Final Report
Small Tributary Restoration: Middle Creek

Swasey Sediment Basin Before 2000 Cleanout

Swasey Sediment Basin Cleanout

Cooperative Agreement #97-NCV-02
Agreement No. 1448-11330-97-J075

Funded by the U. S. Fish & Wildlife Service
Anadromous Fish Restoration Program:
Central Valley Wide Action 11

WESTERN SHASTA
RESOURCE CONSERVATION
DISTRICT

FINAL REPORT

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Grant Term: 3-15-97 to 12-15-00

ABSTRACT

Middle Creek is a tributary to the Sacramento River, approximately 5 miles west of Redding, California. Middle Creek supports spawning runs of rainbow trout, steelhead and salmon. Due to accelerated erosion within the watershed, the Coordinated Resource Management Planning (CRMP) group, Western Shasta Resource Conservation District (WSRCD), and the Natural Resources Conservation Service jointly recommend implementation of a project to address the fine sediment input in Middle Creek. The result was the Swasey Sediment Dam Cleanout Project to remove fine sediment that accumulated behind a small concrete dam on Middle Creek. Sediment accumulation had been increasing due to housing and road development projects. The fine sediment would potentially negatively impact steelhead/rainbow trout and salmon habitat in Middle Creek, and ultimately the Upper Sacramento River. A Technical Team was formed to examine the proposed plan and review and approve each sediment removal activity. Fish and Wildlife Service provided a grant for dredging the Swasey Sediment Basin on Middle Creek as frequently as necessary, in order to provide additional storage capacity for future sediment capture.

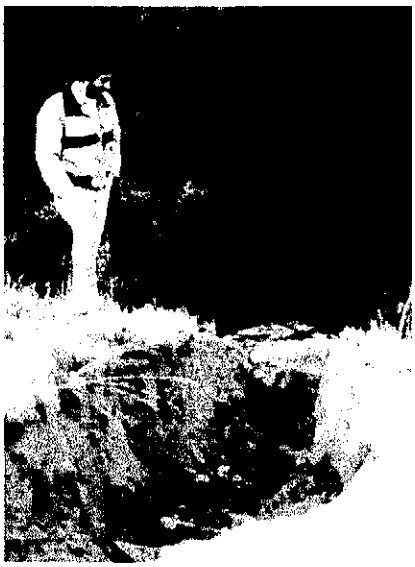
This program supports the objectives of the Anadromous Fish Restoration Program plan to "improve habitat for all life stages of anadromous fish through improved flows, water quality, and physical structure" and "involve partners in the implementation and evaluation of restoration actions." WSRCD set up sediment monitoring in the reservoir and obtained the necessary permits. The sediment basin was cleaned out in 1997, 1998, and 2000, with 150, 208 and 240 cubic yards removed consecutively.

Fine sediment continues to accrue at the Swasey Sediment Dam site, so further cleanouts will be necessary into the future.

INTRODUCTION

As part of a plan to increase the natural production of anadromous fish in the Central Valley, the Western Shasta Resource Conservation District works with agencies, landowners and stakeholders to identify problems, develop solutions, and implement actions to address small-scale restoration of Middle Creek, a tributary that enters the Sacramento River about 5 miles west of Redding, California. Middle Creek supports spawning runs of rainbow trout, steelhead and salmon. A reconnaissance survey conducted by the USDA Soil Conservation Service (now NRCS) in November, 1990, estimated over 2,000 cubic yards of sediment present in the north fork, south fork, and main stem of Middle Creek. At that time the sediment was largely confined to the upper watershed, but without mitigation, the sediment was expected to move downstream during high rainfall events into principal spawning habitat.

The survey showed two major sources of erosion: 1) soil erosion from unsurfaced roads, cut and fill (side-cast) banks, and 2) erosion from housepads at various stages of completion. Poorly compacted side-cast material showed the most severe erosion with high densities of rills and some gullies present. Most of the development occurred, and continues to occur, on steep terrain and on highly erosive decomposed granitic soils.



Site in Middle Creek displaying the highly erosive decomposed granitic soil common throughout the watershed.

Middle Creek in the early 90's.

Federal, state, and local agencies initiated emergency actions to capture and remove sediment from the creek. A private developer and the Shasta County Public Works Department cooperated on the repair of a large sediment catchment basin near Swasey Drive, upstream of prime spawning habitat. California Conservation Corps workers also constructed smaller rock dams to capture additional sediment in the channel. The overall solution required a coordinated effort of source control and sediment capture/removal, from which the Swasey Sediment Dam cleanout program was implemented.

