Draft Final Report: July 1992

East Branch North Fork Feather River
Spanish Creek and Last Chance Creek

Non-Point Source Water Pollution Study
Section 205(j)(2): Clean Water Act

Primary Funding by California Water Resourses Control Board
Sponsered by Plumas County Community Development Commission
Coordinated by Plumas Corporation

Table of Contents

Final Report:205j Study:10/92

Spanish and Last Chance Creeks

EBNFFR 205 (J) (2) TASKS

PROJECT MANAGEMENT & ADMINISTRATION
1.1 Project Management
1.2 Quarterly Progress Reports

PUBLIC PARTICIPATION

2.1 Prepare Public Participation Plan
2.2 Prepare Responsiveness Summary
2.3 Form a Technical Advisory Committee

REVIEW EXISTING STUDIES & DETERMINE SEDIUENTATTON VOLUMES FOR FBNFFR
3.1 Evaluate Existing Erosion & Sediment Studies
3.2 Determine Channel Sedimentation Volumes for EBNFFR
3.3 Prepare Interim Task Report

DOUMENT NONPOINT SOURCE WATER QUALITY PROBLEMS IN THE SPANISH & LAST CHANCE CK. SUBWATERSHEDS & IDENTIFY AREAS NEEDING FURTHER STUDY
4.1 Classify Last Chance & Spanish Ck. Streams into Geomorphic Stream Types
4.2 Develop Data Base Maps -for Last Chance & Spanish Ck. Subwatersheds
4.3 Field Verification of Erosion Data
4.4 Recommend Priority Areas for Intensive Study
4.5 Prepare Interim Task Report

IDENTIFY POSSIBLE CAUSES OF MAJOR EROSION & SEDIMENT SOURCES FOR AREAS IDENTIFIED IN MANAGEMENT PRACTICES & TREATMENTS NEEDED FOR CONTROLLING EROSION & SEDIMENTATION
5.1 Compile Relevant Management Practices
5.2 Compile a List of Relevant Structural Treatments for Various Erosion Problems
5.3 Prepare Interim Task Report

PRIORITIZE SPECIFIC EROSION CONTROL TREATMENTS IN PRIORITY AREAS
6.1 Develop Evaluation Criteria & Ranking System for Prioritizing Areas
6.2 Compile a Field Tour Information Packet 6.3 Conduct a Field Tour of Priority Areas
6.4 Prioritize Generic Management Practices & Treatments for Priority Areas
6.5 Field Verify Proposed Practices & Treatment in Priority Areas
6.6 Develop Conceptual Plans for Corrective Actions of Priority Areas
6.7 Rank Areas for Implementability

RECOMMEND SPECIFIC TREATMENTS AND MANAGEMENT PRACTICES FOR SELECTED SITES ON LAST CHANCE & SPANISH CK.
7.1 Select Two Sites for Intensive Studies
7.2 Survey Selected Sites
7.3 Develop Best Management Practices (BMPs) & Cost Estimates
7.4 Develop Rehabilitation Plans for Two Sites

8. IMPLEMENTATION. INSTITUTIONAL & FINANCIAL PLANNING
8.1 Prepare Implementation Plan
8.2 Prepare Implementation Evaluation Checklist Form

9. PREPARE DRAFT PROJECT FINAL REPORT
9.1 Finalize Interim Task Reports
9.2 Evaluate the Geomorphic Approach
9.3 Compile & Circulate Draft Project Final Report

10. PREPARE PROJECT FINAL REPORT

EBNFFR 205 (J) (2)
DELIVERABLES

TASK	ITEM	SPANISH CK.	LAST CHANCE	PRODUCT OVERALL
1.2	Quarterly Reports			As submitted
2.1	Public Participation Plan			As submitted
2.2	Responsiveness Summaries			As submitted
3.3	Peak Sedimentation Date Report			SCS "Erosion Inventory" 2/89 PG&E "Sediment Transport" 7/90
4.5	Problems Inventory & Assessment Report	USFS "Results of Inventory" 1/92	Draft Final Report 7/92	USFS 2/90 "Last Chance Riparian Initiative"
5.3	Inventory of Appropriate Treatment & Management Practices Report			SCS-SWRCB MOU 7/31/90
6.3	Field Tour	Held 11/91	Held 7/91	
6.6	Conceptual Plans for Priority Areas	Greenhorn Army Corps 404 Permit 8/91	USFS "Clarks 2000" Stewartship proposal 12/91	
6.7	Area Rankings for Implementability			Clifton, USFS "Channel type & Condition" 7/92
7.4	Rehabilitation Plans for Two Sites	See 404 Permit	See "Clarks 2000"	
8.1	Implementation Plan	See 404 Permit	See "Clarks 2000"	Draft Final Report 7/92
8.2	Implementation Evaluation Check List			
9.3	Draft Project Final Report			Draft Final Report 7/92
10	Project Final Report			

205(J)(2) EBNFFR

SPANISH & LAST CHANCE CREEKS

COMPONENT STUDIES AT 10-31-92

	NAME	DATE	205(J) PRODUCT/BASELINE
SCS:	"EBNFFR EROSION INVENTORY REPORT"	2/89	Baseline
DWR:	"ANTELOPE RESERVOIR SEDIMENTATION SURVEY"	5/90	Baseline
SCS:	"RIVER BASIN STUDY REPORT FOR INDIAN VALLEY WATERSHED "•	7/89	Baseline
PG&E/ MORRISON-KNUDSEN:	"STUDY REPORT ROCK CK. RESERVOIR SEDIMENTATION"	7/86	Baseline
PG&E:	"ROCK CK. RESERVOIR DRAINAGE BASIN EROSION SOURCE INVENTORY"	4/84	Baseline
LEE & COMBS:	"COMPUTATION OF SEDIMENT TRANSPORT. . . "	8/90	205(J)(2) Product
USFS:	"205(J) INTERIM REPORT -LAST CHANCE WATERSHED"	2/90	205(J)(2) Product
CLIFTON, USFS:	"DRAFT RESULTS OF LAST CHANCE & SPANISH CKS. WATERSHED CONDITION SURVEY"	1/92	205(J)(2) Product
CLIFTON, USFS:	"STREAM CLASS & CHANNEL CONDITION SURVEY, WITH AN INVENTORY OF SEDIMENT SOURCES FROM ROADS & STREAM COURSES"	7/92	205(J)(2) Product
WILLS & SHEEHAN:	"EVALUATION OF THE GEOMORPHIC APPROACH"	7/92	205(J)(2) Product
	"DRAFT FINAL REPORT"	7/92	205(J)(2) Product
	FINAL REPORT	10/92	Product

7/22/92

ABSTRACT

Task 9.3. a. I

Draft Final Report: 7/92

Spanish Creek/Last Chance Creek

Non-Point Source Water Pollution Assessment
Sec. 205 (J)(2): Clean Water Act

This Water Quality Assessment covers the grant period between 2/1/90 and 10/31/92. This Draft Final Report is intended for circulation to and comments by the public and interested parties. This draft will be put in Final Report form after comments are received and then submitted in Final form to the California Water Resource Control Board (SWRCB) during September, 1992. This is SWRCB Standard Agreement #9-148-250-0. The project grantee is Plumas County Community Development Commission and the project has been coordinated by Plumas Corporation, the local economic development corporation. Plumas Corporation is the designated coordinator of the East Branch North Fork Feather River Coordinated Resource Management group.

The project has a variety of specific objectives, tasks and deliverables. The lists of tasks and deliverables are attached.

The study objectives are:

1) Develop a coordinated, comprehensive approach to sediment and erosion assessment and control in the East Branch North Fork Feather River (EBNFFR) through the organizational mechanism of the EBNFFR Coordinated Resource Management (CRM) group: a public-private partnership.

2) Evaluate sediment sources and erosion control management practices in the Spanish Creek (SC) and Last Chance Creek (LC) tributaries to the EBNFFR.

3) Develop treatment parameters (structural and management) for priority areas in LC and SC subwatersheds. Develop site specific designs for at least one priority area in each

of those subwatersheds.

4) Develop a list of potential investors and contacts for erosion and sediment control projects in the EBNFFR.

OVERALL RESULTS

Objectives 2-4 have been totally met.A major stream meander restoration project was constructed on Greenhorn Creek in the Spanish Creek watershed. The"Clarks 2000" management program was initiated on that subwatershed of Last Chance Creek and other projects have received project level designs. The Spanish Creek and Last Chance Creek subwatersheds were surveyed during 1990 and 1991 to define sediment sources, management practices and priority areas. More than a dozen entities (public, private, local, state and federal) are consistent investors and participants in the CRM projects. The project has developed a comprehensive method of assessing sediment and erosion sources in the EBNFFR. The objective of developing a comprehensive approach to erosion CONTROL, on the other hand, is an objective that only time and effort will prove to be met or unmet.

