, maintaining the appropriate pressure head becomes more complex when integrating the proposed inlet works facilities into the existing structures at the dam.

The final consideration for the screening process is operational complexity. This applies to options that require seasonal or more frequent mechanical system operation, such as pumps, gate valves, and gate systems needed to increase water surface elevation. In addition, consideration must be given to an integrated system which would provide water to both the existing fishery and the outlet pipeline.

The following chart describes the rating criteria that will be applied to each option for Facility Operability.

Rating	Description
Best	All factors of system capacity, pressure head, and operational complexity meet project needs.
Satisfactory	All factors of system capacity, pressure head, and operational complexity are acceptable, but one or more factors may be difficult.
Unacceptable	One or more of system capacity, pressure, head and operational complexity cannot be met or is extremely difficult.

Route Screening Criteria

Screening criteria were developed to identify the preferred alignment option when more than one option was identified for a particular pipeline segment. An overview of the route options is illustrated in Figure 3 and listed as follows:

1. Dry Creek Road
    a. In the road
    b. In the road up to a bury depth of 15', then in agricultural property
2. East side agricultural road parallel to Dry Creek
3. Dry Creek Road and Canyon Road
4. West Dry Creek Road
    a. In the road
    b. In the road up to a bury depth of 15', then in agricultural property

Alignment Length

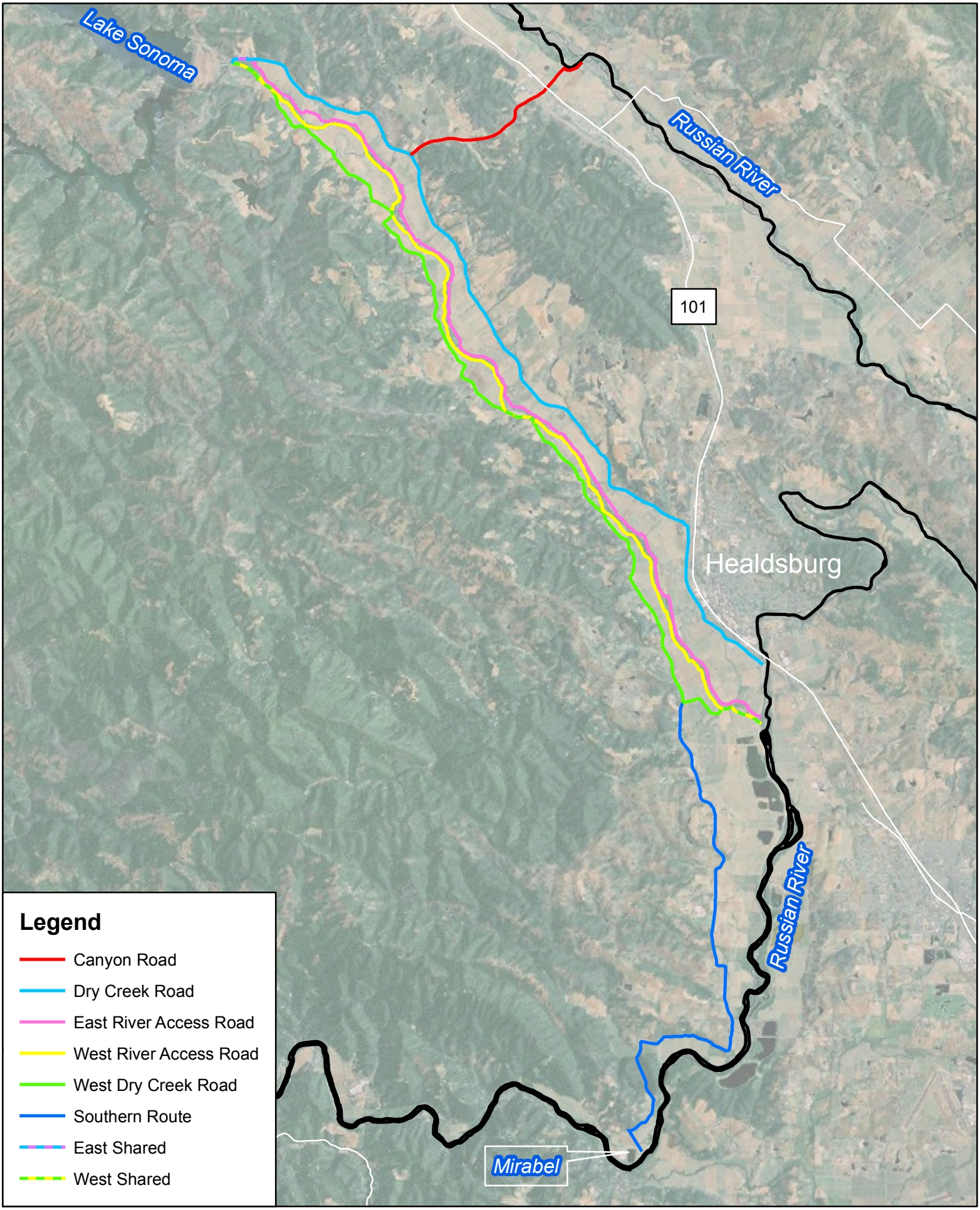
Pipeline length and right-of-way (ROW) acquisition directly affect project complexity and construction costs. Thus, in cases where the length of the alignment options differed by greater than 10 percent, the shorter alignment option will be selected for inclusion in the alignment alternative.

Rating	Description
Best	Pipeline segment is greater than 10% shorter than other options. .
Satisfactory	Pipeline segment options are within 10% of each other.
Unacceptable	Pipeline segment is greater than 10% longer than other options.

Topography

This criterion will be used to assess the constructability of the pipeline along a given alignment. Depending on the inlet option, the available hydraulic grade line (HGL) may be limited to only 220 feet above sea level at Warm Springs Dam. Thus, the presence of hills along an alignment could require deep bury depths (e.g., greater than 25 feet) in order to stay below the HGL. In that case, alternate alignments (e.g., across private property) or construction methodologies (e.g., trenchless installation) will be identified, if available.

Rating	Rating
Best	Entire pipeline route is below the HGL.
Satisfactory	Portions of the pipeline route would be above the HGL, although an alternate alignment or construction methodology is feasible.
Unacceptable	Portions of the pipeline route would be above the HGL and no alternate alignments were identified



HDR

Figure 3
Preliminary Pipeline Routes
Dry Creek Bypass Pipeline Feasibility Study

SONOMA COUNTY WATER AGENCY

Outlet Screening Criteria

The screening criteria for the outlet facility were developed to identify feasible discharge locations for each of the potential pipeline route termination notes Figure 4 illustrates the four pipeline routes down Dry Creek Valley, the pipeline termination points being considered, and the respective potential discharge area. Figure 5 illustrates the pipeline route over Canyon Road to the Russian River and potential discharge area.

The screening criteria will be applied in sequence to develop a preferred option for each of the discharge areas based on the distance from the pipeline termination point and constructability. Application of the screening criteria in this manner will result in a feasible outlet site near the pipeline termination points. The screening process considers site locations only. The outlet facility type will be evaluated as part of the alternative evaluation.

Proximity to the Confluence with Dry Creek and the Russian River

The proximity to the confluence with Dry Creek and the Russian River was selected as an initial screening criterion for the following reasons;

(1) Discharge in Dry Creek close to the confluence of the Russian River would address the fishery issues identified in the Biological Opinion and limit the reaches in Dry Creek with increased flows.

(2) Maintaining discharges near the confluence of Dry Creek and the Russian River would mimic the current flow conditions, where discharges from Lake Sonoma combine with natural flows in Dry Creek to increase flows in the River at that location.

(3) Discharges to the Russian River upstream from Dry Creek would be subject to increased losses from evaporation and infiltration than currently occur, which could potentially decrease the amount of water available for diversion by the SCWA downstream. Conversely, discharges downstream of the confluence would similarly decrease the potential losses and would therefore potentially increase the amount of water available for diversion by the SCWA.

For discharge locations on Dry Creek, it would be preferable for the location of the outlet works to be near the confluence of Dry Creek and the Russian River. Discharging at the confluence would eliminate the need to use the creek for conveyance.

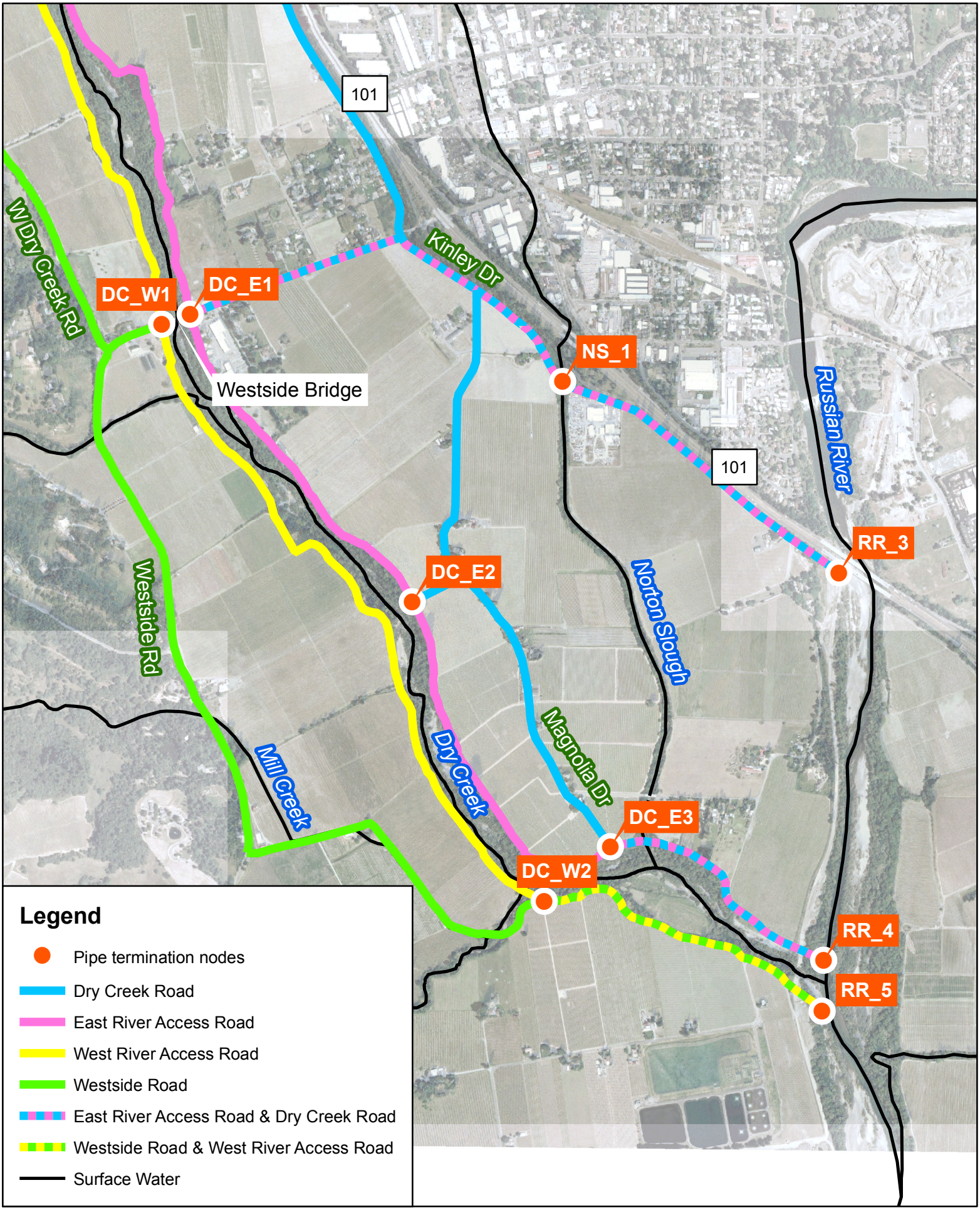


Figure 4
Potential Outlet Sites Near Dry Creek Confluence
Dry Creek Bypass Pipeline Feasibility Study

Figure 5
Potential Outlet Sites On Russian River Near Geyserville
Dry Creek Bypass Pipeline Feasibility Study

For discharge locations on the Russian River, it would also be preferable for the location of the outlet works to be near the confluence of Dry Creek and the Russian River. However, there may also be some advantages to discharging downstream of the confluence. The following ratings were assigned to each potential site.

Discharge to Dry Creek

Rating	Description
Best	Less than 1 mile upstream of Confluence with the Russian River
Satisfactory	1 and 3 miles upstream of Confluence with the Russian River
Unacceptable	More than 3 miles upstream of Confluence with the Russian River

Discharge to the Russian River

Rating	Description
Best	Less than 1 mile upstream or downstream from Dry Creek Confluence
Satisfactory	1 and 2 miles upstream or downstream from Dry Creek Confluence
Unacceptable	Greater than 2 miles from Dry Creek Confluence

Proximity to Pipeline Terminus

The proximity to the pipeline terminus was selected as an initial screening criterion since the additional pipeline length required to discharge beyond the end of the pipeline, as identified in the Route Screening TM, would directly impact the construction cost and could potentially have a greater environmental impact.

It would be preferable for the location of the outlet works to be adjacent to or near the pipeline termination point, typically near a bridge or at a section of the road that is close to the creek. However, it is understood that in the natural environment there may be a compelling reason to move the discharge point further upstream or downstream. Therefore, the following ratings were assigned to each potential site.

Rating	Description
Best	Less than 1,000 feet from pipeline terminus node
Satisfactory	Between 1,000 and 2,000 feet from pipeline terminus node
Unacceptable	Greater Than 2000 feet from pipeline terminus node

Evaluation Criteria

The evaluation criteria will be used to evaluate alternatives developed from the screening analysis. Some criteria are common to the inlet facility, pipeline routes, and outlet facility evaluations, and some are specific to only one element.

On October 22, 2009, a meeting was held with interested members of the Dry Creek Advisory Committee to discuss evaluation criteria. The concerns/criteria identified during that meeting and the method in which these concerns/criteria were addressed and incorporated into the study are listed below:

1. Loss of trees along Dry Creek due to damage to roots during construction. HDR contacted an arborist, who said that limited damage to the tree would occur if the pipe was installed outside of the drip line (i.e. tree canopy diameter). This concern has been added as a new criterion.

2. Right of way issues along riparian corridor. These will be addressed along with other right of way criteria, as described in the evaluation criteria presented in this memorandum.

3. Concerns about stability or structures/banks with high flows. These will be addressed along with other impacts such as scour.

4. Impacts to the Russian River, control of water loss, and impact at Dry Creek/Russian River confluence resulting from a release at Geyserville. This issue will be integrated into the operations criteria.

5. Impacts to groundwater and water loss under different scenarios/routes; especially after a series of dry years. This is important, but not a criterion because a minimum flow in Dry Creek will provide for groundwater recharge. This issue will be addressed in a technical memorandum regarding flows in Dry Creek and the bypass pipeline.

6. Construction seasonality, especially impacts to agricultural operations and impacts to recreation (especially cycling). This criterion has been added to pipeline constructability.

In considering complete alternatives, the evaluation criteria will be applied to each element of the alternative as listed in Table 2, on the following page.

Engineering

The engineering criteria range between excellent and undesirable. Based on the specific criteria, as few as three rating categories are needed to describe the range of conditions.

Table 2 Evaluation Criteria Applied to Each Element of the Alternatives

Inlet Facility	Pipeline Route	Outlet Facility
	Engineering	
Reliability and Enhancement	Reliability and Enhancement	Reliability and Enhancement
Constructability	Constructability	Constructability
Permitting	Permitting	Permitting
Operations	Operations	Operations
Right of Way Acquisition	Right of Way Acquisition	Right of Way Acquisition
Liquefaction and Hazard Potential	Liquefaction and Hazard Potential	Liquefaction and Hazard Potential
	Hydropower Potential	River Channel Stability
	Special Crossings	Accessibility
	Environmental	
Wetlands	Wetlands	Wetlands
Habitats and Sensitive Species	Habitats and Sensitive Species	Habitats and Sensitive Species
Hazardous materials	Hazardous materials	Hazardous materials
	Impact to trees (roots)	
Cultural Resources	Cultural Resources	Cultural Resources
		Water Quality/Fisheries
	Economic	
Capital Cost	Capital Cost	Capital Cost
O&M	O&M	O&M
Net Present Value	Net Present Value	Net Present Value

Reliability and Enhancement

Because the capacity of Dry Creek to receive flow has not been specifically determined, the flexibility of the inlet, outlet, and pipeline alternatives are important. Some alternatives have greater flexibility when it comes to handling increasing or decreasing flow capacity. A system having the ability to handle a broad range of flows is more reliable and flexible in the long term. Specific issues such as the potential for erosion and bank stability at the outlet works are addressed for each system component.

Some of the pipeline routes and discharge points have an increased opportunity to enhance specific areas through the supply of additional water to tributaries, decreasing water temperature, and increasing dissolved oxygen (DO). Improvements should be consistent with the biological opinion, basin plan, and plans to improve Dry Creek.

Rating	Description
Excellent	All elements of the alternative can handle the range of flows and has the ability to enhance specific areas.
Above Average	All elements of the alternative can handle the range of flows, but has a limited ability to enhance specific areas.
Satisfactory	Elements of the alternative can dominantly cover the range of flows with no or very limited ability to enhance specific areas.
Poor	Some elements of the alternate cannot cover the range of flows.
Undesirable	Elements cannot cover the range of flows.

Constructability

Constructability is composed of several sub-criteria, including utility conflicts, tree conflicts, topography, access, excavation and dewatering. Utility conflicts consider overhead utility lines and existing or planned large-diameter utilities. Topography and access impact the construction efficiency and effort required to perform the work. The excavation required to install the facilities can be a significant work effort for all of the project elements.

Inlet Works Constructability Criteria

Interconnection with the existing temperature control structure requires significant tunneling and complex construction methods to tie the bypass pipeline to the existing stand-pipe. The headbox requires limited excavation and construction of a concrete box at the ground surface. Constructability was evaluated on the complexity of construction.

Rating	Description
Excellent	Low technology, open construction
Satisfactory	Complex technology, underground
Undesirable	Unusually complex construction

Pipeline Route Constructability Evaluation Criteria

Utilities - Along the pipeline route are overhead power lines, trees, plantings, and roadside improvements. Reaches of some route alternatives have water, sewer, natural gas, and fiber optic lines in parallel and crossing the proposed route. This criterion evaluates the degree of difficulty required to accommodate utilities, trees, and roadside improvements.

Rating	Description
Excellent	Minimal existing utility conflicts. Minimal tree conflicts. Excellent topography and easy access. Minimal excavation and/or dewatering requirements.
Above Average	Minimal existing utility conflicts. Minimal tree conflicts. Good topography with some access coordination needed. Increased excavation and/or dewatering requirements.
Satisfactory	Moderate existing utility conflicts. Moderate tree conflicts. Some topography and access coordination. Increased excavation and/or dewatering requirements. Some trenchless boring required for creek crossings and to avoid wetlands or vineyards.
Poor	Significant existing utility conflicts. Significant tree conflicts. Poor topography and tight access requirements. Significant excavation and/or dewatering requirements. Some tunneling required, lengths greater than 1,000 ft.
Undesirable	Significant existing utility conflicts. Significant tree conflicts. Very poor topography requiring special construction with critical access needs. Significant excavation and/or dewatering requirements. Significant tunneling required.

Impacts to Agricultural Operations and Recreation - The Dry Creek valley contains about 9,000 acres of vineyards and 63 wineries. The harvest season is critical and adds an increased amount of traffic flow associated with transportation of crops. Throughout the year, visitors come to the area for the scenery, wine, boating, and recreational activities. Dry Creek road is a critical access route throughout the valley. Major events occur from spring through fall.

In general, the project will be designed to minimize the disruption during harvest and during critical area-wide events. The contractor will be directed to stop work and provide access during these periods. At all other times, the contractor will provide traffic control and safe passage. The following rating criteria are based on the impact to main roads and ability to provide alternative paths around the construction.

Rating	Description
Excellent	Minimum interruption with construction in non-arterial routes and alternative travel options.
Satisfactory	Minimum interruption with construction within arterial traffic routes.
Undesirable	Routes that would create access problems for agricultural activities and the public.

Outlet Works Constructability Criteria

Proximity to Channel - Some outlet alternatives are closer and some further from the existing channel. Distance from the channel impacts stream and potentially bank stabilization and effects the construction requirements to mitigate problems at and downstream from the discharge location.

Rating	Description
Excellent	Less than 100 ft from channel
Satisfactory	Between 100 and 150 feet from channel
Undesirable	More than 150 feet from channel

Access - Some outlet locations are near paved roads or roads providing industrial or commercial access. Other areas are along unpaved roads regularly used to access industry or commercial areas. Undesirable locations have access that is only through a vineyard or private residence, typically on a dirt road.

Rating	Description
Excellent	Near a high volume road in an industrial or commercial area
Satisfactory	Near low volume road in a industrial or commercial area
Undesirable	Only access is through a vineyard or private residence

Floodplain - For this criterion, outlet works are either in or out of the 100-year floodplain.

Rating	Description
Excellent	All of the site is out of the 100-year floodplain
Satisfactory	Most of site is outside the 100-year floodplain
Undesirable	Most of site is inside the 100-year floodplain

Permitting

The discharge permitting criterion was used to identify sites with the greatest potential or significant obstacles to obtain a permit. Discharge to surface waters is regulated under the Clean Water Act's NPDES permit program and administered by the Regional Water Quality Control Board (RWQCB). The discharge permit program accounts for the potential impacts of direct discharge and sets limits on it. It is not clear at this time how the North Coast RWQCB will regulate the discharge of water from Lake Sonoma from the bypass pipeline.

Construction permitting is also considered in this criterion and addresses whether a potential site is known to contain any unique conditions that would require special permitting relative to other sites. For example, a site near a bridge would have additional permitting coordination requirements with Caltrans or the agency that maintains the bridge, increasing the permitting risk. Areas identified as having cultural resources may also have additional coordination requirements with the Office of Historic Preservation, which would similarly increase the permitting risk.

Rating	Description
Excellent	Low relative permitting risk.
Satisfactory	Average relative permitting risk.
Undesirable	High permitting risk

Operations

The pipeline and outlet works are designed to be free from operator attention. Some maintenance will be required, but there is no seasonal or regular operation required. The inlet works have varying decrees of operational needs based on the strategy used to create the flow split between the hatchery flows, bypass flows, and additional flow discharged to Dry Creek. Operating criteria also includes the distance from the outlet to the SCWA well field as a measure of response between release and water availability.