Swasey Sediment Dam was not designed to be a sediment basin. The dam is approximately 4 feet high and is made of rock and mortar. It is a historic wagon trail pathway and due to its historic nature, the dam could not be modified or altered to make it more efficient for trapping sediment. The existence of the basin does allow for the capture of sediment that previously existed in the stream above the catchment basin and the capture of sediment still being produced in the watershed. The efficiency of the basin to trap sediment declines considerably as it fills with sediment.

NRCS and WSRCD worked with landowners, residents and interested stakeholders to form a Coordinated Resource Management Planning (CRMP) group to address solutions to the sediment impacts on fisheries habitat. The Middle Creek CRMP group identified the local watershed's

resource issues and documented their findings in the *Middle Creek Local Implementation Plan (add year, author.*

In 1993 the district signed Agreement No. 93-0643 with the Department of Fish and Game (DFG) for permission to "alter a streambed" for the purpose of removing decomposed granite from Middle Creek at Swasey Dam. In 1994, funding from Section 319(h) of the Clean Water Act was used to implement erosion control projects in the Middle Creek watershed.

The DFG agreement was renewed on October 2, 1997 for the period August 25, 1997 through October 31, 2001. Coordinated Environmental Documentation was done with USFWS and BLM. A Categorical Exclusion was approved on September 22, 1994.

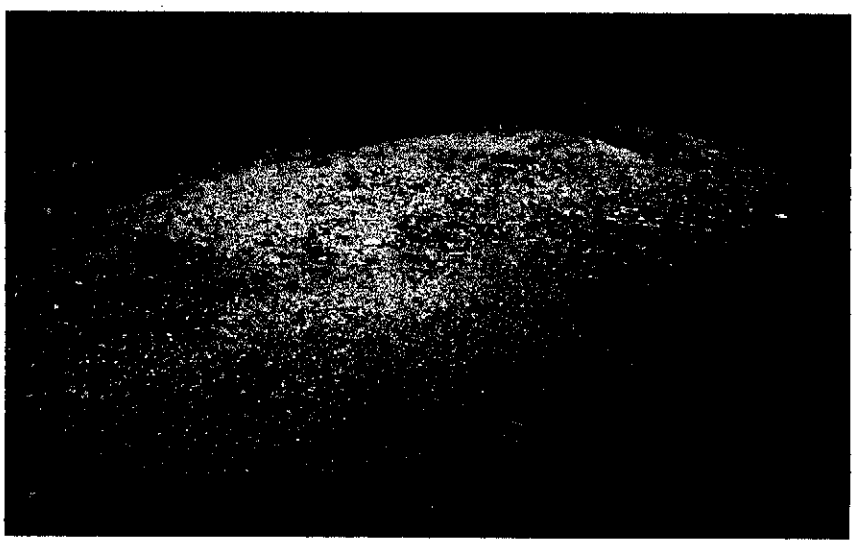
DESCRIPTION OF STUDY AREA

Middle Creek, a tributary to the Sacramento River, is an intermittent stream draining 2,193 acres of mixed conifer forest and brushland. The lower reach of Middle Creek supports spawning runs of rainbow trout, steelhead and salmon from the Sacramento River.

METHODS AND MATERIALS

The initial plan was to conduct sediment removal operations twice yearly, as needed, to maintain adequate sediment storage capacity at the Swasey dam site. Sediment would be excavated with a front end loader and hauled off site with dump trucks. During wet weather excavating, flows in Middle Creek would be diverted through a culvert to be placed approximately 200 feet upstream from the dam to dewater the sediment storage basin. This project became a cooperative effort with the Bureau of Land Management, California Department of Fish & Game and Shasta County Public Works.

A meeting with several resource agencies was held in 1997 to identify the overall sediment monitoring needs and habitat restoration needs for the Middle Creek watershed. The meeting was also held to determine if sediment removal was necessary and warranted. It was decided at that meeting that sediment removal should occur in 1997 but another sieve analysis should be conducted the following year to determine if trapping sediment was getting courser over time. The sediment removal was completed on September 30, 1997, when approximately 208 cubic yards of sediment was removed from the site.



Swasey Sediment Dam prior to cleanout, 1997.

Phil Garbutt, WSRCD, at Swasey Sediment Dam after cleanout of 1997.

NRCS AND WSRCD presented design options for a diversion structure around the dam to enable sediment cleanout throughout the year, to the CRMP group. The CRMP agreed upon a design that would divert stream flow around the basin into a temporary plastic pipe while heavy equipment worked to remove the sediment. An attempt was made to use the stream diversion around the Swasey Dam site, but several complications made it clear the task was not feasible. A side tributary that enters the reservoir below the diversion caused the reservoir to stay wet, which could have caused water quality problems. Therefore, the diversion idea was scrapped and the group concluded only dry weather clean outs would be conducted.