Organizationally, the CRM structure has proven to be a useful tool in restoring stream functions. The interdisciplinary and interagency melding of resources that is the CRM framework has successfully carried out a series of riparian improvement projects that have received international acclaim. The unforeseen by-products of CRM:

* stream monitoring curricula and vocational training at the local junior college and high schools,
* a new privately-owned, native plants nursery, featuring high altitude re-vegetation stock and
* training for local contractors in geomorphic stream restoration techniques,

have helped to educate CRM participants and observers on the synergy involved in a comprehensive watershed approach. The geomorphic discipline of mimicking nature and "thinking like a stream" has forced the CRM members to use their combined skills to arrive at designs or management approaches that are innovative yet duplicative. On the ground solutions, unique to the particular stream reach, have proven to be the only method for arriving at approved and buildable designs and management practices. The CRM's agreed upon conflict resolution mechanism of participant consensus backed by the congruence of specializations has enabled the CRM to increase its project volume and completions during each year of this planning grant. The CRM organizational structure has been modified during this planning process. It now has an unorthodox, non-hierarchical cast that enables projects to proceed, but only after that hand-won consensus has been achieved. This structure has proven difficult for non-CRM participants to understand and time consuming to carry out. The coordinating function, though key, has not yet received or identified long term funding from any participant.

The mechanisms for a comprehensive approach to erosion control in the East Branch North Fork as well as the entire upper Feather are in place but barriers remain.

Impediments to implementation

The major barriers to continuation and expansion of this comprehensive erosion control project on the river include:

*Federal Regulatory Rigidity

The two federal regulatory agencies that permit and set up the monitoring mandates have not yet modified their review processes to expedite CRM projects or soften their monitoring requirements (Army Corps of Engineers and EPA).

*Unfunded Monitoring.

None of the CRM participants has been able to secure a source of steady funding for the ongoing monitoring and maintenance of CRM projects, once built.

*Vagaries of Funding.

No continuing source of funds has been identified by any of the participants. All projects as well as the coordinating functions are limited by often conflicting annual funding cycles and availability.

*Limitations of Geomorphic Approach.

The geomorphic approach is a profound and workable method for defining and analyzing the condition of a stream and predicting its responses to different treatments. The. treatments for riparian and stream improvements contemplated in the geomorphic approach, (primarily meander reconstruction) need to be integrated, through experience, with other, less intrusive and less costly treatments such as re-vegetation, rest and other management options. Some other design modifications are evolving in the standard geomorphic treatments in order to accommodate California's drought regimes.

INTRODUCTION -Scope of the Study

A DISCUSSION OF EROSION AND SEDIMENTATION PROBLEMS IN THE FEATHER RIVER WATERSHED

TASK **9.3.A. 2**
SCOPE OF STUDY

Erosion and sedimentation in the East Branch North Fork Feather River (EBNFFR) are impairing fisheries, water based recreation, aesthetics, water diversions for domestic and irrigation uses, downstream hydroelectric and State Water Project users. The Last Chance Creek subwatershed is estimated to contribute 9.5 percent of total sediments in the EBNFFR and the Spanish Creek subwatershed is contributing 20.3 percent of total sediments to the EBNFFR according to the 1988 SCS Erosion Inventory study. Declining water quality and eroding stream banks are desertifying meadows, lowering property values and reducing the productivity of Plumas County's agricultural, hydroelectric, and recreational economic base.

This study has assessed and evaluated existing pollution sources in the Last Chance and Spanish Creeks. Study results have been used to develop geomorphic structural and vegetative erosion control measures for project sites in each of these sub-watersheds.

The specific objectives of this study were largely met. A coordinated and comprehensive approach to sediment and erosion assessment and control in the EBNFFR has not been finalized but has moved forward via incorporation of the geomorphic approach into problem assessments and prioriti-zation procedures.

Existing sediment sources and existing erosion control management practices in the Spanish and Last Chance Creek subwatersheds have been inventoried using geomorphic stream type response units and prioritized using geomorphic and other indicators of stream riparian conditions, trends and restoration potential.

Developing a list of structural and managerial erosion and sediment control treatments for priority areas in the Last Chance and Spanish Creek subwatersheds proved to be an unproductive effort until monitoring data by stream type on current restoration projects is available for a longer period of time. Site-specific designs for at least one priority area in each subwatershed have been developed.

A list of potential funding sources for sediment and erosion control in the EBNFFR was developed for the Greenhorn Creek Project. Contracts with grantors were implemented during 1991 and Spring 1992. The final implementation report for the Greenhorn Creek Project and the implementation plan for road closures and modifications in the Clarks Creek Watershed for the "Clarks 2000" project was submitted 3/92.

BACKGROUND INFORMATION ON THE OVERALL STUDY APPROACH AND TECHNIQUES TASK **9.3A.2**

The EBNFFR Coordinated Resources Management (CRM) group's approach followed the Soil Conservation Service (SCS), 1987-88.EROSION INVENTORY STUDY on EBNFFR:

The approach has been;

(1) to implement cooperative demonstrations of innovations in erosion control techniques;

2) to undertake cooperatively funded comprehensive studies of erosion sedimentation causes and other water quality problems in the highest priority areas.

This two part approach of contemporaneous studies and monitored demonstration projects has generated the requisite knowledge, commitment and political will at the local and landowner level for the on-going water quality and quantity enhancement program to be successful over the past seven years.

Prior to the 205 (J) (2) study there was no way to systematically link monitoring results from demonstration projects to erosion study results. The 205(J)(2) funded studies have helped the EBNFFR CRM group link monitoring of scattered individual erosion control projects with comprehensive subwatershed studies by using the geomorphic stream classification system. The CRM group can now begin to organize and evaluate the information being generated from studies and project monitoring into useful categories (stream types) and useful parameters (e.g., the effects of treatments on stream patterns and functions, condition and various trends by stream type).

The geomorphic approach is providing to CRM & needed context for asking questions, for organizing information and for debating cause and effect Culmative Watershed Effects (CWE) relationships. The geomorphic approach has not as of yet provided any easy answers for CWE problems. Using a common language and stream type and a common design goal (mimicking nature) has in some ways intensified debate among the varied disciplines and philosophical perspectives represented in the CRM group. The geomorphic approach's insistence on understanding and mimicking nature instead of simplifying and controlling nature has in the short run posed more questions than answers. By indicating potential relationships between the numerous stream type parameters without specifying the exact nature of those relationships, the geomorphic approach has opened a Pandora's Box of multiple causes and effects to consider or ignore. Intense debate has ensued about the relative tolerances of parameters and the relative dominance of parameters, etc. It has been questioned whether the geomorphic approach will ever be capable of resolving the debate about CWE cause and effect relationships for different geomorphic stream types; no matter how much monitoring data is collected or no matter how much experience is gained.

The 205 (J) (2) study has provided the opportunity to add a geomorphic option to the CRM decision making process for: (1) predicting erosion and sedimentation rates (2) predicting condition and trend of beneficial water uses.

At the local level, if the needed funding is maintained, monitoring of five EBNFFR geomorphic projects will continue for eight years. Eight years of monitoring data can then be compared to the pre-project geomorphic soil loss calculations using the Standard Rural Soil Loss Equation data (RSLE) and the stream bank lateral recession rates data (LRR) for the project areas. Hopefully the current incongruence between geomorphic erosion and sedimentation predictions and the RSLE and the LRR rates can be resolved to an acceptable range of congruity. Hopefully stream parameter relationships can be specified and relative dominance and tolerances between parameters will become established through direct measurement and monitoring of geomorphic stream restoration projects.

STUDY RESULTS TASKS 9.3.3 - 9.3.5

The attached report, "Channel Condition & Survey" (Clifton, U.S.F.S., July 1992) is an update of previous reports on Spanish Creek and Last Chance Creek under this 205(J)(2) study.

The Clifton report contains:

(1) a discussion of data collection and/or sampling methods and rationale for applying those methods, discussion and evaluation of any field data which was collected, and interpretation of collected data for each appropriate section of the report (TASK **9.3.3)** and

(2) a discussion of the development and use of any evaluation and/or ranking criteria for selection and decision-making processes for each appropriate section of the report. Specific references are found as follows: (TASK 9.3.4)

ROADS, SKIP TRAILS AND LANDINGS

Introduction and Problem Definition and Assessment

(P.17)
TASK 9.2a

Data Collection Procedures
(P. 23)
TASK 9.3a

Ranking Criteria
(P. 27)
TASK 9.4a

EVALUATION OF THE GEOMORPHIC APPROACH

by Leah Wills and John Sheehan

October 27, 1992
TASK **9.2**

INTRODUCTION

The Geomorphic Approach is a method for typing streams, analyzing their condition and prescribing treatments, primarily structural, designed to improve the stream's "competence" or ability to transport bedload sediment at all flow stages. The geomorphic approach was pioneered by David Rosgen, a former Forest Service Hydrologist from Colorado. The approach is continuing to evolve as it is practiced at various places. Rosgen has served as an advisor to the EBNFFR CRM since 1988.

The stream classification system takes a more comprehensive view of the peculiarities of a particular stream reach. Each stream reach can be given a classification (e.g. "F-4 trending to C-4") which incorporates the following factors:

* width/depth ratio * confinement * slope

* sinuosity * bank and bed particle size and type

A stream reach's present classification (e.g. F-4) and a designed classification (E.G. C-4) can be determined by a blending of present day and historical aerial/topographic mapping with in-depth field surveys. The geomorphic "language" enables EBNFFR CRM participants, who have received training in the methodology, to effectively communicate in an understandable shorthand. This improves problem definition and trend analyses as well as limiting the universe of possible treatments. The attached "Stream Class and Channel Condition..." report by Clay Clifton of the Plumas National Forest shows how two major watersheds have been defined, using the geomorphic approach, as part of this 205 (J) (2) study'

The companion geomorphic construction methods have concentrated on restoring the naturally prescribed, competent stream system. The breakdown of meander type systems is a primary cause of ongoing erosion in mountain streams. These meanders properly make use of the flood plain in high flows to reduce erosive energy while providing sufficient energy to transport bedload in the "bankfull" meandering channel. They also provide a narrow, deep channel for low flows. The prime techniques of the geomorphic meander reconstruction method include:

* Focus sing low flow stream courses through the embedding of large "vortex" rock structures in the stream bed. Flows are focused to the center of riffle reaches and constructed revetments at the outside curve of the meander.