Rating	Description
Excellent	No operator attention
Satisfactory	Seasonal operator attention to adjust weirs, valves, or gates
Undesirable	Monthly or weekly attention to adjust weirs, valves, or gates

Right of Way Acquisition

ROW acquisition can add a significant amount of time, complexity, and cost to the project. Construction in an existing ROW is always preferred over ROW acquisition. It is expected that some ROW acquisition will be required for all alternatives. Sites requiring the acquisition of fewer ROW are preferred. For direct discharge, some sites would require an easement on only one parcel to accommodate facilities, whereas others might require several. Sonoma County Assessors Parcel maps will be used to determine potentially affected parcels.

Rating	Description
Excellent	Public ROW with sufficient area or width (40 feet minimum) available.
Above Average	Mostly public ROW with sufficient width (40 feet minimum) available, temporary/permanent local easements required at limited locations (≤ 20% of the pipeline alignment).
Satisfactory	Mostly public ROW but with limited or restricted width, private easements required along alignment, (≤ 40% of the pipeline alignment).
Poor	Limited access to public ROW. Significant private easements required (≤ 50% of the pipeline alignment).
Undesirable	Very limited access to public or utility-owned ROW. Multiple private easements required (.>50% of the pipeline alignment)

Liquefaction and Seismic Hazard Potential

This criterion will be used to assess the likelihood that a prospective site would experience liquefaction during a seismic event, which could cause significant damage to the facility.

Earthquakes can cause soil movement when soils are saturated with groundwater. As soils become unstable, they cannot support forces in the pipe or support infrastructure built along the slopes next to the river. Liquefaction maps for the Dry Creek and Russian River area are available from U.S. Geological Survey (USGS) OFR 00-444 (Knudsen et al., 2000) and USGS OFR 06-1037 (Witter et al., 2006). USGS classifications of liquefaction used are very high, high, moderate, and low. In general, all of the soils on or near the river have a high potential of liquefaction.

Rating	Description
Excellent	No or minimal apparent seismic, landslide, or erosion hazards exist along the pipeline route or at the discharge location (low USGS classification).
Satisfactory	A moderate portion of the pipeline route has one or more seismic/landslide/erosion hazards and requires some piling, stabilization, or remediation effort to mitigate (moderate USGS classification).
Undesirable	A more than significant portion of the pipeline route has multiple seismic/landslide/erosion hazards and requires extensive piling, stabilization, or remediation effort to mitigate (high and very high USGS classifications).

Hydropower

Hydropower can be obtained from the existing generator discharging through the outlet structure or through a new turbine on the bypass pipeline. Power generation varies with the flow demand and the split between flow through Dry Creek and the bypass pipeline.

Hydropower capacity is based on the remaining hydraulic head available to generate hydropower and the flow through the generator. Flows vary depending on the amount of flow discharged to Dry Creek versus the flow to be bypassed.

Rating	Description
Excellent	Use of the existing generator up to its maximum capacity.
Satisfactory	Installation of a new generator and use up to its maximum capacity.
Poor	Two generators and a flow split that does not maximize the capacity of the generators.
Undesirable	No excess power generation, thus no revenue from generation.

Special Crossings

Crossings of state highways or multi-lane streets, railroads, and waterways and wetlands may require trenchless construction, piling supports, or other engineering solutions. “Difficult” crossings may be considered to be those with deep/long borings, high groundwater conditions, or difficult soil conditions.

Rating	Description
Excellent	<4 special crossings along the pipeline route; none are considered difficult. No state highway or railroad crossings.
Above Average	4 - 8 special crossings along the pipeline route; less than 3 may be considered difficult. No state highway or railroad crossings.
Satisfactory	6 -10 special crossings along the pipeline route; 3 – 4 may be considered difficult. No state highway or railroad crossings.
Poor	8 - 12 special crossings along the pipeline route; 4 - 5 may be considered difficult.
Undesirable	More than 12 special crossings along the pipeline route; 5 or more may be considered difficult.

River Channel Stability

Channel stability includes the evaluation of bank stability, degree of meander and potential for scour. Relevant data were collected during recent field investigations, through historical aerial photography, and by GIS evaluation. Together, these three evaluation criteria provide a good indication of the stability of a channel and suitability for an outlet facility.

Bank Stability

Bank stability is considered to be the potential for a riverbank to erode or experience undercutting over time. Factors affecting bank stability are vegetation, angle of bank inclination, and location of the primary channel on the inside or outside of the bend. Increased vegetation generally increases stability. Angles of inclination for banks should be relatively low unless comprised mostly bedrock. Banks on the outside of a bend are generally less stable because of higher shear velocities.

Rating	Description
Excellent	High degree of riverbank stability.
Satisfactory	Less stable to slightly eroding bank requiring more engineering stabilization.
Undesirable	Eroding bank.

Meander

The degree of meander, or the meander envelope, is assessed based on the degree to which the low-flow channel moves within a wider channel over time. These criteria are important because facilities located in reaches of the river with a high potential for scour or erosion, or a high potential for the channel to move away from its current location, have a great likelihood of failure. The change in meander of the river has been traced and summarized for the past 65 years for the Russian River and for the past 40 years for Dry Creek, through a series of aerial photographs and topographic maps. Meander was categorized as low, moderate, and high, with high indicating the greatest likelihood of the channel to move based on the historic record.

Rating	Description
Excellent	Low degree of river meander.
Satisfactory	Modest meander that would not impact the discharge works.
Undesirable	High degree of meander that would require stabilization and maintenance.

Scour

Scour is the removal of material from the bed and banks of a river by stream flow. It can be affected by many factors, including changes in hydrologic conditions, engineered structures such as bridges or riprap, the curvature or sinuosity of the stream, channel width, the presence of point bars, gradient, and the strength of the geologic materials in which the stream flows. Scour potential was summarized as high, moderate, and low.

Rating	Description
Excellent	Low scour potential.
Satisfactory	Moderate scour potential.
Undesirable	High scour potential.

Environmental Considerations

Environmental criteria have been defined using a scale ranging from excellent to undesirable. It is expected that the evaluation of environmental impacts will be further developed during the CEQA process.

Cultural Resources

The presence of cultural materials and artifacts may slow construction and require the investigation and relocation of artifacts prior to and during construction. Sites with identified cultural resources would require coordination with the State Office of Historical Preservation and possibly county agencies. This could bring into play additional construction requirements and significant schedule delays.

A focused records search will be conducted of the North Central Information Center (NCIC) of the California Historical Resources Information System (CHRIS). In addition, Native American groups may be consulted regarding the presence of major population centers in the records search area, including unmapped burial sites and cemeteries.

Rating	Description
Excellent	No resources within area of potential effect.
Satisfactory	Resources within area of potential effect not likely to be affected.
Undesirable	Resources within area of potential effect likely to be affected.

Wetlands and Other Waters of the U.S.

Waters of the U.S. include streams (including intermittent streams) and wetlands. Construction in waters of the U.S. requires permitting and mitigation. Sites or routes having streams and/or wetlands would be less desirable if other sites or route alternatives are available.

The U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) maps will be used to estimate the acreage of streams and wetlands for the various alternatives. USGS 7.5 minute quadrangle maps will be used to estimate the acreage of streams, including blue-line streams that would be potentially affected.

Rating	Description
Excellent	No wetlands or streams.
Satisfactory	Minor or temporary impacts to wetlands and streams.
Undesirable	Permanent impacts to wetlands and streams.

Sensitive Habitats and Species

Construction in areas with protected habitat and sensitive plant and animal species requires additional permitting and sometimes significant mitigation. Sites and pipeline routes with sensitive habitat and species will be identified using the California Natural Diversity Database

(CNDDB) developed by the Department of Fish and Game (CDFG). The primary function of the CNDDB is to gather information on the status of rare and endangered plants, animals, and vegetation types. The database is intended to provide the most current information available to the government agencies, the private sector, and conservation groups in order to promote better-informed land-use decisions.

The CNDDB is an ongoing and continuously updated database; however, it does not constitute an official response from any state agency and will not in itself meet the requirements of the California Endangered Species Act. It should also be noted that absence of data in the CNDDB does not constitute the basis for a negative declaration.

Sensitive habitat and species that are likely to occur in the project area will also be identified using the USFWS's Sacramento Fish and Wildlife Office website and CDFG's Special Animals List and Special Plant List.

Rating	Description
Excellent	No protected habitat and/or sensitive species present.
Satisfactory	Potential protected habitat and/or sensitive species may be present.
Undesirable	Protected habitat and/or sensitive species present.

Hazardous Materials

Construction through areas where hazardous materials are present requires the removal and disposal of the materials prior to construction and could invoke additional permitting requirements and significant schedule delays. A hazardous waste assessment was conducted to identify recognized environmental conditions (RECs) or Notable Findings with the potential to negatively impact environmental conditions at a given location. As defined by the American Society of Testing and Materials (ASTM) E 1527-05 for the performance of a Phase I ESA, a REC is "the presence or likely presence of any hazardous substance or petroleum products on a property under conditions that indicate an existing release, a past release, or a material threat of a release of any hazardous substance or petroleum products into the structure, on the property, or into the ground, groundwater, or surface water of the property." Additional details about the hazardous waste assessment will be provided in the Hazardous Waste TM.

Rating	Description
Excellent	No known hazardous materials. Previous hazardous materials are cleaned up; or isolated.
Satisfactory	Past or present hazardous material likely near project location.
Undesirable	Significant hazardous materials/large near project location.

Potential Loss of Trees

Construction may require tree removal because of route limitations. Construction within the "drip line" (diameter of the canopy) has the potential of damaging the tree. The tree may go

into shock because of the loss of root system or become susceptible to topping over in high winds. Final determination of the pipeline route and impact to trees will be evaluated by a local arborist. For the purpose of evaluation, the linear footage of pipe to be constructed within the canopy will be estimated using the high resolution aerial photos and field survey.

Rating	Description
Excellent	Limited need for tree removal and/or proximity of pipeline construction within the tree drip line.
Satisfactory	Some need for tree removal and/or proximity of pipeline construction within the tree drip line.
Undesirable	Significant need for tree removal and/or proximity of pipeline construction within the tree drip line.

Impacts to Fisheries

The most significant issues associated with the bypass pipeline and release of bypassed water back to Dry Creek or the Russian River are those associated with water quality. Key water quality criteria to consider include temperature, dissolved oxygen (DO), turbidity, and channel morphology/ velocity.

Water quality

Temperature and DO – Temperatures should be at or less than the ambient water temperature. Ideally temperatures should be less that 65°F. Dissolved oxygen (DO) should be at or greater than the ambient dissolved oxygen levels. Satisfactory DO levels are at least greater than 8ppm.

Rating	Description
Excellent	Ability to provide DO levels at or near Saturation, no increase in temperature.
Satisfactory	Ability to meet or exceed ambient DO and temperature.
Undesirable	Reductions in stream DO <5 ppm or increases in temperature > 65°F due to diversion discharge.

Turbidity – There is a low likelihood of discharge containing increased turbidity levels than currently occur (suitable). However, the design of the outfall facility must carefully consider the potential for erosion of the bank and channel and fluidization of bottom sediments over time so that increases in turbidity would not occur as a result of the discharge facility.

Rating	Description
Excellent	Low likelihood of discharge containing or increasing turbidity.
Satisfactory	Some risk of increased minor movement of fines but increase is not significant.
Undesirable	Increases in turbidity and gravel movement that potentially impact fisheries.

Channel morphology – Discharge volumes/velocities that can affect banks and the channel bottom could be harmful to fish habitats, especially to habitat attributes such as substrate composition and integrity of critical habitat. Velocities greater than 8 feet per second (ft/s) form impediments to adult migration. Higher velocities should not be an issue with juvenile

migration. The design of the discharge facility would address maximum velocities and available area for fish passage.

Rating	Description
Excellent	Channel velocities less than 2 ft/s
Satisfactory	Channel velocities less than between 2 and 4 ft/s.
Undesirable	Channel velocities greater than 4 ft/s.

Appendix E-1

Letter from the NMFS confirming funds to TU constitutes completion of the SCWA's obligation for implementing the Willow Creek Fish Passage Enhancement Project

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
777 Sonoma Ave., Room 325
Santa Rosa, California 95404-4731

COPY

September 15, 2010

In response, refer to:
2006/07316:WH

ORIGINAL DOCUMENT
SONOMA COUNTY WATER AGENCY
To MANNING
CUED
SEP 17 2010

Grant Davis, General Manager
Sonoma County Water Agency
404 Aviation Boulevard
Santa Rosa, California 95403

CF/45-5.7-2 Willow Creek Fish Passage Enhancement Project

RE: Willow Creek Fish Passage Enhancement Project

Dear Mr. Davis;

As you are aware, NOAA's National Marine Fisheries Service (NMFS) issued the *Biological Opinion for Water Supply, Flood Control Operations, and Channel Maintenance conducted by the U.S. Army Corps of Engineers, the Sonoma County Water Agency, and the Mendocino County Russian River Flood Control and Water Conservation District in the Russian River Watershed* (Russian River BO) on September 24, 2008. The Russian River BO is a culmination of more than a decade of consultation between the Sonoma County Water Agency (SCWA), the U.S. Army Corps of Engineers (Corps), and NMFS regarding the impact of the SCWA's and Corps' water supply and flood control activities on three fish species listed under the federal Endangered Species Act: Central California Coast steelhead, Central California Coast coho salmon, and California Coastal Chinook salmon. The California Department of Fish and Game (CDFG) issued a consistency determination on November 9, 2009, finding that the Russian River BO was consistent with the requirements of the California Endangered Species Act (CESA) and adopted the measures identified in the Russian River BO.

One component of the reasonable and prudent alternative (RPA) identified in the Russian River BO is the enhancement of salmonid rearing habitats in tributaries to Dry Creek and the Russian River (Page 267, Russian River BO). A total of ten potential tributary enhancement projects are listed in the Russian River BO with the requirement that SCWA implement at least five of these projects by the end of year 3 of the 15 year period covered by the Russian River BO. One of the projects listed is the Willow Creek Fish Passage Enhancement Project, as described below:

> "Willow Creek is a tributary to the lower Russian River that once supported an abundant subpopulation of coho salmon. The creek continues to support significant potential spawning rearing habitat; however, access to that habitat is blocked by impassable road culverts and a shallow braided channel that passes through forested wetland. DFG has identified artificial structures that are passage barriers for one or more life stages of anadromous salmonids within the Willow Creek Watershed. A Sonoma County road crossing culvert has been identified as a complete barrier to salmonids and a partial barrier to bedload associated with impacted watershed conditions. DFG has funded road improvement projects on

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private and public roads to reduce non-point source sediment and non-profit entities have implemented improvements to point-source sediment sources. The California State Parks and Stewards of the Coast and Redwoods, a non-governmental environmental organization, have funded the engineering design and completion of the CEQA document for the improvement of fish passage opportunity at the "2nd Bridge" on Willow Creek. The 80% engineering design is scheduled for completion by May 2008; CEQA documentation is scheduled for completion by September 2008. The project will likely be able to be constructed during 2008; however, the remaining engineering design and project construction will need funding. SCWA will support this fish passage enhancement project by State Parks by funding $100,000 of the construction costs. This project will help restore adult coho salmon and steelhead access to 9480 m^2 of spawning and rearing habitat for these species. The passage project will improve passage for adult salmonids by a 50% improvement factor (B.Coey, DFG, personal communication)." Pages 270-271, Russian River BO.

To implement the Willow Creek Fish Passage Enhancement Project, the SCWA intends to contribute $100,000 in funding to Trout Unlimited towards the removal of a complete barrier in Willow Creek. A copy of the proposed scope of work to be funded by the SCWA is enclosed. The project will restore passage to 7.3 and 4.7 miles of historic steelhead and coho spawning and rearing habitat, respectively, for all life stages by replacing 6 culverts and a bermed roadway with a 43-foot, single-span bridge. SCWA funding will be used to cover the cost of pile installation and rough grading and culvert removal associated with the bridge construction.

- **Pile installation**: Procure materials, stake locations, drive piles though existing road bed, cut piles to existing roadbed surface. Cost: $74,364

- **Rough grading and culvert removal**: Remove and off-haul asphalt, remove existing culverts, over excavate and compact bottom of cut for approach roads, install engineered fill to approach road subgrade, install culvert, rough grade channel, establish abutment bypass lane for construction vehicles. Cost: $25,636

This letter confirms that SCWA's contribution of $100,000 to Trout Unlimited towards construction of a new bridge on Willow Creek as described above and in the enclosed scope of work constitutes SCWA's completion of Willow Creek Fish Passage Enhancement Project as described in the Russian River BO.

Sincerely,

Dick Butler
North Central Coast Office Supervisor
Protected Resources Division

Enclosure

cc: William Hearn, PRD, NMFS, Santa Rosa
ARN#151422SWR2000SR150

Willow Creek 2nd Bridge Fish Passage Project
Sonoma County Water Agency Scope of Work

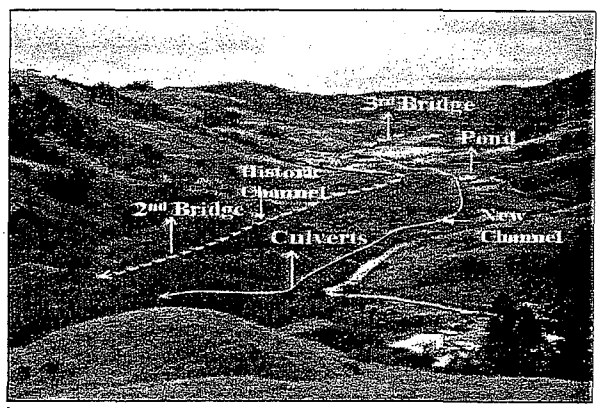
Overview

Sonoma County Water Agency (SCWA) funding will contribute to the removal of a complete barrier in Willow Creek, a tributary to the Russian River in Sonoma County, California. The project will restore passage to 7.3 and 4.7 miles of historic steelhead and coho spawning and rearing habitat, respectively, for all life stages by replacing 6 culverts and a bermed roadway with a 43-foot, single-span bridge. SCWA funding will be used to cover the cost of pile installation ($74,364) and rough grading and culvert removal ($25,636).

Background

The Willow Creek watershed is essentially a wilderness system, with 90% of the land in public preservation ownership and very few pressures on its habitat or water. It is a coastal watershed with mature, second-growth redwood and fir forests, and the streams are unconstrained by human infrastructure except at the project location. Willow Creek Road is owned by the County of Sonoma and is managed by the Department of Transportation and Public Works. All of the land in the immediate vicinity is owned and managed by State Parks as part of the 10,286-acre Sonoma Coast State Park.

Since the 1980s, salmonid population numbers have dropped dramatically and coho have disappeared altogether. The single greatest limiting factor to salmonid success in the Willow Creek watershed is the migration barrier at the second bridge area road crossing.
The lower Willow Creek valley is in an accelerated valley-filling phase due to natural geologic conditions exacerbated by historic logging and land-use practices. The appropriate channel form in these situations is a highly dynamic, multi-thread channel system. Beginning no later than the 1940s, the channel was actively managed to maintain a single-thread channel along the northeast edge of the valley. The stream was moved and straightened, a bridge was installed, and the channel was dredged on a regular basis.



After the property was purchased by State Parks in the late 1970s, dredging was discontinued in 1987 due to ecological concerns. Willow Creek immediately began to aggrade in the vicinity of the 2nd bridge, culminating in complete filling and abandonment of the historic channel on the east side of the valley. Streamflow is now concentrated on the west side of the valley where elevations are lowest.

The bermed roadway across the valley floor and floodplain on the west end of the second bridge crossing acts as a low-head dam, slowing streamflow and restricting fish passage upstream and downstream during spring and winter base-flow conditions. Multiple culverts are located within this bermed roadway, and were originally installed for overflow drainage. These culverts are

damaged, frequently fully submerged, and often blocked with debris during annual high flows. The culverts were not designed for fish passage. Streamflow slows and spreads across the floodplain, overtopping the roadway during most high flows. This condition does not provide a clear path for upstream salmonid migration. With a lack of channel continuity in this reach, upstream migration by adults and downstream migration by juveniles is severely restricted for steelhead and is a complete barrier for coho.

Assessment of the physical limitations and design of a solution to fish barrier issues in lower Willow Creek has been underway since the late 1980s. A multi-agency/organization Technical Advisory Committee (TAC) was formed in 2001 and has evaluated all of the data, constraints, and options for restoring channel processes and fish passage. In 2001, Stewards of the Coast and Redwoods formed the TAC to provide independent scientific and technical advice. This effort resulted in publication of two planning documents for fish passage and habitat improvement: *Sustainable Channel Development in Lower Willow Creek, Sonoma County, California* (PCI 2005a) and the *Willow Creek Watershed Management Plan* (PCI 2005b). Subsequent meetings of the TAC led to selection of the preferred alternative for the crossing. The TAC recommended a stream-crossing structure design that will accommodate channel-forming flows, pass sediment and debris, and be viable for 20-50 years.

Project Description

A preferred alternative to restore fish passage at the 2nd Bridge road crossing has been chosen and designed by Prunuske Chatham, Inc. (PCI) for Stewards of the Coast and Redwoods with funding from the California State Coastal Conservancy (SCC), Sonoma County Fish and Wildlife Commission, and State Parks. Based on the evaluation of the crossing structure types, a precast, single-span bridge was chosen as the preferred alternative. Construction costs for precast concrete bridges are similar to concrete arched culverts; however, a bridge is preferred over an arched open-bottom culvert because of its greater channel capacity for a given base width. Further, it does not require additional fill (up to 2 feet) on top of the structure for the road base.

The project is ready for construction; 80% site designs are complete, a Mitigated Negative Declaration (CEQA) has been prepared, and a geotechnical evaluation of the site has been performed. Preliminary structural bridge engineering and 90% site plans are funded for finalization in December 2009. Funding for preparation of environmental permits is secured, and all permits will be in place by spring 2010.

The following licensed engineers performed the services described above:

- Jonathon Mann, #C63782, Prunuske Chatham, Inc.
- Eric G. Chase, #GE2628, RGH Consultants, Inc.
- Jeff Morris, RCE#46005, Morris Engineering
- Matt O'Connor, #CEG2449, O'Connor Environmental, Inc.

Due to the unique geomorphic channel setting and existing culvert installation/function (i.e., very low gradient, submerged culverts, backwater conditions across the upstream floodplain), the standard practices for evaluating fish passage criteria for culvert retrofits do not apply at this location. A FishXing analysis was performed; however, the results were inconclusive.