A sieve analysis was conducted in 1997 and again in 1998, which showed that sediment trapped behind Swasey Dam was finer in 1997 (see table on page 5). Because the California Regional Water Quality Control Board (RWQCB) had previously shown concern regarding whether sediment removal was necessary, they were consulted prior to holding another meeting. Upon conducting a site visit, Dennis Heiman (RWQCB) indicated that he agreed that the material was finer than the prior year and concurred that a clean-out was warranted.

In October of 1998, WSRCD implemented a spawning gravel injection project approximately one mile upstream from the mouth of Middle Creek and the Sacramento River. This project was funded by the Cantara Trustee Council, and NORCAL Guides and Sportman's Association.

SUMMARY AND CONCLUSIONS

The removal of sediment from Swasey sediment basin has been instrumental in keeping decomposed granitic sediment from settling in spawning beds and area fish habitat. Recent sediment samples indicate that the percentage of fines less than 0.25" remains high in the sediment fraction, which is detrimental to salmonid embryo incubation (Bjornn & Reiser, 1979).

The reduction in total volume of sediment removed at Swasey can be attributed to better erosion control practices in the watershed. Although the original plan was to remove sediment twice yearly, no cleanout was needed during 1999. The original plan also included the diversion of Middle Creek through a culvert so cleanout could be done in wet weather, but this proved impractical, so cleanouts have continued only during the dry season. Sieve analysis shows the sediment is getting finer over time, therefore additional funding to continue the periodic cleanout of the basin is important for the continued protection of spawning beds and fish habitat in Middle Creek.

SUMMARY OF EXPENDITURES

The budget for this project from 3-15-97 to 12-15-00 was $20,000. Expenditures are as follows:

Payroll	6,964.45
Supplies	2,832.66
Professional Services	5,840.85
Rent & Leased Equipment	3,140.00
Transportation	318.32
Total	19,096.28

APPENDICES

1. Information on the construction of a temporary diversion structure above Swasey dam to facilitate wet weather cleanout.
2. Letter from Dennis Heiman on Sediment Monitoring, 1-5-96
3. Notes from Technical Team Meeting on 8-20-97
4. Sieve Analysis 9-11-97.
5. Letter from Dennis Heiman on Sediment Sampling, 1-13-98
6. Technical Team Meeting Notice for 2-6-98.
7. Sediment Sample 7-27-99
8. Letter to Technical Team on 5-30-2000.
9. Sediment Sample 7-26-00
10. Letter to Technical Team with results of 1999 Sieve Analysis
11. Habitat Requirements of Anadromous Salmonids, D.W. Reiser, T.C. Bjornn, 1979.
12. Map of Upper Sacramento River Restoration Sites Worked in 1990 and 1991

LITERATURE CITATIONS

1. Middle Creek Local Implementation Plan, April 1995, Natural Resources Conservation Service.
2. Middle Creek Watershed Best Management Practices Intermediate Conclusions, June 1994, Western Shasta Resource Conservation District
3. 1997 Revised Draft Anadromous Fish Restoration Program Plan (Adopted as Final January 9, 2001) U. S. Fish and Wildlife Service.
4. 1993 Erosion and Sediment Control Study: Middle Creek Watershed, USDA, Soil Conservation Service.

Fish & Game

General Technical Report PNW-96
October 1979

Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America

HABITAT REQUIREMENTS OF ANADROMOUS SALMONIDS

D.W. REISER and T.C. BJORNN

U.S. Department of Agriculture Forest Service
Pacific Northwest Forest and Range Experiment Station

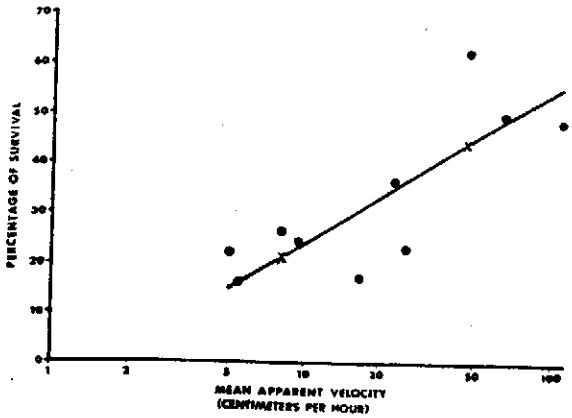


Figure 17—Relation between apparent velocity and embryo survival (from Coble 1961).