* Revetment construction using natural materials such as root wads, logs and boulders.
* Re-vegetation of the floodplains and revetments with native grasses, sedges and trees.
* Reconstruction of "step/riffle" or "step/pool" sequences as energy dissipators.

This construction method has been used on Greenhorn Creek in the Spanish Creek Watershed in 1991, Wolf Creek I in 1990, and Wolf Creek II and III projects in summer 1992. These are major projects with over a dozen investors and costing over $500,000 each. The construction method is intrusive on the stream and costly.

The unusual flow regime from 1989-92 has delayed the evaluation of the geomorphic approach's usefulness for predicting sediment transport and stream stability under different flow regimes until a more "normal" pattern weather resumes. However, I - 5 year flows have occurred and allowed visual observation of scour and deposition patterns, consistent with predictions. Baseline and post project monitoring of five geomorphic erosion control projects is under way in the watershed. Monitoring results will document the channel responses to the next eight years • flow regimes.

During the 205J study period the geomorphic approach has been used to accomplish the following study tasks:

(1) Documenting and prioritizing erosion and sedimentation problems in the Last Chance Creek and Spanish Creek watersheds (Task 9.3 Draft Final Report).

(2) Designing the geomorphic erosion control and trout .1m 06 enhancement project on Greenhorn Creek. (Task 7.4) in the Spanish Creek Watershed (SCW).

(3) Conceptualizing the geomorphic erosion control and ground water recharge - wetland restoration for Big Flat in the Last Chance Creek Watershed (LCCW) (Task 6.6).

(4) Conceptualizing the ecosystem management planning for the Clarks 2000 Stewardship Project in the LCCW (Task 7.4).

(5) Predicting soil loss potential to justify PG&E's contribution to the Greenhorn Creek and Wolf Creek I, II and III Projects in terms of avoided dredging costs (Task 7.2).

(6) Predicting erosion trends using stream types in the LCCW and SCW (Task 9.3 - Clifton).

(7) Predicting rehabilitation potential by stream type (Task 9.3 - Clifton).

(8) Comparing possible treatments and management practices.
(Please see the five alternatives in the Draft Environmental Assessment for the Big Flat Restoration Project (See June 30th Quarterly Report). See also the Army Corps 404 Permit for the Greenhorn Creek Trout Enhancement Project (Task i . 5.3).

OVER ALL EVALUATION

During the 205J grant period, the geomorphic approach has affected all phases of the CRM decision making and implementation processes.

GENERAL POLICY IMPLICATIONS:

The CRM is evolving toward controlling erosion and sedimentation by using natural healing processes and active restoration when necessary.

The CRM is evolving a geomorphic restoration policy of mimicking natural stream function and succession in erosion control designs to address all Cumulative Watershed Effects (CWE) issues including loss of bio-diversity.

As C. Clifton points out in his attached Report, Bio-diversity in California is related to the culmative degradation or loss of riparian and wetland habitat from erosion, sedimentation and other ecosystem conversions such as urbanization and catastrophic wild fires. "A significant number of wildlife species are found only in riparian habitats. Twenty-five percent of California's mammals, 80 percent of amphibians, and 40 percent of reptiles are limited to or dependent upon riparian areas, and more than 135 species of California birds depend on or prefer riparian habitats, (Sorenson 1989); not to mention the numerous plant and insect species that live and die in and around streams."

The use of the geomorphic philosophy of mimicking nature has encouraged the CRM towards involvement with the CWE of the White Fir invasion of naturally fire resistant pine and true fir dominated forest stands. CWEs include: (1) snow pack evaporation (2) groundwater depletion (3) wild fire caused mass wasting of burned slopes and liquefaction of soils into water courses. (4) catastrophic wild fire's effect on the local timber resource, the forest economy and on spotted owl habitat.

GENERAL PLANNING IMPLICATIONS

The Geomorphic Stream Classification System has been used by the CRM as a framework for project level bio-assays and impact analyses such as fish habitat inventories, stream condition surveys, aquatic and riparian plant and animal inventories as well as soil and vegetation potential studies. Stream type segments in a study or project area are used to break bio-assay areas into sampling units having comparable (stream type) characteristics.

On the watershed planning level, organizing restoration planning around stream and landscape types provides a more neutral context for balancing diverse environmental needs and economic opportunities. The geomorphic philosophy of mimicking nature offers planners maximum management flexibility with maximum accountability, when monitoring progress towards the shared landscape goal is fully integrated into project development. The geomorphic planning focuses more on eco-system response (function, stability, diversity, succession) and less on the management or restoration tools used. Innovative designs and management are encouraged, resulting in more opportunities for sustainable economic and environmental balance.

The geomorphic stream classification system indicates thresholds and tolerance ranges for different stream characterizations. These include width/depth ratios, pool/riffle ratios, meander length and meander amplitude ratios. A stream type shift is always a significant (positive or negative) impact depending on the stream types involved.

GENERAL DESIGN AND IMPLEMENTATION IMPLICATIONS

Although the geomorphic approach has structured and focused CRM policy and planning efforts, it has complicated CRM design and implementation efforts.

Structural, functional or successional relationships between riparian and wetlands, aquatic eco-systems, stream channel stability and culmative watershed effects are not well enough understood to encourage consensus on geomorphic design and implementation. As more parameters are integrated into the geomorphic design concept, more conflicts occur among specialists about their relative importance and impact on other design parameters.

Absent a CRM type, inter-disciplinary team approach and commitment to cooperative resolution of design issues, specialists tend to over simplify or distort design parameter assessments to conform with the conventional thinking of their discipline. It is ironic that the geomorphic approach is gaining statewide credibility in the restoration movement at the same time that struggles between professionals are intensifying over control of restoration design and implementation on the state level. The CRM decision making process seems critically important to using the geomorphic approach correctly. Boxing ecological restorations into a hierarchy of licensed specialists in order to guarantee quality control for restoration designs may backfire. Quality control in geomorphic design depends on specialist synergy. Correctly designing how to "think like a river" is unlikely to occur in a hierarchical decision making setting.

The geomorphic approach (at this early stage) relies on monitoring feedback to a greater extent than more conventional erosion control technology. However, the current i -expensive and long term monitoring requirements (by regulatory agencies in the Army Corps 404 process) penalize innovation. The current process penalizes restorationists by in effect, making them fund mitigation research. The current regulatory approach to monitoring restoration projects is to require long term (10 yrs.) and expensive monitoring. The few grantors who fund monitoring will not do so over a 10 year period. Money for monitoring is thereby diverted from the scarce restoration funds. The CRM recognizes that the good intentions on the part of restorationists do not in themselves guarantee good restoration work. Restoration innovation should result in cost effective mitigation strategies if documented well enough through comprehensive long term monitoring.

The current monitoring requirements are discouraging cooperative and innovative comprehensive solutions to CWE problems on private lands. Using required monitoring of restoration projects to generate information for more regulation could backfire politically. Ironically, groups like EBNFFR CRM want to monitor and want to know if their treatments are working. Successful and documented strategies will be shared and disseminated quickly through the growing network of conferences and professional/trade organizations.

A more reasonable approach to achieving documentation and accountability for restoration work that is innovative and that has significant mitigation potential, is to make unused pollution fines and abatement funds available for monitoring of cooperative, CWE solutions.

SPECIFIC EVALUATION CRITERION
ACCEPTANCE

Public Acceptance in the vicinity of the four geomorphic erosion control projects completed or to be completed by 12/92 (Wolf Creek I, II and III and Greenhorn Creek 1) has been high. A major part of the popularity of these projects has been due to the excellent work by the local construction firms and the high school student monitoring crews. Other acceptance factors include the positive aesthetic qualities of geomorphic erosion control designs, the dramatic construction events, the immediate clarity of the water and channel bottom, the development of user friendly flood plains for recreation, managed grazing and wildlife habitat as well as good uses of local labor and local materials. Public concerns about the rate of log decay and the flood worthiness of the revestment will have to be addressed by long term monitoring that is currently unfunded.

Professional Acceptance (within the CRM) of the geomorphic meander and floodplain restorations has been mixed, ranging from skepticism to enthusiastic endorsement. At the skeptical end of the spectrum, the feeling is that geomorphic reconstruction is a 1990 *s version of "the boys and their toys in the creek" mentality with a lot of fanfare about complicated data collection and design procedures which are of questionable value except for justifying such extensive intervention in a creek. Rest, re-vegetation and better management would, according to some internal critics, achieve the same result with less disturbance and less risk of failure over a longer period of time.

EBNFFR CRM professionals involved with the geomorphic meander restoration projects are concerned about the following issues:

(1) The Low Flow Channel configuration, particularly its width,

(2) The Trade Off between the promised quick and lasting environmental recovery vs. the massive disturbance associated with this technique,

(3) Construction quality control is seen as essential because of the unusually low tolerances associated with the design specifications. For example: Log and rock revetment construction and the vortex rock gradient control placements are no tolerance activities. The CRM strongly recommends that 404 permits for these kinds of restoration, include a requirement of apprenticeship with trained equipment operators, construction monitors and inspectors prior to initiating these kinds of projects. A professional degree, license or years of experience in other kinds of restoration or engineering construction work cannot substitute for on-site geomorphic training.

