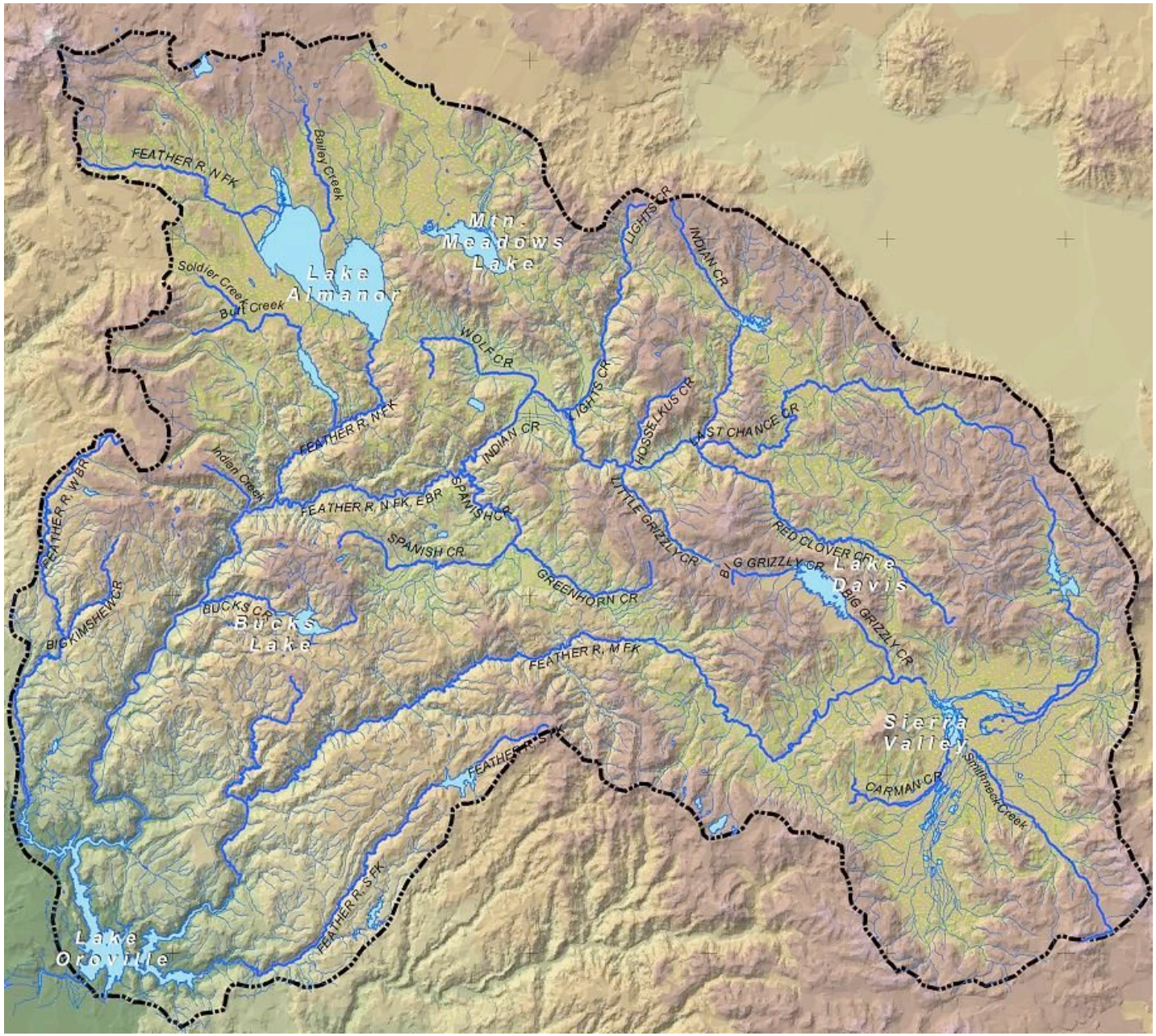
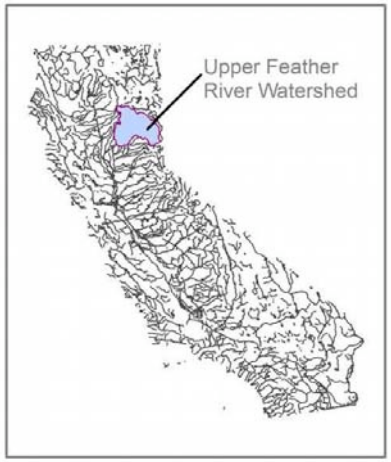
Integrating Water and Land Use Planning - Needs and Opportunities

Linking Water and Land Use in the Upper Sacramento Valley
Local Government Commission / Sacramento River Watershed Program
Red Bluff Community Center
Monday, April 30th, 2007

Presented by Leah Wills

Upper Feather River Watershed





Integrated Regional Water Management Plan

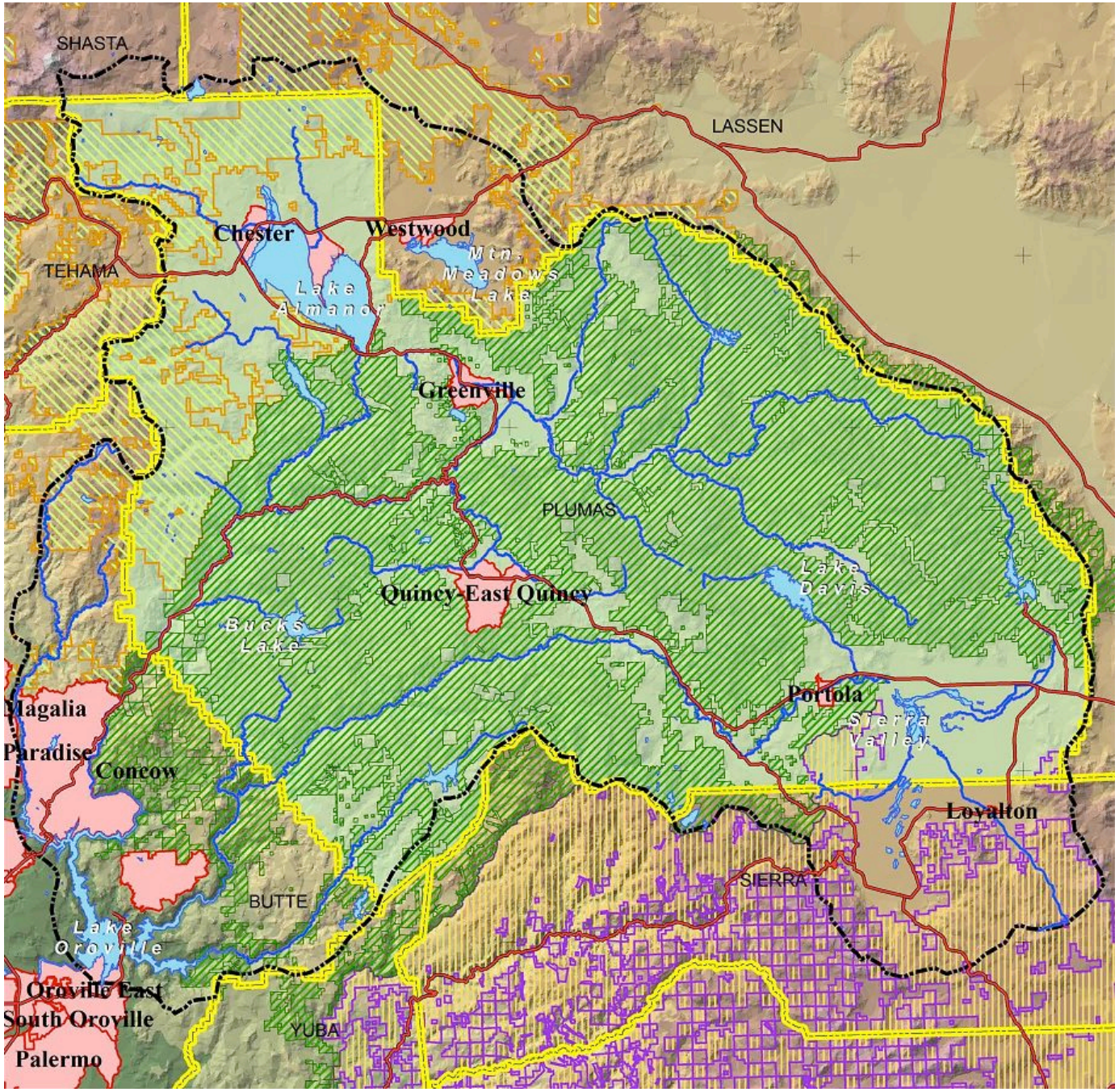
PLUMAS COUNTY 1854 CALIFORNIA

The Four Components of Integration

- Institutional Integration
- Resource Integration
- Watershed Integration
- Analysis and Data Integration

Regional Integration

Integrated Regional
Water Management Plan



Political and Urban Boundaries

Legend

- Lakes and Reservoirs
- Rivers
- Watershed Boundary
- Plumas County
- Highways
- Urban
- Plumas Nat. Forest
- Lassen Nat. Forest
- Tahoe Nat. Forest
- County Boundary

Integrated Regional Water Management Plan

PLUMAS COUNTY 1854 CALIFORNIA

IRWM Participants

Partners

County of Plumas

Plumas National Forest

Sierra Valley Groundwater Management District

Plumas County Flood Control & Water Conservation District

Cooperating Entities

Plumas Watershed Forum - Feather River CRM - Sierra County - Butte County

Quincy Community Services District - Indian Valley Community Services District

Maidu Cultural & Development Group - Other Tribal Entities

Feather River Land Trust - Sierra Institute

IRWM Participants

Feather River CRM

(1985)

Plumas County
Plumas National Forest
California Department of Forestry and Fire Protection
California Department of Fish and Game
California Department of Water Resources
Central Valley Regional Water Quality Control Board
Feather River College
North Cal-Neva Resources Conservation
and Development District
Plumas Unified School District
Natural Resources Conservation Service
U.S. Army Corp of Engineers
U.S. Fish and Wildlife Service
California Department of Transportation
California Department of Parks and Recreation
Plumas County Community Development Commission
U.C. Cooperative Extension
Feather River Resource Conservation
Salmonid Restoration Federation
Plumas Corporation
USDA Farm Services Agency
Trout Unlimited