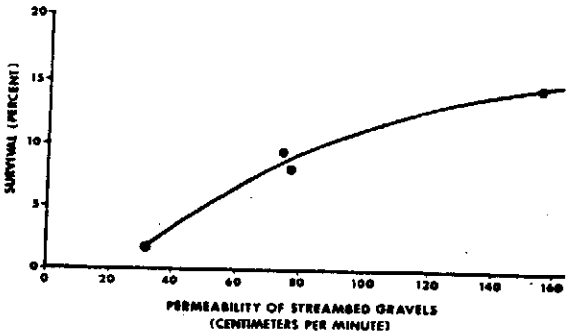


Figure 18—Observed relation reported by Wickett (1958) between permeability of spawning beds and survival of pink and chum salmon to the migrant fry stage (from McNeil and Ahnell 1964).

SUBSTRATE MATERIALS

Spawning bed materials also influence the development and emergence of fry. Permeability of the substrate (the ability of a material to transmit fluids) sets the range of subsurface water velocities (Wickett 1962). Low permeabilities result in lower apparent velocities and reduced oxygen delivery to and metabolite removal from the eggs. Wickett (1958) found that survival of pink and chum salmon eggs was related to permeability (fig. 18). McNeil and Ahnell (1964) concluded that highly productive spawning streams had gravels with high permeability. Permeability was high (24,000 cm/h) when bottom materials had less than 5 percent (by volume) sands and silts that passed through a 0.833 mm sieve and was relatively low (less than 1 300 cm/h) when fine sediments made up more than 15 percent of the bottom material.

Successful fry emergence is hindered by excessive amounts of sand and silt in the gravel. Even though embryos may hatch and develop, survival will be poor if they cannot emerge. Koski (1966) examined redds

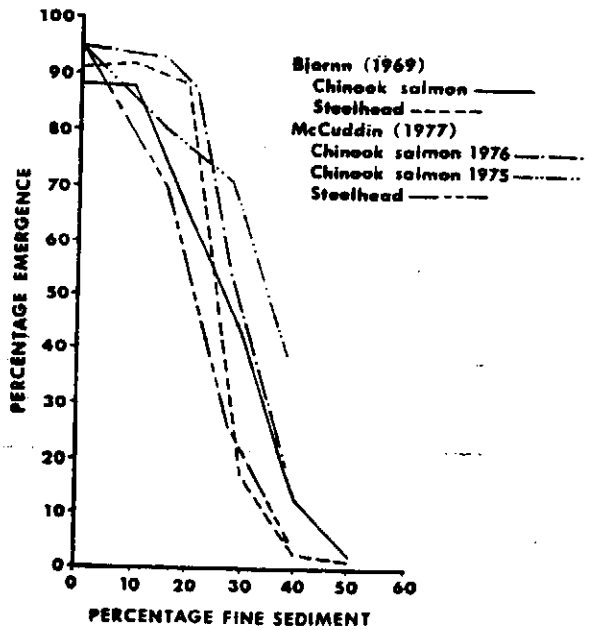


Figure 19—Percentage emergence of fry from newly fertilized eggs in gravel-sand mixtures. Fine sediment was granitic sand with particles less than 6.4 mm.

where eggs had developed normally but the hatched fry were unable to emerge because of sediment. Phillips et al. (1975) found an inverse relation between quantity of fine sediments and fry emergence. Bjornn (1969) and McCuddin (1977) demonstrated that survival and emergence of chinook salmon and steelhead embryos were reduced when sediments less than 6.4 mm in diameter made up 20-25 percent or more of the substrate (figs. 19 and 20).

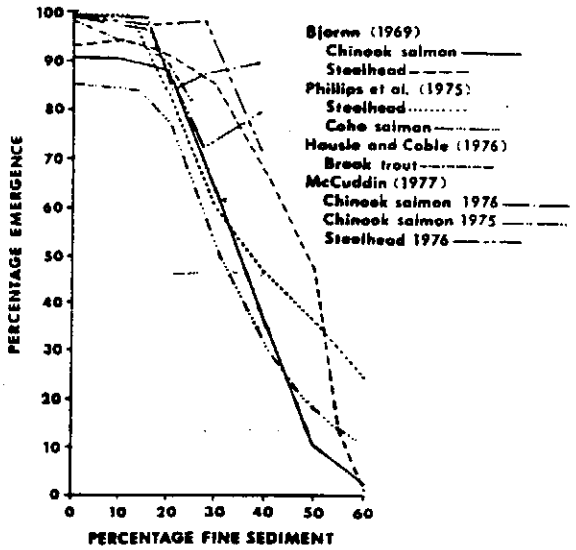


Figure —Percentage emergence of swim-up fry placed in gravel-sand mixtures. Sediments were 1- to 3-mm particles in the study by Phillips et al. (1975), less than 2 mm in the study by Hausle and Coble (1976), and less than 6.4 mm in studies by Bjornn (1969) and McCuddin (1977).