Professional opinions (Bill Cox and Derek Acomb, CDFG; Jon Mann, PCI) during the course of this 8-year planning project are that adults are highly unlikely to swim through the culverts (due to submergence, obstructions, high entrance velocities) and that lack of attraction flows across the backwatered floodplain precludes their use by out-migrating juveniles.

The proposed project will replace six channel-constricting culverts with a single-span, precast concrete bridge. Bridge design details include:

- Clear-span length of 43' with a 23' wide deck at elevation of 20' NGVD,
- 2.5' wide by 5' long by 10' tall bridge abutments supported by 16" diameter pipe piles driven approximately 70' deep,
- Bridge approaches graded to meet existing bridge elevation on the western approach and the 18' road contour on the eastern approach, and
- Bridge guardrails and 6" concrete curb designed to meet Caltrans safe design specifications.

A roughly graded channel will be put in under the bridge with a thalweg at an elevation of 12.6 feet. The up- and downstream ends of the new channel will be graded to conform to the existing low-flow channel. The channel will be unreinforced to allow stream processes to reshape it. To reduce flooding frequency, ±790' of the existing roadway will be raised and repaved. Grading the bridge approaches will include fill at the edges of the roadway to raise the elevation ±3'. Grading will result in ±2,100 cy of cut and 2,500 cy of fill with a net fill of ±400 cy. Minor fill of wetlands will occur and impacts will be mitigated at a 4:1 ratio. Precise location of mitigation will be confirmed during consultation with the Corps as part of the CWA §404 permit.

Morris Engineering will have prepared 90% structural bridge designs with funding from the SCC by December 2009. Prior to construction, Jeff Morris will prepare the final specifications in consultation with the geotechnical engineer (RGH) and the site plan engineer that prepared the 80% design (PCI). Specific construction tasks will include preparation of a Stormwater Pollution Prevention Plan (SWPPP); mobilization; pile installation; rough grading and culvert removal; installation of the bridge, abutments, guardrails, and drain system; road reconstruction; erosion control and site stabilization; and clean up. Implementation management and oversight will involve documentation of final construction design coordination with subcontractors and the geotechnical and bridge engineers; and preparation of geotechnical monitoring reports, as-built plans, and a final construction report. Jeff Morris and Eric Chase will perform construction monitoring to ensure compliance with the project plans and specifications.

Scope of Work

$100,000 of SCWA funding will be used to fund pile installation and rough grading and culvert removal.

- **Pile installation**: Procure materials, stake locations, drive piles though existing road bed, cut piles to existing roadbed surface. Cost: $74,364
- **Rough grading and culvert removal**: Remove and off-haul asphalt, remove existing culverts, over excavate and compact bottom of cut for approach roads, install engineered fill to approach road subgrade, install culvert, rough grade channel, establish abutment bypass lane for construction vehicles. Cost: $25,636

Appendix F-1

Fish Screen Design Feasibility Study

Mirabel Fish Screen Reconfiguration Feasibility and Alternatives Study

Final Report - December 2009

Prepared for

SONOMA COUNTY WATER AGENCY

Prepared by

PRUNUSKE CHATHAM, INC.

Mirabel Fish Screen Reconfiguration Feasibility and Alternatives Study
Final Report – December 2009

This report, including analyses and conceptual designs contained within, was prepared by, and under the supervision of:

Jonathon Mann, P.E.
Principal Engineer
Prunuske Chatham, Inc.
400G Morris Street
Sebastopol CA 95472

The Mirabel Fish Screen Reconfiguration Feasibility and Alternatives Study is a project of the Sonoma County Water Agency.

Project Manager:
Mathew Vail
Water Agency Principal Engineer
PO Box 11628
404 Aviation Boulevard
Santa Rosa CA 95406

This study was accomplished with the great help of Matt Vail and the following individuals:

Erik Brown, Water Agency Engineer
Steven Chatham, President, Prunuske Chatham, Inc.
Grant Davis, Assistant General Manager, SCWA
Rob Hammond, Water Agency Coordinator
Darryl Hayes, P.E., Prunuske Chatham, Inc.
David Manning, Principal Environmental Specialist, SCWA
Jim Zambenini, Water Agency Coordinator

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Summary of Study Results

Sonoma County Water Agency manages the Russian River diversion at Mirabel as a critical water supply component for providing high quality drinking water to over 600,000 people in Sonoma and northern Marin Counties. The inflatable dam serves to increase production capacity during peak demand months. Fish screening facilities ensure the safety of the fish in the river and permanent fish ladders provide fish passage when the dam is raised. (Information from http://www.scwa.ca.gov/water-supply/) As a result of the Biological Opinion issued by NMFS, the fish screening facilities have been found to perform less than adequately for full protection of fish and downstream migration.

This study was conducted to develop a preferred conceptual design that meets many of the project objectives while ensuring that the fish screening facilities adhere to contemporary fish screening design criteria. A Technical Advisory Committee composed of the Sonoma County Water Agency, National Marine Fisheries Service, and the California Department of Fish and Game provided guidance in refining the objectives and identifying alternatives.

Six concept alternatives were evaluated for meeting the project objectives. Schematic designs and critical details were developed for these concept alternatives to assess physical feasibility and to be able to evaluate the alternatives relative to the objectives. The preferred concept design alternative was determined through an interactive evaluation and was selected because it meets or exceeds the project objectives.

The preferred concept design alternative includes a new intake with an inclined flat plate fish screen system, an oversized screen for increased bypass flow control and capacity, and a bypass fishway in the form of a vertical slot fish ladder. It also includes a fish viewing chamber with a window which will allow for real-time monitoring along with excellent education and outreach opportunities. The preferred conceptual design alternative will be a significant improvement for the water supply system and ecosystem protection. This alternative best meets the project objectives and is considered feasible for construction.

The estimated construction cost of the preferred conceptual design alternative is in the range of $3.5M to $4.0M. The construction cost estimate is not a total project cost. Other project costs will be considered in the next phase of project planning and design.

The next step of the project is to begin detailed environmental evaluation and engineering design of the preferred conceptual design alternative. It is feasible to complete the design of the project by October 2011 and the construction of the project by October 2014, as required by the Biological Opinion.

Introduction

The Sonoma County Water Agency (Agency) operates and maintains the Mirabel area inflatable dam and water diversion facilities on the Russian River. The facilities are located downstream of Wohler Bridge as shown in Figure 1. Figure 2 shows the existing configuration of the dam and diversion from an aerial perspective and Figure 3 is a photograph of the dam and diversion facilities from the East bank during routine operations. The inflatable dam is used to impound the river to a water surface elevation of approximately 38 feet. This allows for a surface water diversion of up 100 cubic feet per second (cfs) through the intake structure, fish screens and pump station, into the adjacent infiltration ponds. The Agency generally raises the dam once in spring when flow in the river reaches 400 cfs and lowers the dam in the fall/winter when flow reaches 1,000 cfs.

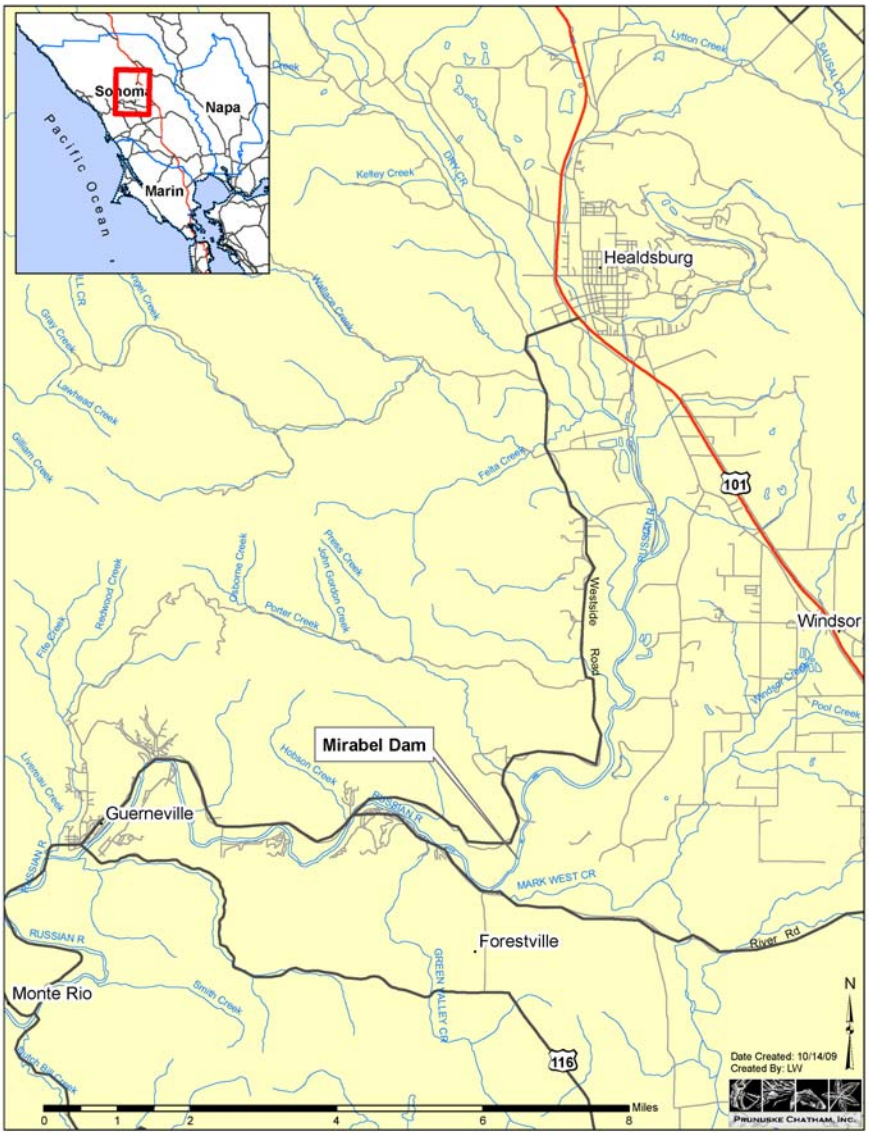

Figure 1 - Location Map

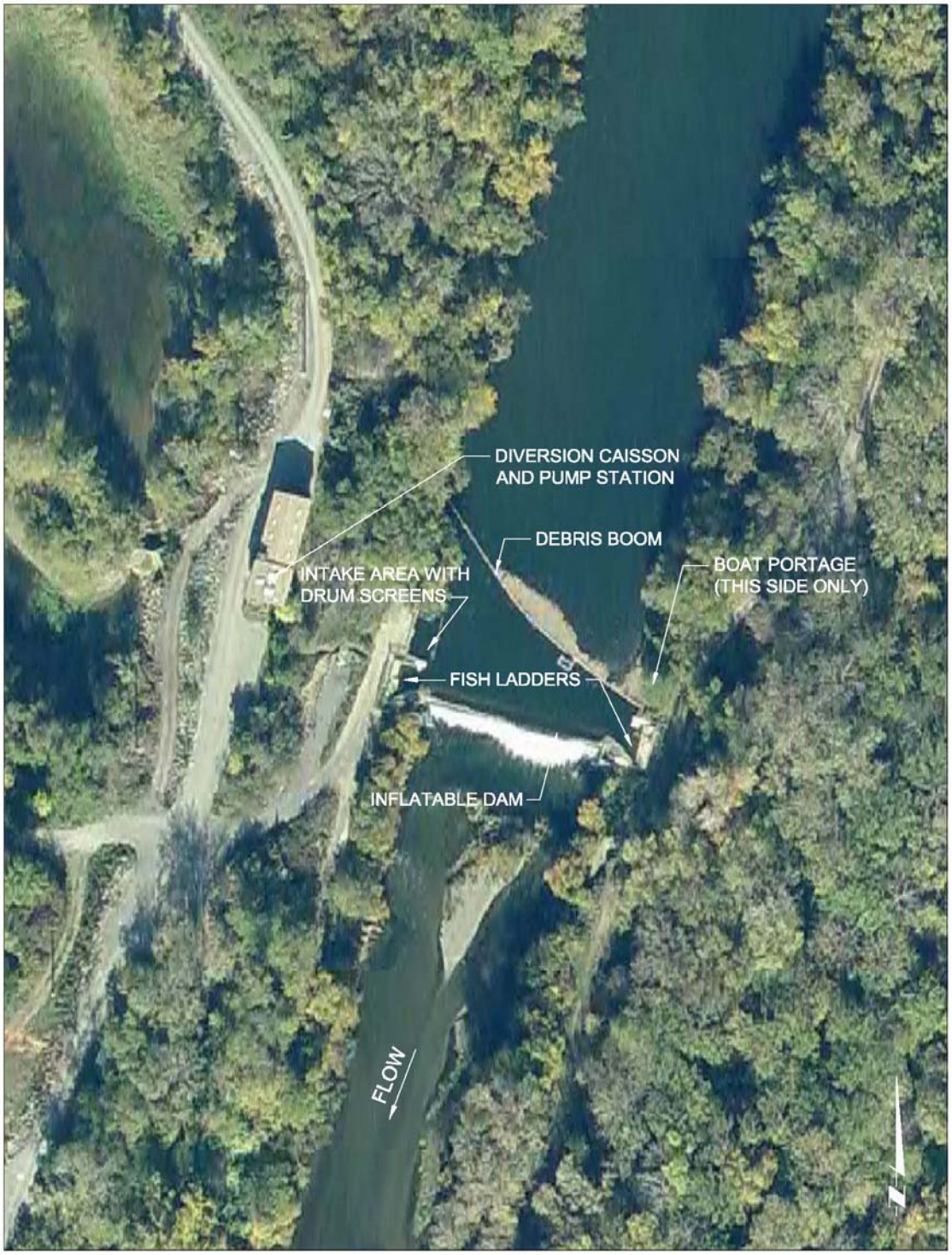

Figure 2 - Mirabel Diversion Facility

Figure 3 - Inflatable Dam under Normal Operation with Diversion on West Bank

The Agency is required to operate these facilities for long-term reliability, sound watershed stewardship, and good economy for its customers. The Agency is interested in supporting healthier fish populations, finding a solution to eliminate fluctuations in downstream flow rates that occur from notching of the inflatable dam, and replacing the fish screens to meet contemporary criteria as required by the National Marine Fisheries Service (NMFS) in the recent Russian River Biological Opinion (NMFS 2008). The Biological Opinion specifically says the Agency "shall complete design of the new fish screen at Mirabel within three years of the issuance of this biological opinion, and replace the fish screen within three years after completion of the design". The Biological Opinion was issued on September 24, 2008. In addition, the Agency would like to provide opportunities for public outreach and education. The first step to achieve these outcomes is this Fish Screen Reconfiguration Feasibility and Alternatives Study (Study) that was initiated in April 2009.

The fish screens and intake consist of two drums that rotate about a vertical axis with intake pipes directly under the drums (see Figures 4 and 5). A fish screen performance evaluation was conducted in 2000 under the Biological Assessment work leading up the Biological Opinion. This evaluation (Borcalli and Associates 2000) identified that the upstream screen takes more of the diversion flow than the downstream screen. Although this is expected given the intake pipe configuration (see Figure 6), it results in approach velocities through the

upstream screen that are much higher than NMFS allows. The downstream screen was found to operate at the margin of acceptable approach velocities. The opinion of the evaluators was that "the fish screen structure will require modifications to alleviate the concern of impinging juvenile salmonids upon the screen face during the Agency's routine diversion operations."

Figure 4 - Intake Drum Screens at Low Water Level

Figure 5 - Intake at Normal Operating Water Level with Drum Screens Submerged

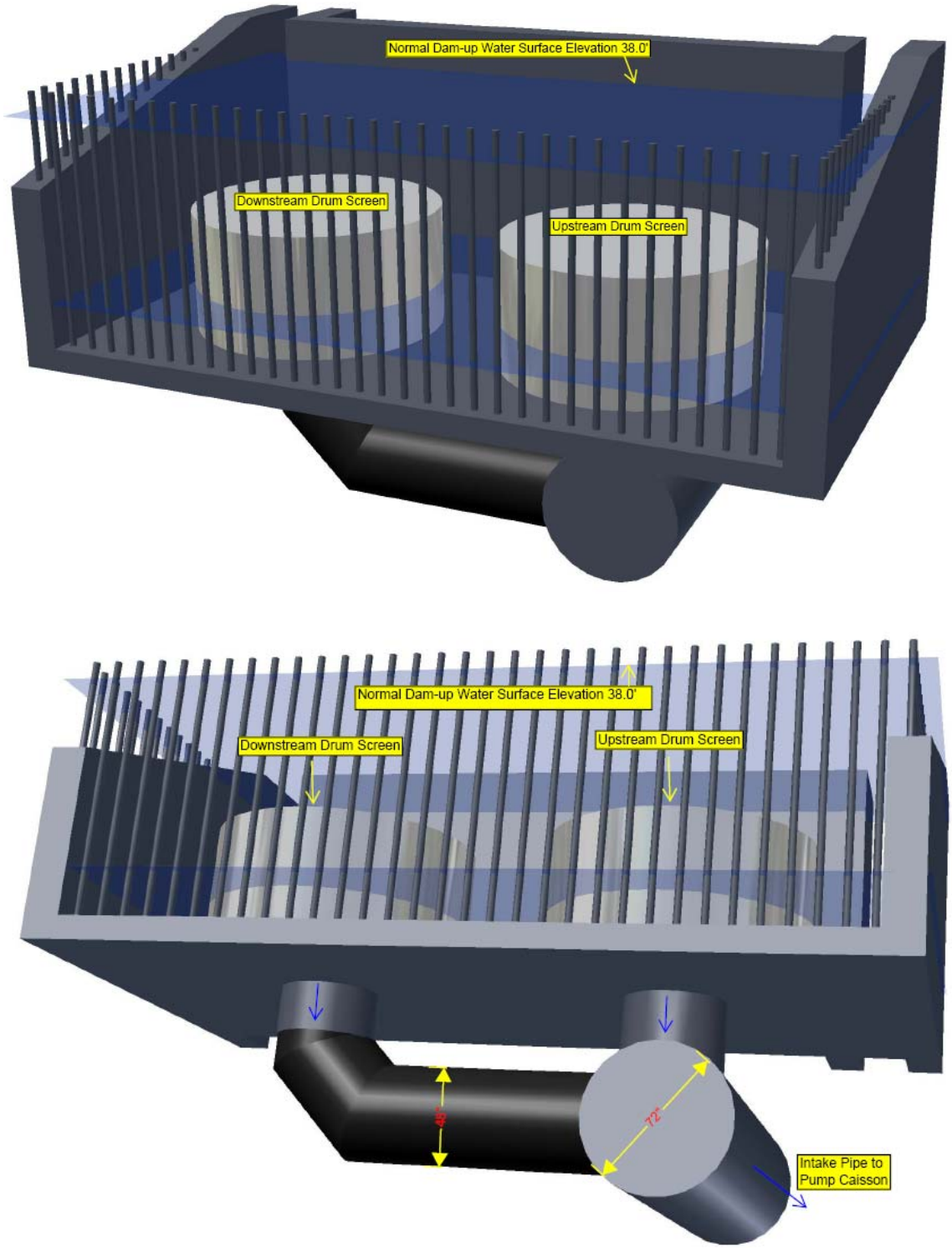

Figure 6 - Existing Intake Pipe Configuration below Drum Screens

The Agency is also required to maintain steady bypass flows downstream of the Mirabel dam. A study conducted by the Agency from 2001 to 2004 (Manning, et. al. 2005) showed significant improvement in downstream fish migration rates through notching of the inflatable dam. Figure 7 shows the dam in a notched configuration. This notching creates unsteady bypass flows as the dam material heats up from increased surface exposure to the sun and results in changing the notch shape in a diurnal fashion. Continued notching of the inflatable dam is also an undesirable operation from a structure fatigue standpoint and is not a long-term solution.

Figure 7 - Inflatable Dam in Notched Configuration

In addition to the above, the Agency would like its water contractors and the general public to have more opportunity to understand their efforts to recover salmonid populations. The Agency desires to use the Mirabel area facilities to contribute to such outreach and education.

Study Methodology and Process

The Study began in April 2009 with a scoping meeting between the Agency and the consultant team. A draft statement of objectives was developed and a range of project design concepts were discussed. After careful review of existing conditions information the advantages and disadvantages of the range of project design concepts were considered. The statement of objectives was also refined.

These project objectives include:

1. Provide for a fish screen that meets contemporary hydraulic design criteria (approach velocity = 0.33 fps; sweeping velocity = 2 times approach velocity) at the 100 cfs maximum diversion rate.
2. Maintain or improve downstream fish passage and provide for control of steady bypass flows. Control should be through the use of a fish friendly hydraulic structure or structures that can accommodate a range of expected bypass flow requirements.
3. Maintain existing diversion rate and operating water surface. (Elevation 38.0' is normal operating water surface, elevation 39.0' is maximum operable, elevation 36.0' is considered the minimum operable water level).
4. Provide a design that is compatible with and does not preclude opportunities for significant future dam modifications or replacement.
5. Maintain or improve upstream fish passage monitoring capability.
6. Maintain or improve upstream fish passage.
7. Provide for educational opportunity.
8. Maintain recreational river portage around dam and enhance portage with new facilities that also provide educational opportunities.
9. Identify a project that offers good value and reliable known costs over the next 50 years.
10. Provide for river diversion at low, non-impounded flows.

Schematic designs and critical details were developed for selected alternatives to assess physical feasibility and to be able to evaluate the alternatives relative to the objectives. These alternatives will be described in the next section of the report. A Technical Advisory Committee (TAC) was formed with representatives from the Department of Fish and Game (DFG), NMFS, and Agency technical support personnel. The first TAC meeting was held on July 20, 2009 in which the statement of objectives was reviewed and selected fish screen replacement alternatives were discussed. The meeting helped guide the concept designs toward a preferred alternative.

The preferred concept design alternative was determined through interactive evaluation with the Agency and was presented at a second TAC meeting on September 28, 2009. The TAC also reviewed the preferred concept design alternative in the field during a site visit. TAC feedback was positive for the concept design and it was agreed that it was the preferred concept to carry

forward to the next phase of design. The preferred concept design alternative is described initially in the next section and more fully in a subsequent section of the report.

Concept Alternatives Considered

The first concept alternative considered was to simply retrofit the existing drum screens or intake. One variation of this could include fixing the drums in place so that they do not rotate, baffling behind the screen material, replacing the solid top of the drum with screen material, and other features to help reduce the chaotic nature of the hydraulics around the drums. This approach is considered experimental and would likely require many trial and error attempts at proving that the retrofit would meet fish screen criteria. It would also not meet many of the project objectives and was dropped from further consideration.