Plumas Watershed Forum

(2003)

Plumas County Flood Control District

California Department of Water Resources

State Water Project Contractors

Technical Advisory Committee

Plumas National Forest
Sierra Valley Groundwater Management District
Sierra Valley Resource Conservation District
Sierra County
Feather River CRM
U.C. Cooperative Extension
California Department of Fish and Game
Feather River Resource Conservation District
Maidu Cultural & Development Group
Central Valley Regional Water Quality Control Board
Natural Resources Conservation Service

Integrated Regional
Water Management Plan

Preexisting Management Plans and Obligations

IRWM Goals and Objectives	FERC #1962 (page, Appendix: Section numbers)	FERC #2105 (page, Appendix: Section numbers)	Monterey Settlement Agreement (page number)	Feather River Watershed Management Strategy (page numbers)	FRCRM Plan (Appendix: page number)	Plumas NF-LRMP (page numbers)	SV Groundwater Management (Bill: Article numbers)
Improve Local Water Retention	■	■	19 ●	19 ●	1 ●	4-7 ●	1391:6,7 ●
Reduce Flood Potential	A:2 ●	A:3 ●	△	△	△	■	■
Improve Water Quality (temperature and sediment)	5 A:1,4 ●	6 A:5 ●	19 ●	21 ●	A:3 ●	4-7 ●	■
Improve Water Quality to Meet TMDL Limits	■	■	19 △	21 ●	1 △	■	■
Improve Upland Vegetation Management	■	■	19 ●	9, 17 ●	2 △	4-5 ●	■
Improve Groundwater Retention and Storage in Major Aquifers	■	■	19 ●	19 ●	1 ●	■	1391:8 ●
Restore Salmon Fishery in North Fork and Middle Fork Feather River Mainstems and Tributaries	5 A:3 △	5 A:5 △	■	■	■	■	■
Maintain Continuous Flow in Perennial Streams	5 A:2 △	5 A:1 ●	19 △	19 ●	1 ●	4-7 ●	■
Streambank Protection	5 A:2 ●	5 ●	19 △	16, 19 ●	2 ●	4-7 ●	■
Sediment Transport Reduction	5 A:4 ●	5 ●	19 ●	15, 21 ●	2 ●	4-7 ●	■
Stream Temperature Improvement	5 A:1 ●	8 ●	△	△	2 △	4-7 △	■
Agriculture NPS Waiver Program	■	■	■	■	■	■	■
Wetland Wastewater Treatment	■	■	■	21 △	2 △	■	■
Road Closure or Improvement	■	■	△	15 ●	A:3, 6 △	4-10 ●	■
Grazing Management	■	■	△	9 ●	2 ●	4-5 ●	■
Groundwater Recharge-Extraction Balance	■	■	19 ●	16 ●	■	■	1401:1 ●
Instream and Riparian/Wetland Habitat	5 A:3 ●	5 A:1 ●	19 △	16 ●	2 ●	4-7 ●	■
Education and Outreach	■	A:6 ●	■	21, 25 ●	2 ●	■	■
Monitoring and Adaptive Management	A:2,4,7 ●	A:1,5,7 ●	■	24 ●	4 △	■	■

Key:

■ = Does not address the subject.

● = Fully addresses the subject.

△ = Partially addresses the subject.

Integrated Regional Water Management Plan

Plumas National Forest

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Water Management Plan

Watershed Integration
Sustainable Resource Management

Integrated Regional
Water Management Plan

"Watershed Management"

Integrating land use and water use across jurisdictions, land ownerships, and beneficial uses of water.

A consistent strategy to restore hydrologic function and biological connectivity across urban and rural landscapes and land uses.

IRWM Plan Strategies

1. **Water Quantity Strategy**
2. **Water Quality Strategy**
3. **Flood Control Strategy**
4. **Temperature/Sediment Strategy**
5. **Groundwater Strategy**
6. **Land Management Strategy**
7. **Habitat Strategy**

Strategic Implementation

Eligible IRWM projects must have:

1. **Water Quantity Strategy**
2. **Water Quality Strategy**

... and at least one of the following:

- **Flood Control Strategy**
- **Temperature/Sediment Strategy**
- **Groundwater Strategy**
- **Land Management Strategy**
- **Habitat Strategy**

Key to Successful IRWM Implementation

"The Rule of 3s"

- **3 IRWM strategies**
- **3 Cooperating entities (led by willing landowner)**
- **3 designated beneficial uses* of water**

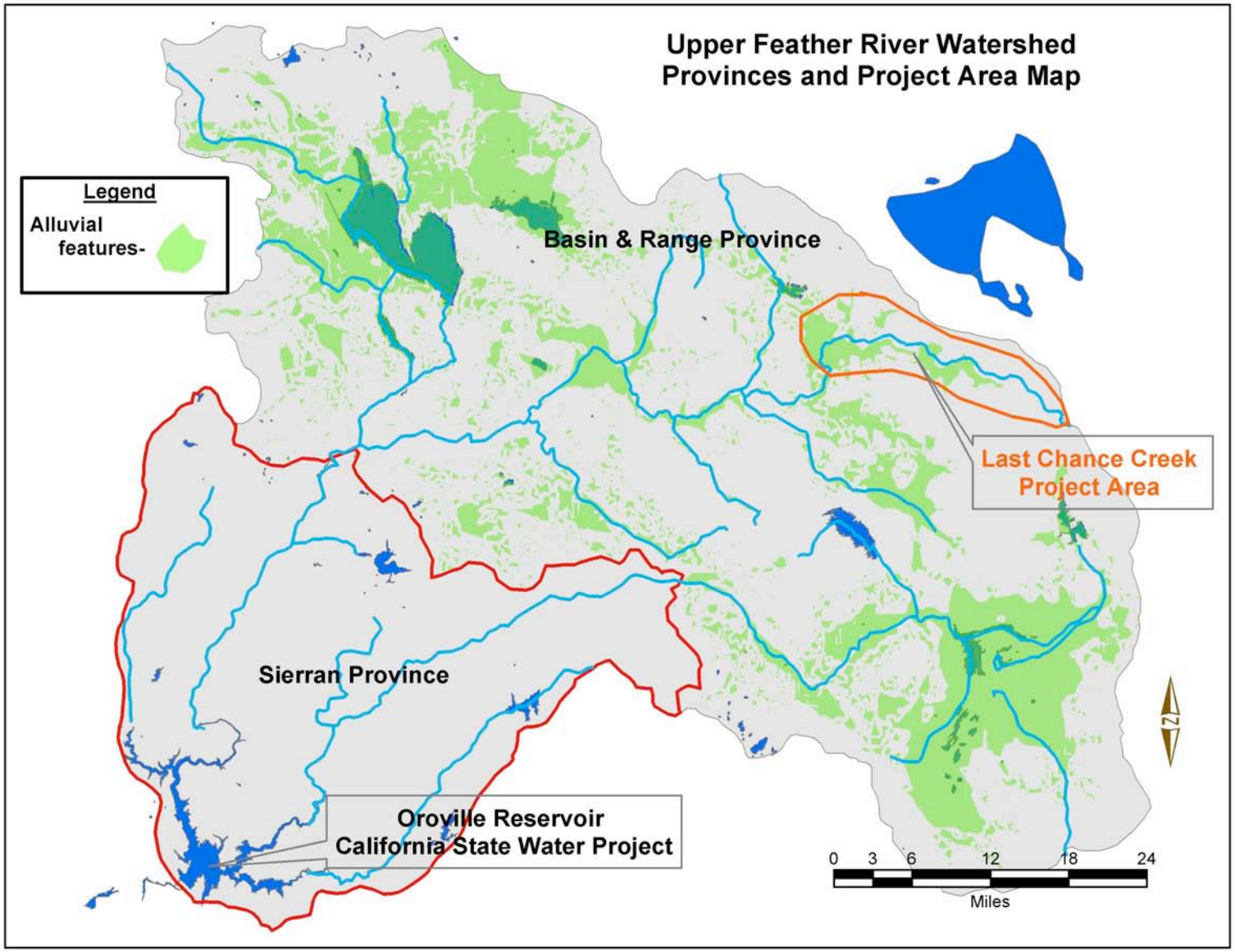
Central Valley Basin Plan - Feather River Beneficial Uses: Municipal, Agricultural, Hydroelectric, Recreational, and Cold Water Fishery

North Fork Feather River Watershed Characteristics

- 2,156 square miles
  - North Fork (Upper/Lower) – 1,131 square miles
  - East Branch – 1,025 square miles
- Precipitation 15”-70”
- Average Annual Discharge
  - North Fork (Upper/Lower) – 1,400,000 acre feet
  - East Branch – 726,000 acre feet
- Public and private land
- Intermountain vegetation types
- Historic land uses/impacts
- Significant sediment producer

In the Feather River Watershed we define watershed degradation as the loss of hydrologic function:

- **Loss of groundwater-surface water connection**
- **Loss of floodplain connection**
- **Loss of vegetative structure**
- **Loss of biological processes**
- **Loss of physical inputs**
- **Loss of chemical processes**

