

Memorandum

F1-067

Date : July 25, 1997

To : Lester Snow, Executive Director
CALFED Bay Delta Program
1416 Ninth Street
Sacramento, California 95814

From : Department of Water Resources

Subject: Category III Proposal

Enclosed are project proposals being submitted by the Northern District of the California Department of Water Resources in response to the CALFED Bay Delta Program Category III Request for Proposals. The proposals are titled:

- Upper Sacramento River Watershed Water Temperature Assessment
- Identification and Characterization of Water Quality Factors Affecting Beneficial Uses: A Prerequisite to Restoration in the Deer Creek Watershed
- Identification and Characterization of Water Quality Factors Affecting Beneficial Uses: A Prerequisite to Restoration in the Big Chico Creek Watershed
- Identification and Characterization of Water Quality Factors Affecting Beneficial Uses: A Prerequisite to Restoration in the Butte Creek Watershed
- Identification and Characterization of Water Quality Factors Affecting Beneficial Uses: A Prerequisite to Restoration in the Mill Creek Watershed

These proposals will identify factors affecting priority species and their habitats. Such information is vital for management of the ecosystem, development of restoration programs, and documenting success of those programs.

Thank you very much for your consideration. If you have any questions, please call me at (916) 529-7342.

Douglas Dent
for Naser J. Bateni, Chief
Northern District

Enclosure

Executive Summary

F1-067

Project Title: Identification and Characterization of Water Quality Factors Affecting Beneficial Uses: A Prerequisite to Restoration in the Big Chico Creek Watershed

DWR WAREHOUSE

Big Chico Creek Watershed

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Applicant: Gerald Boles

California Department of Water Resources
2440 Main Street
Red Bluff, California 96080

Approach: The proposed project is a water quality assessment program for the Big Chico Creek watershed to determine changes induced in stream water quality due to land-based activities. Monitoring stations will be established at various locations in the watershed. Descriptive stream condition/habitat assessments will be conducted at each site. Basic water chemistry (minerals, nutrients, minor elements, and physical parameters) will be assessed since these parameters determine the beneficial uses of water and become elevated due to pollution, which often results in deleterious effects to aquatic life and other beneficial uses. Water temperature will be assessed via continuous recorders since this parameter has often been significantly altered from stream management activities and is important for determining the suitability of a water body for survival and reproduction of anadromous fish. Coliform bacteria levels will be assessed since these organisms are indicative of contamination which may impact health. Aquatic macroinvertebrates, which form the basis of the aquatic food web and are excellent indicators of long-term water quality conditions, will be assessed throughout the watershed.

The direct measurement of toxicity to aquatic organisms will determine the ability of the stream to support aquatic life. Toxicity assessment in stream bed sediments and the water column will identify impacts to fish and their food organisms from toxic substances. Fish tissues, which accumulate various toxic substances, will be analyzed to determine the presence of toxic substances which may not be identifiable through other means.

Sedimentation is a major impairment in streams, adversely impacting salmonid reproduction and food organisms. Analyses of sediments in stream gravels will determine areas of impact and aid in identification of sources of sediments.

Big Chico Creek flows through a major urban area (Chico) with numerous stormwater drains and other urban runoff to the creek. Urban runoff assessment will determine potential impacts to the creek. Drainage from the abandoned Minihaha mine in the upper watershed will also be assessed for this project.

The project will begin upon execution of a contract and is proposed to continue for a three year period with annual progress reports.

Justification: The proposed project will provide information about system stressors in the Big Chico Creek watershed which affect priority aquatic species and their habitats. Monitoring water resources in the watershed is essential to detect and document pollution. Water quality affects the beneficial uses of streams, including the beneficial use as fish habitat. Yet, very little water quality data are available for the Big

Chico Creek watershed. Without water quality data, environmental effects to migrating, spawning, and rearing salmon and steelhead cannot be realistically determined, nor can mitigation be developed until the scope of the problem is defined. Data will be developed by the proposed program that identify current conditions of various resource issues related to water quality, and provide a baseline to determine the effectiveness of mitigation activities in the watershed. Data developed by the proposed project will be used by a variety of agencies and groups to implement mitigation activities to improve habitat conditions related to water quality. This project is important to water resource managers and will provide a strong basis for better decision making by federal, State, and local agencies and environmental groups.