STREAMFLOW

Streamflow requirements of incubating salmonid eggs are largely unknown partly because of the lack of information on interactions of surface flows and the intragravel environment. According to Stalnaker and Arnette (1976), most agencies that are concerned with fish habitat do not attempt to deal specifically with streamflows for incubation but only for spawning, on the assumption that flows suitable for spawning will be suitable for incubation. U.S. Fish and Wildlife Service personnel at times have recommended an increase in flow for incubation over that present at spawning (Hale in Hooper 1973). Oregon Department of

Table 9. General habitat guidelines for incubation of salmonid embryos

Parameter	Recommended limit
Dissolved oxygen	At or near saturation; lower threshold - 5.0 mg/l
Water temperature	4°-14°C 1/
Permeability	More than 1 300 cm/h
Sediment composition	Less than 25% by volume of fines ≤6.4 mm
Surface flow	Sufficient to allow fry to emerge
Surface velocity	Velocities should be less than those that scour the redds and displace spawning bed materials
Apparent velocity	More than 20 cm/h
Biochemical oxygen demand	Should not diminish or deplete the dissolved oxygen content below stated levels

1/ Upper and lower values are threshold temperatures. Eggs will develop normally at lower temperatures provided initial development has progressed to where they become tolerant of cold.

8/20/97 Swasey Dam Team Meeting

Sediment Removal

Discussion of whether to continue to remove sediment. Some concern that it may not be necessary. There appears to be more gravel/cobble sized material than before, may be removing material that is favorable.

Decided to sample w/backhoe and meet again to make a final decision.

Monitoring Needs

The following monitoring methods were discussed and generally prioritized:

1, Repeat McNeal sampling that was done by Jane Vorpagel to look at suitability.

1, Fish sampling.
Could be handed over to Shasta Elementary School eventually.

3. Repeat depth of sediment measurements done by F&G, SCS.
(Spring)
Measured pools.

3. Repeat RWQCB sampling from 1989, 1993/94.
Turbidity, suspended sediment, and settleables.

5. Invertebrate sampling.
Questionable.

Restoration Needs

The following restoration options were discussed but were not prioritized. More information was to be gathered for future discussion:

1. Spawning gravel injection.

2. Habitat typing.
Could possibly be done by USFWS when they are in the area.
December

3. Improve fish passage at currently impassable falls.

4. Instream structures.

5. Upland erosion control.

Sieve Analysis 9/11/97

Swasey Reservoir Sediment

Sieve Sizes

1.0" = 25.0 mm
0.5" = 12.5 mm
0.25 = 6.3 mm

Sample #	> 1.0"	1.0" -0.5"	0.5" - 0.25"	< 0.25"
1 (%)	-0-	-0-	-0-	100
2 (%)	68	07	04	21
3 (%)	01	03	03	93
4 (%)	19	10	09	63
5 (%)	03	06	10	81
Total (%)	**25**	**5**	**5**	**65**

SAMPLE LOCATIONS

Sample # 1 - Pit # 1 (0"-36")
Sample # 2 - Pit # 2 (0"-10")
Sample # 3 - Pit # 2 (10"-36")
Sample # 4 - Pit # 3 (0"-22")
Sample # 5 - Pit # 3 (22"-36")

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

415 Knollcrest Drive, Suite 100
Redding, CA 96002
Phone (530) 224-4845
FAX (530) 224-4857

Cal/EPA

Pete Wilson, Governor

13 January 1998

Jeff Souza, Western Shasta Resource
Conservation District
3179 Bechelli Lane, Suite #110
Redding, CA 96002-2041

MIDDLE CREEK SEDIMENT SAMPLING

On 26 November 1997, during an early season rainfall/runoff event, I sampled Middle Creek for the previously monitored sediment parameters, i.e., turbidity, suspended solids and settleable solids. The sample locations were the same as those monitored during the 1992-95 CRM program. The storm event was of sufficient magnitude to produce substantial flow in Middle Creek and, given that it was the first major flow event of the season, should have represented a "worst case senario" regarding erosion and sediment discharge. Results of the survey are as follows:

Sample Number	Location	Est. Flow (cfs)	Turbidity (NTU)	Settleable Solids (ml/l)	Suspended Solids (mg/l)
1	WF Middle Creek	5	23	.02	26
2	SF Middle Creek	5	54	.2	109
3	Middle Cr pond		37	tr.[1]	65
4	Middle Cr bl pond	20	38	tr.	59
5	Middle Cr @ IMM Rd		25	.1	NA[2]
6	Dr Fr Crystal Cr Agg	5	58	.05	57
7	Middle Cr bl IMM Rd		33	.05	NA
8	Middle Cr @ Sacto R	40	31	.1	46
9	Rock Cr @ Sacto R	100	25	tr.	33
10	Salt Creek @ Hwy 299		10	0	10

[1] - trace [2] - Not Analyzed

My analysis of the survey results follows:

- Turbidity, suspended sediment and settleable solids levels were greatly reduced from 1992-93 levels (see attached monitoring summary memo) and were similar to measurements last done in 1995 (it may be that we are approaching something approximating "background levels").