EASE OF USE

The concept of mimicking nature is easy to grasp but hard to implement. Some CRM members, recognizing that the geomorphic approach is science and the art of "thinking like a river", support rest and monitoring as the best geomorphic restoration design. Most CRM members support rest and monitoring incombination with other restoration techniques. The CRM's principle of "congruence of data using multiple assessment techniques" should be applied to all geomorphic design efforts, including rest and monitoring. The CRM group is actively seeking ways to finance long term rest and monitor options for riparian/wetland land owners. Long term "water bank" leases with land owners for low/or non-use, as well as selected restoration management strategies may be the most cost effective, low risk geomorphic strategy for most areas in a river system. In cases where stream courses are too degraded by CWE to heal with non-use alone, the natural tendencies of the river will be more evident in a rest prescription and how to mimic nature will be clearer with some level of rest and monitoring. Since 1986, the long California drought has simulated an intensive rest program because flood flows have been insufficient to scour degraded stream channels and the new post '86 vegetation. The riparian and channel responses have been dramatic and will be incorporated into the upcoming PL566 Indian Creek geomorphic restoration project in Genesee and Indian Valleys (6 miles).

The CRM ID team's consensus design and implementation approach is another safeguard against mis-reading the landscape. Misreading the landscape is the other significant vulnerability of the geomorphic approach (besides low design and construction tolerances) .

Reading a river or a landscape from the perspectives of as many sciences and multiple resource users as possible may prevent a specialist blindness from distorting real tendencies and processes in ecosystems and stream systems. Again the CRM rule of congruence between multiple data sets and multiple scientific and on the ground user perspectives is very important for the complex task of mimicking nature.

Monitoring for milestones or indicators of geomorphic river or ecosystem stability is also the other critical component of "thinking like a river and/or an ecosystem" (besides specialist synergy). Geomorphic stream monitoring detects stream bank collapse, formation of central channel bars, elongating and unstable side channel bars, increasing bankful channel width/depth ratios, and decreasing pool/riffle ratios. These all mandate investigations of changing hydrographs, sediment yields, downstream gradient controls, streamside vegetation, management, etc.

As indicated earlier the student monitoring programs on Wolf and Greenhorn Creeks are unfunded after 1992, but two years of monitoring have already generated the following design modification recommendations:

(1) Adjust the low flow channel configuration for the summer drought climate of California using the following methods:

(a) adjust vortex rock structures to minimize splitting of summer flows,

(b) install "V" shape riffles to preserve needed cross-sectional area but minimize low flow surface area,

(c) modify the flood plain design to round noses of flood plain bars and revegetate bars heavily immediately after construction to maintain channel confinement. Hold the channel against the vortex and log revetments in order to enhance pool scour, summer shade, and flood flow energy dissipation. To recruit enough flood plain and construction material (especially in gravel mined areas) it may be necessary to dig shallow ponds back against the terrace banks and away from the active channel on flood plain bar areas,

(d) suction dredge or hand clean pools after equipment channel shaping and revetment back filling is complete but before the suspended sediment control dams are removed. California rain or snow flushing flows may not act like the 30 plus days of Colorado snow melt in flushing out pools under the log rootwad revetments which provide summer habitat for cold water fish species.

(2) Emphasize re-vegetation, bio-technical vegetation and state of the art vegetation management techniques over log and rock revetment when possible.

(3) Monitor to understand the local riparian and wetland succes-sion patterns and CWE disturbance responses.

Use monitoring results to understand the flood shear stress thresholds for different riparian and wetland species at different ages and succession stages.

COST EFFECTIVENESS AND FUNDABILITY OF GEOMORPHIC: MEANDER DESIGNS

The following agencies and organizations have invested in design and implementation of geomorphic meander and flood plain erosion control projects in the EBNFFR watershed:

USFS Plumas National Forest - in-kind and range and timber improvement funds

DWR - Department of Water Resources - in-kind and urban stream renewal funds

SWRCB - State Water Resources Control Board 319 and 205J funds and in-kind (regional board staff)

PG&E - Pacific Gas & Electric Co. - in-kind, hydro-generation department and research and development department funds.

CDF&FD - California Department of Forestry and Fire Protection -in-kind, CFIP and Forest Stewardship Funds

CDF&G - California Department of Fish & Game - in-kind and W.C.B. funds

SCS - Soil Conservation Service - in-kind. River Basin Planning funds, PL566 funds and AS SCS program funds.

All investors are pleased with the design and implementation process so far. But they are adopting a wait and see attitude until the monitoring (now unfunded) is in place long enough to generate adequate quantitive information to evaluate the design and construction re-vegetation and management techniques used in the Wolf creek I, II & III projects, the Greenhorn Creek I project as well as the upcoming Genesee Valley/Indian Creek and Big Flat projects.

Please see -the previous section for qualitative concerns. In the interim, if or until meaningful monitoring data becomes available investors have accepted the geomorphic projects as cost competitive with alternative solutions like conventional cement channels or rip-rap and channelization treatments.

Grantors CDF&FP, DWR, CAL-TRANS, SWQCB and SCS are interested in the geomorphic demonstration aspects and transferability of the designs to other areas or problems (including mitigation).

The CRM is slowly evolving its own criterion for cost effectiveness. This involves ranking projects in terms of: (1) innovation potential (2) in-kind contribution potential and, (3) potential for cooperative multiple CWE problem solving. This is counter to the cost competitiveness of each investor's "stand alone" alternatives .

The relative costs of geomorphic construction can best be seen in a review of the costs incurred as part of the Greenhorn I project. Greenhorn Creek I was the implementation project spurred by the 205(j) (2) study within the Spanish Creek watershed. It was constructed during the late summer of 1991 and revegetation work was accomplished in the Spring of 1992. The costs given below are strictly labor, materials, supervision and design costs on the project. The parties involved incurred additional in-kind staff costs of approximately $63,600 for the monitoring plans and program, grazing management plan, fish habitat survey, archeolog-ical survey, other NEPA/CEQA work and CRM training, etc.

GREENHORN CREEK I
Construction Costs: Total $353,050

Source of Funds	Use of Funds	Amount $
CA Wildlife Conservation Bd.	Meanders & Revegetation	$150,000
Land Owners	Fencing, Defer. Grazing	10,000*
Local Developer	Root Wads Donation	70,000*
CA Dept. Forest: CFIP	Transp. Rocks/Logs	35,550
U.S. AS SCS (via SCS)	Fencing Materials	3,500
P.G.&E.	Construction Match	40,000
CASWRCB: 205(j)(2)	Design	10,000
U.S. Forest Serv.: PNF	Rocks and Logs	34,000*

*Estimated Value

2600 L.F.: Labor & Materials

The unit cost, per lineal foot, is $136. Cal-Trans recently provided the CRM with a labor and materials cost estimate of $100 per lineal foot for rip-rap, which is a common flood control tool. A standard add-on for construction supervision and design is 30% which brings the rip-rap comparable to $130 per L.F. It is critical to note that any cost/benefit analysis of meander reconstruction should incorporate the other beneficial uses that were affected by this CRM project. The entire reach had its 100 yr. flood plain reshaped as part of the project to perform in concert with the restored meanders. Three (3) ponds were constructed for use by the landowners since creek access is severely limited as part of the recorded property Management Agreements. Seventeen (17) acres of fenced riparian corridor wetlands were created within the project area. The management plan calls for monitoring a variety of project area responses during the next three years, while excluding grazing from that riparian corridor. The monitoring responses will then lead to a revisiting of the grazing prohibition which may result in a new management prescription (such as "flash" grazing along with continued response monitoring) over the 25 year term of the management agreement).

Greenhorn Creek is, however, first and foremost, a "trout enhancement" project designed and funded to restore what was formerly a prime trout fishery that has degraded over time. The low flow channel was sized to accomplish the flood and erosion control objectives as well as improving the fishery. Any cost comparison, therefore, must take into account these multiple benefits.

DRAFT RECOMMENDATIONS ON GEOMORPHIC APPROACH

CRM AND GRANTORS SHOULD:

1) Prioritize geomorphic erosion control projects that include a fuels management component (P.L.566 Indian Creek Project in Genesee Valley and the Clarks 2000 Project in the LCCW). [See Verner et al "California Spotted Owl Report" 5/92.]

2) Prioritize integrated bridge and/or road management demonstrations (Clarks 2000 (Road & Bridge), CalTrans Middle Fork Project (Bridge) PL566 Indian Creek Project (Bridge).

3) Pursue unused pollution Cleanup and Abatement funds for monitoring of CWE reduction projects. SWRCB should use innovative CWE restoration solutions for erosion and wetland mitigation statewide.

4) Pursue applying the geomorphic "mimic nature" approach in concrete and measurable ways to ecosystems. This would improve management and restoration for a sustain-able economy and environment.

