February 22,2004

Basin Environmental Improvement Project Commission
Project Grant Work Plan
Revised 4/14/04

Applicant: Idaho Department of Environmental Quality on Behalf of the Basin Environmental Improvement Project Commission

Contact: Mark Stromberg, Coeur d'Alene Basin Manager

Amount Requested: **$ 1,788,300**

Introduction

The State of Idaho Legislature established the Coeur d'Alene Basin Environmental Improvement Project Commission ("the Commission") to implement, direct, and/or coordinate environmental remediation, natural resource restoration, and related measures to address water quality and heavy metal contamination in the Coeur d'Alene Basin of Idaho in a manner that is protective of human health and the environment, consistent with local, state, federal, and tribal participation, resources, and authorities.

The 2003 conference report accompanying the congressional appropriation act for EPA included a line item in the amount of $1,778,300 for the "Commission" to carry out a pilot program for environmental response, natural resource restoration and related activities. The Idaho Department of Environmental Quality (DEQ), on behalf of "the Commission", is requesting funding to support work projects of the Commission. The DEQ will serve as the administrator for these funds. This may include direct contracting by DEQ on behalf of the Commission, or entering into subcontracts or interagency agreements to complete the work tasks as DEQ may be directed by the Commission. The DEQ is requesting all $1,778,300 in this application.

The major objectives of the projects proposed for this phase of funding are:

1) monitor groundwater quality and potential metal loading from contaminated groundwater reaching surface water in Canyon Creek,
2) conduct a flooding/recontamination assessment for the buried surface water diversion for Meyer Creek,
3) monitoring surface and groundwater quality in Nine Mile creek and further evaluation and testing of water treatment pilot project at the Success mine,
4) evaluation of two emerging water treatment technologies to remove metals and nutrients at the Page waste water treatment plant,
5) East Fork Pine Creek revegetation pilot project,
6) inventory and evaluation of private lands for potential restoration of wetland habitats,
7) monitoring fish response to bank stabilization projects in the Coeur d'Alene River,
8) assessment of sediment transport and bed evolution in the lower Coeur d'Alene River,

9) computer model assessment to evaluate Coeur d'Alene Lake's response to watershed remediation,
10) hydrologic and sediment yield study to support project effectiveness of a sediment TMDL implementation plan on the North Fork Coeur d'Alene River,
11) Mica Bay nutrient reduction project, and,
12) Lower lakes aquatic vegetation survey.
13) Canyon Creek Groundwater Metal Source Characterization

The scope of these projects consists of coordination and acceleration of research, investigations, experiments demonstrations, surveys, and studies to the causes, effects, extent, prevention, reduction, and elimination of water pollution in the Coeur d'Alene basin. Results from these projects will be transferable to other areas and communities within the Coeur d'Alene Basin to reduce, eliminate, or prevent water quality pollution.

Stakeholders participating with the Basin Commission and these pilot projects are already investing significant time and resources via the establishment of Commission community and technical leadership groups. These advisory groups reviewed and provided comment on numerous projects proposed for potential funding using this Clean Water Act Grant. The projects listed below were those recommended to, and approved by, the Basin Environmental Improvement Project Commission at its November 2003 and February 2004 meetings.

PROJECT DESCRIPTIONS

Task 1: Woodland Park Groundwater Quality Evaluation

Metals leached from mine wastes in the Coeur d'Alene Basin have increased zinc and cadmium concentrations in the South Fork of the Coeur d'Alene River and its tributaries far above ambient water quality standards. Canyon Creek contributes the greatest load of zinc and cadmium into the South Fork upstream of the Woodland Park area. The shallow hydrology of Canyon Creek is characterized by an alluvial aquifer with a high degree of interconnection between the groundwater and surface water. The USGS described a reach of Canyon Creek where the groundwater discharging into the stream contributed about 150 pounds of zinc per day during low flow conditions. The source of metals to the groundwater is thought to be reworked tailings mixed with stream gravels as well as alluvium that has collected metals leached from overlying tailings.