- Sediment levels in South Fork Middle Creek were much higher relative to West Fork Middle Creek. It appears that there is still some accelerated erosion/sediment discharge in the South Fork subwatershed, possibly from Muletown Road.

- Drainage coming from the Crystal Creek Aggregate area had somewhat higher turbidity but suspended and settleable concentrations were similar to that measured in Middle Creek. On this particular runoff event, the CCA sediment control program seemed to be effective.

- The Middle Creek channel did not show evidence of accumulated sand deposits and the prime spawning areas (gravel beds at the pool tails) looked clean.

If you have any questions, please contact me at (530) 224-4851 or the letterhead address.

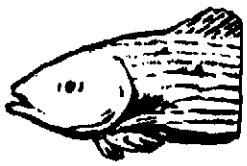
Dennis Heiman

Dennis R. Heiman
Environmental Specialist IV
Shasta Cascade Watershed

DRH:tch

Enclosures

cc w/o: Bob Bailey, U.S. Department of Agriculture, Natural Resources Conservation Service, Redding
Jane Vorpagel, Region 1, Department of Fish and Game, Redding
Jerry Comingdeer, Crystal Creek Aggregate, Redding



Western Shasta RCD
3179 Bechelli lane, Ste. 110
Redding, CA 96002

FAX

To:	From:	
Tricia Parker Dennis Heiman Harry Rectenwald Francis Berg Phil Warner Bob Bailey	Jeff Souza	Date: 2/3/98 Number of Pages: 1 Phone: (530) 246-5299 Fax: (530) 246-5164

Remarks:

SWASEY DAM TECHNICAL TEAM MEETING

February 6, 1998
2:00 - 4:00 P.M.
NRCS Conference Room
3179 Bechelli Lane, Ste. 110

AGENDA

2:00 - 3:00 Determine whether future sediment removal is necessary

3:00 - 4:00 Finalize the future monitoring & restoration needs of Middle Creek

WESTERN SHASTA RESOURCE CONSERVATION DISTRICT

3294 Bechelli Lane, Redding, CA 96002-2005 - Phone: (530) 224-3250 Fax: (530) 224-3253

SWASEY DAM TECHNICAL TEAM

May 30, 2000

Dennis Heiman, RWQCB
Jane Vorpagel, DFG
Phil Warner, DFG
Francis Berg, BLM
Bob Bailey, NRCS
Tricia Parker, USFWS

Dear Team Member:

At the present date we are trying to determine if the sediment stored behind Swasey Dam should be scheduled for removal. Last year the stored sediment was only at approximately half of the maximum capacity and it was determined not to remove the stored sediment. Stored sediment has increased over the past winter season

A sieve analysis of the sediment has not been completed at present due to the fact that water is still flowing in the channel. It is anticipated that the channel will be dry by late July, early August. A sieve analysis will be conducted at that time and you will be notified of the results

I would like to schedule a field trip to Swasey Dam in the month of July to discuss the removal of the sediment for this year. Please find enclosed a calendar for the month of July, as well as, the results from the last several years of sieve analysis. Please indicate the days and times on the calendar that you are **unable** to attend the field trip and return to me as soon as possible by mail or fax.

If you have any questions, feel free to contact me at 224-3250, ext. 3

Sincerely,

Jeff Souza
Projects Manager

Encl: July 2000 calendar
Sieve Analysis Results

WESTERN SHASTA
RESOURCE CONSERVATION
DISTRICT

3294 Bechelli Lane, Redding, CA 96002-2005 - Phone: (530) 224-3250 Fax: (530) 224-3253

SWASEY DAM TECHNICAL TEAM

June 6, 2000

Dennis Heiman, RWQCB
Jane Vorpagel, DFG
Phil Warner, DFG
Francis Berg, BLM
Bob Bailey, NRCS
Tricia Parker, USFWS

Dear Team Member:

After receiving your replies to our the letter that was sent out about the Swasey Dam clean out, I have come scheduled July 12th as the date to conduct a field trip. I would like to start at 9:00 AM at the WSRCD office and discuss any points of interest prior to going out into the field.