During the Biological Assessment work, and subsequent to the Mirabel fish screen performance evaluation, a concept design alternative of permanent modifications to the facility was developed (Borcalli and Associates 2001). This alternative was designed to strictly meet the objective of adhering to contemporary fish screen criteria. This 2001 concept alternative included a vertical, flat plate fish screen oriented on a diagonal to the bank and integrated into the existing intake structure with some concrete intake modifications at the upstream end. It also included mechanical straps to adjust the dam shape for more controlled hydraulics and flow over the dam. Based on recommendations from the dam manufacturer, the Agency has determined that the mechanical straps over the dam will not be allowed. This concept alternative was included with the others in the evaluation process but because it did not significantly improve downstream fish migration and bypass flow control it is not considered viable going forward. The fish screen configuration was used as a design basis in the other concept design alternatives.

The next concept design alternative that was considered is a newer type of modular fish screen system called a cone screen. Two removable cones screens would be placed into a retrofitted intake as shown in Figure 8. As part of this concept the intake pipes under the drum screens would be relocated to better balance the flows between them. Because this concept would require substantial reworking of the intake and does not meet many of the other project objectives it was not considered further.

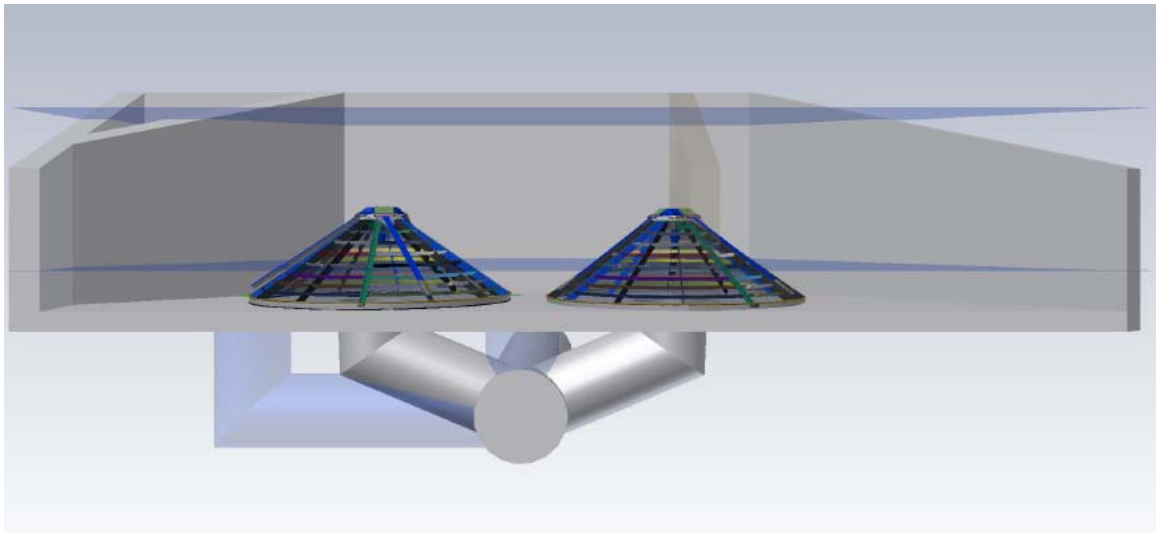

Figure 8 - Cone Screen Concept

Three more concept design alternatives were developed. These included a new inclined fish screen with a vertical slot fish ladder, a new vertical fish screen with pool-and-chute fish ladder, and a left bank bypass channel (opposite side of river) with a separate fish screen improvement inclusive of the above concepts. The ladders and bypass channel were primarily considered for enhancing the quantity and attractiveness of flow components for downstream fish migration. The bypass channel was analyzed for the left bank because there are two rows of sheetpile around the dam abutment about 20 feet apart that can form the sides of a bypass channel. It is understood that this area was used as a river bypass during the construction or repair of the dam.

A summary of the concept design alternatives evaluation relative to the project objectives is shown in Table 1. A revision of one of the concept design alternatives (number 4) was carried forward as the preferred alternative. An explanation of the basis for the preference and a detailed description of the concept design are provided in the next sections of this report.

Table 1 – Concepts and Project Objectives Evaluation

		Objectives											
		1	2	3	4	5	6	7	8	9	10		
	Concept	Provide for a fish screen that meets contemporary hydraulic design criteria at the 100 cfs maximum diversion rate.	Maintain or improve downstream fish passage and provide for control of steady bypass flows.	Maintain existing diversion rate and operating water surface.	Provide a design that is compatible with and does not preclude opportunities for significant future dam modifications or replacement.	Maintain or improve upstream fish passage monitoring capability.	Maintain or improve upstream fish passage.	Provide for educational opportunity.	Maintain recreational river portage around dam and enhance portage with new facilities that also provide educational opportunities.	Identify a project that offers good value and reliable known costs over the next 50 years.	*Provide for river diversion at low, non-impounded flows. (added May 14)*	**General Pros**	**General Cons**
1	Retrofit existing drum screens and dam	Experimental - may require trial and error fixes and hydraulic evaluations to prove.	Maintaining or improving depends on dam retrofit. Straps may be experimental.	Maintained with existing Denil ladders.	Yes	Maintained at existing Denil fish ladders.	Maintained	Limited to interpretive signage.	Maintained. Enhanced if river portage is also included on right bank (intake side) with interpretive signage.	Maybe - trial of drum or intake box retrofits could add up in long term.	Limited to existing condition.	Limited modification of existing intake (e.g., minimal concrete work). Possibly low costs.	May not solve hydraulic performance problems. Still needs improved, fish friendly bypass flow control structure through dam retrofit or other configuration.
2	2001 Borcalli new vertical fish screen and intake reconfiguration with dam retrofit (straps)	Yes	Maintaining or improving depends on dam retrofit. Straps may be experimental.	Maintained with existing Denil ladders.	Yes	Maintained at existing Denil fish ladders.	Maintained	Limited to interpretive signage.	Maintained. Enhanced if river portage is also included on right bank (intake side) with interpretive signage.	Yes	Limited by fish screen sill elevation.	Contemporary fish screen configuration.	Requires substantial modification of existing intake. Still needs improved, fish friendly bypass flow control structure through dam retrofit or other configuration.
3	Cone screens with intake retrofit	Yes - if caisson intake pipes are reconfigured.	Maintaining or improving requires added component such as dam retrofit or other configuration.	Maintained with existing Denil ladders.	Yes	Maintained at existing Denil fish ladders.	Maintained	Limited to interpretive signage.	Maintained. Enhanced if river portage is also included on right bank (intake side) with interpretive signage.	Yes	Yes - similar to existing condition. Could be improved by lowering intake floor when reconfiguring caisson intake pipes.	Contemporary fish screens with ease of maintenance and good reliability. Limited construction footprint with modification of existing intake.	Still needs improved, fish friendly bypass flow control structure through dam retrofit or other configuration.
4	New vertical slot fish ladder with new integrated intake/screen	Yes	Improved - Vertical slot ladder capacity is approx. 50 cfs and auxiliary flow can increase total bypass flow without spill over dam to 150 cfs. Will need bypass slot/weir at dam abutment since ladder inlet is 100 ft upstream of dam.	Maintained. There are advantages to a lower operating water surface for a shortened ladder.	Yes. There are advantages to include dam replacement coincident with construction of new fish ladder and screen.	Improved through use of full depth monitoring/viewing chamber.	Improved with vertical slot ladder that allows for different hydraulic patterns compared to the Denil ladders and full depth slot may favor wider range of species preferences. Possible reduced delay for salmon.	Yes - underwater, full depth viewing chamber can provide excellent educational opportunity in addition to interpretive signage.	Maintained. Enhanced if river portage is also included on right bank (intake side) with interpretive signage.	Values and costs not assessed at this time.	Yes - depends on intake floor/fish screen sill elevations.	Smallest footprint for a new ladder. Enhanced upstream fish passage and diversity of upstream fish passage when combined with existing left bank Denil ladder. May be able to take all of minimum bypass flows through new ladder and auxiliary flow components. Improved monitoring and active underwater viewing/educational component.	Requires substantial reworking of existing intake and river bank. Inlet location relative to dam may still cause some downstream passage delay compared to an inlet closer to the dam. River training structures and/or channel maintenance may be needed for sediment accumulation near new inlet.
5	New pool-and-chute fish ladder with new integrated intake/screen	Yes	Improved - Ladder to take majority or all of minimum bypass flow. This large pool-and-chute ladder can handle over 85 cfs alone. Will need bypass slot/weir at dam abutment since ladder inlet is 120 ft upstream of dam.	Maintained. There are advantages to a lower operating water surface for a shortened ladder.	Concept calls for reconfiguring right abutment and shortening dam. New fish ladder can be pushed into bank to avoid right abutment work but trade-off is more bank reconfiguration with bigger retaining walls. There are advantages to include dam replacement coincident with construction of new fish ladder and screen.	Improved through use of full depth monitoring/viewing chamber.	Improved passage for other species and life stages. Possible reduced delay for salmon.	Yes - underwater, full depth viewing chamber can provide excellent educational opportunity in addition to interpretive signage.	Maintained. Enhanced if river portage is also included on right bank (intake side) with interpretive signage.	Values and costs not assessed at this time.	Yes - depends on intake floor/fish screen sill elevations.	Enhanced upstream fish passage and diversity of upstream fish passage when combined with existing left bank Denil ladder. May be able to take all of minimum bypass flows through new ladder. Improved monitoring and active underwater viewing/educational component.	Large footprint. Requires substantial reworking of existing intake and river bank. Inlet location relative to dam may still cause some downstream passage delay compared to an inlet closer to the dam. River training structures and/or channel maintenance may be needed for sediment accumulation near new inlet.
6	Left bank bypass channel with separate fish screen improvement	Would need to be combined with fish screen improvement option which could include any of the first three concepts.	Improved - Channel can be sized to take majority or all of minimum bypass flows. Denil ladders at dam can be maintained for additional bypass routes and flow.	Maintained. There are advantages to a lower operating water surface for a shorter bypass channel.	Yes	Maybe maintained - monitoring efficiency may be reduced with large channel inlet configuration. Existing Denil fish ladders can be retained.	Improved passage for other species and life stages. Possible reduced delay for salmon.	Yes - Interpretive signage. Underwater viewing windows may still be possible with an in ground chamber.	Bypass channel may provide boat-pass. Safety and nuisance factors will need to be considered. Quicker pass-by and not getting out of boat will limit interpretive signage observing.	Values and costs not assessed at this time.	Depends on fish screen improvement option.	Enhanced upstream fish passage and diversity of upstream fish passage when combined with existing left bank Denil ladder. May be able to take all of minimum bypass flows through new channel. Enhanced recreational opportunity if used as a boat-pass. Channel may provide enhanced temporal habitat compared to adjacent river.	Requires modification of left river bank between sheet pile walls. Sheet pile walls may also need substantial reconfiguration for longer, better performing channel. Monitoring reliability may be decreased.

Prepared by J. Mann, Prunuske Chatham, Inc. - July 17, 2009

Basis for Preferred Concept Design Alternative

In working through the concept design alternatives it became increasingly apparent that the objectives of improving downstream fish passage and providing for control of steady bypass flows were equally as important as providing a fish screen that meets contemporary hydraulic design criteria. It was also found that a new fish screen meeting criteria can be easily designed with a substantial modification of the intake so long as a fish-friendly passageway component for flow bypass can be combined with the new intake structure. The challenge was not in providing an adequate fish screen so much as providing for attractive fish migration and bypass flow control and increased capacity. In essence, the integration of a new fish screen, and its associated hydraulics, with a large bypass for downstream fish passage was an important concept design strategy.

Many variations and options of a fish-friendly configuration that also provided good bypass flow control and capacity were considered. These included replacing all or part of the dam with overflow gate systems, integrating a gate and control system just outside of either dam abutment, and relocating the diversion into a canal. These options vary in degrees of fish-friendliness and flow capacity and control but in general, the more fish-friendly any individual component or system may become the less capacity and control for bypass flow it tends to have. A balance of the two aspects was obtained by focusing the design strategy on developing a large capacity fish-friendly bypass structure. The friendliest structure for fish passage, other than a natural channel, is a fishway (fish ladder). The advantage of fishways, with well-defined flow ranges, is that they can be located in smaller areas by folding their hydraulic profile into a smaller footprint when compared to a natural channel.

A revision of the inclined fish screen with a vertical slot fish ladder was developed and better matched the project objectives compared to previous concepts. The components of this revised concept include a new intake with an inclined flat plate fish screen system, an oversized screen for increased bypass flow control and capacity, and a bypass fishway in the form of a vertical slot fish ladder. The preliminary drawings for this concept design are shown in Appendix A.

The evaluation of the project objectives with the preferred concept design is listed here (bold indicates assessment of how the design meets each project objective):

1. Provide for a fish screen that meets contemporary hydraulic design criteria at the 100 cfs maximum diversion rate. **Yes, screen oversized for improved bypass flow control.**
2. Maintain or improve downstream fish passage and provide for control of steady bypass flows. Control should be through the use of a fish friendly hydraulic structure or structures that can accommodate a range of expected bypass flow requirements. **Improved – bypass fishway flow**

capacity can be significantly increased compared to existing Denil fishway and auxiliary flow from bypass pipe can increase total bypass flow capability with improved control and without spill over dam (flow calculations to be completed in next phase of design).

3. Maintain existing diversion rate and operating water surface. (Elevation 38.0' is normal operating water surface, elevation 39.0' is maximum operable, elevation 36.0' is considered the minimum operable water level). **Maintained – bypass fishway can more easily accommodate water surface elevation ranges compared to existing Denil fishways.**
4. Provide a design that is compatible with and does not preclude opportunities for significant future dam modifications or replacement. **Yes**
5. Maintain or improve upstream fish passage monitoring capability. **Improved through use of full depth monitoring/viewing chamber.**
6. Maintain or improve upstream fish passage. **Improved with vertical slot ladder that allows for different hydraulic patterns compared to the existing Denil fishway and full depth slot may favor wider range of species preferences. Possibly improved performance and higher capacity for salmon.**
7. Provide for educational opportunity. **Yes - underwater, full depth viewing chamber can provide excellent educational opportunity in addition to interpretive signage on the river bank.**
8. Maintain recreational river portage around dam and enhance portage with new facilities that also provide educational opportunities. **Maintained. Enhanced if river portage is also included on right bank (intake side) with interpretive signage.**
9. Identify a project that offers good value and reliable known costs over the next 50 years. **Yes**
10. Provide for river diversion at low, non-impounded flows. **Yes - with intake floor at elevation 25.0' and fish screen sill elevation at approx. 25.5' up to approximately 30 cfs of diversion capability (river water surface at 28.0' and submerged depth of fish screens at 2.5').**

Some general advantages of the preferred concept design alternative include:

1. Higher certainty of hydraulic performance and meeting fish screen criteria.
2. Higher level of bypass flow control compared to existing condition. This configuration will be able to take all of minimum bypass flows through new bypass fishway and auxiliary flow components.
3. Enhanced upstream fish passage and diversity of upstream fish passage, especially when combined with existing left bank Denil fishway.
4. Improved monitoring and active underwater viewing and educational component.
5. Smaller footprint for a new fishway compared to other ladder types.

Some disadvantages of the preferred concept design alternative may include:

1. Requires reworking of existing intake and river bank.
2. River training structures and/or channel maintenance may be needed for sediment accumulation near new intake.
3. Bypass fishway entrance (downstream end) requires substantial depth.
4. Bank grading and tall retaining walls may be required in addition to new walls for intake and bypass fishway.

Description of Preferred Concept Design Alternative

Drawings for the preferred concept design alternative are included in Appendix A. A summary of hydrology that was used as a preliminary basis of design is included in Appendix B.

Diversion Intake and Fish Screen Configuration

Sheet 1 of the concept drawing shows the plan and elevation view of the proposed fish screen layout. The inclined fish screen was conceptually designed using the DFG Fish Screening Criteria (CDFG 2000) and the NMFS Fish Screening Criteria for Anadromous Salmonids (NMFS 1997). The intent of the fish screening criteria is to provide design guidelines and criteria that result in juvenile fish being prevented from entrainment in, or impingement upon, a water diversion's intake. This is basically to make the diversion hydraulically transparent to the fish and to not alter their natural biology. In this case, the target fish being excluded from the diversion intake are salmonid fry. Because of the life history of juvenile salmonid fish in the Russian River, and that diversion operations may occur during the early spring when juvenile fish are present, the fry criteria portion of the screen criteria is used. NMFS will normally assume that fry-sized salmonids are present at all sites unless adequate biological investigation proves otherwise.

The fish screening criteria determines the required area of the screen by the amount of water diversion occurring and where the intake is placed (river, canal, tidal, etc.) for the maximum approach velocity allowed. Approach velocity is the water velocity vector component perpendicular to the screen face. With a maximum allowable approach velocity of 0.33 ft/s for screens in streams and rivers, and a maximum pumped diversion of 100 cfs, the minimum required wetted screen area is 303 square feet. Adding 25 percent to the required wetted area to compensate for a reduction of screen area due to structural members is a common design practice. The required screen area then becomes approximately 380 square feet.

The proposed intake screen will consist of removable panels of stainless steel profile bar set into the reinforced concrete intake structure. The intake screen consists of four 14-ft x 10-ft panels, with a total area of 560 square feet. A photo of an example screen panel is shown in Figure 9. Not all of the screen area is submerged during normal diversion operations. The proposed design has the panels sitting on a concrete sill that elevates them above the forebay floor. This allows for some variability from sediment that may accumulate and for a brush cleaning arm to extend slightly beyond the screen face for complete cleaning coverage. Additionally, the proposed design configuration will allow for some freeboard on the screen for slight variation in operating water surface elevation and pump flow curves.

Figure 9 – Example Intake Screen Panel

The oversizing of the screen area also allows for a bypass flow control pipe to be considered between the intake and the pump caisson as shown on the concept design. Operators of the facility have expressed a desire to have more bypass flow quantity control. They are currently limited to about 20 cfs of flow control from the existing intake bypass. Regulating the flow in that bypass at low flows is not conducive to the hydraulics for fish passage in the existing intake. A new, precisely controlled bypass valve and pipe for increased flow as conceptually designed would likely be limited only by the availability of excess screen area after subtracting out the area required for the diversion pumping rate. If the

diversion rate is maxed out at 100 cfs there will be approximately 180 square feet of screen area for about 60 cfs of bypass flow. Lowering the pumping rate of the diversion on occasion, usually in 20 cfs increments based on water supply demand, will allow for increased bypass flow and more precise control. Another advantage to the bypass pipe with its inlet located behind the intake screen is that it can be the source of auxiliary water for the fishway entrance (the outlet at the downstream end). The auxiliary flow and bypass fishway will be explained in the next section of the report. Detailed hydraulic analysis for the bypass flow control pipe and optimization of screen size with respect to bypass flow control requirements will be conducted in the next phase of design.

For water supply reliability during drier winter and spring conditions the Agency may need to divert water from the free-flowing river when the inflatable dam is down. The pumping capability when the dam is down is lessened because of the lack of head from the impoundment and is determined by the river flow and water surface elevation. Appendix B contains an estimated dam-down rating curve of the river channel and Figures 10 and 11 show the river with the dam down at different flow rates in which dam-down diversions could occur. The lowered forebay floor and intake screen sill elevations of the proposed concept design may allow for adequate screen area during these lessened diversion operations depending on the pumping capability and water supply demand. The diversion pump station currently contains two 100 horsepower and one 50 horsepower pumps that when combined in operation have a 100 cfs capacity with the design head and dam-up conditions (water surface elevation of 38 feet). The pumping capacity is lessened when the dam is down and dependent upon the river water surface elevation. It is expected that dam-down diversion rates will be in the range of 15 to 40 cfs depending on pump operations. Detailed hydraulic analysis for the intake elevations and optimization of screen area with respect to dam-down diversion operations will be conducted in the next phase of design.

Figure 10 – 4/30/2009 – Free Flowing River at ~ 250 cfs and Water Surface El. of 28.7′

Figure 11 – 2/13/2002 – Free Flowing River at ~ 1,100 cfs (Hacienda Gage) After Peak Flow of 44,000 cfs on January 3rd., Estimated River Depth = 3 ft

The fish screening criteria requires that the sweeping velocity be greater than the approach velocity. Sweeping velocity is the water velocity vector component parallel and adjacent to the screen face. Observed sweeping velocities at the location of the proposed fish screen are near zero during normal diversion conditions with the inflatable dam in the up position and depending on incoming river flow. Because of the impounding effect of the dam and these slow velocities, the sweeping velocity criteria may not be met during some flow conditions. In addition to downstream fish migration attraction hydraulics, as explained previously, this is an important consideration in locating the bypass fishway relative to the intake screen face. The concept design locates the bypass fishway at the downstream end of the intake screen to provide a drawing of flows along the face of the screen as sweeping velocity. The influence of this drawing effect is determined by the amount of flow going down the bypass fishway and the geometry of the intake relative to the bypass fishway inlet. Detailed hydraulic modeling and analysis will occur during the next phase of design to ensure sweeping velocities and distribution of approach velocities are satisfactory. Training walls or other appurtenances for enhancing sweeping velocities will be considered at that time. The Agency will include in the design phase of the project a requirement for such a modeling effort.

The fish screening criteria also requires uniform flow distribution over the surface of the screen. The configuration of the intake relative to the river channel and river hydraulics is usually the first step in ensuring uniform flow distribution. In this case, because the river velocities are very low during routine diversion operations (dam-up), the intake was designed to be symmetrical about the caisson pipe and the transition plenum component added to help transition flows as equally as possible. This design approach for considering hydraulics at the macro-scale was taken in the absence of a detailed study to optimize the intake configuration. A detailed study can be conducted as part of other hydraulic modeling and analysis efforts mentioned previously. Some intake screen designs use porosity plates, louvers, baffles, isolation walls, and valves, or combinations of these components to ensure uniform flow distribution. The proposed concept design has four equalization bays, one for each screen panel. The bays are connected to the transition plenum and individually controlled with a valve. This allows for flow control and hydraulic tuning of the individual screen panels. While this will likely help with tuning of the macro-scale hydraulics, other components in the individual bays may be needed to fine tune the micro-scale hydraulics (juvenile fish scale size). Porosity plates are an example of a component that may be installed behind the screen to ensure an even flow distribution over the face of each individual screen panel.