Overall Implementation Plan

Tasks 8.1 & 8.2

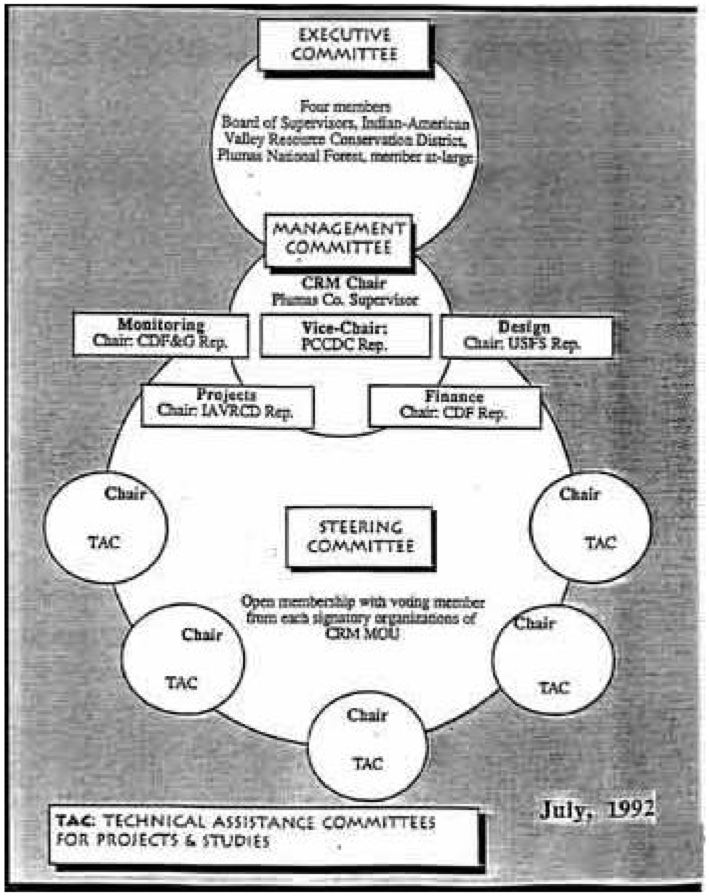
The East Branch North Fork Feather River Coordinated Resource Management program has accomplished a level of watershed wide planning and implementation that has become a model for similar efforts elsewhere. The combining of federal, state and local, public and private, financial and human resources has led to profound improvements in the treated stream reaches within the watershed. Surveys have identified and prioritized all other areas for future treatments. The CRM decision-making mechanism has proven to be inclusive and meaningful to the participants. The CRM implementation plan is to continue these approaches and expand geographically. Most would-be investors (see Grantors and Investors section of this report) have been identified and are currently participating. The investor network should, however, be expanded to include Private Foundations as well as users of the State Water Project, the end users of the Feather River. Enclosed in this section is a CRM project implementation checklist that can be used as a recap and review of each project as well as a record of monitoring on project deliverables (Task 8.2).

<u>Implementation Priorities</u>

The following implementation projects have been approved by the CRM Management Committee and should be undertaken within the next five years within the CRM framework. These projects were prioritized either as part of the 205 (j) (2) study or through other study mechanisms. Years are shown if known. Those projects in the Spanish Creek (SC) or Last Chance Creek (LC) watersheds, are shown with those abbreviations. Projects outside the current boundaries of the EBNFFR CRM, yet within the Feather River Watershed in Plumas County, are asterisked .Those projects primarily on public lands are given. the >< symbol.

Project Name	**Focus**
Wolf Creek II & III	Meander Reconstruction ("92)
Indian Creek: Public Law 566	Meanders and Mgmt.("93-"95)
Walker Mine Tailings ><	Superfund Site ("93-"98)
Clarks 2000 (LC) ><	Roads,Monitor.& Mgmt.("92-"93)
Big Flat Rewatering (LC) ><	Meanders & Mgmt. ("92-"94)
Squaw Queen (LC) ><	Wetland/Wildlife *('92-'* 95)
Cooks Creek Rewatering	Meanders & Mgmt.
Ward Creek Stabilization	Check Dams & Mgmt.
Red Clover II & III ><	Reveg. , struct .& Mgmt. ("92-"95)
Greenhorn Creek II (SC)	Habitat Restoration
Mill Creek I & II (SC)	Flooding
Red Clover I	Management Plan ("93)
Haskins Creek*	Fish Habitat/Checkdams ("93)
North Fork*	Fish Ladders ("93)
Middle Fork @ Mohawk*	Meanders/Bridges ("93-" 95)
Jamison Creek* ><	Restoration ("96)
Dunn Pasture (LC) ><	Revegetation ("92)

These projects should take the remainder of this decade to accomplish .They are dependent upon congressional legislative or voter approved appropriations as well as the financial participation of the private sector .This list of projects will be added to or subtracted from dependent upon the interest of the financial contributors (particularly the property owners) ,the availability of funds and future prioritization by CRM. A current CRM Organizational Chart and a review of grantors/ investors follows.



Grantors and Investors

The CRM group has used a wide variety of funding mechanisms to carry out the various projects and studies accomplished between 1985 and 1992. The CRM is able to draw upon the staff resources of the participant entities, irrespective of land ownership. This staff resource, although the key to EBNFFR CRM success, is not readily quantifiable. Entities that provide mainly critical staff or other volunteer, membership & in-kind support, yet are not primary investors in construction activities, include:

University of California: Cooperative Extension Service,
California State University-Chico U.S. Environmental Protection Agency,
Plumas County,
U.S. Fish and Wildlife Service,
U.S. Army Corps of Engineers,
California National Guard,
California Department of Transportation,
lzaak Walton League,
Feather River Flyfishers,
Friends of Plumas Wilderness,
California Women Flyfishers,
Cal Trout, Ducks Unlimited,
Plumas County Schools,
Feather River College,
Roundhouse Council,
North Cal-Neva Resource Conservation and Development Area,
Indian-American Valley Resource Conservation District,
Greenville Community Services District,
Quincy Community Services District,
Milford Grazing Association,
Sierra Valley Resource Conservation District.
Individual private ranchers and landowners,
California Conservation Corps.
Student Conservation Association

Each project constructed so far has received funding from a wide variety of sources. The projects have ranged in size from *5,000 to $750,000. Plumas Corp's role is to work with investors to secure the necessary resources for pre-project planning, permitting, environmental analysis, construction/revegetation and post project management agreements/monitoring. Each of the following investors has contributed ongoing staff support to CRM as well as financing. Funding time lines, which vary widely, are not shown since the two contemplated projects (in the 205(j)2) have already been designed and implemented. A partial list of ongoing financial investors follows:

Entity	Primary Interest	Type of Funds
Pacific Gas & Electric Co.	Sediment Control above hydro dams	Hydro operating, Research & Devel.
USDA, Forest Service, Plumas National Forest	Cumulative Watershed Effects on public lands	Knutson -Van den berg Timber mitigation, Riparian Initial., road funds,etc.
USDA,Soil Conservation Service	erosion on private grazing lands	watershed protection funds,Public Law 566,River Basin Planning Funds,etc. via ASACS
CA Dep't Forestry & Fire Protection	private forest and range improvements	CA Forest Improve. Program (CFIP), Forest Stewardship Prog ram, etc •
CA Wildlife Conservation Board	trout & wildlife habitat	voted Bond funds, license plate funds, etc. with CA Fish and Game
CA Dep't Fish'& Game	trout & wildlife habitat	Dingell-Johnson funds
Plumas County Fish & Game Commission	wildlife habitat	Receipts from Fines.
Plumas Job Training Center, Inc.	vocational training	U.S. Dep't. of Labor;JTPA funds.
Plumas County Community Devel. Commission	community & econ .devel.	U.S. Dep't of Hsng.& Urban Devel. ;CDBG funds U.S. Dep't. of Health & Human Services:CSBG
CA Regional Water Quality Control Board	cumulative watershed effects	Cleanup and Abatement account
State Water Resource Control Board	non-point source water pollution	Clean Water Act: Sec.319 & *205j2*
CA Dep't of Water Resources	water production & improvements	Urban Streams Program

Feather River Coordinated Resource Management
PROJECT IMPLEMENTATION LIST

Name of Project	
Location: R T Sec Lead Entity	
Landowner Name & Phone	
Agent Name & Phone	
Prime Focus of Project	
Technical Assistance Committee Chair & Phone	
CRM Projects Committee Approval Date:	
CRM Design Plan: Committee Approval Date	
CRM Monitoring Plan: Committee Approval Date:	

Project Financing:		
Source	**Use**	**Amount ($) (%)**
		Total $:

Permits:			
	Date Applied For	**Date Required**	**Date Issued**
404			
1603			
1603			
County			
Landowner Agrmnt			
NEPA Clearance			
CEQA Clearance			

Project Phasing:		
	Begin	**End**
Material Delivery		
Construction		
Revegetation		

Monitoring Frequency:			
	Parameter/Type	**Planned Dates**	**Actual Dates (>l yr.)**

Stream Classification and Channel Condition Survey,
With an Inventory of Sediment Sources From Roads and Stream Crossings

Conducted in The
Last Chance and Spanish Creek Watersheds
Plumas National Forest

SEPTEMBER 1992

FINAL DRAFT

Clay C. Clifton *Watershed Wildlife Biologist* Plumas National Forest

"We must quit looking at just a pool, a riffle, or even a reach, but address the problem as it fits into a complete watershed. How often have we visited a good looking K-Dam, stream deflector, or rock crib to enhance a small reach, only to look around the watershed and see it crumbling down upon us."

W. S. Plaits

TABLE OF CONTENTS

ACKNOWLEDGMENTS

The Author is grateful to many people and several organizations for their generous cooperation in producing this report. The following list are people who were directly responsible for the study. Many others contributed along the way.

Chuck Stury gave guidance, advice, and strong management leadership so necessary in the early days of the project.