Thanks for your assistance, if you have any questions, feel free to contact me at 224-3250, ext. 3

Sincerely,

Jeff Souza
Projects Manager

WESTERN SHASTA
RESOURCE CONSERVATION
DISTRICT

3294 Bechelli Lane, Redding, CA 96002-2005 - Phone: (530) 224-3250 Fax: (530) 224-3253

SWASEY DAM TECHNICAL TEAM

Dennis Heiman, RWQCB
Jane Vorpagel, DFG
Francis Berg, BLM
Bob Bailey, NRCS
Tricia Parker, USFWS

August 10, 1999

Dear Team Member:

At the present date we are trying to determine if the sediment stored behind Swasey Dam should be removed. The amount of sediment stored is estimated to be about $120^{\pm}$ cubic yards which is down from the past several years.

Please find enclosed the results of a sieve analysis. The sediment sieve analysis was performed on 7/27/99. We have also included a summary of the past 3 years. We will contact you in the next couple of weeks to set up a meeting so we can make a decision.

If you have any questions, feel free to contact me at 224-3250, ext. 203.

Jeff Souza

Project Manager

Encl: Results for 1999 Sieve Analysis

Swasey Dam Sediment Sample 7/27/99

PIT #1

SANDY SURFACE PROFILE

0-12" sand primarily with gravel and leaf litter

SAMPLE #4

PIT #2

SANDY SURFACE PROFILE

0-30" sand primarily with gravel

SAMPLE #3

SIEVE SIZES

1.0"=25.0MM

05"=12.5MM

0.25"=6.3MM

SAMPLE #	>1"	1"-0.5"	0.5"-0.25"	<0.25"	TOTAL
1(vol)	3.1	1.9	1.7	5.8	12.5
1(%)	25	15	14	46	100
2(vol)	1.5	1.3	1.6	6.7	11.1
2(%)	14	12	14	60	100
3(vol)	0	0.2	0.6	8.9	9.7
3(%)	0	2	6	92	100
4(vol)	0.3	0.4	1.5	8.9	11.1
4(%)	2	4	14	80	100
TOTAL (VOL)	**4.9**	**3.8**	**5.4**	**30.3**	**44.4**
TOTAL (%)	**11**	**9**	**12**	**68**	**100**

NOTE: **VOLUME MEASURED IN LITERS**

1997	>1"	1"-0.5"	0.5"-0.25"	<0.25"	TOTAL
%	25	5	5	65	100

TOTAL YARDS REMOVED = 240 cubic yards

1998	>1"	1"-0.5"	0.5"-0.25"	<0.25"	TOTAL
%	6	5	4	85	100

TOTAL YARDS REMOVED = 208 cubic yards

1999	>1"	1"-0.5"	0.5"-0.25"	<0.25"	TOTAL
%	11	9	12	68	100

ESTIMATED YARDS STORED = 120* cubic yards

PIT #3

SAND WITH GRAVEL SURFACE PROFILE

0-10" sand with gravel

10-24" sand primarily some gravel

SAMPLE #1 0-10"

SAMPLE #2 10-24"

Swasey Dam Sediment Sample 7/26/00

PIT #1

LEAF LITTER ON SURFACE

PROFILE

0-6"	leaf litter with sand	
6-16"	sand	

SAMPLE #1

	>1"	1"-0.5"	0.5"-0.25"	<0.25"	TOTAL
			AVERAGE		
vol	0.1	0.1	0.5	7.5	8.1
%	1	1	6	92	100

PIT #2

SANDY SURFACE

PROFILE

0-24"	sand with leaf litter	
24-36"	sand	

SAMPLE #2

	>1"	1"-0.5"	0.5"-0.25"	<0.25"	TOTAL
			AVERAGE		
vol	4.1	2.3	1.9	9.5	17.8
%	23	13	11	53	100

SIEVE SIZES

1.0"=25.0MM

.05"=12.5MM

0.25"=6.3MM

SAMPLE #	>1"	1"-0.5"	0.5"-0.25"	<0.25"	TOTAL
1(vol)	0.1	0.1	0.5	7.5	8.1
1(%)	1	1	6	92	100
2(vol)	0.0	0.1	0.4	10.7	11.2
2(%)	0	0	4	96	100
3(vol)	4.1	2.3	1.9	9.5	17.8
3(%)	23	13	11	53	100
TOTAL (VOL)	4.2	2.4	2.8	27.7	37.1
TOTAL (%)	11	7	8	75	100

NOTE: VOLUME MEASURED IN LITERS

1997	>1"	1"-0.5"	0.5"-0.25"	<0.25"	TOTAL
%	25	5	5	65	100

TOTAL YARDS REMOVED = 240 CUBIC YARDS

1998	>1"	1"-0.5"	0.5"-0.25"	<0.25"	TOTAL
%	6	5	4	85	100

TOTAL YARDS REMOVED = 208 CUBIC YARDS

1999	>1"	1"-0.5"	0.5"-0.25"	<0.25"	TOTAL
%	11	9	12	68	100

ESTIMATED YARDS STORED = 120± CUBIC YARDS (NO MATERIAL WAS REMOVED)