The intake screen will have a cleaning system that will be determined in the next phase of design. A flat plate screen with this kind of river location and with this type of operational condition typically has a sweeping brush system controlled by a motor located on top of the intake structure. Other cleaning systems like air

backwash or water backwash may also be considered. Stage sensors on both sides of the screen panels can be installed to ensure cleaning system frequency is adequate and to ensure flow equalization.

A debris rack will be required in front of the intake screen to prevent damage to the screen face from large floating debris. The debris rack will be built with 12-inch wide openings between vertical members. This allows for the least amount of flow restriction and allows enough room for fish passage through the members without sacrificing too much in debris catching efficiency. Provisions for cleaning the debris rack may include a superstructure on top of the rack for maintenance and mechanized equipment for debris removal. The exact placement and configuration of the debris rack will be determined in the next phase of design.

Bypass Fishway Configuration

Removing the existing Denil fishway and replacing it with a larger and better performing fishway will provide greater bypass conveyance capacity during routine diversion operations. It will improve fish passage while avoiding significant changes to the water diversion operations. The bypass fishway consists of a new vertical slot reinforced concrete fish ladder and an auxiliary water supply system that provides increased attraction flow at the fishway entrance (downstream end). Vertical slot fish ladders are commonly used for salmon and steelhead, among other fish species, throughout California and the West Coast of North America. A vertical slot fish ladder consists of a sloped, rectangular channel separated by vertical slot baffles. The baffles are located at even increments to create a step-like arrangement of resting pools. The design is self-regulating and provides nearly constant velocities, flow depths, and water surface differentials at each baffle throughout a range of operating conditions.

This new bypass fishway is an integral component of the new intake screen in that the fishway inlet is immediately downstream of the screen panels. This provides juvenile fish an attractive and safe pathway as they migrate downstream and is a major accomplishment of downstream fish passage objectives. The vertical slot configuration is well-suited for this application because it provides a full depth for fish to use as they move either upstream or downstream. The higher conveyance capacity of the bypass fishway also improves upstream fish passage by enhancing attraction at the entrance. The larger size and inherent hydraulics of vertical slot fishways also provides improved upstream passage for a wider range of fish species and life stages.

The footprint of the new fishway will be larger than the existing Denil fishway but will have a turn along its length to keep the entrance near the same location. The increased flow capacity and location of the entrance enhances the ability for fish to find the ladder. Exact placement of the entrance and its configuration relative

to the dam spill under different river flow conditions will be optimized during the next phase of design.

During normal water diversion operating conditions with a water surface elevation of approximately 38.0 feet (when the dam is up and the river is impounded) the bypass fishway will convey approximately 50 to 80 cfs, depending on final design. Currently, the inflatable dam, the intake bypass openings, and the Denil fishways control the water surface elevation in the river and bypass flow quantity. The capacity of each Denil is approximately 20 cfs and the intake bypass openings can pass another 20 cfs. So a total bypass flow capability, without spill over the dam, with the existing facilities is approximately 60 cfs. With the new bypass fishway and bypass flow control pipe (as described with the intake screen improvements) this total bypass flow can be more than doubled over existing conditions without spill over the dam. The exact amount will depend on final configurations of the bypass fishway and the ultimate capacities of the bypass flow control pipe and auxiliary water system. A vertical slide gate may be installed on the east bank Denil fishway to help control bypass flow rates during routine diversion operations. These capacities will be determined during detailed hydraulic analysis in the next phase of design.

Diagrams with the proposed conceptual design alternative have been illustrated to help understand preliminarily, the flow routing and new component capacities under different river flows and operating condition scenarios. These diagrams are provided in Appendix B.

The bypass fishway design also includes viewing chamber and window located on the side of the ladder near the intake. This chamber and window allows for fish migration monitoring and would replace the monitoring video box that is currently used to count Chinook salmon migrating upstream through the Denil fishways. The monitoring video box for the Denil fishway on the East side would remain. Because the bypass fishway is a vertical slot ladder and fish may pass at any depth the window will need to be full depth. The video monitoring equipment used with the new fish ladder will need to be spread out over this depth depending on camera field of view and quality of fish recognition needed. To improve fish recognition (species and size) a background wall and flow separation gratings can be installed temporarily that will allow fish to be closer to the window. An example of a viewing chamber, window, marked background wall, and monitoring camera is shown in Figure 12.

Figure 12 – Fishway Monitoring Chamber and Viewing Window, Woodbridge Dam near Lodi

The viewing chamber and window will also allow for live, in-person monitoring of fish and increased educational and interpretive opportunities. California aquariums were contacted for feasibility determination of such a large window. Reynolds Polymer Technology, Inc. of Grand Junction, Colorado has been supplier of large windows to aquariums and some fishways. The exact size and design details, along with operating and maintenance considerations for the fishway viewing window will be determined in the next phase of design.

Operations and Maintenance Considerations

An operations and maintenance plan will be developed as part of the next phase of design. It will be reviewed and approved by DFG and NMFS prior to design completion. Operational capability and control is expected to increase with the proposed conceptual design alternative and maintenance demands will likely be the same as existing conditions. Since the vertical slot bypass fishway is self-regulating the flow controls will be with the bypass pipe and auxiliary water system. Flow sensors on the bypass pipe and valve controls will be required to maintain accurate bypass flow releases.

To ensure fish screen approach velocity criteria are met, stage sensors can be installed on the upstream and downstream side of the screen panels. Flow sensors can also be installed on the valves of the flow equalization bays to monitor the flow through the panels. These sensors can serve to actuate controls for flow, alarms, or shut down the pump station if an undesirable condition is sensed. The sensors will also serve to monitor the small debris accumulation on the screen panels and help to determine the performance of the screen cleaning system on a real-time basis. Periodic maintenance and cleaning of the screens will be necessary, similar to what occurs now with the drum screens.

Functional reliability can be increased with designed-in features of the intake and to allow for easier screen maintenance. For example, screen panel removal and cleaning during diversion operations can be accomplished by inserting a blank panel behind the screen panel and removing and replacing the screen panel with a clean one. Cleaning typically includes pressure washing the panels to remove small debris and algae buildup.

Large debris accumulation on the debris rack will require routine removal, typically at the onset of diversion operations. Sediment accumulation on the intake forebay floor may occur during river floods and needs to be considered during final design to minimize potential maintenance requirements. Sediment accumulation in the bypass fishway will likely flush out as flows increase in the ladder, similar to what occurs now with the Denil fishways. Resilience to flood damage of the improvements will likely be the same or slightly better when compared to the existing condition.

Steel grating will be used to cover the top of the bypass fishway to help ensure the safety of personnel working on or around the structure, and to help prevent large debris from entering the bypass fishway when the river is in flood stage. The grating will also be used as a walkway and working platform to access different parts of facility for maintenance activities.

Preliminary Construction Cost Estimate

The preliminary cost estimate for construction is based on the work conducted as part of this Study, the conceptual drawings and current industry standard construction costs. Comparisons were also made with recent, similar fish passage projects. The cost estimate is subject to review by the Agency. The quantities and costs illustrated are preliminary and not intended for bidding or construction purposes as final design work may result in changes to any or all quantities and costs. The final cost estimate will ultimately be determined by the final design engineer and the Agency.

For a conservative estimate it was assumed that the project construction may need to occur in two separate phases over two different years of the in-stream

construction work window (June to October). The order of construction is that the intake screen will be constructed as a first phase with limited, temporary components and then the fishway bypass will be added in the second phase. Construction of both phases is likely possible with one in-stream construction work window of five months and the cost savings for one versus two years of construction is mainly within some of the general costs like mobilization and some of the construction preparation costs like dewatering associated with each phase. The estimated construction cost of the preferred conceptual design alternative is within the range of $3,500,000 to $4,000,000.

The construction cost estimate does not include the following costs that are typically part of total project costs and will need to be considered in the next phase of project planning and design:

- Final engineering design, permitting or other environmental compliance work
- Construction procurement, management, administration and inspections
- Pumps or other equipment that may be necessary for temporary surface water supply diversion during the construction (it is expected that the emergency intakes downstream of the dam will be used for the temporary diversion)
- Any mitigation that may be required for the project
- Annual operations and maintenance costs

Project Preliminary Schedule Estimate

As mentioned previously, construction for the preferred conceptual design alternative is estimated to occur within a five month (summer) in-stream construction work window. However, environmental compliance, engineering design, and permitting will be required prior to construction. Below is an estimated project schedule assuming that funding availability does not restrain the timeline. The Biological Opinion requires that the Agency complete design of the project by October 2011 and construct the project within three years after completion of the design. If design of the new intake screen and bypass fishway are completed in 2011 the construction of the project could occur anytime during the summers of 2012, 2013, and 2014.

End of 2009	Agency reviews feasibility and provides direction for the next phase of the project
2010 -2011	Engineering design environmental compliance, and permitting
2012 -2014	Construction and commissioning

Final Design Considerations

The concept drawings contained in this report will be used as a basis during the final design process. Additional surveys may be necessary because of changes in the site conditions since this Study was conducted. Detailed hydraulic analyses will be needed to gain additional information required for final design. Final designs will be subject to approval by DFG, NMFS, and others.

Final design work will be governed by the following codes and standards:

- Structural design will comply with the latest Uniform Building Code requirements.
- Concrete design will comply with the latest American Concrete Institute Building Code Requirements for Reinforced Concrete Design.
- All current applicable Cal OSHA safety standards will be met.
- All environmental permit conditions will be met.

Final designs will adhere to the following requirements and criteria:

- An operations and maintenance manual should be made available for review by DFG and NMFS prior to design completion.
- Follow NMFS and DFG fish screen design criteria and widely recognized fishway design guidelines.
- The elevations shown in drawings are based on as-built and survey information provided by the Agency. Descriptions and elevations of control points can be obtained from the Agency.
- Actual concrete thickness, foundation requirements, and reinforcement requirements will be determined by the final design engineer.
- Some concrete, grading, and other work was included for cost estimating purposes but are not shown on the concept drawings. Actual dimensions and extent of work required for construction will be determined by the final design engineer.
- Fences, railings, gratings and other components for safety, security and maintenance will require consideration in the final design.

Bank grading and changes to the alignment of the emergency pump intakes access road downstream of the dam will likely be required to facilitate ingress and egress for vehicles. Retaining walls may be needed to handle steep or abrupt grade changes in and around the new works. Access ramps into the river for channel maintenance and boat portage at the upstream and downstream ends of the new works should be considered in the next phase of design.

Detailed hydraulic analysis of the river that occurs for the optimization of the intake screen configuration and bypass fishway will likely result in elevation differences of those components as compared to the concept design drawings.

Special Considerations

The Mirabel inflatable dam and river diversion is located within a Federal Emergency Management Agency Flood Insurance Rate Map Zone AE, special flood hazard area and floodway. The Russian River floods frequently at this location and overtopping of the intake, dam abutments and fishways is a common occurrence. The replacement of the intake and construction of a new fishway bypass within the river channel's cross section is not expected to raise the 100 year base flood elevation within this reach of the river. This must be verified in final design and the provisions of Code of Federal Regulations Chapter 44, Part 65 (Identification and Mapping of Special Hazard Areas) considered.

Construction Considerations

Construction access for the site is from the Westside Road gate and the Agency's access roads in the Mirabel area. An access road to the intake and dam exists on the West side of the river near the pump station. All access roads are surfaced with gravel and are presently in good condition. Staging areas for the construction are available near the pump station. The limits of construction, staging areas, and access roads will be determined in the next phase of design.

Excavation will be required at the project site for the intake screen and bypass fishway. Excavated material will either be reused at the project site or hauled off to a disposal site, which will be determined by the Agency. The excavation will require the construction area to be dewatered for preparing the foundation and placing concrete. A dewatering and river flow control plan will be developed in the next phase of design. A cofferdam would be required to isolate the work area for construction of the new intake and the bypass fishway. Given the composition of the subgrade in this area seepage from the river is expected to be significant. Use of sheetpile as cofferdam to isolate the construction activity and control seepage into the work area may be necessary. Water pumped from the work area may be allowed to be discharged into the adjacent infiltration ponds where water would percolate readily and prevent sediment from entering the river.

A species protection plan will also be required. Aquatic species will need to be relocated from the dewatered area. Adequate fish passage for the construction window should be incorporated in the dewatering plan if diversion of the river flow around the whole channel will be required or the dam is used to impound the river during construction. This may be accomplished by utilizing the existing East bank Denil fishway if full or partial impoundment occurs during construction. Maintaining the water surface elevation in the river upstream of the dam may be desirable during the summer for increased infiltration rates for water supply demand. The existing emergency pumps intakes downstream of the inflatable

dam may need to be used for temporary surface water diversion during construction, depending on water supply demand and Agency operations.

Construction of the improvements would be of conventional construction with generally available materials, equipment and labor. The work includes earthwork, reinforced concrete construction, pipeline installation, miscellaneous mechanical and metalwork installation, electrical controls, and associated electrical services. Concrete would come from common suppliers in the area and rock for slope protection is locally available. Permanent cut slopes will be shaped, graded, and vegetated, as appropriate, to ensure the slopes remain stable and erosion is controlled. Existing roads will be regraded and resurfaced with gravel as necessary for pre-project use and future use related to the project. All areas temporarily disturbed by construction will be restored to pre-project conditions. Staging areas will be restored to the previous condition.

Conclusions and Recommendations

The Association of California Water Agencies Board of Directors has recently (Nov. 2008) adopted policy principles embracing environmental and economic sustainability as equal priorities for water management in California. The principles express strong support for policies that promote significant improvements in both water supply reliability and ecosystem health. One of the principles outlines that investments in fish screens, fish ladders, and habitat improvement projects are investments in sustainability because the reliability of the water supply system and the health of the ecosystem are inextricably linked. It is also recognized that investments in water system improvements made in an environmentally sustainable system serves the economic interests of all water users, can significantly lower conflict levels between water supply and environmental objectives, and assure the long-term reliability of available supplies.

The preferred conceptual design alternative will be a significant improvement for the water supply system and ecosystem protection. This alternative best meets the project objectives and is considered feasible for construction. Final feasibility determination will likely occur in the next phase of design and requires analyzing the project relative to environmental impacts and funding availability. Performing more detailed hydraulic analysis and modeling will be required to optimize the configuration of the preferred conceptual design. A two-dimensional (2D) hydraulic model is recommended at a minimum. A 2D or 3D model is particularly useful for analyzing flows with in-stream structures and complex geometries. It can help to analyze circulation patterns, local velocities and variations, and flow over and around structures.

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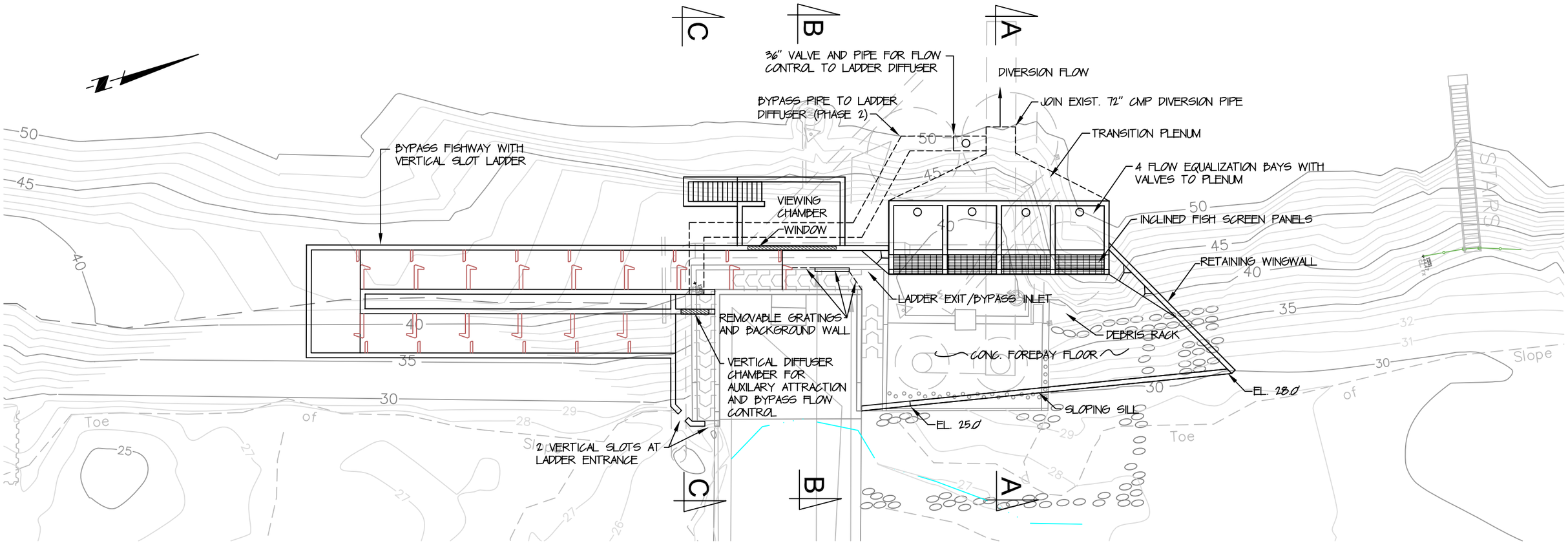
Appendix A

Preferred Concept Design Alternative



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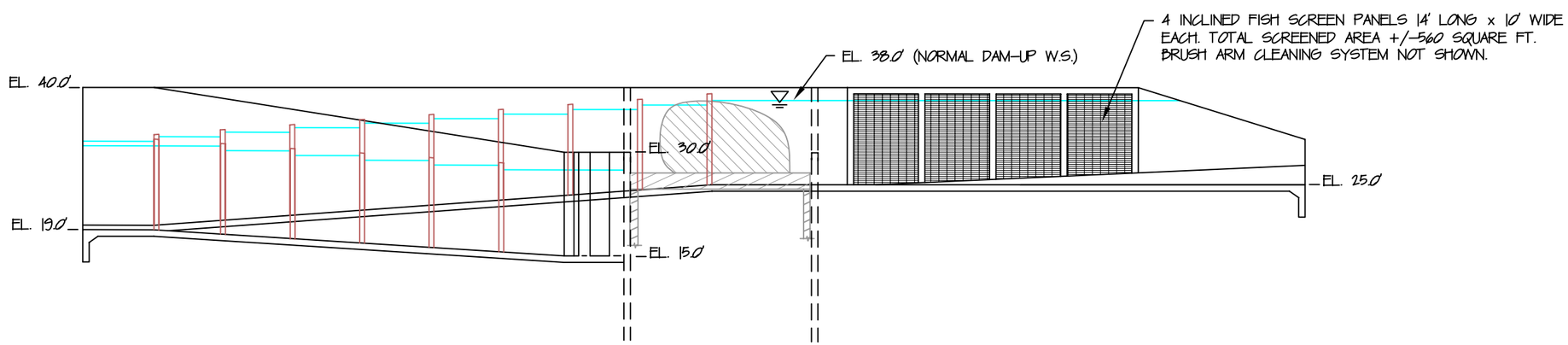

PROFILE

PRELIMINARY

DATE : Sep 24, 2009

PRUNUSKE CHATHAM, INC.
400 MORRIS STREET, SUITE G
SEBASTOPOL, CA 95472
(707) 824-4600

DATE: SEPT. 10, 2009
SCALE: 1" = 20'
DESIGNED BY: JMANN
DRAFTED BY: JP
CHECKED BY: JMANN

REVISIONS	DATE	BY

PREPARED FOR:
SONOMA COUNTY WATER AGENCY
MIRABEL FISH SCREEN RECONFIGURATION AND ALTERNATIVES STUDY

INCLINED FISH SCREEN WITH BYPASS FISHWAY CONCEPT ALTERNATIVE

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SHEET 1 OF 2

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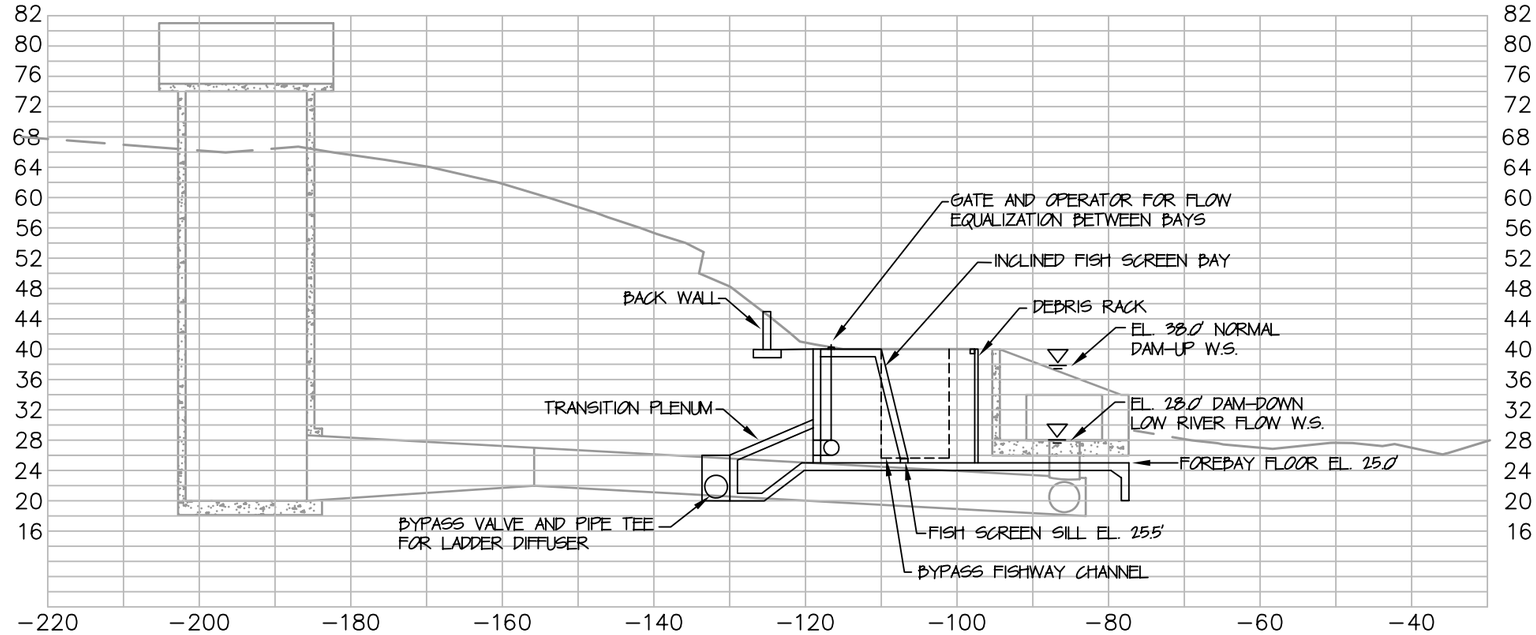
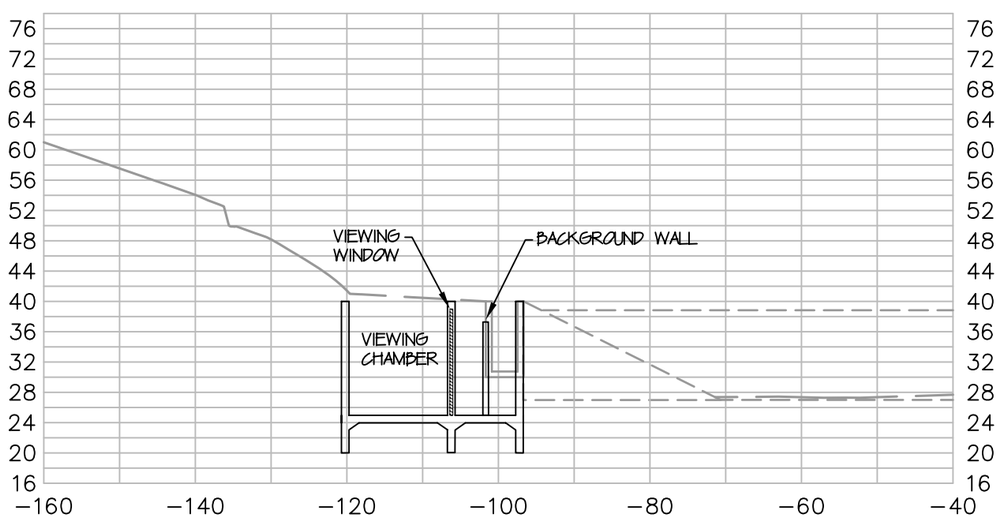