Budget Costs: The total annual cost for this project is \$138,000. Cost sharing from the Sacramento River Watershed Program and Department of Water Resources reduces the contribution from CalFed to \$57,000 the first year, and \$82,000 for each of the second and third years, for a total project cost of \$221,000 for the three year project.

Third Party Impacts: There are no third party impacts associated with the conductance of this project.

Applicant Qualifications: The project manager and field staff have many years of experience with the Department of Water Resources conducting similar projects. The Department has all necessary equipment to conduct the project.

Monitoring and Data Evaluation: Data will be used to determine present effects from stressors to instream aquatic habitat and priority species, and to determine effectiveness of watershed management and mitigation activities. Data from the proposed project will be compared to the sparse historic data that is available to determine long-term changes that may have occurred. Data will also be compared with criteria established for protection of aquatic life and assessment results from the Sacramento River Watershed Program, which is assessing similar parameters in the mainstem of the Sacramento River.

Support/Coordination: Data from the proposed assessment program will be used by the Sacramento River Watershed Program to determine the contribution from Big Chico Creek to water quality impairment in the Sacramento River. The proposed program is supported by the Big Chico Creek Watershed Alliance, Department of Fish and Game, Regional Water Quality Control Board, Sacramento River Preservation Trust, Department of Parks and Recreation, Butte County, City of Chico, and Sacramento River Watershed Program.

Compatibility with CalFed Objectives: This project addresses water quality problems which adversely impact high-risk aquatic species and their habitats, including spring-run and late-fall run chinook salmon, steelhead trout, and instream aquatic habitat. The project also provides information necessary for actions to improve and increase aquatic habitats and improve ecological functions, consistent with the objectives in the Ecosystem Restoration Program Plan.

**Identification and Characterization of Water Quality
Factors Affecting Beneficial Uses**

**A Prerequisite to Restoration in the
Big Chico Creek Watershed**

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Type of Organization: State Government
(Tax Exempt)

Implementation Participants and Collaborators
Big Chico Creek Watershed Alliance
(formerly Big Chico Creek Task Force)
City of Chico
California State University, Chico
Department of Fish and Game

RFP Project Group Type: Other Services

July 16, 1997

Project Description

Project Description and Approach:

The proposed project is a water quality assessment program for the Big Chico Creek watershed. Basic water chemistry (minerals, nutrients, minor elements, and physical parameters) will be assessed since these parameters determine the beneficial uses of water and become elevated due to pollution, which often results in deleterious effects to aquatic life and other beneficial uses. Water temperature will be assessed since this parameter controls the rate of chemical and biological processes, has often been significantly altered from stream management activities (such as dams and diversions), and is of utmost importance in determining the suitability of a water body for survival and reproduction of anadromous fish.

Coliform bacteria levels will be assessed since these organisms are indicative of fecal contamination and the possible presence of far more serious microorganisms which may impact health. Aquatic macroinvertebrates form the basis of the aquatic food web and are excellent indicators of long-term water quality conditions since specific communities develop in response to specific stream conditions and perturbations. These organisms will be assessed throughout the watershed.

The direct measurement of toxicity to aquatic organisms will determine the ability of the stream to support aquatic life. Toxicity assessment in stream bed sediments will identify impacts to the

benthic community forming the basis of the food web. Water column toxicity assessment will identify direct impacts to fish from toxic substances dissolved or suspended in the water column. Fish tissues accumulate certain toxic substances, often in higher concentrations than found in the environment. Though these substances may not be directly lethal, bioaccumulation may result in death of the fish, impairment of life function such as reproduction, and adverse effects to higher trophic levels (including people) which ingest the fish. Analyses of fish tissues will determine the presence of toxic substances which may not be identifiable through other means.

Sedimentation is a major impairment in streams. Sediments in stream gravels adversely impact salmonid reproduction and organisms (aquatic macroinvertebrates) important as food for fish. Analyses of sediments in stream gravels will determine areas of impact and aid in identification of sources of sediments.