2000	>1"	1"-0.5"	0.5"-0.25"	<0.25"	TOTAL
%	11	7	8	75	100

ESTIMATED YARDS STORED= 220± CUBIC YARDS

PIT #3

SAND AND GRAVEL ON SURFACE

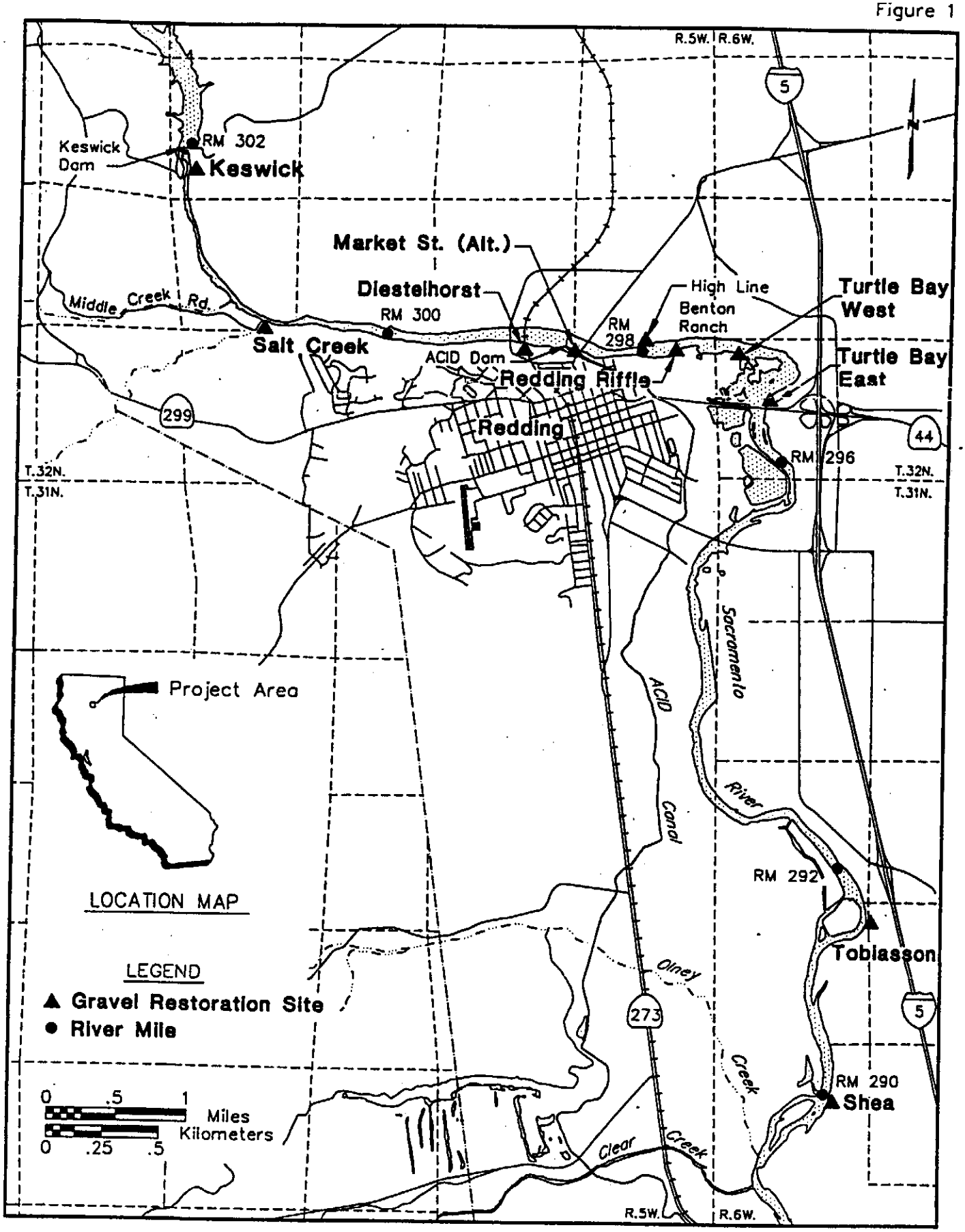
PROFILE

0-6"	sand with gravel
6-18"	sand, gravel, & cobble
18-24"	sand with gravel

SAMPLE #3

	>1"	1"-0.5"	0.5"-0.25"	<0.25"	TOTAL
			AVERAGE		
vol	4.1	2.3	1.9	9.5	17.8
%	23	13	11	53	100

Figure 1



Upper Sacramento River Restoration Sites Worked in 1990 and 1991