SECTION A-A



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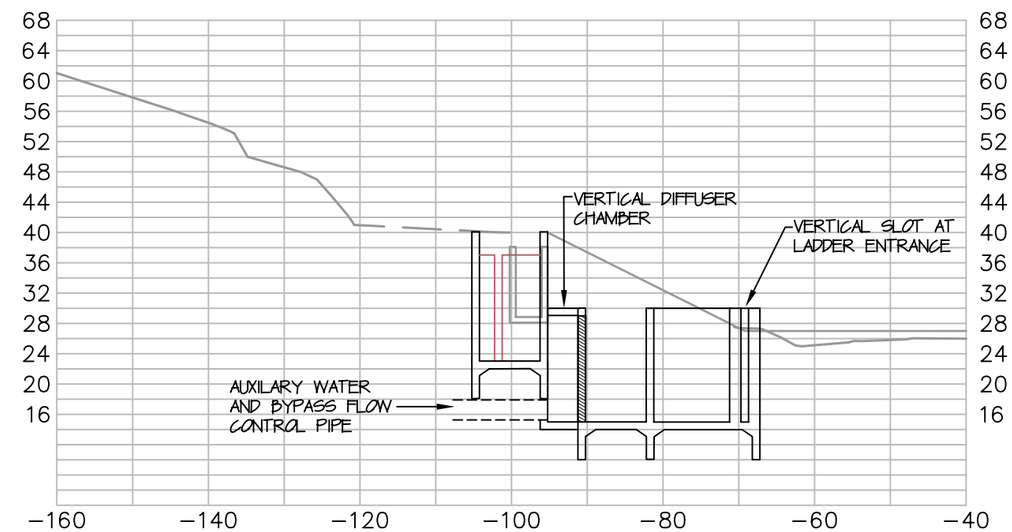

SECTION C-C

PRELIMINARY

DATE : Sep 23, 2009

PRUNUSKE CHATHAM, INC.
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DATE: SEPT. 10, 2009
SCALE: 1" = 20'
DESIGNED BY: JMANN
DRAFTED BY: JP
CHECKED BY: JMANN

REVISIONS	DATE	BY

PREPARED FOR:
SONOMA COUNTY WATER AGENCY
MIRABEL FISH SCREEN RECONFIGURATION AND ALTERNATIVES STUDY

INCLINED FISH SCREEN WITH BYPASS FISHWAY CONCEPT ALTERNATIVE

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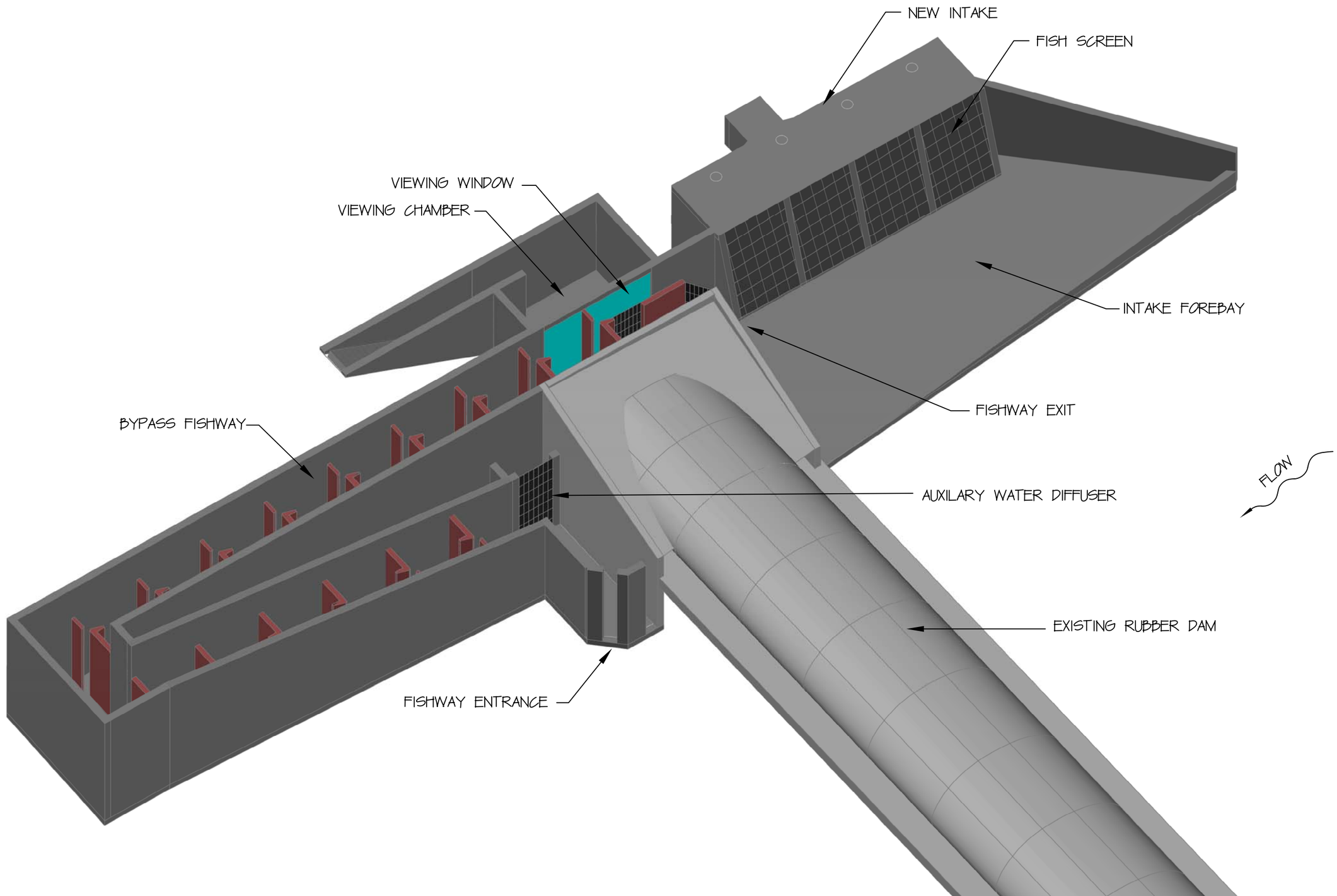
SHEET 2 OF 2

[AutoCAD file name: G:\ACAD Drawings\SCWA Mirabel Fish Screen v2008\dwg\Mirabel Fish Screen-hc phase 1-2_30.dwg]
[Xref files: Dam Trenches; WFMA NAD83 \2007; 7357TOPO; wfdms_RDS] [Image files: mirabel; Pcl_logo_for_plans.jpeg] [Plot Date:Sep 23, 2009 12:10pm]



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PREPARED FOR:
SONOMA COUNTY WATER AGENCY
MIRABEL FISH SCREEN RECONFIGURATION AND ALTERNATIVES STUDY

INCLINED FISH SCREEN WITH BYPASS FISHWAY CONCEPT ALTERNATIVE ISOMETRIC VIEW

FIGURE
1

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[AutoCAD file name: G:\ACAD Drawings\SCWA Mirabel Fish Screen v2008\dwg\3d ladder3.dwg]
[Xref files:] [Image files: mrlabel; mrlabel.bmp2; Pci_logo_for_plans.jpeg;] [Plot Date:Nov 06, 2009 12:10pm]

Appendix B

Hydrology Summary
River Channel Rating Curve
Flow Routing and Capacity Diagrams

Russian River at Mirabel Hydrology Summary – version date: 9/25/09

Historical flow data sources include the USGS gages upstream of Wohler, which is upstream of the Mirabel area. The most immediate upstream gages are USGS 11464000, Russian River near Healdsburg, and USGS 11465350, Dry Creek near mouth near Healdsburg. Another USGS gage, number 11463980, Russian River at Digger Bend near Healdsburg, is upstream of USGS gage 11464000 and is a low flow (recorded data below 400 cfs) only gage. The Dry Creek gage is also a low flow only gage with recorded data only below 200 cfs.

During the dry season (June through October), most of the flow in the Russian River is water released from Lakes Mendocino and Sonoma. The coincident records of USGS gages 11464000 and 11465350 were combined to estimate the total flow at Wohler in select periods of the year to perform flow duration frequency analysis. The coincident period of record is October, 1981 to April, 2009. There are some periods of time during the record in which there is no data. The dates and data for those times were not used in the analysis. It should be noted that this is only an estimate since there are contributing streams and diversions between the gages and Wohler. In addition, the SCWA diverts water at Wohler and the reach loses flow depending on the operation of collectors (pumping plants) along the river.

The flow duration analysis resulted in the following flow exceedances:

11464000 and 11465350 Combined Flow (cfs) *

Percent of time flow is equaled or exceeded*	Entire Year	April through November	April through October	April only	May only	June only	July only	August only	September only	October Only	November Only	December Only
1%	1598	1238	1187	1838	1587	811	493	349	390	1556	1485	1898
10%	766	545	557	1012	871	558	376	323	319	651	499	1133
50%	302	284	281	550	385	304	271	269	259	286	307	422
90%	209	206	204	303	239	202	216	217	194	195	218	213
99%	156	156	154	180	149	126	186	179	168	163	184	180

* Dry Creek gage data limited to 200 cfs and below. Flows during months other than summer may actually be higher in response to storms and will skew exceedance calculations during April, May, November, December, and possibly June and October.

These would approximate the river flow statistics in the Wohler and Mirabel areas and can be used as a surrogate for the flow coming into the Mirabel facility to design new facilities or for determining ranges of operation and design. The maximum diversion rate is 100 cfs though the Mirabel intake and the actual diversion depends on the number of operating pumps at the River Diversion Structure (RDS). Most diversions do not occur at the maximum rate at the beginning of the diversion season.

Minimum streamflows are specified in the State Water Resources Control Board's (SWRCB) Decision 1610, which stipulates that the annual minimum instream summer flow in the Russian River downstream of Dry Creek is:

- 125 cfs during normal water supply conditions;
- 85 cfs during dry water supply conditions; and
- 35 cfs during critical water supply conditions.

These are subject to change pending the outcome of the recent D1610 petition.

Russian River at Mirabel Hydrology Summary – version date: 9/25/09

The Sonoma County Water Agency also maintains a water level gage called RDS just upstream of the Mirabel Dam and intake indexed to the structure and ground elevations. Data from 5/27/2003 to 4/29/2009 was analyzed for correlation to flow data. A statistical summary of the data is included here:

RDS Gage Mean – 36.3' (all parts of years)
RDS Gage Median – 38.0' (June to October for normal dam operating years)
RDS Gage Max – 62.9' (December 14 and 25, 2003 and January 1-2, 2006)
RDS Gage Min – 27.4' approximate base of dam/river control, represents very low flow periods

The nearest downstream gage is the USGS 11467000, Russian River near Guerneville, and is also referred to as the Hacienda gage. Between the Mirabel site and this gage there is a very large contributing watershed, Mark West Creek and tributaries. The tributaries include Santa Rosa Creek and tributaries along with the Laguna de Santa Rosa and its tributaries. The watershed area of the Hacienda gage is 1,338 mi^2. USGS gage 11466800 is located on Mark West Creek approximately 3 miles upstream of the Russian River confluence. The drainage area at this gage is 251 mi^2. Daily discharge data is available for gage 11466800 since October 2005. The data from this gage was subtracted from concurrent daily flow data of the Hacienda gage to estimate the flow at Mirabel during the period of January to April 2009. This data from the USGS is provisional and subject to revision when officially published for the water year (October 2008 – September 2009).

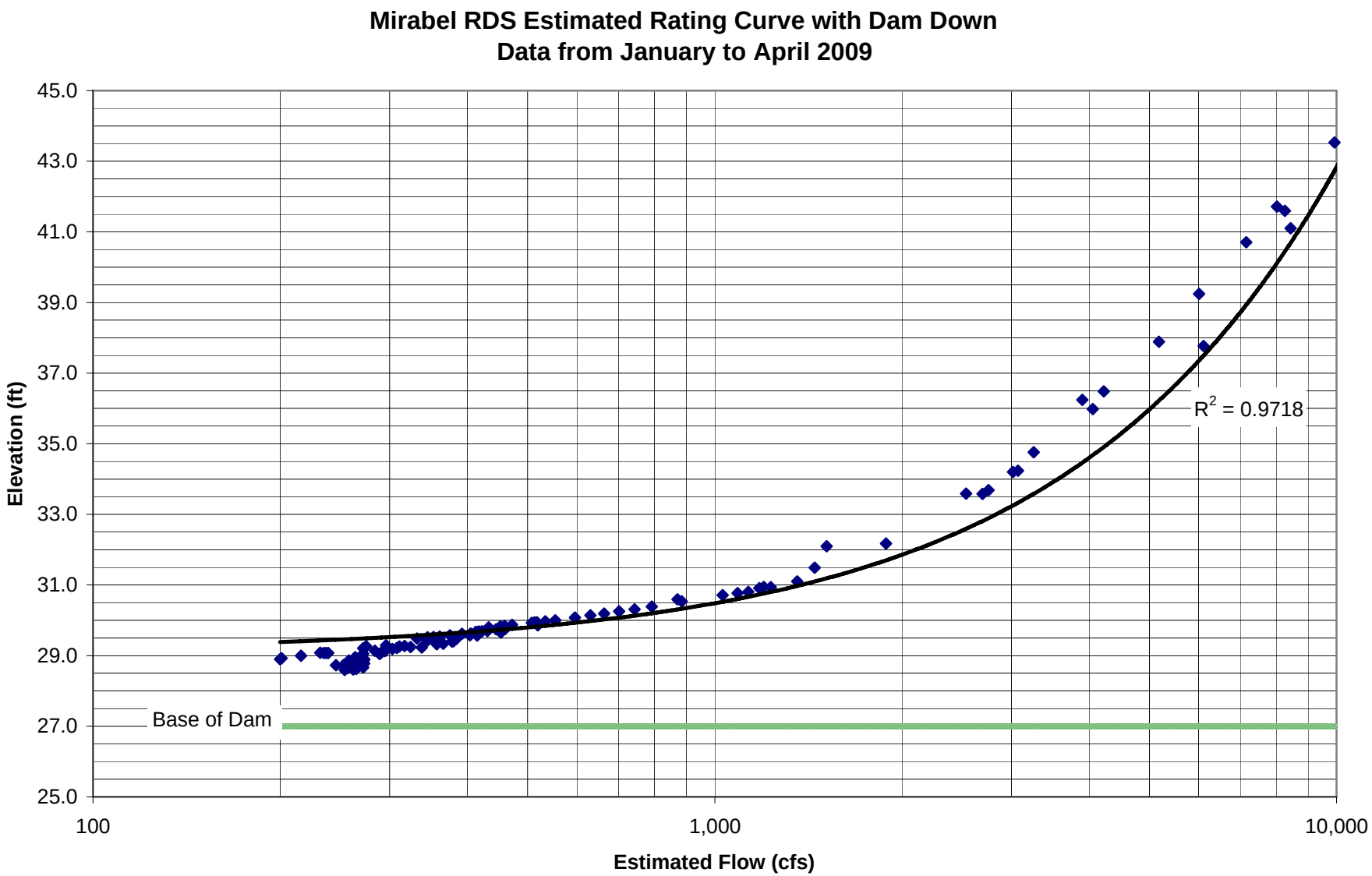
To evaluate water surface elevations that can be used for design, a rating curve was developed for the river from data when the inflatable dam was down. The curve was developed using the estimated flows as described in the previous paragraph matched to the concurrent RDS gage level data. This data provided by SCWA is preliminary and is not reviewed in accordance with quality control/quality assurance procedures. The correlated data is presented in the following table.

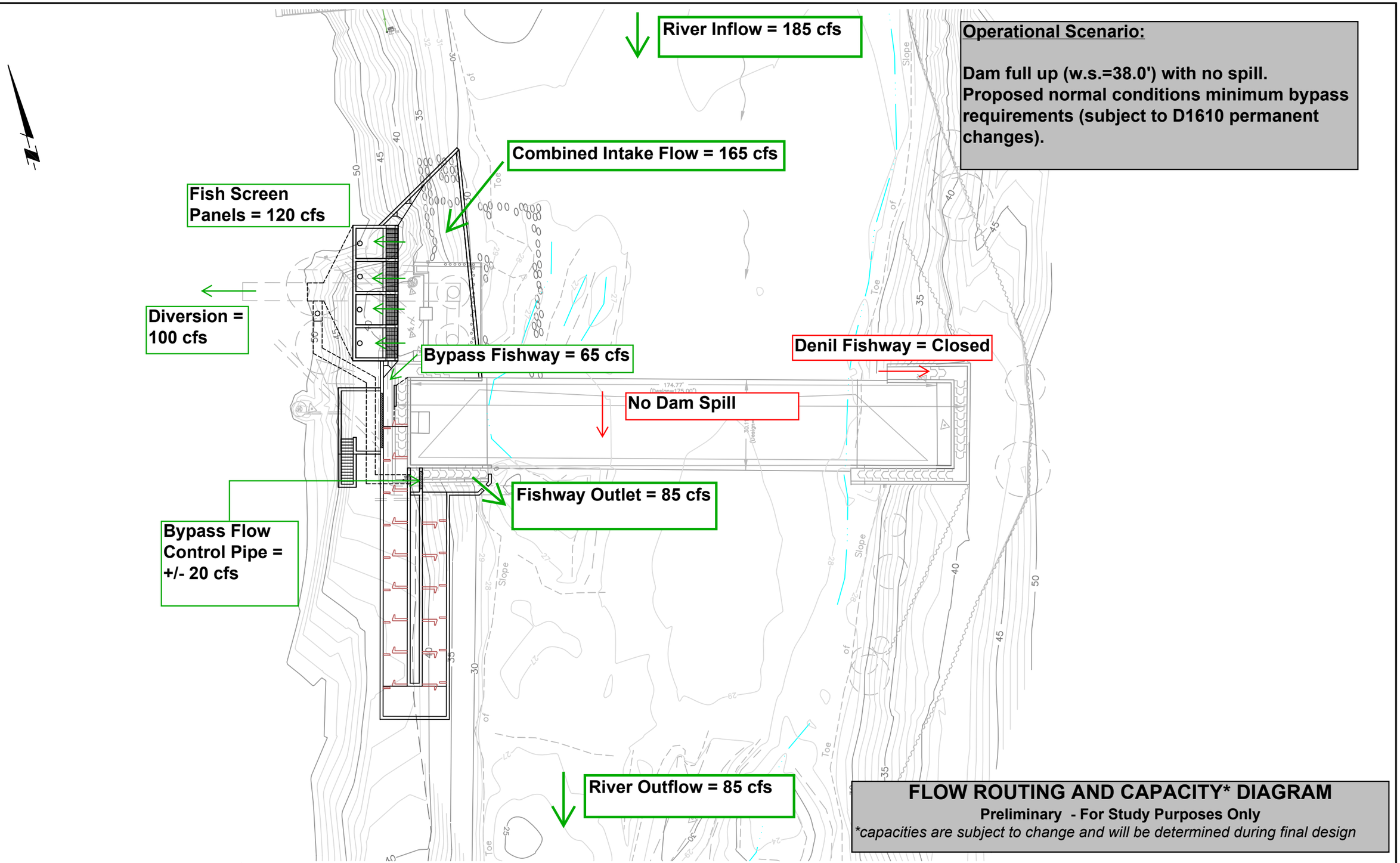
January - April 2009 Date	RDS Water Surface Elevation (ft)	Mirabel Estimated Flow (cfs)
1/1/2009	29.7	445
1/2/2009	29.7	417
1/3/2009	29.7	418
1/4/2009	29.8	460
1/5/2009	29.7	431
1/6/2009	29.7	417
1/7/2009	29.7	450
1/8/2009	29.7	422
1/9/2009	29.6	392
1/10/2009	29.6	375
1/11/2009	29.5	361
1/12/2009	29.5	353
1/13/2009	29.5	345
1/14/2009	29.5	332
1/15/2009	29.3	317