Bill Lachenmyer, Range and Watershed Staff Officer, Plumas National Forest, gave the necessary Staff support for the project.

Terry Benoit, Hydrologist, Plumas National Forest, gave technical advice and guidance, and reviewed the many drafts of this report.

Technical Advisory Committee - Roads, Skid Trails and Landings Survey and Inventory; Terry Benolt, Hydrologist; Clay Clifton, Wildlife Biologist; Ozzie Cumnings, East Zone Engineering; Wayne Johannson, Soil Scientist; Gordon Keller, Geotechnical Engineer; Alien King, Geologist; Corky Lazzarino, East Zone Engineering.

Technical Advisory Committee - Stream Classification and Channel Condition Survey; Terry Benoit, Hydrologist; Ken Cawiey, Hydrologist; Denny Churchill, Soil Scientist; Clay Clifton, Wildlife Biologist; Scott Conroy, Range Conservationist; Richard Flint, Regional Fisheries Biologist, Calif. Dept. of Fish and Game; Mike Kossow, Restoration Technician; Ken Roby, Resource Officer; John Sheehan, Executive Director, Plumas County Community Development Commission; Leah Wills, Coordinator for East Branch North Fork Feather River Coordinated Resource Management Watershed Restoration Projects.

Field Crew Leaders;; Mike Kossow; Clay Clifton.

Field Crew; Michelle Eaton; Ethan Casady; Shawn Sutherland; Sarra VanPetten; Vickle Krols; Ellse Faike; Joe Schultz; Rick Colcock; Shawna Monrow.

STREAM CLASSIFICATION AND CHANNEL CONDITION SURVEY WITH AN INVENTORY OF SEDIMENT SOURCES FROM ROADS AND STREAM CROSSINGS

THE LAST CHANCE AND SPANISH CREEK WATERSHEDS

SUMMARY

Of the many streams In the Last Chance and Spanish Watersheds, 78% are unstable and eroding, causing degradation to water quality, fish and wildlife habitats, recreation opportunities, etc. In addition, 35% of the roads are contributing excess runoff and sediment to those streams, creating even greater degradation problems. Much of the degradation occurred as a result of past land uses but continues today, both because of increasing demands, better land use technologies and because constant use binders natural recovery processes. Before 1850, most meadows were wet, supporting a myriad of plant and animal communities. Today these meadows are dry terraces, drained by deeply incised, unstable channels that have established lowered base levels to which the tributary channels are trying to meet. Current management has resulted in improved conditions in some areas, but most riparian and channel areas remain degraded and, in fact, continue to worsen.

To reverse the effects of over 100 years of overgrazing, Improper and numerous' roads, and poor logging techniques, an aggressive and long term effort must be made. Past remediation techniques have, at best, only halted degradation on site. A combination of proper management, site specific restoration and monitoring Is required to successfully remediate current conditions.

Controlling stream channel erosion, sedimentation and streamside land uses Is the first priority in the Last Chance Watershed, followed by road problems. In the Spanish Creek Watershed, road and skid trail problems need immediate attention, followed by streams and meadows crossing problems. Updating Allotment Management Plans Is key to restoring the Last Chance Watershed as Is relocating and obliterating poorly located roads and reducing the number of miles of roads in Decomposed Granite. In the Spanish Creek Watershed, the number of miles of roads and stream crossings need to be reduced. Eroding skid trails need to be stabilized and kept to a minimum. Unstable stream channels need to be stabilized so that natural restoration can occur.

PURPOSE

This report summarizes data and information about the Last Chance and Spanish Creek Watersheds. It meets the needs of the East Branch North Fork Feather River (EBNFFR) Coordinated Resource Management (CRM) data base needed to plan the proper management and restoration of these watersheds. Surveys and Inventories were conducted during the 1989 and 1990 seasons. The Forest Service's Riparian Initiative financed and helped establish guidelines for the 1989 stream/riparian survey. In addition, roads and timber harvest skid trails and landings causing water quality and riparian damage were Inventoried and integrated into the total program. This phase was financed through the Federal Facilities program, using funds appropriated through the Clean Water Act. The EBNFFR CRM finance committee sought and received additional funding for the program from the California State Water Resources Control Board Public Law 319. Section (j), grant program.

Participation in the EBNFFR CRM and the Forest's efforts to restore degraded watershed conditions complies with the Goals and Standards and Guidelines in the Plumas national Forest Land and Resource Management Plan (Plumas Plan) for riparian, water, soil, range, fish and wildlife, facilities, and timber.

Above all, the work described in this report meets the requirements and stewardship goals for which the Plumas National Forest was established.

OVERVIEW OF THE WATERSHED RESTORATION PROGRAM

The restoration program as it applies to the North Fork Feather River watersheds, including Last Chance and Spanish Creek, is herein briefly described.

Through the Coordinated Resource Management and Planning (CRMP) process, the goals of sediment reduction and watershed restoration are to be accomplished through four general steps:

1. Identify Major Problems and Problem Areas. Using known information and field verification, estimate sediment volumes from delineated watershed areas by source. Rank the delineated watersheds by order of sediment contribution to a downstream location.

2. Investigate Watersheds on a Priority Basis. Develop a data base of stream types and conditions, road related water quality problems, mining and other sediment source areas. Rank potential project areas or project subwatersheds.

3. Develop Restoration Plans on a Priority Basis for Project Areas or Project Subwatersheds. Conduct field evaluations, develop specific objectives, perform necessary environmental planning, obtain permits, and develop plans and designs.

4. Implement and Monitor. Planning to include monitoring for compliance with permits, project successes and maintenance needs.

THE LAST CHANCE WATERSHED

Watershed Description. The Last Chance Watershed drains an area of 197.2 square miles (126,177 acres). The watershed was subdivided into 10 sub-watersheds, ranging In size from 10 to 35 square miles (see Appendix E, CRM WATERSHED AND SUBWATERSHED MAP). Each sub-watershed was further subdivided into "response units," contiguous areas in which watershed responses are expected to be similar, based on Dave Rosgen's Stream Classification System stream types "A," "B," and "C" (Rosgen, 1985) (see Appendix E, EXAMPLE SUBWATERSHED RESPONSE UNIT DELINEATION, FITCH CANYON). There are a total of 137 response units in the Last Chance Watershed.

Along with Red Clover and Upper Indian Creek Watersheds, the Last Chance Watershed forms the headwater drainage's for the Indian Creek Watershed. Indian Creek and Spanish Creek form the East Branch North Fork Feather River at their confluence (see the Location Map, next page). Indian Creek flows through two large, agricultural valleys, Genesee and Indian Valleys.

Water from the East Branch North Fork Feather River makes up approximately 35%-of the flow In the North Fork Feather River, a major hydroelectric production corridor, and approximately 21% of the water flowing Into Lake Oroville, the major water storage reservoir In California's water storage and distribution system. Water from the Last Chance Watershed makes up approximately 9% of the flow In the EBNFFR and contributes approximately 14% of the sediment (SCS, 1989).

Within the Last Chance Watershed Itself, the two primary land uses are livestock grazing and timber harvesting. Of significant Importance to the watershed are Its fish, wildlife, plants (some rare), and aesthetic appeal. Host of these values are centered around the watershed's perennial streams, meadows, springs, and seeps.


Watershed Map
East Branch North Fork
Feather River
PG&E
Mountain Meadows
Reservoir
Lake
Almanor
Butt
Valley
Reservoir
North
Fork
Feather
River
Wolf Cr.
Lights
Cr.
Antelope
Valley
Reservoir
Last
Chance Cr.
Indian Cr.
Clover Cr.
Spanish Cr.
East Branch
North Fork
Feather
River
90-1-30

Climate and Hydrology. Precipitation falls primarily as snow, but summer thunder storms frequently occur, sometimes very severe. The average annual precipitation varies from 18 to 30 inches, yielding from 2 to 8 Inches of runoff. The Last Chance Watershed is in the rainshadow of the Sierra Nevada Crest. This results in a great range of daily and seasonal temperatures, lower precipitation amounts, a greater contribution to total precipitation from summer thunderstorms, and lower humidity. Most of the precipitation Is from winter frontal disturbances enhanced by orographic uplift as storm systems move into the area from the Pacific (Harris, 1981).

Over 50% of the annual precipitation falls during December, January and February. Summer months receive less than 1% of the annual amount, resulting in low natural runoff rates for the watershed during the late summer and early fall months. Surface runoff depends upon the snowmelt regime, which normally extends into late spring and early summer and sustained base flow from recharged ground water aquifers.

This means that wet meadows and perennial flow are very important for many of the watershed's resources, especially during the dry season, which can last from June through November, 6 months.

A 1987 survey of conditions throughout the Last Chance Watershed found evidence that upland areas are contributing to increased runoff. First, upland areas have been heavily impacted by poorly placed and engineered roads and actively eroding logging trails and landings (see Section 1, INVENTORY OF ROADS, SKID TRAILS AND LANDINGS CAUSING WATER QUALITY AND RIPARIAN AREA DEGRADATION and section 2, INVENTORY OF STREAM AND MEADOW CROSSINGS CAUSING WATER QUALITY AND RIPARIAN AREA DEGRADATION). Many slope areas are actively eroding, as indicated by rills, gullys, pedestals and erosion pavements (Benoit, 1987)' Second, all stercaa orders are showing the direct effect of these impacts. The upper most channels have been used as skid roads and are eroding or accumulating large amounts of sediment. Almost all alluvial valleys now concentrate runoff in gullys instead of spreading water over valley bottoms. Most of these gullys are developing diminished sinuosity and higher gradients (see Section 3, STREAM CLASSIFICATION AND CHANNEL CONDITION SURVEY).