Urban runoff contains a wide variety of pollutants, including petroleum products, fertilizers, pesticides, minor elements, asbestos, and organic materials. Big Chico Creek flows through a major urban area (Chico) with numerous stormwater drains and runoff to the creek from residential developments, shopping centers, industrial centers, and rural /semi-agricultural areas. Urban runoff assessment will determine potential impacts to the creek.

Abandoned mines also contribute pollutants that impact aquatic life.

Drainage from the Minihaha mine in the upper watershed, which has never been analyzed, will be assessed for this project.

Monitoring stations will be established at various locations in the watershed to determine changes induced in stream water quality due to land-based activities. Stations include fourteen sites on Big Chico Creek, one site on Mud Creek, and one site on Lindo Channel. Descriptive stream condition /habitat assessments will be conducted at each site. Temperature recorders will be placed at each station. Physical parameters will also be collected monthly at each of these stations, including pH, conductivity, dissolved oxygen, and turbidity.

Water samples will be collected monthly at five stations to assess chemical constituents, including minerals (calcium, sodium, potassium, magnesium, sulfate, chloride, boron, and alkalinity), nutrients (nitrate plus nitrite, ammonia, dissolved orthophosphate, and total phosphorus), and minor elements (aluminum, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, selenium, and zinc).

Monthly bacterial sampling at seven locations within the watershed for total and fecal coliform will use the membrane filtration method. These data will supplement data collected by Stewart Oakley of California State University, Chico for the City of Chico. Additional biological sampling will include annual aquatic macroinvertebrate sampling at seven locations, with additional late spring sampling in Mud Creek and Lindo

Channel and at the corresponding station on Big Chico Creek. The pathogens *Giardia* and *Cryptosporidium* will be analyzed near the contact recreation areas in Big Chico Creek.

Toxicity tests will include fish tissue sampling, bed sediments, and water column testing. Tissue samples will include sculpin or the Asiatic clam, *Corbicula*. Water column testing will use *Ceriodaphnia* and the fathead minnow. Bed sediment toxicity assessment will use the amphipod *Hyalella*.

Spawning gravels will be sampled at eight of the sample sites for laboratory determination of particle size distribution. Subsequent monitoring will be conducted to identify specific sources of sediments in impacted reaches.

Storm water samples will be collected at key locations throughout the Chico Urban Area. Sampling areas will include a variety of land-use activities. Sampling will occur during the first significant storm of the season, the second significant storm of the season, and a third mid-season storm determined by a percentage of the annual rainfall. Constituents sampled will include fecal coliforms, conductivity, pH, temperature, turbidity, total suspended and dissolved solids, nutrients, minor elements, and organic constituents.

Water samples will be collected following the first significant storm of the season upstream and downstream from the abandoned Minihaha Mine. Analysis will include minor elements as well as physical parameters.

This monitoring schedule will continue for three years. Additional stations or parameters may be added as data analyses identifies problem reaches within the watershed. Following the first three years of water quality assessment, data analyses may show that some parameters may not be necessary to continue to monitor, thus allowing laboratory expense to be lessened. Future assessments will maintain a base level of monitoring to identify long-term changes, and concentrate additional studies on areas shown to be degraded in order to identify sources of adverse effects and develop remedial actions.

Location of Project: The proposed project includes the entire reach of Big Chico Creek in Butte County. Big Chico Creek flows through the City of Chico before entering the Sacramento River about five miles to the west. The creek drains a watershed of about 72 square miles on the eastern side of the Sacramento River.

Expected Benefit: The proposed project will provide information about system stressors in the Big Chico Creek watershed which affect priority aquatic species and their habitats. The stressors for which this project will provide valuable information include: 1) alteration of flows and other effects of water management, including hydrograph alterations, migration barriers and straying; 2) water quality; 3) water temperature; and 4) land use, including grazing, gravel mining, urbanization, and forestry and agricultural practices. Natural flows in Big Chico Creek are altered by pumping water for golf course

and other irrigation, and dams at One Mile and Five Mile recreation areas in the City of Chico. These alterations to the natural flow may adversely affect water quality and sediment transport. Adverse water quality conditions created by hydrograph modification, especially as related to water temperature modification, may result in delaying or blocking migration by anadromous fish. Contaminants from urban runoff, agricultural runoff, abandoned mine drainage, and other pollution sources may lead to toxicity to aquatic organisms in Big Chico Creek. Water temperatures, especially during lower flows, may adversely affect the ability of the creek to provide suitable migration, spawning, and nursery habitat for anadromous fish as well as other aquatic species.