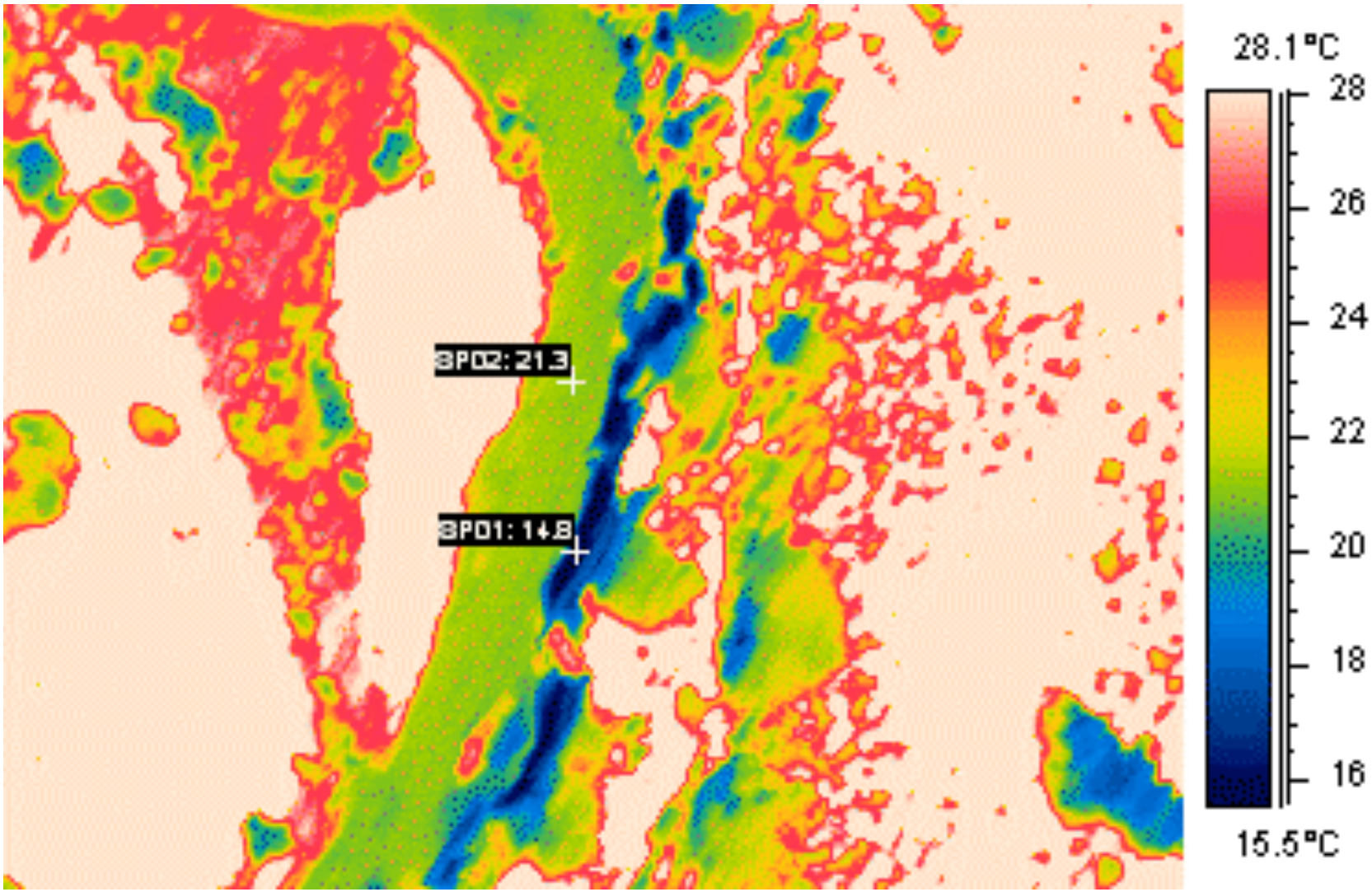

Upper Feather River Watershed
Provinces and Project Area Map
Legend
Alluvial features-
Basin & Range Province
Last Chance Creek Project Area
Sierran Province
Oroville Reservoir
California State Water Project
N
0 3 6 12 18 24
Miles

Degraded Pre-project Condition

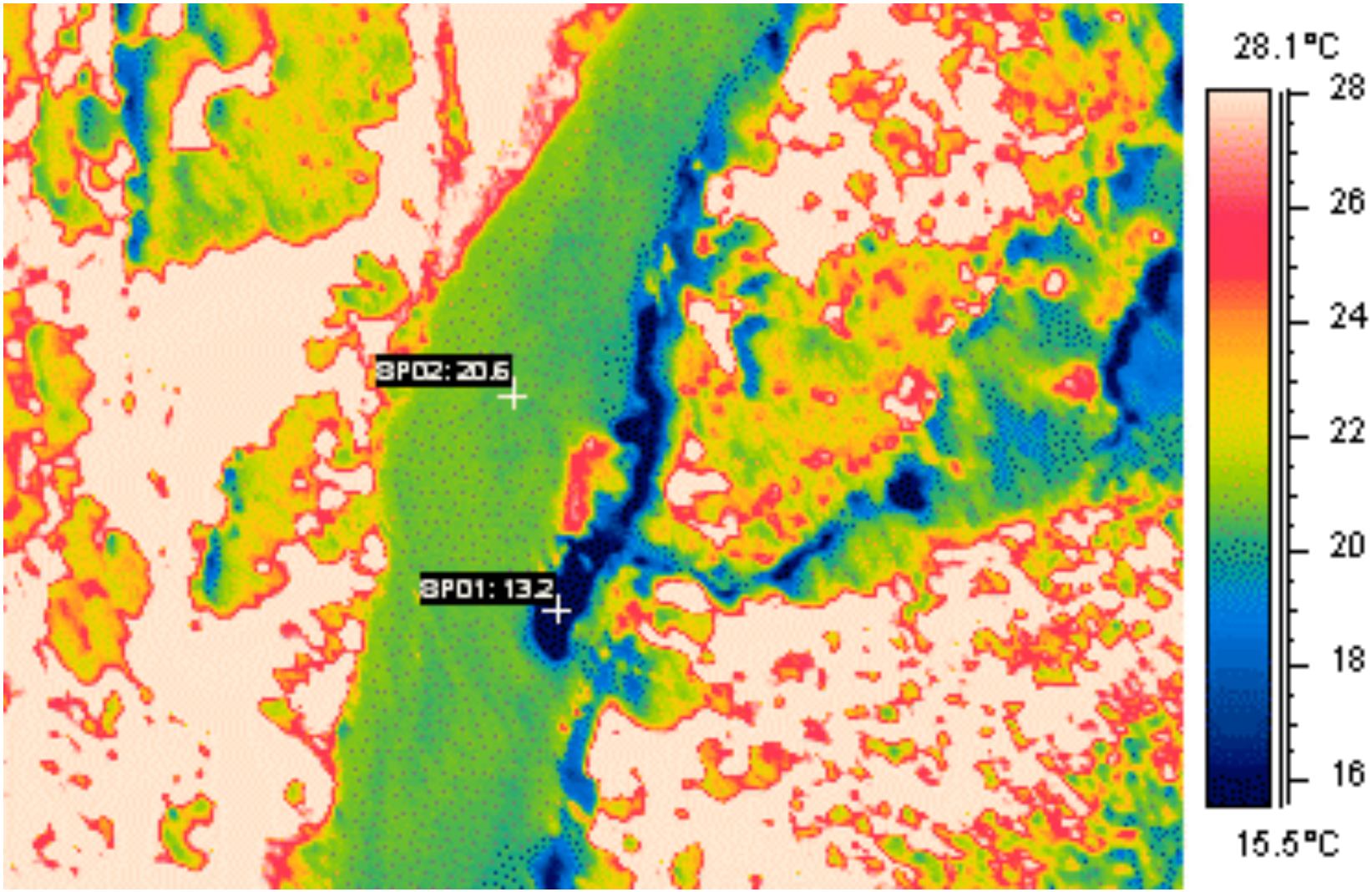
Aerial of Typical Pre-Project Conditions

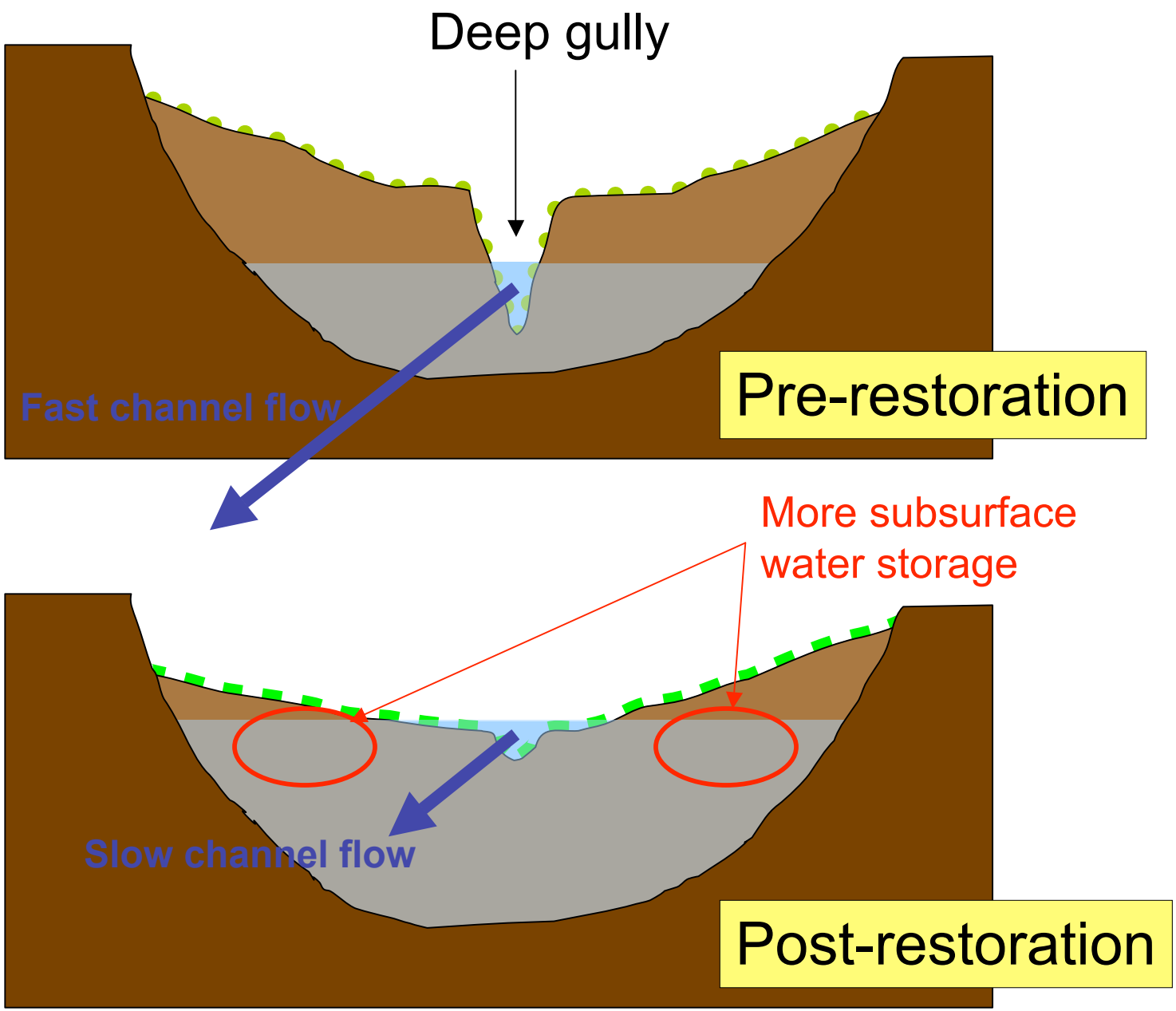
Last Chance Creek Pre-Project Conditions