Project Description: This study is designed to monitor water quality in this shallow alluvial groundwater system in Woodland Park area of Canyon Creek. The project goal is to gain a better understanding of the metal concentrations and potential loading from groundwater to the Canyon Creek surface water system. The results from this monitoring effort will directly contribute to ongoing investigations on groundwater hydrology and water treatment currently under study by EPA in Canyon Creek.

Under this study, monitoring will occur at approximately 30 existing well locations in Canyon Creek Segment 5. These wells include:

- Group #2 (14 Remedial Investigation wells in CCSeg05); and
- Group #4 (16 IDEQ wells in CCSeg05)

The sampling task will include all 30 wells to be sampled on a quarterly basis (4 sampling events) for dissolved metals (Pb, Cd, As, Zn, Ca, Mg). Field parameters including pH, conductivity, and temperature will be obtained. Standard operating procedures will be followed to sample the wells, such as purging until parameters stabilize, etc.

Implementing Agency: Idaho DEQ

Deliverables: The work deliverables from this project will include: 1) quarterly groundwater data quality control and data result updates to be presented to the Technical Leadership Group and Water Treatment Project Focus Team, and 2) a final data summary report on groundwater quality in the lower Canyon Creek drainage near Woodland Park. The report would be reviewed by the Commission's TLG before submission and presentation to the Commission.

Date: October 2005 (final report)

Budget Requested- **$35,948**

Task 2: Meyer Creek Flood Control Assessment

Meyer Creek is located in the City of Osburn, Idaho. The creek drains through mine impacted waste materials to the south of Osburn and then through buried pipes and ultimately to the South Fork Coeur d'Alene River. The condition of the buried pipeline and its condition are not known however the system is believed to be over 50 years old. The current condition of Meyer Creek through Osburn is very similar to the condition that existed for Milo Creek in Kellogg and Warder prior to the flooding of 1997. This 25-year event lead to city infrastructure damage and induced blood lead level increase in area children due to contaminated sediments. A presidential declared Natural Disaster area followed which allowed the Federal Emergency Management Agency (FEMA) authority to respond. This incident required an estimated $16 million for a flood control project and infrastructure repairs and replacement and over $500,000 in repair of residential properties in the Bunker Hill Superfund site that were recontaminated from this flooding event. If a similar event occurred at Meyer Creek, and just 20 properties were recontaminated within the flood route, the cost alone to re-remediate these properties could be in excess of $400,000 in the city of Osburn. Thus, addressing this potential risk would reduce risk associated with loss of property value and public safety.

Project Description: The project is to conduct a preliminary investigation and assessment of the condition of the Meyer Creek diversion system, characterize upgradient sediment and potential water quality contaminate sources, and develop alternative remedial recommendations and order of magnitude cost estimates. The project is an investigation into the current status and condition of the buried pipeline, preliminary characterization of upgradient contaminants, and assessment of potential water quality pollution through

this system. The project also seeks to protect public health and property values by preventing recontamination of residential yards that are currently being remediated in this area of Osburn under a Superfund human health response action. Specific tasks would include conducting a field investigation of the current system conditions, , collection and analysis of upstream sediment sources and water quality sampling, and conduct a preliminary engineering review and cost estimate to improve the system The analysis will be conducted in coordination with the city of Osburn and potentially affected landowners.

Implementing Agency: Idaho DEQ

Deliverables: The work deliverables from this project will include: 1) An outline of the technical report for TLG review at the onset of the project that provides scope and schedule for the assessment, and 2) a technical report summarizing its findings and recommendations. An order of magnitude cost opinion with assumptions will be provided. This report is expected to provide a design basis for the City and county to pursue other funding sources to implement the improvement recommendations to minimize flood risk and recontamination of the CERCLA remedy being implemented under other authorities.

Date: September 2004 (final report)

Budget Requested: **$31,521**

Task 3: Upper East Fork and Success Mine Site – Water Quality Evaluation, and Treatment System Enhancement

This project involves two aspects: 1) The continuation and experimental enhancement of a water treatment system demonstration project, and 2) performance evaluation and measurement of existing surface water and groundwater conditions in the area of the Success and Interstate Mines along the Ninemile Creek Drainage.