1/16/2009	29.2	308
1/17/2009	29.2	303
1/18/2009	29.1	295
1/19/2009	29.1	291
1/20/2009	29.0	289
1/21/2009	28.9	273
1/22/2009	28.8	266
1/23/2009	28.9	273
1/24/2009	28.8	273
1/25/2009	28.7	272
1/26/2009	28.6	265
1/27/2009	28.6	262
1/28/2009	28.6	254
1/29/2009	28.7	246
1/30/2009	29.1	239
1/31/2009	29.1	237
2/1/2009	29.1	235
2/2/2009	29.1	232
2/3/2009	29.0	216
2/4/2009	28.9	200
2/5/2009	28.9	201
2/6/2009	29.3	275
2/7/2009	29.6	404
2/8/2009	29.4	345
2/9/2009	29.3	296
2/10/2009	29.2	272
2/11/2009	29.4	345
2/12/2009	29.9	519
2/13/2009	30.6	871
2/14/2009	31.5	1448
2/15/2009	34.2	3073
2/16/2009	41.6	8260
2/17/2009	43.8	10270
2/18/2009	41.7	8020
2/19/2009	36.2	3900
2/20/2009	33.6	2536
2/21/2009	32.2	1886
2/22/2009	37.8	6110
2/23/2009	49.4	17250
2/24/2009	48.9	16510
2/25/2009	40.7	7160
2/26/2009	37.9	5180
2/27/2009	36.0	4055
2/28/2009	34.2	3018
3/1/2009	33.7	2755
3/2/2009	41.1	8440
3/3/2009	45.1	11910
3/4/2009	43.5	9930
3/5/2009	39.2	6010
3/6/2009	36.5	4224
3/7/2009	34.8	3259
3/8/2009	33.6	2695

3/9/2009	N.A.	2255
3/10/2009	N.A.	1942
3/11/2009	N.A.	1698
3/12/2009	32.1	1514
3/13/2009	31.1	1357
3/14/2009	30.9	1231
3/15/2009	30.8	1132
3/16/2009	30.8	1088
3/17/2009	30.9	1199
3/18/2009	30.9	1179
3/19/2009	30.7	1030
3/20/2009	30.6	N.A.
3/21/2009	30.5	N.A.
3/22/2009	30.5	N.A.
3/23/2009	30.6	N.A.
3/24/2009	30.5	885
3/25/2009	30.4	792
3/26/2009	30.3	743
3/27/2009	30.3	702
3/28/2009	30.2	664
3/29/2009	30.1	631
3/30/2009	30.1	596
3/31/2009	30.0	554
4/1/2009	30.0	534
4/2/2009	29.9	518
4/3/2009	29.9	513
4/4/2009	29.9	508
4/5/2009	29.8	459
4/6/2009	29.8	433
4/7/2009	29.7	413
4/8/2009	29.9	472
4/9/2009	29.8	452
4/10/2009	29.8	458
4/11/2009	29.7	453
4/12/2009	29.6	415
4/13/2009	29.6	405
4/14/2009	29.5	384
4/15/2009	29.4	378
4/16/2009	29.4	380
4/17/2009	29.3	366
4/18/2009	29.3	357
4/19/2009	29.2	338
4/20/2009	29.2	324
4/21/2009	29.3	311
4/22/2009	29.2	297
4/23/2009	29.1	284
4/24/2009	29.1	272
4/25/2009	29.0	264
4/26/2009	28.9	258
4/27/2009	28.7	253
4/28/2009	28.7	257

N.A. = Not Available


Mirabel RDS Estimated Rating Curve with Dam Down
Data from January to April 2009
45.0
43.0
41.0
39.0
37.0
35.0
33.0
31.0
29.0
27.0
25.0
Elevation (ft)
Base of Dam
R2 = 0.9718
100
1,000
10,000
Estimated Flow (cfs)



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DATE: SEPT. 10, 2009
SCALE: 1" = 30'
DESIGNED BY: JMANN
DRAFTED BY: JP
CHECKED BY: JMANN

REVISIONS	DATE	BY

PREPARED FOR:
SONOMA COUNTY WATER AGENCY
MIRABEL FISH SCREEN RECONFIGURATION AND ALTERNATIVES STUDY

INCLINED FISH SCREEN WITH BYPASS FISHWAY CONCEPT ALTERNATIVE

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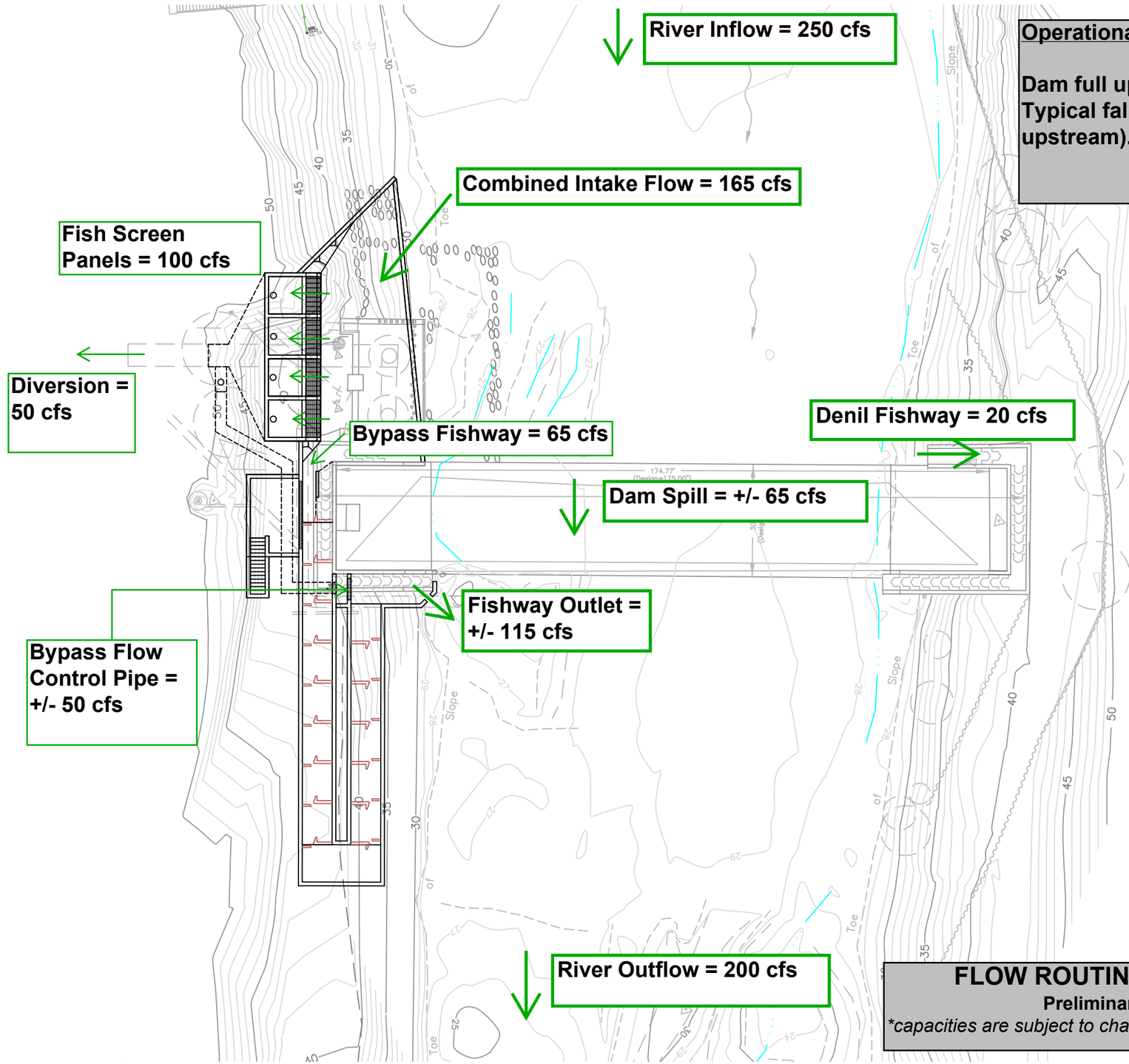
[Xref files: Dam Trenches; WFDMA NAD83 \2007; 7357TOPO; wfdmo_NO3] [Image files: mirabel; PcL_logo_for_plans.jpeg] [Plot Date:Sep 24, 2009 10:14am]



Operational Scenario:

Dam full up (w.s.=38.0') with spill.
Typical fall flows (with Chinook migrating upstream).

FLOW ROUTING AND CAPACITY* DIAGRAM

Preliminary - For Study Purposes Only

**capacities are subject to change and will be determined during final design*

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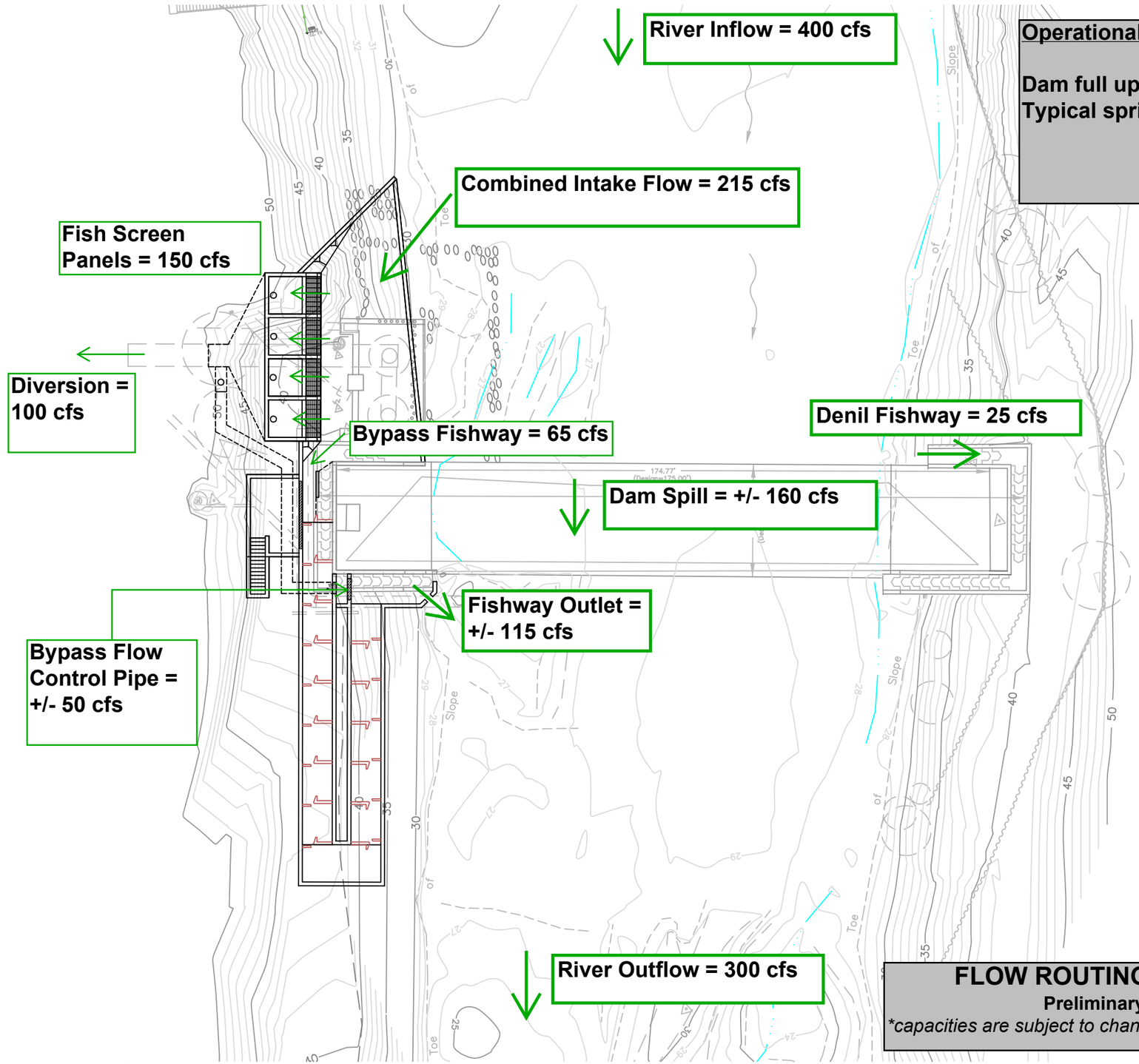

Operational Scenario:

Dam full up (w.s.=38.0') with spill.
Typical spring flows.

FLOW ROUTING AND CAPACITY* DIAGRAM

Preliminary - For Study Purposes Only

**capacities are subject to change and will be determined during final design*

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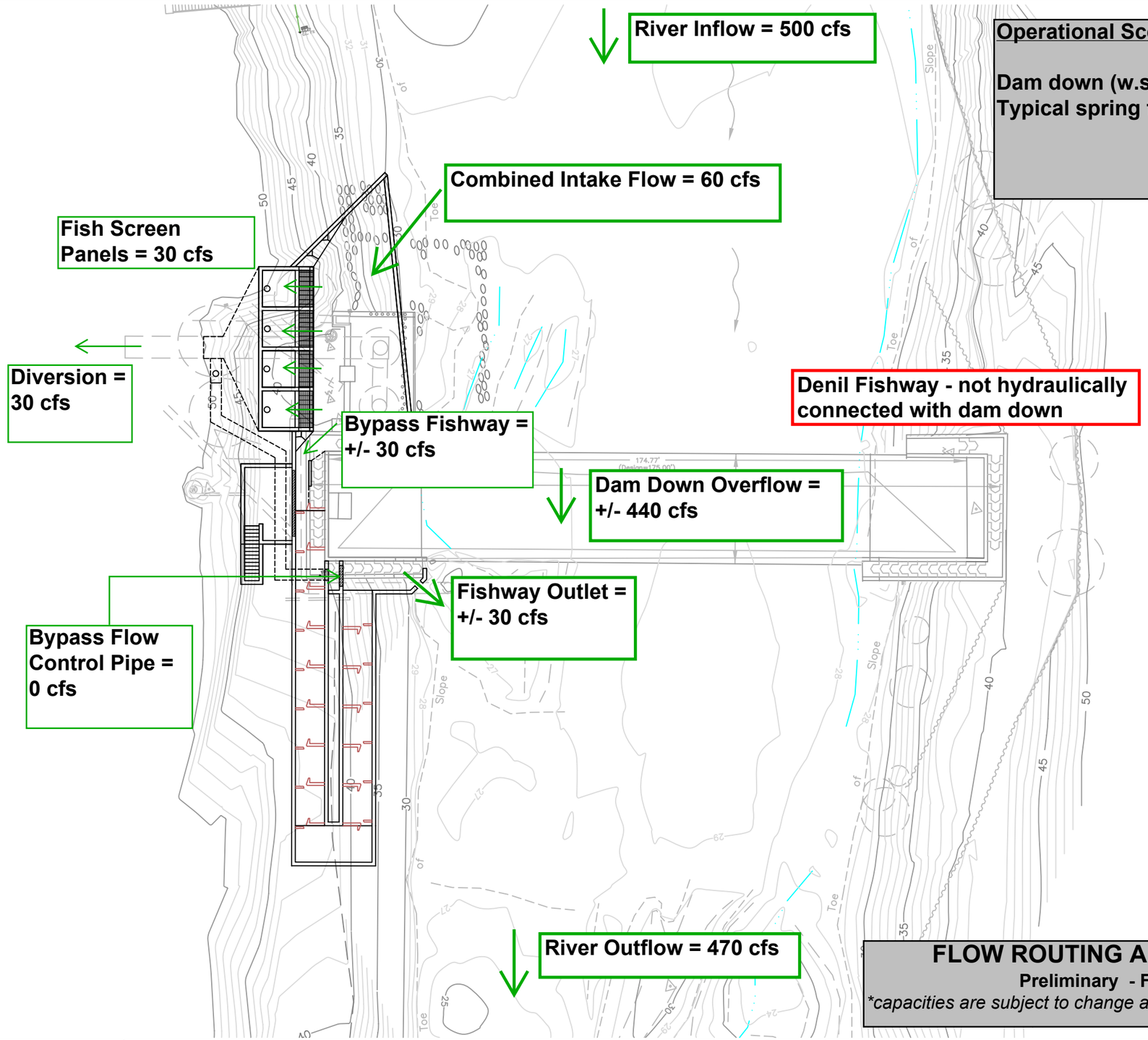

Operational Scenario:

Dam down (w.s.= 29.7') with limited diversion. Typical spring flow of ~ 500 cfs.

FLOW ROUTING AND CAPACITY* DIAGRAM

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Appendix G-1

Location map of Chinook Redds

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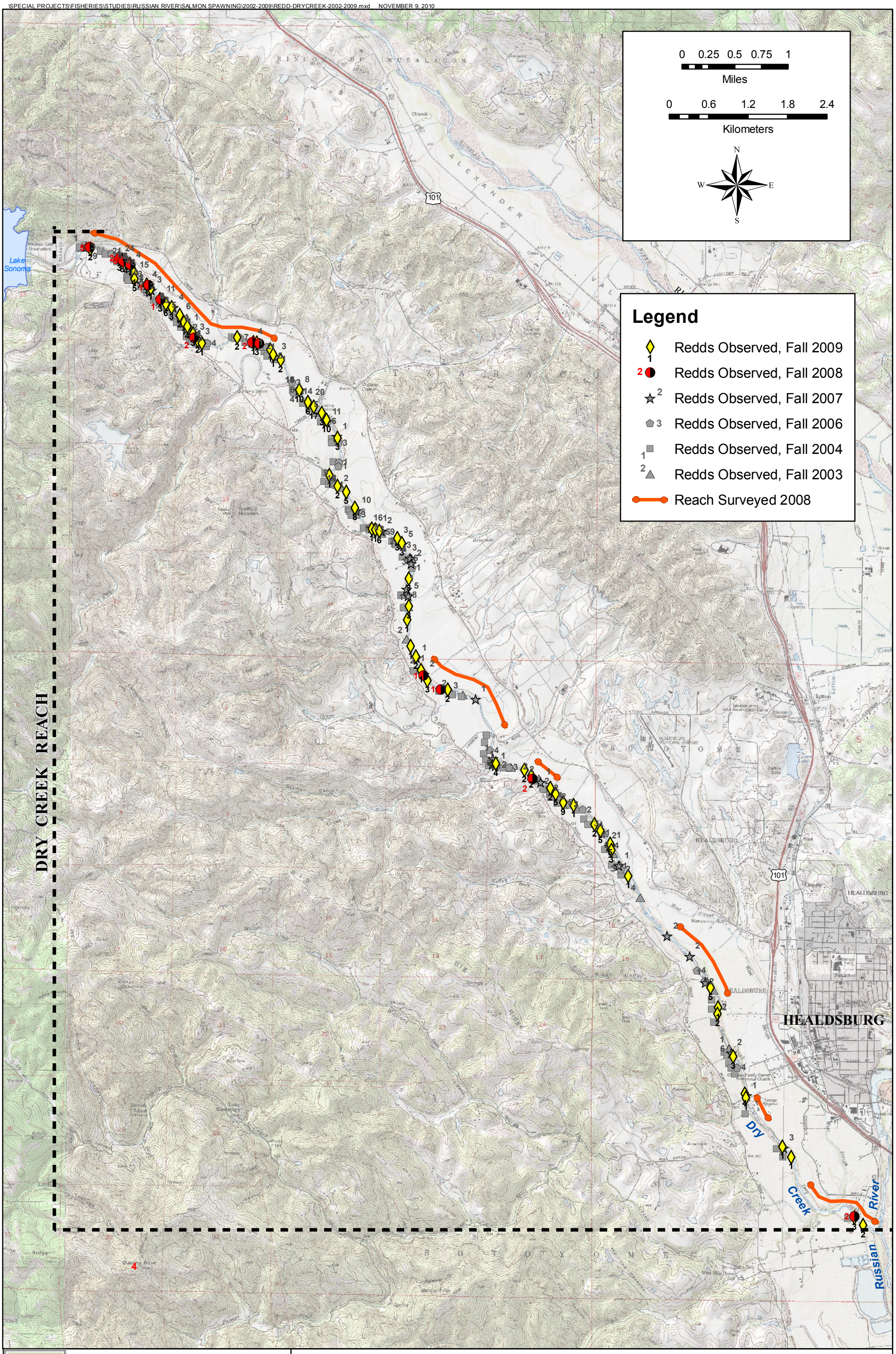

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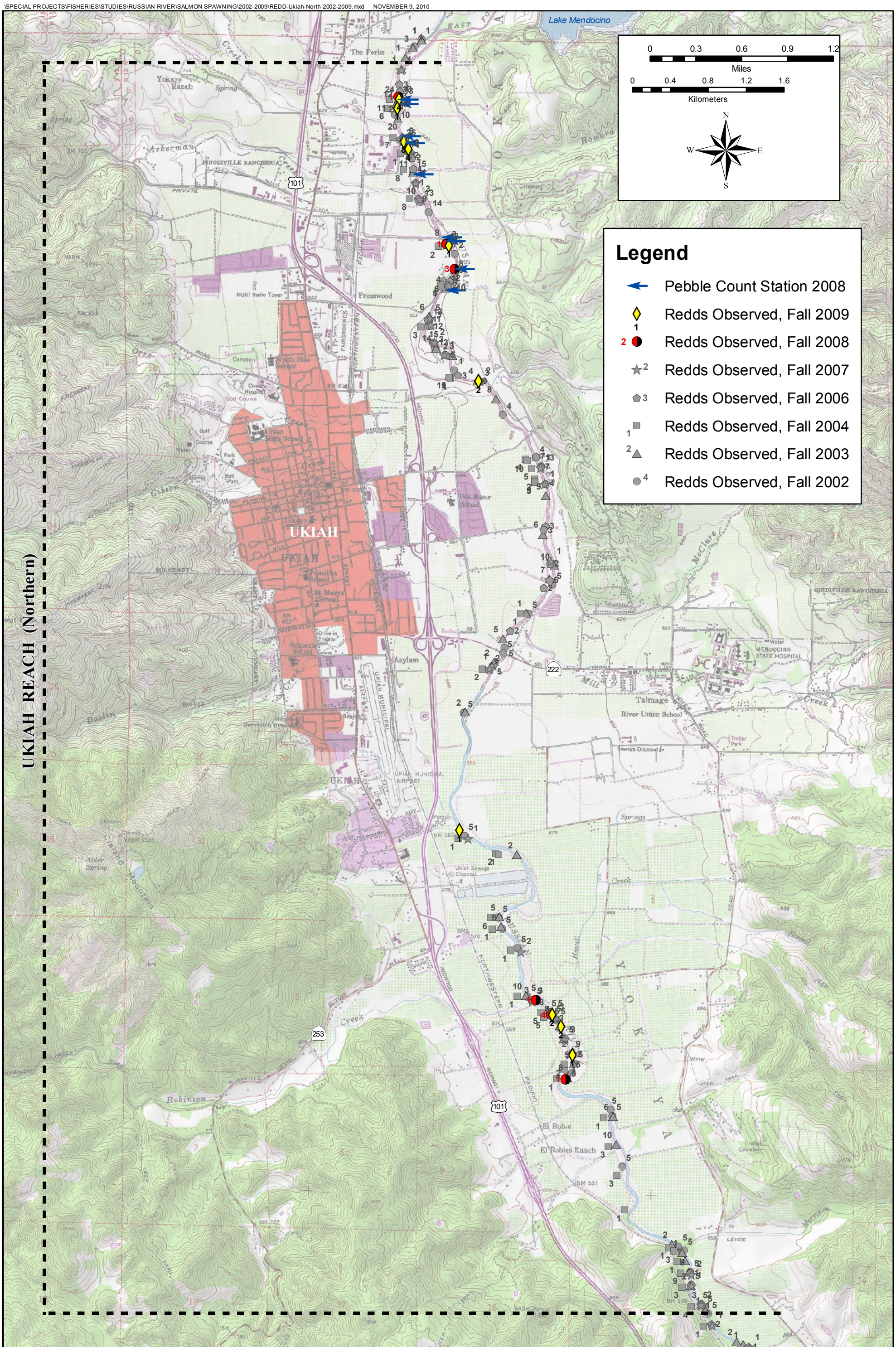
Chinook Salmon Redd Sites, Dry Creek Reach