The habitat type affected by stressors in the Big Chico Creek watershed is primarily instream aquatic habitat. The priority species in this habitat type affected by stressors in the watershed include spring-run and late-fall-run chinook salmon and steelhead trout. This project will provide primary benefits to this habitat type and these species by identifying water quality impairments that are limiting the quality of the habitat and reducing survival of these species. The project provides secondary benefits for adaptive management by establishing baseline conditions to evaluate the effects of other mitigation and amelioration activities that occur in the watershed. The project also fosters efforts by the City of Chico and the Big Chico Creek Watershed Alliance by providing basic data for watershed planning and management.

Background and Biological/Technical Justification: Monitoring the water resources in a watershed is essential to detect and document pollution. Monitoring is also necessary to continually assess water quality and the health of the water resource. The most reliable way to determine if changes in land-based activities have affected water quality is to monitor the water resource before, during, and after a change in land management or restoration occurs. At a watershed scale, this relationship between changes in land management and water quality can only be determined by following a strict experimental plan, or monitoring protocol. Detailed tracking of water quality is essential to provide information to decision makers about the effectiveness of nonpoint source pollution control efforts.

Water quality affects the beneficial uses of streams, including the beneficial use as fish habitat. Yet, very little water quality data are available for the Big Chico Creek watershed. Without water quality data, environmental effects to migrating, spawning, and rearing salmon and steelhead cannot be realistically determined, nor can mitigation be developed until the scope of the problem is defined.

Multi-agency efforts, including those of the Department of Fish and Game, Regional Water Quality Control Board, Sacramento River Preservation Trust, Department of Parks and Recreation, Butte County, and the City of Chico, are underway to address water quality issues, fisheries restoration, and stream flow management in the Big Chico Creek watershed. The Department of Fish and

Game has identified Big Chico Creek as the fourth most important producer of spring-run chinook salmon of the east-side tributaries to the Sacramento River. The Big Chico Creek Watershed Alliance (formerly known as the Big Chico Creek Task Force) was formed to assist the City of Chico in evaluating urban impacts to the anadromous fisheries, but has since embarked on a comprehensive stream management strategy.

Water quality assessment and monitoring are necessary to characterize existing conditions within the watershed, determine contaminants and their origins, and understand the interactions of toxicants and biological components of the ecosystem. Data will be developed by the proposed program that identify current conditions of various resource issues related to water quality, and provide a baseline to determine the effectiveness of mitigation activities in the watershed. This assessment plan will address historic as well as current water quality conditions to define those factors that most affect the water quality conditions within the Big Chico Creek watershed. Data developed by the proposed project will be used by a variety of agencies and groups to implement mitigation activities to improve habitat conditions related to water quality, including stream temperatures, toxicants, and stream sediments. This project is important to water resource managers and will provide a strong basis for better decision making by federal, State, and local agencies and environmental groups.

The Department of Water Resources had maintained a basic water quality

monitoring station in Big Chico Creek in the City of Chico for several years. This program, however, provided only minimal inorganic chemical analyses. The Department is embarking on an expanded water quality assessment program in the Big Chico Creek watershed, in cooperation with the Big Chico Creek Watershed Alliance, City of Chico, Department of Fish and Game, Sacramento River Watershed Program, and other agencies and environmental groups. The Sacramento River Watershed Program has allocated \$25,000 to the Department to help support assessment activities in the Big Chico Creek watershed. However, the Department still has insufficient funds to assess all the water quality factors identified in this proposed project, which are similar to those being assessed in the main stem of the Sacramento River by the Sacramento River Watershed Program, that affect habitat conditions and priority species within the Big Chico Creek watershed.