The objective of this work is to develop, implement, and report on a water-quality study of the East Fork of Ninemile Creek, with particular emphasis on the zones near the Interstate and Success sites. The project will determine the metals concentrations and resulting loading occurring at critical locations. The results of this study will provide or contribute to the development of a valid conceptual model for this stream reach and the pollutant sources impacting it. The model will provide a basis for decision-making on further actions and monitoring needed at these mine sites. This project will pursue an initial evaluation of the groundwater behavior effects of the treatment system at the Success. In addition, this study will evaluate engineering modifications to enhance the long-term usefulness of the Apatite II reactive medium as well as evaluating alternatives.

In 1995 the Success site was identified as the largest remaining source of metals loading in the Ninemile Creek drainage. In April 2000 the Silver Valley Natural Resource Trustees selected semi-passive groundwater treatment at the Success Mine as part of EE/CA process. It was selected as the preferred alternative since it best met the

evaluation criteria, represented a timely response action, could be completed with existing funds and provided an opportunity to complete a full-scale demonstration project that would not preclude other response action in the future. The engineering system included construction of a barrier wall, the interception of impacted groundwater from the shallow unconsolidated aquifer, and treatment in a passive treatment system using Apatite II fishbone apatite as the reactive media. Since installation this system has removed an estimated 30 lbs. of cadmium, 65 lbs. of lead, and 4,900 lbs. of zinc. However, flow through the system has declined from 32 gpm in May 2002 to 3.1 gpm in June 2003. Since untreated water has been noted bypassing the treatment media it is evident that the system is not allowing water to pass through the cells as designed.

The permanent reduction of dissolved metals concentrations (in particular Cd and Zn) and loads being released into the East Fork of Ninemile Creek are a significant objective. The predominant impact to water quality in the East Fork are the Interstate and Success mine sites. The relationship of the Success and Interstate to surface water chemistry and metals concentrations has not been examined comprehensively or recently. The performance of the Success barrier wall containment approach has not been evaluated relative to stream chemistry, groundwater conditions, and river flow.

Project Description**:**

Subtask A: Treatment Enhancement: This part of the project will further evaluate the effectiveness and operation and maintenance requirements for Apatite II via implementation of several experimental engineering upgrades to the system and monitoring to determine the effectiveness of the upgrades. The objectives associated with the treatment system evaluation include:

1) evaluation and implementation of engineering upgrades to reduce sedimentation of the headworks,
2) "fluidization" of one of the existing apatite II cells and monitoring of flow response, and,
3) evaluation of an alternative treatment medium or applications.

Engineering upgrades to the existing treatment system at Success would include designing and installation of an upgradient sediment trap, this would include collecting samples upstream of the treatment system and performing a particle size distribution that would be used to design the sediment trap. The sediment trap will need to be cleaned out periodically and should be constructed in such a manner as to make this step as simple as possible. (2) Designing and installing a backflush system using air or water to backflush the inlet box, and development of an engineering approach to routinely fluidize the media in the treatment system. The fluidization system will be constructed to allow the medium in the barrier to be periodically mixed to test potential improvement in media hydraulic performance. (3) A routine monitoring plan will be designed and implemented to evaluate these engineering improvements to this type of passive water treatment system. If successful these design improvements may be transferable to similar treatment systems in the baisn.

The preliminary in-situ treatment concept to be tested is to create an in-situ reductive zone by the injection of the appropriate biologically degradable (typically food-grade) nutrients into the groundwater or into contaminant source areas to create sufficiently reductive electrical potentials to precipitate or dechlorinate the contaminants of concern. The injection process is managed so that the zone created in the subsurface will be available to continue to treat the diffusion-controlled contaminant release from earthen materials, and prevent rebound phenomenon observed with many other treatment approaches. Nutrients would be injected upgradient of the treatment cell may be evaluated as a means to potentially to immobilize contaminants in place. Monitoring would be conducted in the groundwater piezometers installed under Task B, in the headworks to the treatment cell, and through the surface water monitoring conducted under Task C. This project could complete the initial pilot objectives of groundwater treatment at Success and inform future water quality and remedial action needs at these site and other passive and potentially in-situ water treatment systems under consideration for other remote mine sites in the Basin.