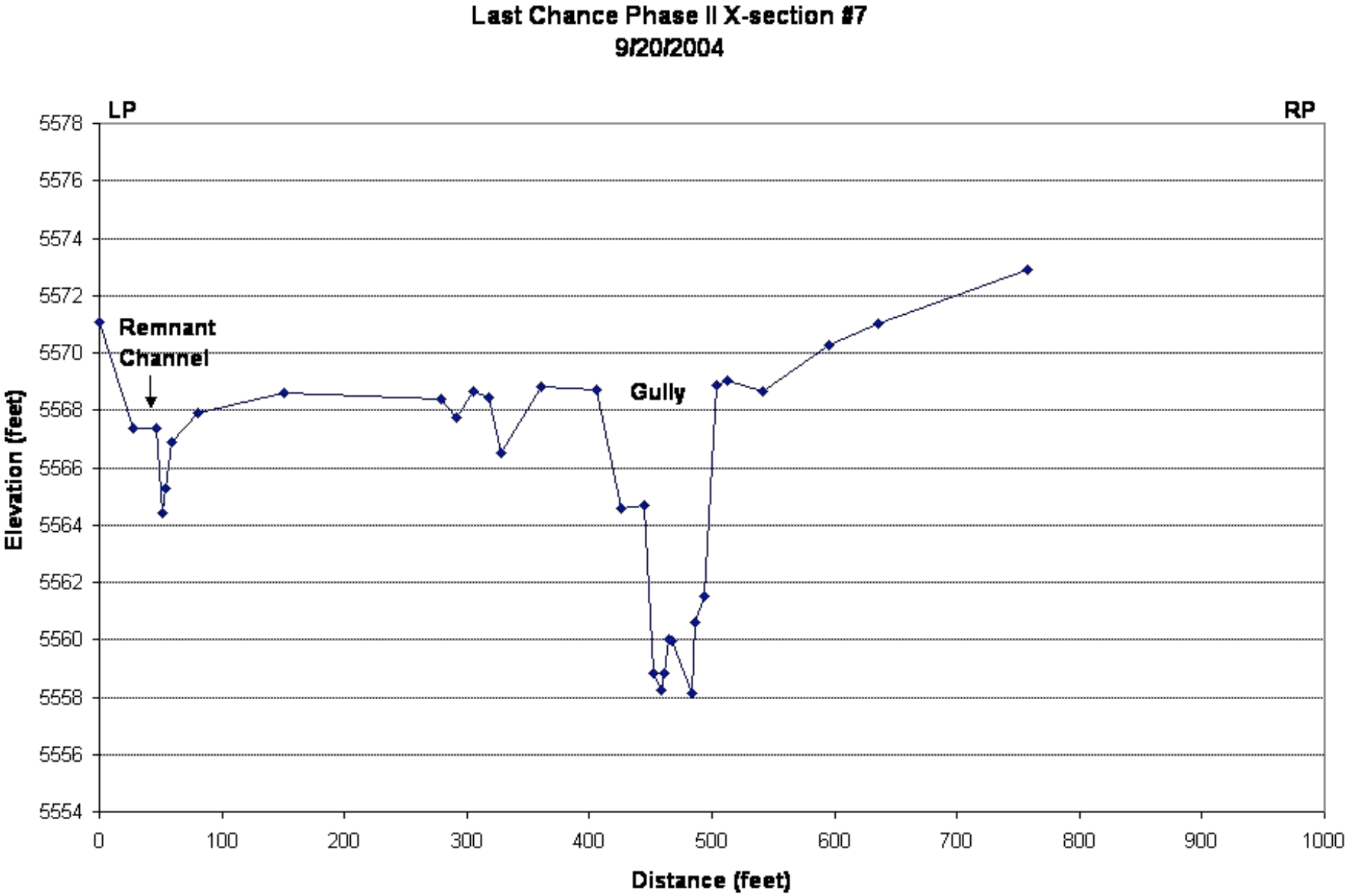
Typical Pre-Project Thermograph

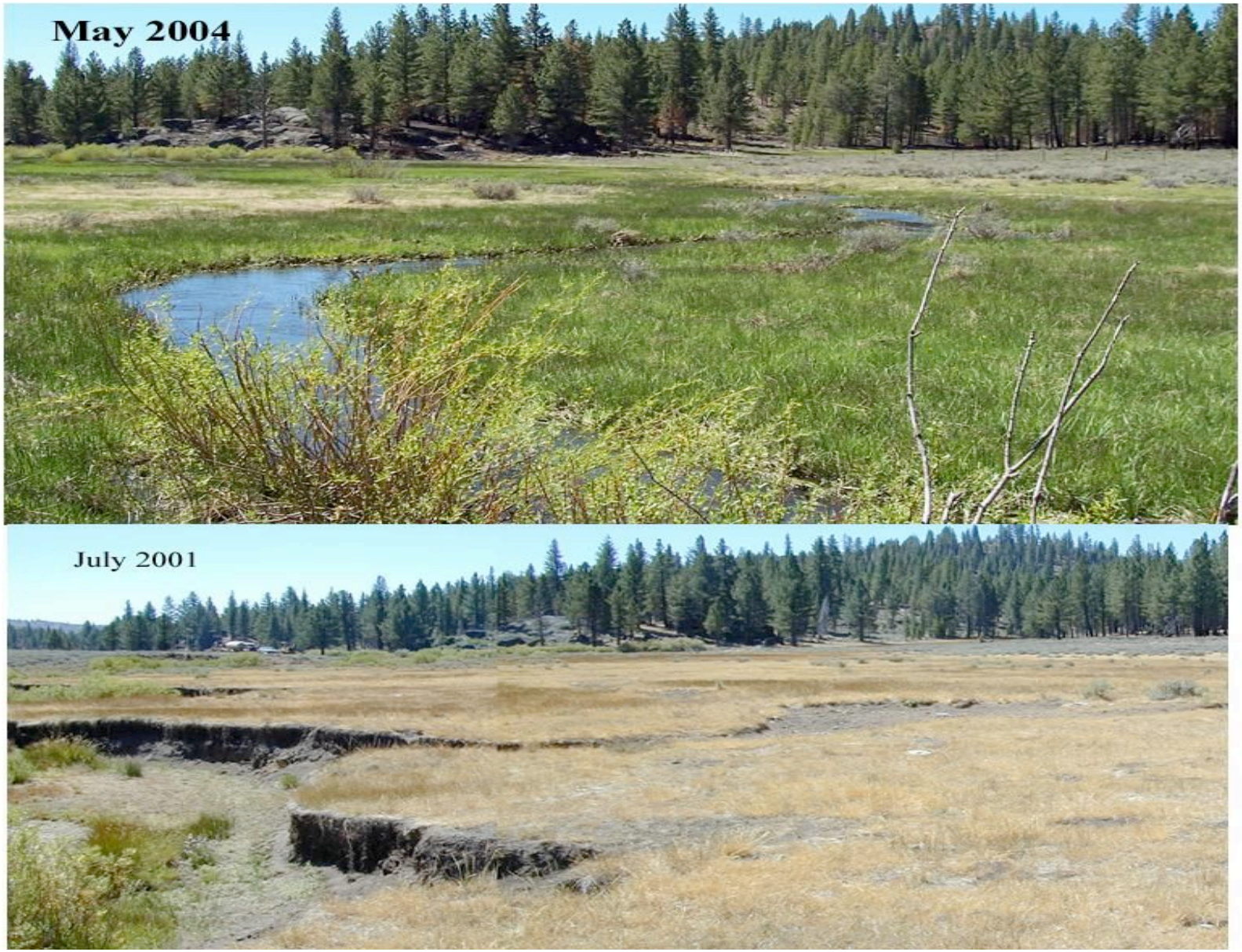


Typical Pre-Project Thermograph




Deep gully
Fast channel flow
Pre-restoration
More subsurface
water storage
Slow channel flow
Post-restoration


Last Chance Phase II X-section #7
9/20/2004
LP
RP
Remnant
Channel
Gully
Elevation (feet)
Distance (feet)
5578
5576
5574
5572
5570
5568
5566
5564
5562
5560
5558
5556
5554
0
100
200
300
400
500
600
700
800
900
1000