Chinook Salmon Spawning Study, Russian River Fall 2002 - 2009

Figure 10

\SPECIAL PROJECTS\FISHERIES\STUDIES\RUSSIAN RIVER\SALMON SPAWNING\2002-2009\REDD-Ukiah-North-2002-2009.mxd NOVEMBER 9, 2010



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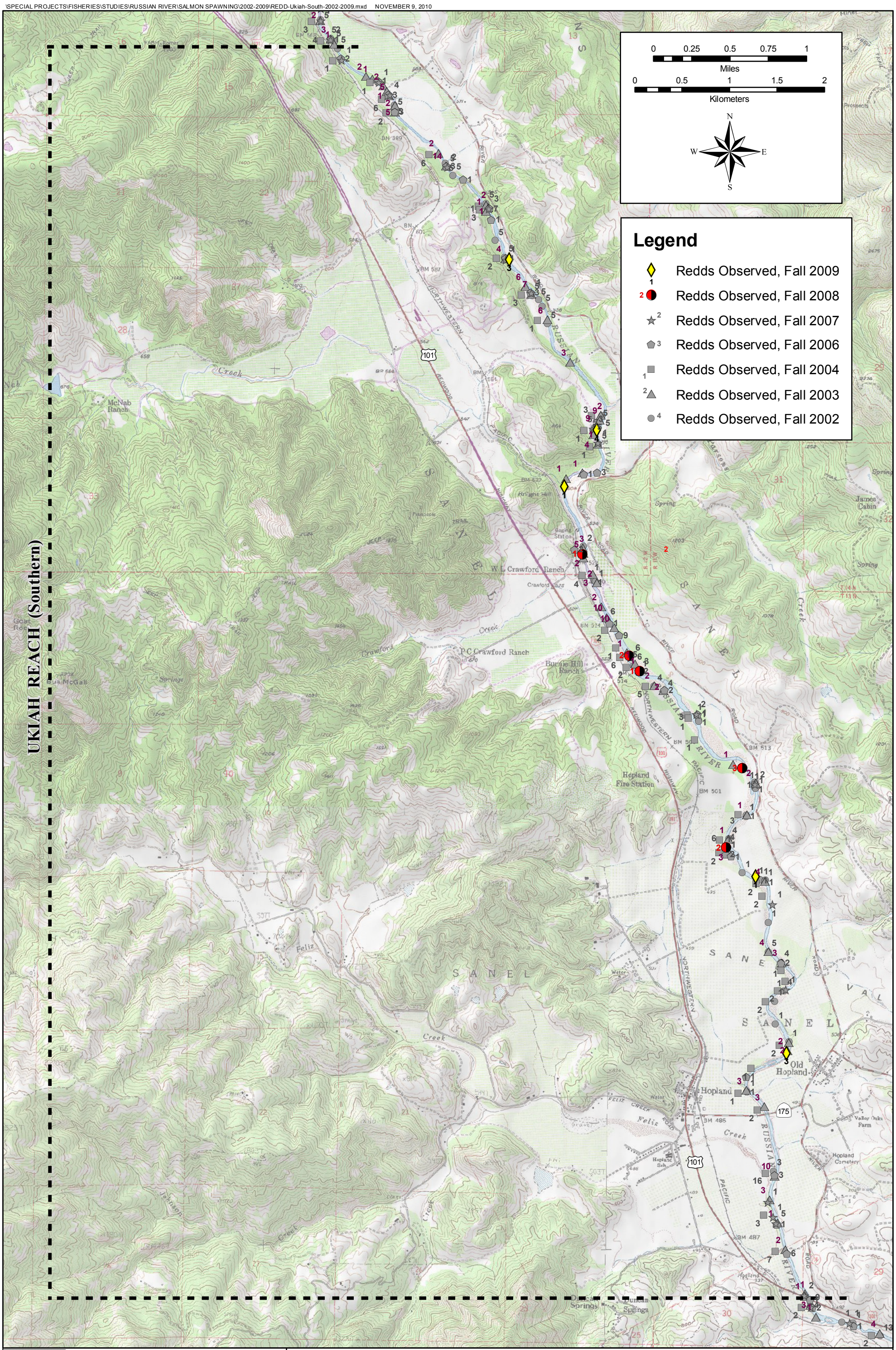
Chinook Salmon Redd Sites, Ukiah Reach (Northern)

Chinook Salmon Spawning Study, Russian River Fall 2002 - 2009

Figure 4

\SPECIAL PROJECTS\FISHERIES\STUDIES\RUSSIAN RIVER\SALMON SPAWNING\2002-2009\REDD-Ukiah-South-2002-2009.mxd NOVEMBER 9, 2010



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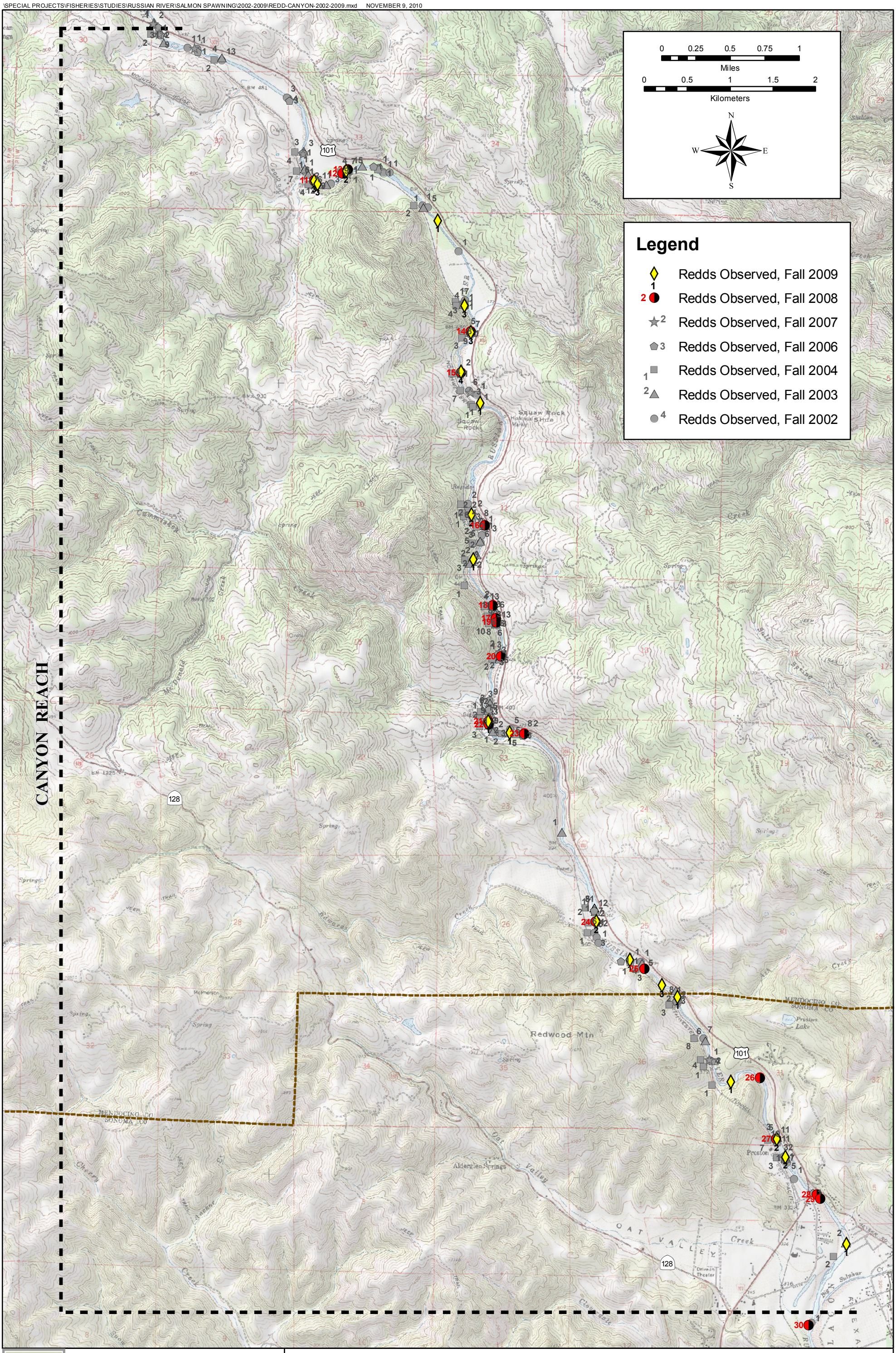
Chinook Salmon Redd Sites, Ukiah Reach (Southern)

Chinook Salmon Spawning Study, Russian River Fall 2002 - 2009

Figure 5

\SPECIAL PROJECTS\FISHERIES\STUDIES\RUSSIAN RIVER\SALMON SPAWNING\2002-2009\REDD-CANYON-2002-2009.mxd NOVEMBER 9, 2010



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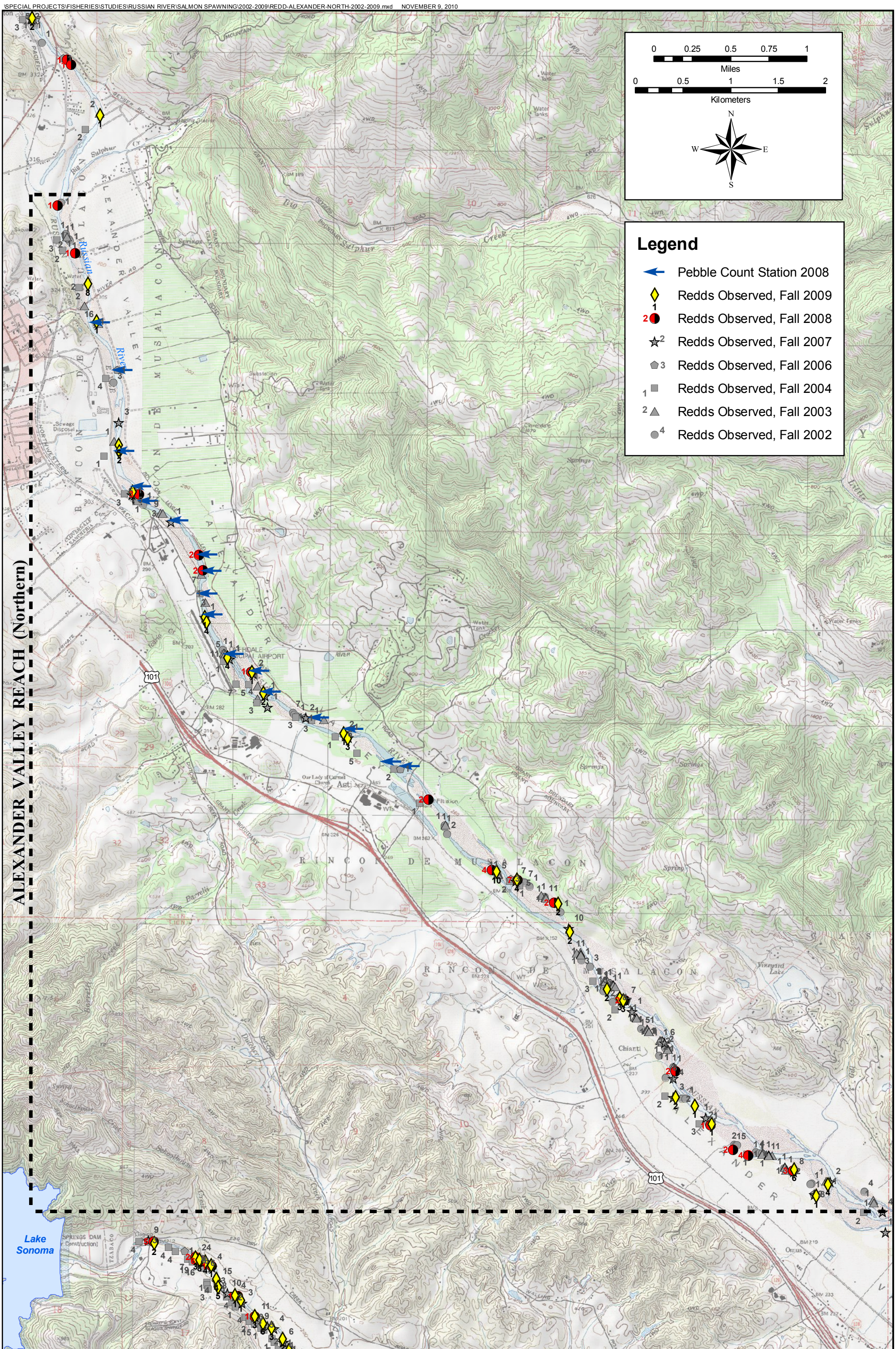
Chinook Salmon Redd Sites, Canyon Reach

Chinook Salmon Spawning Study, Russian River Fall 2002 - 2009

Figure 6

\SPECIAL PROJECTS\FISHERIES\STUDIES\RUSSIAN RIVER\SALMON SPAWNING\2002-2009\REDD-ALEXANDER-NORTH-2002-2009.mxd NOVEMBER 9, 2010



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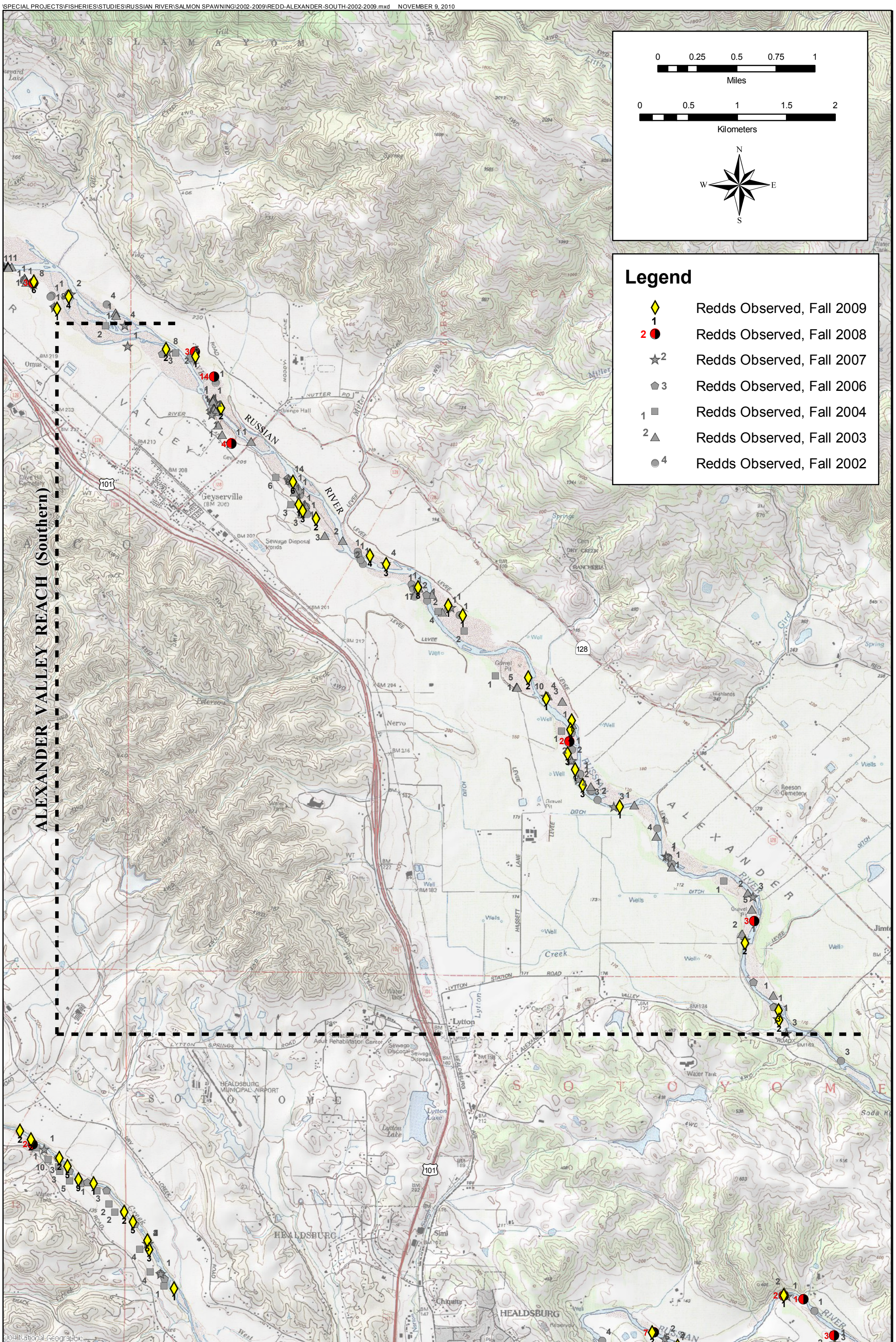
Chinook Salmon Redd Sites, Alexander Valley Reach (Northern)

Chinook Salmon Spawning Study, Russian River Fall 2002 - 2009

Figure 7

\SPECIAL PROJECTS\FISHERIES\STUDIES\RUSSIAN RIVER\SALMON SPAWNING\2002-2009\REDD-ALEXANDER-SOUTH-2002-2009.mxd NOVEMBER 9, 2010



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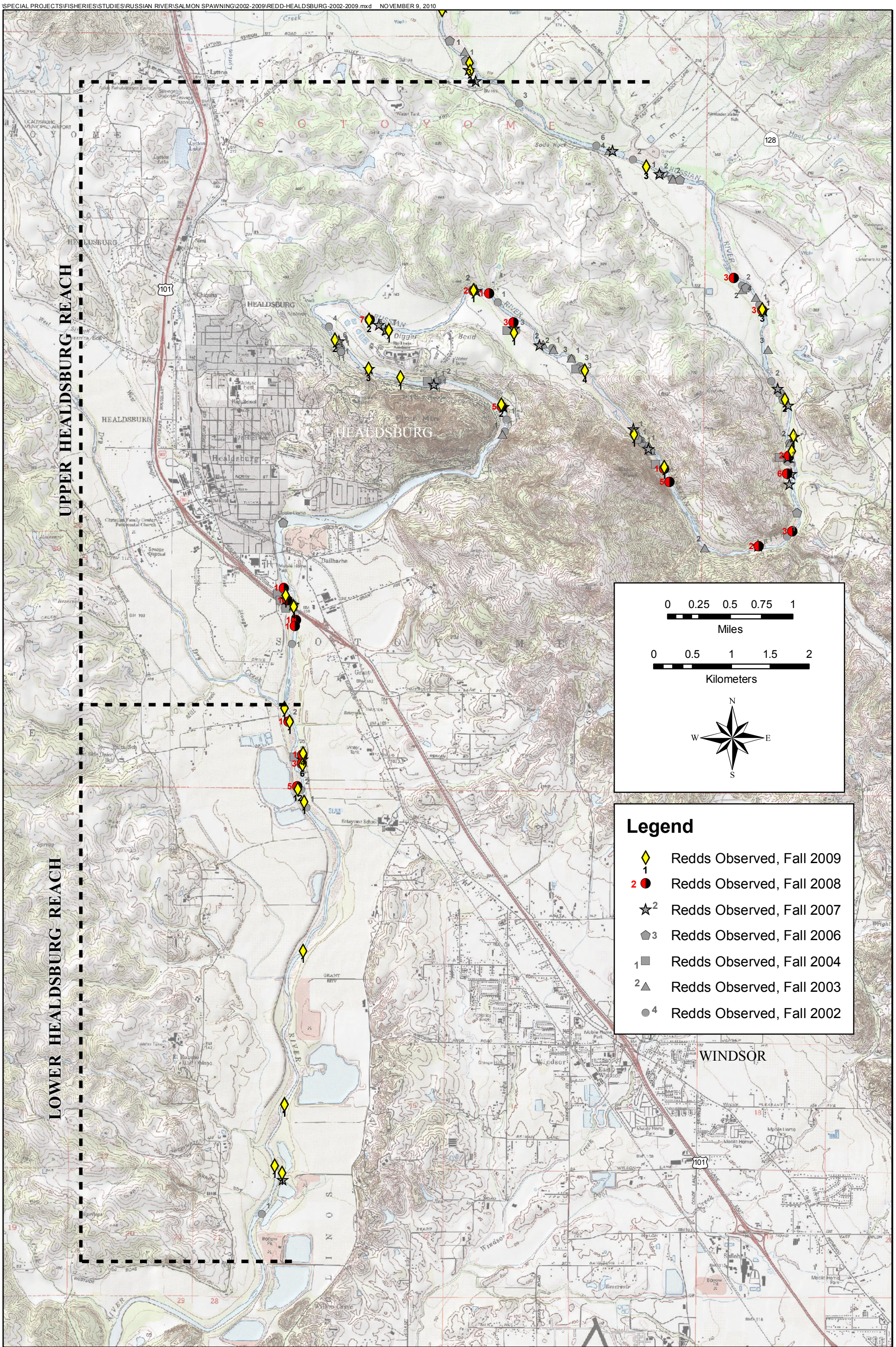
Chinook Salmon Redd Sites, Alexander Valley Reach (Southern)

Chinook Salmon Spawning Study, Russian River Fall 2002 - 2009

Figure 8

\SPECIAL PROJECTS\FISHERIES\STUDIES\RUSSIAN RIVER\SALMON SPAWNING\2002-2009\REDD-HEALDSBURG-2002-2009.mxd NOVEMBER 9, 2010



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Chinook Salmon Redd Sites, Upper & Lower Healdsburg Reach

Chinook Salmon Spawning Study, Russian River Fall 2002 - 2009

Figure 9