Physiography, Geology and Soils. The 197 square mile drainage area of the Last Chance Watershed contains gentle to moderately steep slopes surrounding nearly level, alluvial valleys. Every major tributary stream, and many of their tributaries, contain alluvial meadows (stringer meadows), that have historically served as annual floodplains. Some of these alluvial meadows extend from mouth to watershed head.

Twenty seven percent (27%) of the watershed ia highly erodible or unstable, primarily due to the decomposing granitic parent material found in the western portion of the watershed. Most of the remainder of the watershed is composed of volcanic breccia parent material, forming moderately erodible soils. Rock outcrops and cobbly soils are common. Elevations vary from 3800 feet at the mouth of Last Chance Creek to over 7700 feet at Thompson Peak. The average elevation is approximately 5500 feet. The northeastern boundary of the watershed is the top of the Honey Lake Escarpment and the beginning of the Basin-and-Range Province.

The primary forces forming the extensive alluvial valleys and meadow systems are a relatively dry climate, low average runoff, active uplifting, erosion, and the ability of riparian vegetation and one particularly significant mammal to trap and hold sediment. The beaver is a "keystone species," upon which entire plant and animal communities have historically come to depend and upon which the competence of the fragile, alluvial valleys also depend (Authors' conclusion from field observations and consultation with other scientists. As of this writing, a 1500 year old beaver dam was located and carbon dated in Red Clover Valley, a large valley adjacent to and southwest of the study watershed).

The soils that make up the many meadows are characterized by sandy loam and loamy sand, with weak, very fine granular structure. They are friable, nonsticky and nonplastic (Churchill, 1988). In effect, without plant roots to hold them together, they are easily washed away. An estimated 6 to 12 inches,' or more, of top soil has been lost from many meadow and upland areas. Large, numerous gullys have formed in almost every meadow, with some 100 to 300 feet wide and 8 to 20 feet deep, running the full length of the valleys. Headwater meadows are plagued by numerous, discontinuous gully systems (Benoit, 1987).

Vegetation. The Last Chance watershed is characterized as a mixture of the Yellow Pine and Jeffrey Pine belts of the Northern Sierra Nevada east of the Sierra Crest. This area contains open, broad meadows .in the valley bottoms with mixed east side pine on the slopes. Dominant species include, Jeffery pine, ponderosa pine, white fir, Douglas fir, incense cedar, lodgepole pine, aspen, mountain mahogany, Sierra Juniper, sagebrush, rabbibbrush, and bibberbrush (Munz and Keck, 1965., Storer and Usinger, 1963).

Riparian Areas. The riparian area definition can be found in the Glossary. Basically, riparian areas are composed of both the stream (aquatic ecosystem) and its adjacent lands (riparian ecosystem). Riparian areas also include lakes, ponds, marshes, and spring and seep areas. The recently approved Plumas Plan clearly spells out that management of these areas must favor riparian dependent resources when conflicts arise. These resources include water (its flow conditions and quality), fish, aquatic insects, most wildlife species, riparian plants, and riparian aesthetics.

There are many demands placed on riparian areas. Many of these demands are competing and often incompatible. Current management strategies will need to change on both public and private lands in order to restore and enhance riparian and stream conditions, and to realize the many benefits of healthy ecosystems, both on and off site.

Host riparian areas in the Last Chance Watershed are associated with perennial and intermittent streams, although there are many springs and seeps in the watershed. These riparian areas vary from long, narrow, "stringer" meadows, to large "pastures". These large meadows are associated with "C" type channels in the Rosgen Stream Classification System, while the stringer meadows are usually associated with "B" type channels. Many headwater meadows also exist and many of these are associated with the steeper "A" type channels. They each react differently to runoff events and land use impacts, but are similar because past practices have destabilized them and current impacts keep them in a degraded condition.

THE SPANISH CREEK WATERSHED

Watershed Description. The Spanish Creek Watershed drains an area of 196.5 square miles (125,780 acres). The watershed was subdivided into eight subwatersheds, ranging in size from 9 to 36 square miles (see Appendix E, CRM WATERSHED AND SUBWATERSHEDS). Each sub-watershed was further subdivided into "response units," contiguous areas in which watershed responses are expected to be similar, based on Dave Rosgen's Stream Classification System stream types "A," "B," and "C" (Rosgen, 1985) There are a total of 92 response units in the Spanish Creek Watershed.

The Spanish Creek Watershed is drained by Greenhorn Creek from the east and Spanish Creek from the west. Their confluence is at the mouth of American Valley. Spanish Creek joins with Indian Creek to form the East Branch North Fork Feather River. Three small valleys with minor agricultural and urban uses can be found within the watershed. These are Meadow Valley, American Valley (where Quincy is located), and Thompson Valley (contiguous with American Valley).

Water from the East Branch North Fork Feather River makes up approximately 35% of the flow in the North Fork Feather River, a major hydroelectric production corridor, and approximately 21^ of the water flowing into Lake Oroville, the major water storage reservoir in California's water storage and distribution system. Water from the Spanish Creek Watershed makes up approximately 30% of the flow in the EBNFFR and contributes approximately 21% of the sediment (SCS, 1989).

Within the Spanish Creek Watershed, the primary land use is timber harvesting. Of significant importance to the watershed are its fish, wildlife, plants, and aesthetics. Most of these values are centered around the watershed's perennial streams, meadows, springs, and lakes

Climate and Hydrology. Precipitation fails primarily as snow above 6000 feet and a mixture of snow and rain below that elevation. Summer thunder storms occur, but not as frequent or as severe as in the Last Chance Watershed. The average annual precipitation varies from 35 to 90 inches, yielding from 16 to 65 inches of runoff. The Spanish Creek Watershed is on the eastside of the Sierra Nevada Crest and the beginning of its rain shadow. This results in a lowered precipitation amounts, with some contribution to total precipitation from summer thunderstorms. Most of the precipitation Is from winter frontal disturbances enhanced by orographic uplift as storm systems move into the area from the Pacific (Harris, 1981).

Approximately 54% of the annual precipitation falls during December, January and February. Summer months receive approximately 3X of the annual amount, resulting in low natural runoff rates for the watershed during the late summer and early fall months. Surface runoff depends upon the snow melt regime, which normally extends into late spring and early summer and sustained base flow from recharged ground water aquifers.

This means that wet meadows and perennial flow are very important for many of the watershed's resources, especially during the dry season, which can last from June through November, 6 months.

Physiography, Geology and Soils. The 196.5 square mile drainage area is comprised of mostly moderately steep to steep slopes and very little area as alluvial valleys. The major streams flow into the alluvial valleys, then back into the confinement of the steep slopes. The alluvial valleys have historically served as annual floodplains, but now their channels are deeply incised, confining flows similar to most of the watershed areas.

Twenty six percent (26%) of the watershed is highly erodible or unstable, primarily due to numerous steep and oversteepened slopes found throughout the watershed. The watershed is composed of volcanic, metavolcanic and metasedimentary rock with intrusions of serpentine, basalt and some volcanic mudflows. Lake sediments and glacial deposits are also common. Soils are moderately erodible on north facing slopes and highly erodible on south facing slopes. Rock outcrops and cobbly soils are common. Elevations vary from 3200 feet at the mouth of Spanish Creek to over 7000 feet at Spanish Peak. The average elevation is approximately 5100 feet. The watershed is bounded on the west by the Sierra-Nevada Crest and on the northeast by Grizzly Ridge.

Vegetation. The Spanish Creek watershed Is predominately mixed conifer of the Yellow Pine belt with Red fir above 6000 feet. Dominant species include, ponderosa pine, sugar pine, white fir, Douglas fir, incense cedar, broadleaf maple, black oak, black cottonwood, alder, willow, and ceanothus, with red fir and lodgepole pine at the higher elevations (Munz and Keck, 1965., Storer and Usinger, 1963).

Riparian Areas. Riparian areas are limited to very narrow strips of land and vegetation along most streams, but larger, alluvial meadows can be found throughout the watershed. These meadows act as floodplains, wildlife habitat and livestock pastures. Large meadows are associated with "C" and "F" type channels in the Rosgen Stream Classification System, while the stringer meadows are usually associated with "B" type channels. The few headwater meadows are associated with the steeper "A" type channels. They each react differently to runoff events and land use impacts, but similar degradation patterns are occurring as gullys form major incisions, cause meadow dewatering and changes to riparian plant and animal communities.

PROBLEM DESCRIPTION: A HISTORICAL AND CURRENT PERSPECTIVE

Existing conditions in the Last Chance and Spanish Creek watersheds are a result of four major impacts. These impacts are both historical and current. They are (1) mining, primarily in the Spanish Creek watershed, (2) wildfire, (3) livestock grazing, and (4} timber harvesting and associated roads, skid trails and landings. At least 60% of each watershed has been impacted, resulting in decreased soil productivity, degraded water quality, greatly diminished riparian plant and animal communities, lowered water tables, frequent damaging flood flows, etc. (Benoit, 1987).