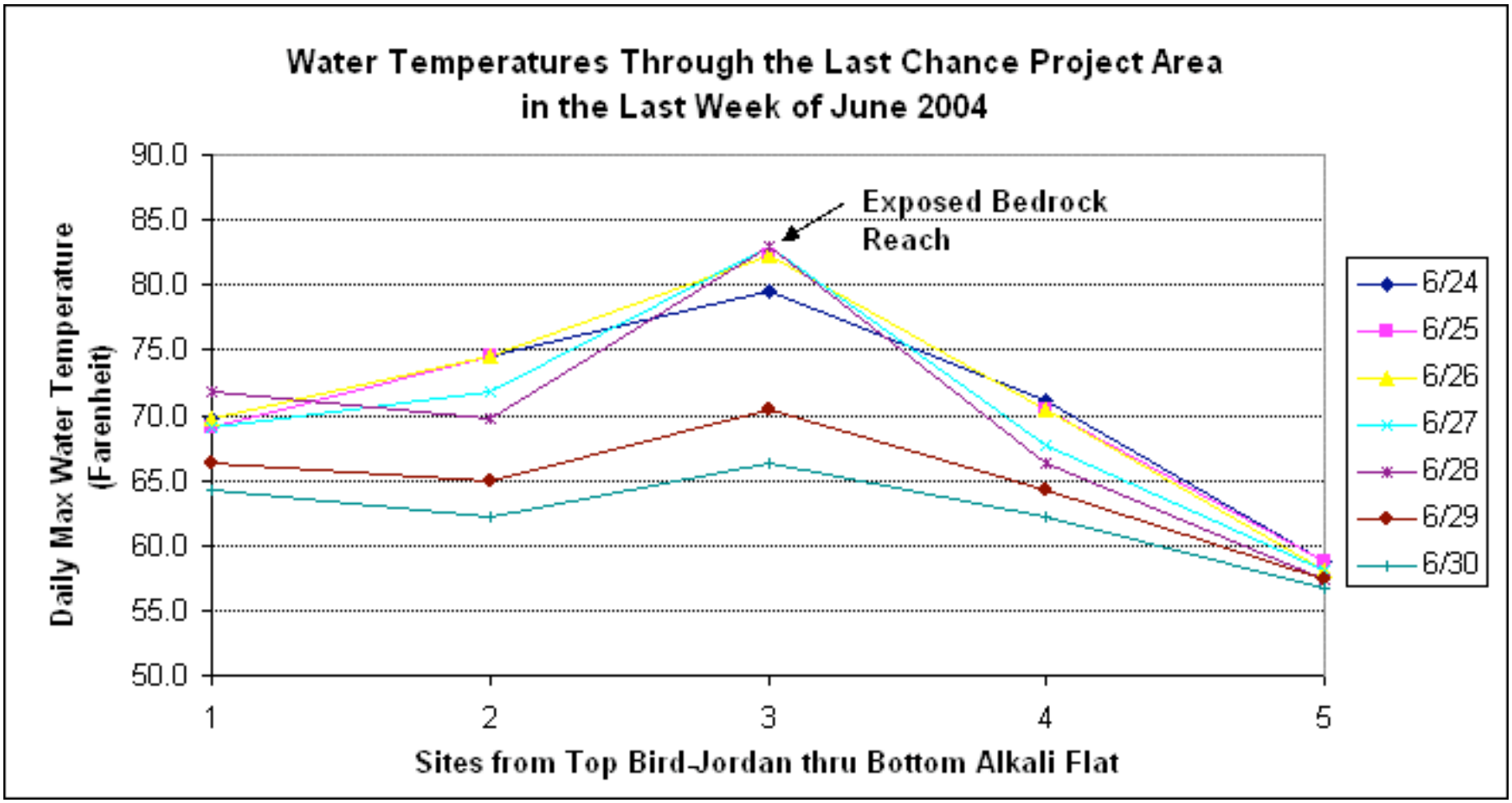

May 2004
July 2001

Last Chance Creek, Alkali Flat, 2003

Last Chance Creek, Alkali Flat, May 2005

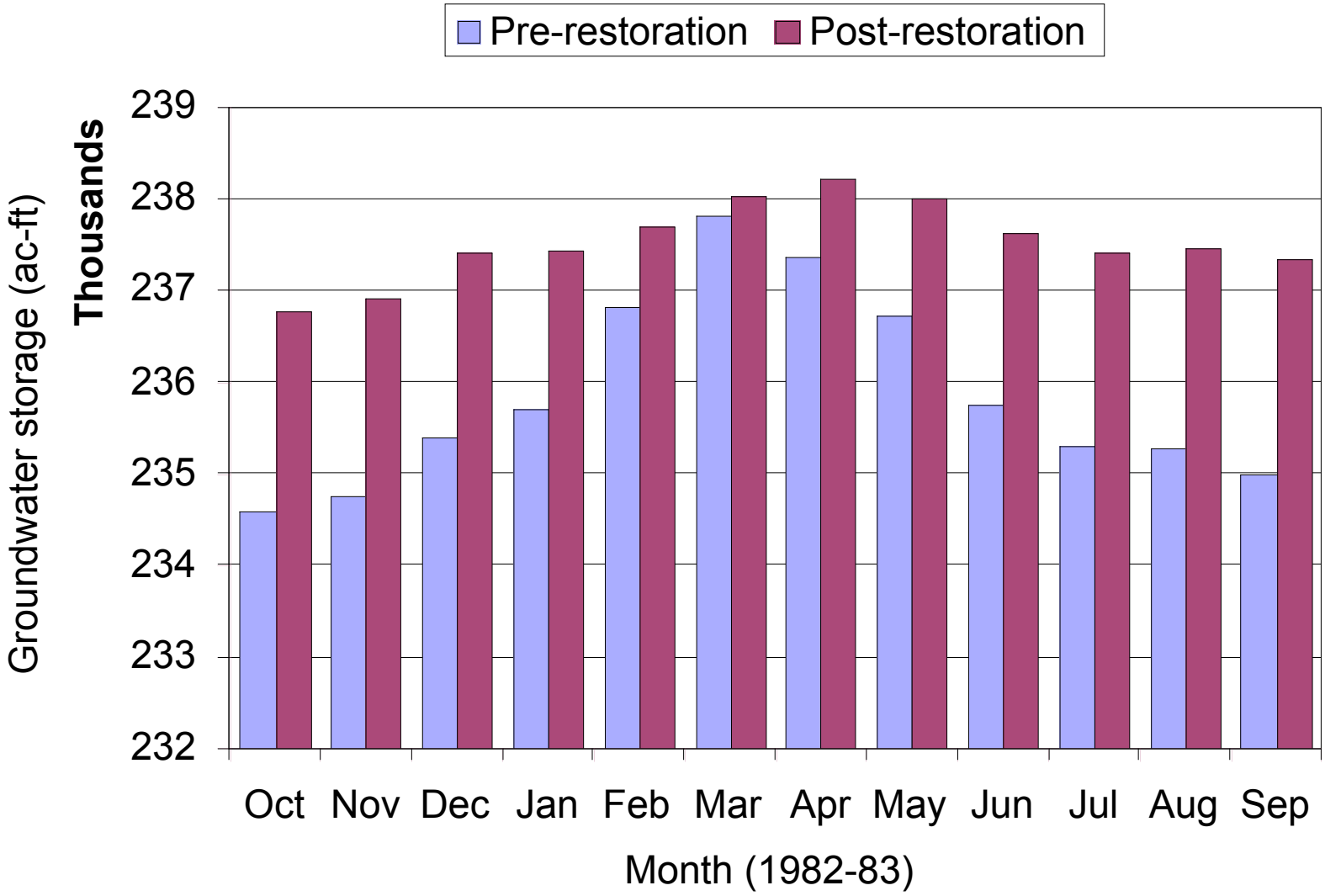
Last Chance Creek, Alkali Flat, July 2005

Last Chance Creek, Alkali Flat, 2005


Water Temperatures Through the Last Chance Project Area
in the Last Week of June 2004
Daily Max Water Temperature
(Farenheit)
90.0
85.0
80.0
75.0
70.0
65.0
60.0
55.0
50.0
Exposed Bedrock
Reach
1
2
3
4
5
Sites from Top Bird-Jordan thru Bottom Alkali Flat
6/24
6/25
6/26
6/27
6/28
6/29
6/30

Groundwater Storage

Pre-restoration vs. Post-restoration
(Oct.1982 - Sep.1983)

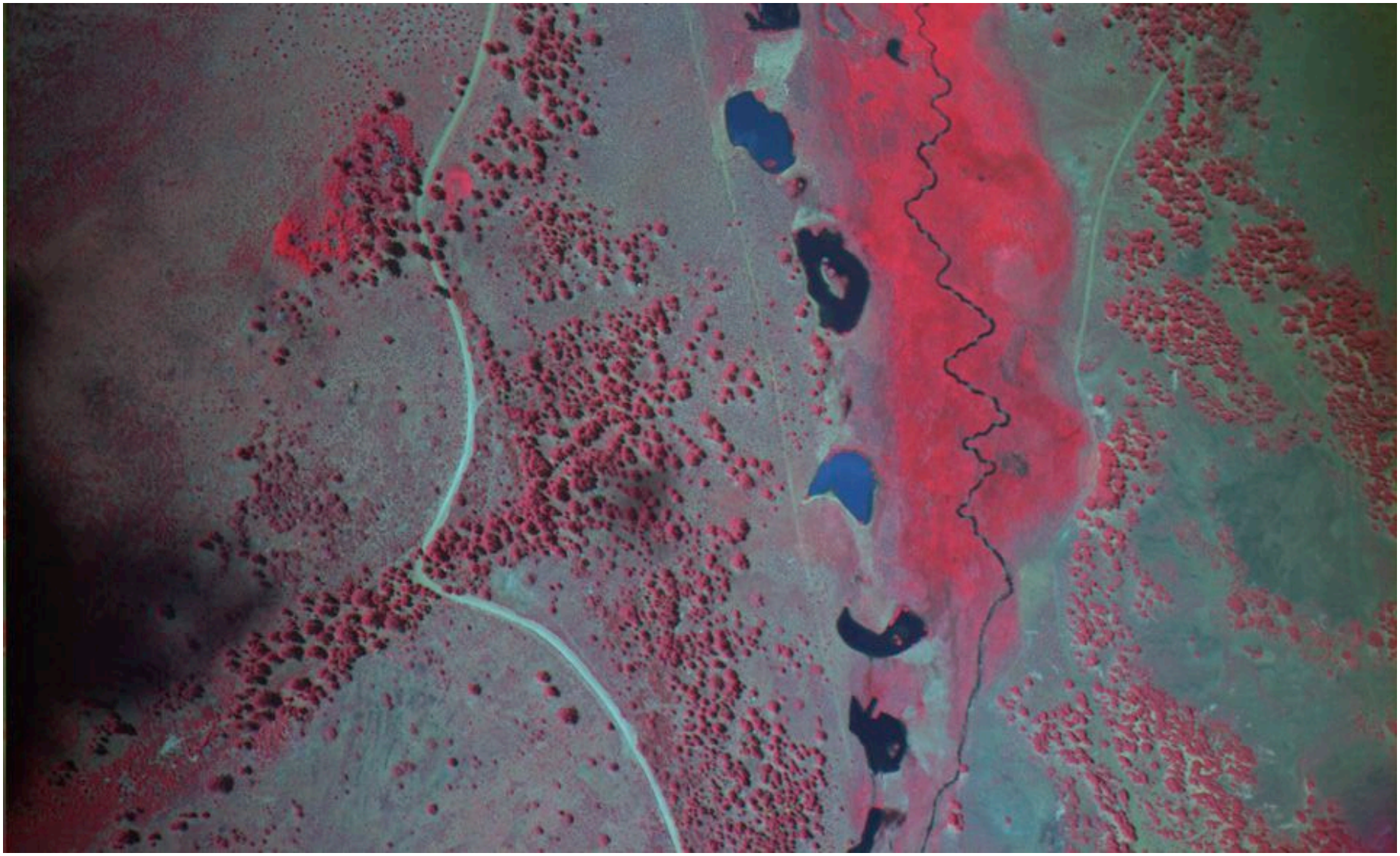


Flows at Doyle Crossing
(Based on Oct.1982-Sep.1983)