Proposed Scope of Work: Field sample and data collection for water quality assessments will be conducted according to the schedule presented in Table 1. After collection, samples will be submitted to laboratories for analyses while field data and laboratory results will be entered into a database. The data will be reviewed monthly to insure the program is on schedule and that the data being collected are providing useful information. Progress reports will be made to the CalFed Bay Delta Program and other interested parties at agreed upon intervals. The project is proposed to continue for three years. An annual report documenting the achievements of

the project will be prepared at the end of the first and second years, while a final report will be prepared at the end of the third year of the program.

Monitoring and Data Evaluation: Data generated from this project will establish baseline water quality conditions for the Big Chico Creek watershed. These data will be used to determine present effects from stressors to instream aquatic habitat and priority species, and to determine effectiveness of watershed management and mitigation activities.

Data from the proposed project will be compared to the sparse historic data that is available to determine long-term changes that may have occurred. Data will also be compared with criteria established for protection of aquatic life and assessment results from the Sacramento River Watershed Program, which is assessing similar parameters in the mainstem of the Sacramento River. Data from the proposed assessment program will be used by the Sacramento River Watershed Program to determine the contribution from Big Chico Creek to water quality impairment in the Sacramento River.

The proposed assessment program has already been reviewed and approved by the Big Chico Creek Watershed Alliance, Department of Fish and Game, Regional Water Quality Control Board, Sacramento River Preservation Trust, Department of Parks and Recreation, Butte County, City of Chico, and Sacramento River Watershed Program. Monthly progress presentations to the Big Chico Creek Watershed Alliance and Sacramento River Watershed Program

will insure that information generated from the program is meeting the needs for assessment and mitigation efforts. All draft reports will be reviewed by these groups.

Implementability: Department of Water Resources staff have current valid scientific collecting permits to enable completion of biological assessments for this project. No other environmental permits are required. Access permission to private property has been obtained.

Although climatic conditions affect the flow in Big Chico Creek, collection of environmental samples in Big Chico Creek is not impeded by such conditions. Access to assessment sites is generally via paved roads or improved dirt roads. Water quality samples during high flows can be collected from bridges, using appropriate sampling equipment. Other parameters, such as aquatic macroinvertebrates and bulk sediment samples, are scheduled to be collected during low flow conditions.

Local agencies have reviewed and support the proposed project. The project scope and objectives have been presented to governmental agencies, environmental groups, and citizens at meetings of both the Big Chico Creek Watershed Alliance and Sacramento River Watershed Program. The Sacramento River Watershed Program has agreed to partially monetarily support the project.

Costs and Schedule to Implement Proposed Project

Budget Costs: Costs for the project are

distributed as indicated in Table 2. Estimated total cost for this work is \$138,000 per year, including field sample collection, laboratory analyses, and data processing. The California Department of Water Resources has sufficient funds to cover about \$56,000 per year, which will cover the costs of thermograph installation and maintenance, water sampling, inorganic chemical laboratory analyses, aquatic macroinvertebrate analyses, and coliform bacteria analyses. The Sacramento River Watershed Program has allocated \$25,000 for the first year to cover part of the cost of the toxicity testing. The Department is seeking additional funds to cover the remaining unfunded toxicity, sediment, fish tissue, and pesticide analyses for this assessment project. Funds needed are \$57,000 for the first year, and \$82,000 for each of the next two years of watershed assessment. The total requested allocation for the three year water quality assessment of the Big Chico Creek watershed is \$221,000.

Schedule Milestones: The Department of Water Resources installed thermographs and began inorganic chemical monitoring and laboratory analyses, and coliform analyses in May 1997. Aquatic macroinvertebrate sample collection and analyses will be conducted in September 1997. The start of assessments for water column and bed sediment toxicity, sediment particle size distribution, fish tissue, and pesticide analyses cannot begin until additional funding is secured. These analyses will begin immediately upon contract execution for the additional funding.

Third Party Impacts: No direct third party impacts are associated with this project. However, third parties may be affected as the results of this watershed assessment project are used to remediate sources of impairment. Third parties may bear some of the costs of remediation, or additional grants will be needed to remediate impairment. The extent of costs for remediation of impairments cannot be determined until the proposed project is implemented and results are obtained.