1. Mining: The California gold rush began in 1848 with crude mining at Bidwell Bar on the Feather River. Small stream placer mining, working along the stream channels, occurred In 1849 and 1850. The early 1850's saw an increase in the scale of mining with more digging and more concentrated efforts. Companies formed and rivers began to be rechannled so that river beds could be mined. The large, stable bars were heavily excavated and tunnels were dug into the hillsides to access additional gravels.
From the mid to late 1850's, miners expanded into all of the Sierras. The upper reaches of the Feather River, including Spanish Creek, were found to be rich In free gold. Water was diverted into ditches and allowed to wash across the diggings, then back to the streams (booming). This was the precursor of hydraulic mining.
The hydraulic mining of old river deposits found In beds on the slopes above existing streams, began in the late 1850's, spread fast, and was uncontrolled until 1884, when the Sawyer Decision limited hydraulic mining. Most major hydraulic pits stopped.
From 1884 to 1900, most mining turned to drift mining, where the miners followed buried gravels. Some hydraulic mining continued.
Bucket Dredging was developed in the Oroville area in the early 1900's and spread to French Creek, Lights Creek and Meadow Valley. Following World War I mining resumed in earnest at most previously worked mines, resulting, in additional sedimentation of streams and damaged riparian areas (James, ' 1987).

2. Wildfire: Man's effect upon wildfire frequency began with native man around AD 500-1000. Fire was used to create open areas to avoid surprise attacks, reduce unwanted plants, aid sprouting of oak to increase acorn production, and, possibly, to stimulate brush and grass sprouting for deer. Many mountain valleys and canyons were subject to burning (James, 1987).
Destructive wildfires have become a recent phenomenon and are attributed to accumulations of logging slash and natural debris and increased vegetation understory density caused by over 70 years of protection from wildfires. It's not the frequency of wildfires that has changed. It's the intensity that has increased. Because of our suppression efforts, the frequent, low Intensity burns have decreased. These fires had a rejuvenating effect upon upland brush and riparian plants (Personal communication with John Maupin, Fire Management Officer, Plumas rational Forest, November, 1989). These more intense wildfires cause increased upland and instream erosion, degraded riparian areas, and reduced water quality.

3. Livestock Grazing: The California Gold Rush began in 1848 and with it came horse and cattle grazing. Highland meadows were grazed early by horses and cattle. By the 1870s, dairy farms were heavily impacting the meadows of the Last Chance Watershed. Wet meadows were first drained to allow more access by livestock, then again irrigated for hay crops (James, 1987). Any beaver that might have survived the heavy trapping that occurred during the first half of the century were now treated as pests to be exterminated.

The later 1800's and early 1900's saw intensive sheep grazing on the upland areas and high meadows, while intensive cattle grazing was occurring in the large meadows. Overgrazing and severe riparian damage was occurring. Serious erosion probably started about 1900. By 1920 the upland areas were seriously eroding and most of the principal meadows were deeply gullyed (James, 1987; Hughes, 1934).

This historical overgrazing by both sheep and cattle has resulted in six to twelve inches of soil loss on some upland and meadow areas in the Last Chance Watershed (Personal communication with Denny Churchill, Soil Scientist, Plumas National Forest, 1989). Almost every meadow, regardless of size, has been affected. Gullys are in every stage of development. Some are headcutting and downcutting, others are hundreds of feet wide and up to twenty feet deep. Xeric plant species have replaced riparian species on many meadows and little to no stabilizing vegetation remains along most channels. Both riparian and aquatic habitats are badly degraded to nonexistent throughout the watershed (see Section 3, STREAM CLASSIFICATION AND CONDITION SURVEY).

Even though much of the Plumas NF east side was overgrazed and gullying prior to establishment of the National Forest, current grazing management, even with its reduced numbers of livestock, does not allow riparian areas to recover, but keeps them in a degraded state and their condition continues to worsen. Degraded upland areas have improved some under government control, but the riparian areas have shown very little to no improvement at all. This can be attributed to three factors:

(1) Over utilization of vegetation in riparian areas because the lesser used upland forage is averaged with that in the overused riparian areas (meadows) to determine allowable utilization.

(2) Cattle managed under a season-long grazing system concentrate in riparian areas during the hot, dry months.

(3) Poor distribution of livestock allows cattle to seek their naturally favored areas near water and green forage.

Management of livestock grazing within riparian areas must change before restoration can occur. This Is not a new concept. This very idea was first presented In 1934 in the HANDBOOK OF EROSION CONTROL IN MOUNTAIN MEADOWS IN THE CALIFORNIA REGION. The authors' first phase for erosion control Is "Proper range management, which Includes the elimination, or at least a marked restriction of grazing until the meadow has again become stabilized" (Kraebel, 1934). Now, over 50 years later, we are again coming to the *same* conclusions. Along with a significant change in riparian grazing management can come the stabilization of gullies and stream channels, both natural and, where necessary, using direct erosion control techniques.

4. Timber Harvesting and Associated Roads, Skid Trails and Landings: Logging began soon after arrival of the miners, but with little consequence because of the inefficient technology used. By the late 1800s and early 1900s. Steam Donkeys and railroad transportation greatly facilitated logging and clearcutting became the preferred logging technique (James, 1987).

Railroad logging was replaced with tractor logging in the 1950s. This technology allowed loggers to access the steeper grounds. Many intermittent and ephemeral channels were used as skid trails. Landings were also located next to or within these same channels. Skid trails and landings were not given the erosion control measures used today and many are still eroding, 30 to 40 years later.

Old roads were often located next to or within meadows and stream channels. Many of these roads are still in use today and continue to contribute sediment and concentrate runoff to streams and gully systems (see Section 1, INVENTORY OF ROADS, SKID TRAILS AND LANDINGS CAUSING WATER QUALITY AND RIPARIAN AREA DEGRADATION).

Roads, skid trails/roads, and landings cover a significant portion of the watershed. It is the opinion of the authors that much of the watershed is experiencing the effects of "cumulative impacts" from the myriad of roads and skid trails, increased fire intensities, unstable channels, gullyed meadows, and reduced floodplains and loss of floodplain roughness from reduced and changed vegetation diversities and soil compaction caused by livestock trampling.

Annually, tons of sediment leave the Last Chance and Spanish Creek watersheds to impact downstream and human developments. Several other watersheds are in similar condition and the combined sediment load to the North Fork Feather River at Rock Creek Reservoir is estimated to average 1,161,500 tons per year ' (961 tons per square mile per year) (SCS, 1989). Eighty-five percent eventually reaches Lake Oroville (personal communication with Larry Harrison, PG&E). It is estimated that the annual sediment production for the Last Chance watershed is 156,600 tons (994 tons per square mile) and 232,500 tons (1,184 tons per square mile) for Spanish Creek watershed (SCS, 1989). Sediment production by source as a percentage of the total produced In each watershed Is as follows (SCS, 1989):

WATERSHED	FROM STREAMBANKS	FROM ROADS	TOTAL
Last Chance	**60%**	**38%**	**98%**
Spanish Creek	**48%**	**51%**	**99%**

It must be kept In mind that all of the above impacts are interrelated. Increased fire intensities, overgrazing, timber harvesting, road building, etc. occur as a system rather than as independent acts. As such, the occurrence of livestock grazing may signal the beginning of an erosional cycle as much as the entry of an area for logging, and the effects may be greater than the expected sum of the different activities.

WATERSHED IMPROVEMENT STRATEGY AND NEEDS

To improve the condition of the watersheds, a data base of conditions and attributes of subwatersheds, uplands, roads, meadows, and stream channels Is being collected. This information will be used to make decisions concerning management and restoration needs, predict successes and outcomes, schedule improvement work, delineate where and what management practices and other improvement techniques are needed, define the magnitude and scope of the needed work, and provide a basis for monitoring and future condition surveys.

Erosion from stream channels and banks, and associated gully systems should have the highest priority for treatment, followed by stream flow changes and erosion brought about by upslope activities (Beschta, 1986). The recommended improvement strategy in order of priority is:

1. Control livestock grazing and other land management disturbances in riparian areas.
2. Treat unstable stream channels and gully systems where natural restoration is slow or trends are down.
3. Treat those roads, skid trails, landings and upland areas directly contributing sediment and overland flow to a stream channel.

All planning and work should be conducted in an integrated fashion, whereby entire areas are treated and whole watersheds taken into account.

To accomplish the first task (control livestock grazing and other land management disturbances in riparian areas), the Allotment Management Plans (AMPs) must be updated to include requirements established in the Plumas Land and Resource Management Plan (LRMP). Before an AMP can be updated, an environmental analysis must be performed for each allotment to select an alternative that plans for proper management, restoration, and monitoring. The selected alternative must meet the "STANDARDS AND GUIDELINES" established in "Rx-9. RIPARIAN AREA PRESCRIPTION," and the "Forest-wide Standards and Guidelines" in the LRMP. Proper riparian management must "Favor riparian-dependent resources and water quality over livestock grazing when conflicts arise" (PLUMAS NATIONAL FOREST LAND AND RESOURCE MANAGEMENT PLAN, 1988).

The second task (Treat unstable stream channels and gully systems where natural restoration is slow or trends are down) is an integral part of the environmental analyses for Forest projects and AMP updating. The actual implementation of each project will probably come from a variety of avenues and funding sources. Where the Forest Service needs technical and financial help, the project(s) will be brought to the EBNFFR CRM.

The third task (Treat those roads, skid trails, landings and upland areas directly contributing sediment and overland flow to a stream channel) will be addressed as part of project environmental analyses and AMP updating. Forest Service roads and trails maintenance, timber sale planning, and special projects of the EBNFFR CRM are examples where this work will occur.