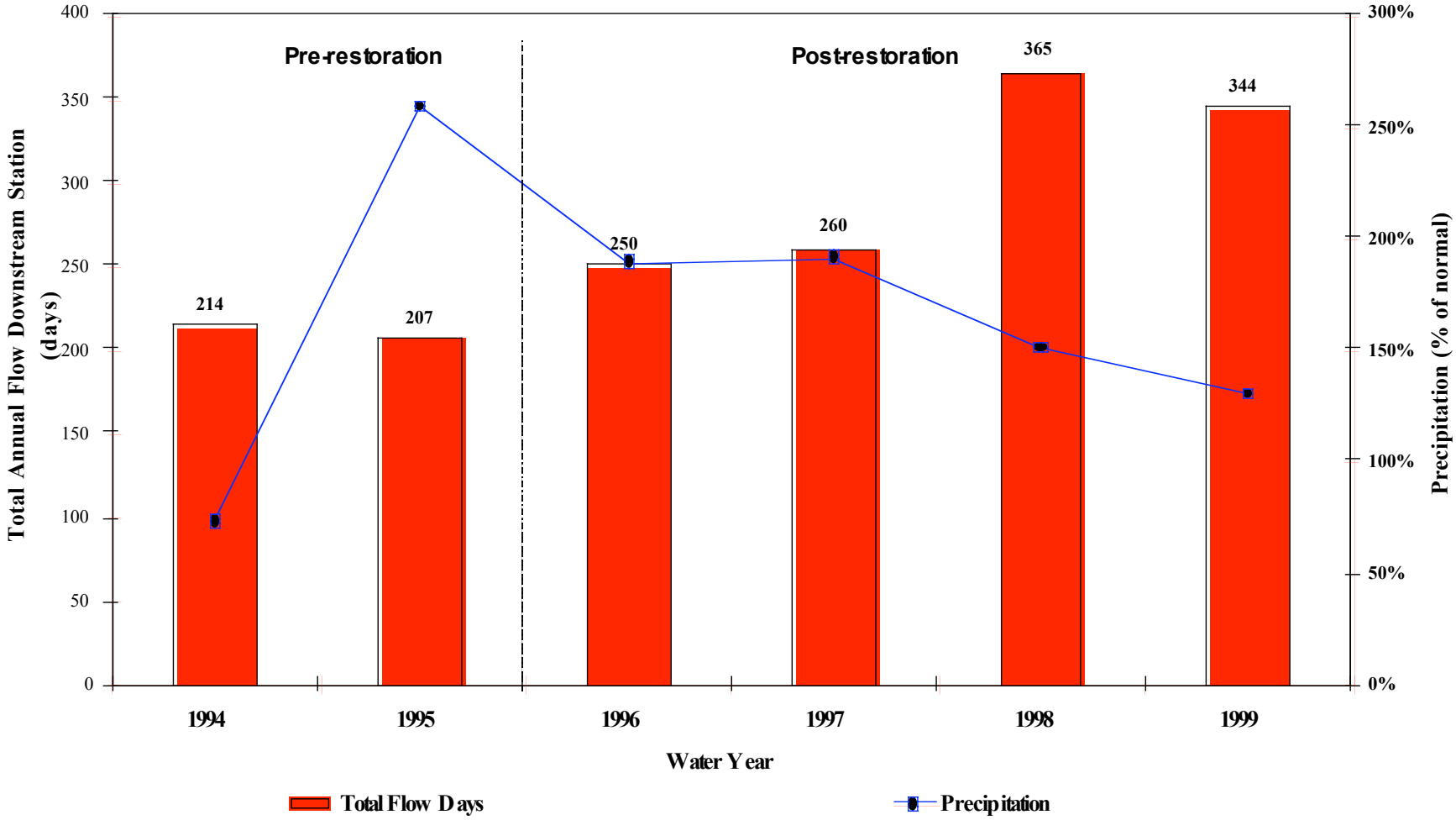
	Pre-restoration (acre-ft)	Post-restoration (acre-ft)	absolute diff (acre-ft)	relative diff (%)
Oct	132	132	0	0.00
Nov	505	499	-5	-1.06
Dec	3133	3109	-24	-0.77
Jan	4916	4388	-528	-10.74
Feb	14204	10631	-3574	-25.16
Mar	26302	17709	-8594	-32.67
Apr	18600	16762	-1838	-9.88
May	11744	11628	-116	-0.99
Jun	4898	5386	488	9.97
Jul	1545	2129	584	37.82
Aug	1680	2222	542	32.28
Sep	749	1393	643	85.84
Annual	88408	75988	-12420	-14.05

32.7% reduction of flow in March (wet month) may be expected, and
85.8% increase of flow in September (dry month) may be expected because of the restoration.

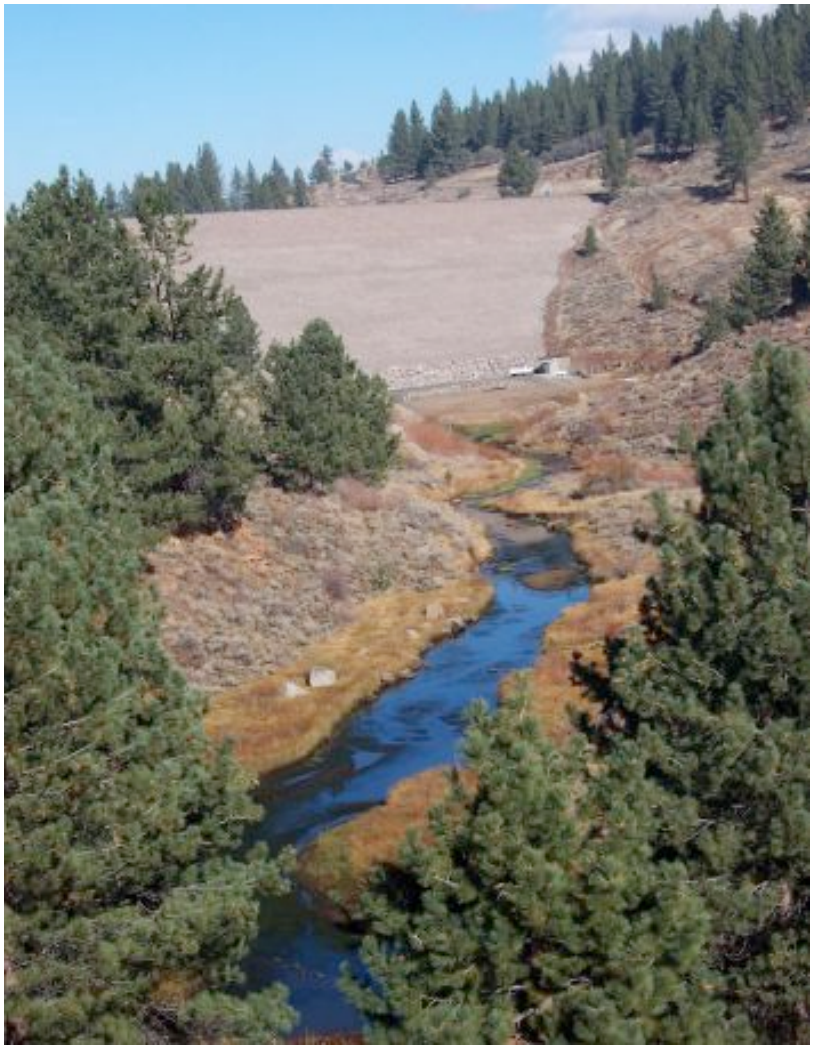
Cottonwood Creek Post-Project Water Table



Flow Duration in Cottonwood Creek near Big Flat Meadow



Integrating
Watershed Management
and Water Infrastructure



Integrated Regional
Water Management Plan

Wolf Creek, Greenville 1999

Wolf Creek, Greenville 2004

Ecosystem Responses

- **Fisheries**
- **Temperature**
- **Wildlife**
- **Vegetation**

Sample Date	Name/Length of Stream Sampled	Species	Total Catch	Population Estimate/mile	Biomass/mile
5/23/2000	Big Flat-100 feet	Rainbow Trout	60	1,126	45,700 m/L
5/24/2000	Clarks Creek-100 feet	Rainbow Trout	14	352	9,700 m/L

Hosselkus Creek Temperature Comparison

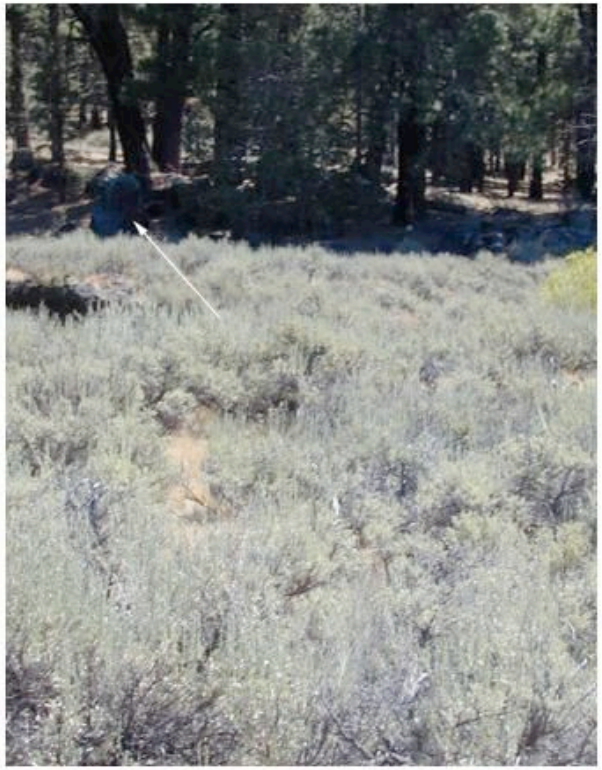
Temperature Data collected on June 27, 2005. Mostly cloudy, air temperature = 24.3C.