Applicant Qualifications

The project will be conducted by staff of the Northern District of the California Department of Water Resources. The project will be directed by Gerald Boles, who is Chief of the Water Quality and Biology Section in the Northern District. Gail Kuenster, an Environmental Specialist II in the Water Quality and Biology Section, will be the lead investigator responsible for field sample collection and data archiving and analyses under direction of the project director. Fraser Sime, an Environmental Specialist III in the same section, will be responsible for overseeing laboratory work for aquatic macroinvertebrate and coliform bacteria analyses. General administrative functions, such as accounting, billing, and contract administration, will be conducted by the Northern District's Administrative Officer, Barbara Polson.

The Big Chico Creek Watershed Alliance, which is directed by Suzanne Gibbs, is the primary participant that will help guide the program. The Alliance is comprised of representatives from the

Department of Fish and Game, Department of Parks and Recreation, Regional Water Quality Control Board, California State University (Chico), City of Chico, Butte County, Sacramento River Preservation Trust, and other environmental groups and concerned citizens. The Alliance will review project progress and results, and make recommendations concerning direction for the project.

Biosketches: Gerald Boles has been the supervisor of the Water Quality and Biology Section in the Northern District of the Department of Water Resources since 1990, and has been conducting water quality studies for the Department since 1975. He has a B.A. degree in Microbiology (minor in Chemistry) and a M.A. degree in Biological Sciences. In addition to years of experience with budgets and general supervisory functions, he has supervised and conducted numerous water quality investigations. He is responsible for both the Water Quantity and Quality Measurement Program and the Water Quality Evaluation Program in the Northern District. His duties have required him to develop and implement studies and research projects to determine environmental effects on water quality, wildlife, plants, and fisheries associated with future water supply projects, geothermal development, weather modification, water transfers, and other projects. Some of the projects for which he has been directly responsible include assessment of impacts to the aquatic macroinvertebrate community following the metam sodium chemical spill in the upper Sacramento River in 1991, development and implementation of a

water quality assessment program at Lake Almanor in cooperation with Plumas County, long-term water quality monitoring at both Clear and Eagle lakes, evaluation of effects to aquatic resources from cloudseeding in the upper Feather River area, groundwater quality assessments in the Sacramento Valley, Eagle Lake, and Cady Springs areas, and assessment of factors affecting the water quality of a drinking water supply reservoir. References include Steve Turek, Department of Fish and Game, 2440 Athens Avenue, Redding, California; Lauri Zander, Lahontan Regional Water Quality Control Board, 2501 Lake Tahoe Boulevard, South Lake Tahoe, California; Laura Barnhouse, Plumas County Environmental Health Department, P.O. Box 545, Chester, California; and Dennis Heiman, Central Valley Regional Water Quality Control Board, 415 Knollcrest Drive, Suite 100, Redding, California.

Fraser Sime earned a B.S. degree in Natural Resources Management from California State University, Humboldt and has been employed since 1988 by the Department of Water Resources. He has been involved in all phases of the District's extensive aquatic macroinvertebrate program, including field sampling, taxonomy, program design, and QA/QC. He currently is responsible for the macroinvertebrate and coliform bacteria programs in the District. Some of his projects have involved identification and enumeration of macroinvertebrates from surface water quality monitoring sites, taxonomic identification of fish stomach contents and macroinvertebrate samples collected by other agencies, several lake

water quality monitoring programs, and assisting other Environmental Specialists with water quality related projects. He also participates as a docent to local schools in conducting field trips in stream and vernal pool ecology. He is a member of the North American Benthological Society and California Inland Invertebrate Working Group. References include Jim Harrington, Department of Fish and Game, 2005 Nimbus Road, Rancho Cordova, California; Steve Turek, Department of Fish and Game, 2440 Athens Avenue, Redding, California; Dr. David Lauck, Aquatic Entomologist (formerly Professor of Entomology at CSU, Humboldt), P.O. Box 1255, Parowan, Utah.