Location	Time	Degrees Centigrade	Degrees Fahrenheit
Hosselkus Creek abv project	1:55 p.m.	23.5	74.3
Hosselkus Creek blw project	12:50 p.m.	18	64.4
Indian Creek abv Hosselkus	1:15 p.m.	20	68.0
Indian Creek blw Hosselkus	12:30 p.m.	19	66.2

Bat Monitoring

Sampling Period	Water Habitat (passes/hour)	Willow Habitat (passes/hour)	Scrub Sage Habitat (passes/hour)
1997-2001 pre-proj.	31.5 ± 2.5	2.84 ± 0.37	2.28 ± 0.30
2002-2004 post-proj.	76.8 ± 8.1	17.7 ± 2.1	25.2 ± 2.0

Vegetation Response



pre-project June 2001

August 2002

July 2003

Clarks Creek Pond and Plug Project

Project Assessment and Evaluation Plan

Last Chance Creek Watershed Restoration Project Phase II

GOALS	DESIRED OUTCOMES	OUTPUT INDICATORS	OUTCOME INDICATORS	TOOLS	TARGETS
Improve groundwater storage in floodplain	- Maximized floodplain water storage	- Completed on-the-ground project	- 75% elevational rise in April groundwater levels at Coyote Flat - Conversion of xeric to moist/mesic plant communities	- Monthly sampling of existing groundwater monitoring wells at Coyote Flat - Three 100' vegetative transects per treated meadow	- Saturated shallow aquifer in floodplains in April - No sagebrush in floodplain meadows
Improve annual hydrograph	- Attenuate peak flows -Augment summer base flow	- Completed on-the-ground project	- Similar storm pre- and post-project peaks flattened by 10% - Daily average summer flow increased by 25%	- Doyle Crossing continuously recorded flow data compared between similar pre- and post-project years.	- Maximized peak length (cannot predict) - Summer daily average flow not less than 10% of annual daily average flow
Improve water quality	- Decreased water temperatures - Decreased fine sediments	- Completed on-the-ground project	- 5% decrease in max daily water temperature at Doyle Xing - 10% decrease in <2mm size class substrate materials at pool tails at FRCRM Monitoring on Last Chance Cr - 10% decrease in turbidity and TSS in event grab samples at Doyle Xing and 3 other accessible points in the project area	- Continuous recording water temperature sensor at Doyle Xing - Wolmann pebble counts & pooltail fines grid toss at FRCRM Monitoring Reach - Storm event grab samples and in-house analysis pre- and post-project	- Not to exceed 20C max daily water temperature - <10% fines at pooltails and riffles - Event turbidity and TSS consistently trending downward
Improve coldwater fish habitat in Last Chance watershed	All of the above, plus: - increased shade - increased bank vegetative cover - increased pool:riffle ratio - increased % EPT of total macroinvertebrate biomass	- Completed on-the-ground project	At the FRCRM Monitoring Reach on Last Chance Cr: - 10% increase in shade - 10% increase in bank veg cover - increase pool habitat by 20% - increase EPT biomass by 10%	At the FRCRM Monitoring Reach on Last Chance Cr: - solar pathfinder - SCI bank stability rating (veg cover) - SCI habitat identification (% pools) - California Rapid Bioassessment	- 40% shade - 80% bank veg cover - 50% pool habitat - 80% EPT biomass

Project Assessment and Evaluation Plan

Last Chance Creek Watershed Restoration Project Phase II

GOALS	DESIRED OUTCOMES	OUTPUT INDICATORS	OUTCOME INDICATORS	TOOLS	TARGETS
Improve coldwater fishery	- Increased trout population	- Completed on-the-ground project	- 10% increase in trout biomass at FRCRM Monitoring Reach on Last Chance Cr & at three sample sites within the project area	- Multiple pass depletion electroshock surveys	- Trout biomass not less than 30 lb/acre of surface water
Improve channel stability	- Decreased entrenchment - Decreased width:depth ratio	- Completed on-the-ground project	- 50% decrease in entrenchment (floodplain width/2xbankfull width) - 30% decrease in width:depth ratio	At 8 sample cross-sections within the project area: - SCI entrenchment & width:depth ratio surveys and calcs	- Entrenchment ratio not less than 10 - Width:depth ratio not greater than 1
Increased riparian vegetative condition	-Riparian community that includes structure and function	- Completed on-the-ground project	- 50% increase in willow/sedge/perennial grass species adjacent to channels	- Modified "greenline" survey from Monitoring Manual (Herrick et al. 2005) in each treatment reach of the project area	- No sagebrush or annual grasses adjacent to channels

REFERENCES
Herrick, J.E., J.W. VanZee, K.M. Havstad, L.M. Burkett & W.G. Whitford. 2005. Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems. USDA-ARS Jornada Experimental Range. Las Cruces, New Mexico. ISBN 0-9755552-0-0

In the following tables, the place and project names have been shortened as follows.

- LCC I abv DOY - Last Chance Creek Phase I Project
- LCC II - Last Chance Creek Phase II Project
- GV - Genesee Valley Project
- Genesee w/abv - Genesee Valley Project with the upstream regions (including LCC II, Upper Indian Creek, Red Clover Creek Project and Ward Creek and Hosslekuss Creek projects)
- PNF- Plumas National Forest Project NFFR- North Fork of the Feather River Watershed
- EBNFFR - East Branch North Fork of Feather River Watershed

Projected monthly baseflow increase at the outlet of East Branch North Fork Feather River in the 11year period, 1983-1994.

Unit: ac-ft	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
LCC II	23.1	-14.4	-43.1	-44.5	-141.4	-142.8	14.7	126.3	49.2	35.5	31.8	29.6
PNF	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6
GV	41.1	40.8	40.1	39.9	39.6	39.4	39.0	39.5	40.1	41.5	41.5	41.4
Total Impact	**80.9**	**43.0**	**13.6**	**12.0**	**-85.2**	**-86.8**	**70.3**	**182.5**	**105.9**	**93.7**	**90.0**	**87.6**
Flow of EBNFFR	10801	28626	48191	62389	69966	125550	67965	70470	33392	10754	8788	8140
Percent change	**0.75%**	**0.15%**	**0.03%**	**0.02%**	**-0.12%**	**-0.07%**	**0.10%**	**0.26%**	**0.32%**	**0.87%**	**1.02%**	**1.08%**

Projected monthly baseflow increase at the outlet of East Branch North Fork Feather River in the dry year, 1987.

Unit: ac-ft	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
LCC II	35.7	6.8	-27.6	-141.7	-6.4	-16.2	5.8	6.3	-1.3	13.6	53.5	59.1
PNF	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6
GV	41.1	40.8	40.1	39.9	39.6	39.4	39.0	39.5	40.1	41.5	41.5	41.4
Total Impact	**93.4**	**64.2**	**29.1**	**-85.2**	**49.8**	**39.8**	**61.5**	**62.5**	**55.4**	**71.7**	**111.6**	**117.0**
Flow of EBNFFR	6571	9680	75295	166942	30101	26242	21814	18292	11644	9182	8607	8539
Percent Change	**1.42%**	**0.66%**	**0.04%**	**-0.05%**	**0.17%**	**0.15%**	**0.28%**	**0.34%**	**0.48%**	**0.78%**	**1.30%**	**1.37%**

Projected baseflow increase at the outlet of East Branch North Fork Feather River during dry months (June-Oct) in the 11-year period, 1983-1994.

Flow at the outlet of EBNFFR (ac-ft)	71875
Baseflow increase (ac-ft)	458
Percentage increase (ac-ft)	0.64%

Projected baseflow increase at the outlet of East Branch North Fork Feather River during dry months (June-Oct) in the dry year, 1987.

Flow at the outlet of EBNFFR (ac-ft)	44543
Baseflow increase (ac-ft)	449
Percentage increase (ac-ft)	1.01%

Projected monthly baseflow increase including completed project effects at the outlet of East Branch North Fork Feather River in the 11year period, 1983-1994.

Unit:ac-ft	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
LCC II	23.1	-14.4	-43.1	-44.5	-141.4	-142.8	14.7	126.3	49.2	35.5	31.8	29.6
PNF	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6
GV	41.1	40.8	40.1	39.9	39.6	39.4	39.0	39.5	40.1	41.5	41.5	41.4
Existing project	41.0	-25.6	-76.6	-78.9	-251.0	-253.4	26.1	224.3	87.4	63.1	56.5	52.6
Total Impact	**121.9**	**17.4**	**-63.0**	**-66.9**	**-336.3**	**-340.2**	**96.4**	**406.7**	**193.3**	**156.8**	**146.5**	**140.1**
Flow of EBNFFR	10801	28626	48191	62389	69966	125550	67965	70470	33392	10754	8788	8140
Percent Change	**1.13%**	**0.06%**	**-0.13%**	**-0.11%**	**-0.48%**	**-0.27%**	**0.14%**	**0.58%**	**0.58%**	**1.46%**	**1.67%**	**1.72%**

Projected monthly baseflow increase including completed project effects at the outlet of East Branch North Fork Feather River in the dry year, 1987.

Unit:ac-ft	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
LCC II	35.7	6.8	-27.6	-141.7	-6.4	-16.2	5.8	6.3	-1.3	13.6	53.5	59.1
PNF	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6
GV	41.1	40.8	40.1	39.9	39.6	39.4	39.0	39.5	40.1	41.5	41.5	41.4
Existing project	63.4	12.1	-49.0	-251.6	-11.3	-28.7	10.4	11.3	-2.4	24.1	94.9	104.9
Total Impact	**156.8**	**76.3**	**-19.8**	**-336.8**	**38.5**	**11.1**	**71.9**	**73.7**	**53.0**	**95.8**	**206.5**	**221.9**
Flow of EBNFFR	6571	9680	75295	166942	30101	26242	21814	18292	11644	9182	8607	8539
Percent Change	**2.39%**	**0.79%**	**-0.03%**	**-0.20%**	**0.13%**	**0.04%**	**0.33%**	**0.40%**	**0.46%**	**1.04%**	**2.40%**	**2.60%**

Expected Load Reductions and Change in Pollutant Concentrations

Approximately 1.1 million tons of sediment annually erode from streambanks and roads in the North Fork watershed during an average runoff year. Of that total, 880,000 tons or 80 percent originates from human-caused activities, including abandoned mine tailing piles. The EBNFFR Prop. 50 projects (Last Chance Creek Phase II, the Genesee Valley Integrated Water Management Project, and Quincy Wetlands Treatment Project) create 1,586 acres of restored floodplains and riparian corridors which trap suspended sediments from overland flows. The proposed projects will reduce sediment loads into the North Fork canyon by 61,433 tons per year (5%).

Sediment Benefits

	Spre(t/yr)	Spost(t/yr)	DS=(Spost-Spre)	%
LCC II	147006	129290	-17716	-12.05
Genesee (w abv)	542711	487032	-55679	-10.26
EBNFF	1100000	1038557	-61443	-5.59

As examples, the meadow and stream restoration projects in the East Branch of the North Fork of the Feather River (EBNFFR) are predicted to improve summer baseflow temperatures by 2.5˚F in June in the North Fork canyon, at least to the confluence of the East Branch with the Upper North Fork at Belden.

Stream Water Temperature Benefits of the project

June

	Tpre (°F)	Tpost (°F)	DT (°F)	%
LCC II	64.96	53.14	-11.82	-18.20
Genesee	65.22	60.18	-5.04	-7.72
Taylorsville	68.83	64.76	-4.07	-5.91
EBNFF	66.38	63.84	-2.54	-3.82

July

	Tpre (°F)	Tpost (°F)	DT (°F)	%
LCC II	69.64	57.99	-11.66	-16.74
Genesee	68.73	60.15	-8.58	-12.48
Taylorsville	73.82	67.74	-6.08	-8.24
EBNFF	68.17	64.58	-3.59	-5.27

August

	Tpre (°F)	Tpost (°F)	DT (°F)	%
LCC II	66.09	54.62	-11.47	-17.35
Genesee	67.72	59.90	-7.83	-11.56
Taylorsville	73.86	68.21	-5.65	-7.65
EBNFF	67.71	64.38	-3.32	-4.91

Tpre - the water temperature under the pre-project condition;
Tpost - the water temperature under the post-project condition;

Daily-Average Flow Peak Discharge Benefits of the Projects

	A	IA	Qpre-k	Cp	Qpre	Qpost-k	Cpt	Qpost	%
	(m^2)	(m^3/s)	(m^3/s)		(m^3/s)	(m^3/s)		(m^3/s)	
LCC I abv DOY	249201360	77.18	32.36	0.419		27.80	0.360		-14.08
LCC II	522672331	170.41			71.44		0.386	65.86	-7.82
Genesee	118095424	36.75			15.41		0.408	15.00	-2.65
Genesee (w abv)	1248008418	449.78			188.56		0.406	182.57	-3.18
EBNFF	2460738331	1958.94	759.77	0.388			0.376	731.63	-3.70
Sierra Valley	1359848788	520.65			218.27		0.380	197.84	-9.36

A – the area of each watershed;
IA – the product of precipictation density and watershed area;
Qpre-k – the daily-average discharge under the pre-project condition known by observations or previous numerical simulations;
Cp – the discharge coefficient under the pre-project condition;
Qpre – the daily-average discharge under the pre-project condition Qpre = Cp*I*A;
Qpost-k - the daily-average discharge under the post-project condition known by obervations or previous numerical simulations;
Cpt - the discharge coefficient under the post-project condition;
Qpost - the daily-average discharge under the post-project condition Qpost = Cpt*I*A;
% - the peak discharge reduction - 100*(Qpost-Qpre)/Qpre.

Watershed name:

LCC I abv DOY - Last Chance Creek above Doyle Crossing
LCC II - Last Chance Creek Phase II region
Genesee - Genesee valley only
Genesee (w abv) - Genesee valley with the upstream regions, including LCC II, Upper Indian Creek, Red Clover Creek and Genesee
EBNFF - East Branch North Fork of Feather River Watershed
Sierra Valley
Lake Davis - Lake Davis- Long Valley watersheds
UMFF - Upper Middle Fork of Feather River Watershed

Note: Last Chance I is an already implemented project. This project demonstrates that the benefits are being generated the first winter after construction.

Power Cost savings and Production

These estimates are displayed in the three following tables. Only projects in the North Fork of the Feather River are used.

Unit: ac-ft	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
LCC II	35.7	6.8	-27.6	-141.7	-6.4	-16.2	5.8	6.3	-1.3	13.6	53.5	59.1
PNF	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6
GV	41.1	40.8	40.1	39.9	39.6	39.4	39.0	39.5	40.1	41.5	41.5	41.4
Total Impact	**93.4**	**64.2**	**29.1**	**-85.2**	**49.8**	**39.8**	**61.5**	**62.5**	**55.4**	**71.7**	**111.6**	**117.0**
Flow of EBNFFR	6571	9680	75295	166942	30101	26242	21814	18292	11644	9182	8607	8539
Percent Change	**1.42%**	**0.66%**	**0.04%**	**-0.05%**	**0.17%**	**0.15%**	**0.28%**	**0.34%**	**0.48%**	**0.78%**	**1.30%**	**1.37%**

Projected baseflow increase at the outlet of East Branch North Fork Feather River during dry months (June-Oct) in the 11-year period, 1983-1994.

Flow at the outlet of EBNFFR (ac-ft)	71875
Baseflow increase (ac-ft)	458
Percentage increase (ac-ft)	0.64%

Projected baseflow increase at the outlet of East Branch North Fork Feather River during dry months (June-Oct) in the dry year, 1987.

Flow at the outlet of EBNFFR (ac-ft)	44543
Baseflow increase (ac-ft)	449
Percentage increase (ac-ft)	1.01%

Value of Additional Power Generated

The value of the additional electricity generation is based on the additional acre feet of water transferred from winter release to early summer release to the Middle and North Forks of the Feather River, the price per megawatt hour, and the amount of generating capacity on each of the river forks. Total water released is 2,323 acre feet, 375 of which will enter the North Fork and the remainder, or 1,948 will be released to the Middle Fork. Water flowing down the North Fork will generate power at the Rock Creek, Cresta, Poe, and Oroville/Thermalito power houses, while water in the Middle fork will affect power generation at Oroville/Thermalito only.

Multiplying the additional mWh's generated by the value of a mWh results in a 2006 value for the additional power generation of $210,765. Discounting at six percent interest for seven years results in a first year of project (2013) value of $140,171 and a 50-year present value (using a 6% discount rate) of $2,349,528.

Upper Feather River

Project Benefits

	Proposal Totals	Forest Water Quality	Genesee Valley Project	Sierra Valley Project	SVGMD – Wells	Quincy Wetlands Treatment	Last Chance – Phase II	Upper Middle Fork
Water Supply								
Third party water benefits								
Dry Year Baseflow Increase (af / Jun-Oct)	2,315	83	206	1,865			161	
Average Year Baseflow Increase (af / Jun-Oct)	2,323	83	205	1,865			170	
Water Quality								
Protect/restore/enhance beneficial uses								
June Stream Water Temp. (ºF)	N/A		-5.04	-1.83			- 11.80	
July Stream Water Temp. (ºF)	N/A		-8.58	-2.99			-11.66	
August Stream Water Temp. (ºF)	N/A		-7.83	-3.34			-11.47	
Reduced Sediment Load (tons/year)	80,046	129	55,679	6,522			17,716	
Impaired water bodies/sensitive habitats								
Western Pond Turtle habitat (Acres)	123					37	86	
Dedicated in-stream flows (af-annually)	712		200	256				256
Avoided water treatment costs	$500K				$500K			
Avoided wastewater treatment costs	$1.5M					$1.5M		

Upper Feather River

Project Benefits

	Proposal Totals	Forest Water Quality	Genesee Valley Project	Sierra Valley Project	SVGMD – Wells	Quincy Wetlands Treatment	Last Chance – Phase II	Upper Middle Fork
Other Expected Benefits								
Ecosystem Restoration								
Restored Stream Channel (Miles)	50.3	38	2.5	0.8			9	
Restored Riparian Corridors (Acres)	2,889	2,432	400				57	
Rewatered Meadow Habitat (Acres)	1,692	300	350	300			742	
Other Restored Wetlands (Acres)	187			150		37		
Flood Control								
Flood Retention (af / Nov-Mar)	386						386	
Flood Peak Reduction (% of discharge)	N/A		-2.65	-9.36			-7.82	
Recreation and Public Access (Stream Miles)	41.3	38	2.5	.8				
Power Cost Savings and Production	$2.87M	$340K	$1.4M				$1.13M	
Research/Demonstration Value			•	•		•		•

Conclusion

Integrated Regional
Water Management Plan