Gail Kuenster has been employed by the Department of Water Resources since 1995. With both a B.A. and M.S. degree, she has been extensively involved in the District's water quality monitoring program, as well as thermograph maintenance and data acquisition, aquatic macroinvertebrate collection, and database administration. She currently is responsible for the collection and processing of samples and data that the Department is collecting from the Sacramento River and its tributaries, including Big Chico Creek. She is the Water Quality and Biology Section's liaison to the Big Chico Creek Watershed Alliance. References include Linnea Hanson, U. S. Forest Service, Oroville Ranger District, Oroville, California; Dr. Rob Schlising, Biology Department, California State University, Chico, California; and Lawrence Janeway, U. S. Forest Service, Oroville Ranger District, Oroville, California.

Compliance with Standard Terms

As a public agency, all standard terms and conditions will be approved at signing of the contract. No forms are necessary for submission with this proposal per Table D1 of the RFP.

Table 1. Proposed Monitoring Schedule for Big Chico Creek

Station	Temperature Recorder	Physical DO, pH, EC, Turbidity, Alkalinity	Chemical Metals/Nutrients, Minor Elements	Aquatic Macroinvertebrates	Coliform Bacteria	Toxicity Tests			Sediment Particle size	Fish Tissue Scrub or Corbicula	Pesticides
						Water Column Fathead minnow	Bed Sediment Ceriodaphnia				
Big Chico Cr @ mouth	c	m									
Big Chico Cr ab Mud Cr	c	m	m	September	m	m	biannually	September	September	fall & winter	
Mud Cr ab Big Chico Cr	c	m	m	September	m	m	biannually	September	September	fall & winter	
Big Chico Cr at Chico (Rose Ave)	c	m	m	September	m	m	biannually	September		fall & winter	
Big Chico Cr N 5-mile Rec	c	m		Sept & May	m			September			
Lindo Channel N 5-mile Rec	c	m		May	m			September			
Big Chico Cr @ Golf Course ab 5-mile	c	m									
Big Chico Cr @ Iron Canyon (Pool)	c	m									
Big Chico Cr @ Iron Canyon (Flow)	c	m	m	September	m	m		September			
Big Chico Cr @ Hennings Hole (Pool)	c	m						September	September		
Big Chico Cr @ Hennings Hole	c	m		September							
Big Chico Cr @ Higgins Hole (Pool)	c	m									
Big Chico Cr @ Higgins Hole (Flow)	c	m								fall & winter	
Big Chico Cr @ Campbell Cr	c	m									
Big Chico Cr @ Cascade Cr at Soda Springs	c	m	m	September	m			September			
Big Chico Cr at Minihaha Mine		m	1								

1 - runoff sampled since debris have begun

c - continuously temperature recorder; serviced monthly

m - exactly sampling and analysis

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Table 2. Annual Cost distribution for Big Chico Creek Watershed Assessment

Project Task	Direct Labor Hours	Direct Salary & Benefits	Overhead Labor	Service Contracts	Material & Acquisition	Miscellaneous	Total Cost
Thermographs	192	4,036	5,303	0	0	0	9,339
Water Sampling	192	4,036	5,303	0	500	0	9,839
Inorganic Analysis (1)	0	0	0	23,332	0	0	23,332
Aquatic Macroinvertebrates	134	1,570	2,065	0	500	0	4,135
Coliform bacteria (2)	168	3,531	4,640	0	1,000	0	9,171
Water Column Toxicity (3)				41,280	0	0	41,280
Bed Sediment Toxicity (4)				6,400	0	0	6,400
Sediment Analysis (5)	192	4,036	5,303	4,000	0	0	13,339
Fish Tissue Analysis (6)	192	4,036	5,303	7,500	0	0	16,839
Pesticide Analysis (7)	0	0	0	4,000	0	0	4,000
Total Project Costs		21,245	27,917	86,512	2,000	0	137,674

1 - monthly analyses for minerals, nutrients, and minor elements at 5 sites plus above and below the mine two times during winter flow conditions

2 - total and fecal coliform analyses at 7 sites each month

3 - monthly assessment at 4 sites

4 - twice per year at 4 sites

5 - annual assessment at 8 sites

6 - annual assessment at 3 sites

7 - analysis at 4 sites during fall and mid-winter

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