Subtask B: This part of the project will result in the installation of at least 3 monitoring wells; 2 installed within the grout wall and treatment area and a third up gradient and outside the grout wall. The project will advance the understanding of how ground water from the Success barrier wall project is behaving physically and chemically relative to the stream and treatment system. Groundwater levels will be monitored relative to the creek, as will the chemistry of the groundwater. Monitoring of groundwater within the grout wall will include the monitoring wells and sampling of the treatment system intake.

Subtask C: The stream monitoring aspect of the project will be focused over the reach from above the Interstate to below the Success. Up to seven sampling events will occur at a series of stations to cover the range of stream flow regimes. Dissolved and total metals will be a part of the analyses, as will flow measurements. The net affect of the engineered treatment or containment projects on stream water quality (metals, nutrients, and other standard general water quality parameters) will be an integral component. The changes in water quality along the stream segments of study and the localized affect of the demonstration projects and mining sites on river flow and chemistry will be confirmed. The study will include the collection of stream flow rates during base-flow conditions through higher flow conditions when safe to do so. Existing monitoring stations may be used, where appropriate

The outcome of the above tasks will enhance engineering knowledge of reactive media treatment, evaluation of the potential for in-situ water treatment, and provide the establishment of a valid conceptual water quality model for this stream reach and the mines impacting it.

Implementing Agency: Idaho National Engineering and Environmental Lab

Deliverables: The deliverables from each subtask will include:

- Subtask A: detailed work plan to be reviewed by the TLG (early spring 2004); design work would be conducted in late spring 2004 and construction in late summer 2004.

Monitoring will be conducted for a minimum of two years or through 2007. Interim monitoring result updates will be provided annually to the TLG and Basin Commission with a final treatment system report prepared and presented to the Basin Commission through the TLG in early 2008.

- Subtask B: A workplan will be completed by early spring 2004 and reviewed by the TLG. Piezometer installation will occur as early as weather conditions permit in the late spring and monitoring will continue for a minimum of one-year (end 2005). A Task 2 summary report will be prepared for TLG comment and presentation to the Board in early 2006.

Subtask C: A monitoring workplan will be completed by August 2004 for TLG review and comment, with the first data collection beginning in the fall of 2004. Annual data results interim reports will be prepared for TLG comment and presentation to the Board. A final monitoring report will be prepared for TLG review and board presentation in early 2006.

Budget Requested: **$193,652**

Task 4: South Fork Sewer District Page WWTP phosphorus and metals removal pilot study.

The surficial geology of the Silver Valley is naturally high in metals. In addition to the natural presence of metals, human activity has used a significant amount of mine tailings as fill and as pipe bedding. When groundwater flows through these materials, the metals are leached, increasing the metals content in the groundwater. This has become a significant issue in the Silver Valley because this high metals groundwater is able to enter damaged sewer pipes and then flows to the wastewater treatment plants.

These high metals concentrations exceed the allowable metals allocations (existing total maximum daily load – TMDL) for the South Fork of the Coeur d'Alene River. Although currently operating under a Waiver from these metals limits, the South Fork Sewer District would be required to meet these levels if the variance is not extended beyond the five years of the permit. The Public Information Document for the WWTP variance proposed that variances would likely extend beyond five years.

As a result, the South Fork Sewer District has been evaluating possible metals treatment options. To date none of the EPA recommended technologies are either affordable or effective. Since the South Fork Sewer District has approached its practical bonding limit (ratepayers cannot afford more increases and the rate payer base is shrinking), the District has limited available funds for any treatment options.

This problem also impacts other discharges in the basin including the active mining companies and inactive mining claims that also will have difficulty meeting the new limits.

In addition to the metals, the District has been identified as a point source discharger of phosphorus to Coeur d'Alene Lake. Since phosphorus is typically the limiting nutrient in algae growth, phosphorus reductions could minimize potential eutrophication of the Lake. Again, the District does not have the financial ability to provide this additional treatment with existing technologies.

Project Description: The Page WWTP uses lagoons to treat approximately two million gallons per day (mgd) of wastewater, but handles peaks of up to 13 mgd. These treatment units are much less energy intensive and can handle higher peak flows. However, they are not as effective at removing metals and nutrients. Use of a final polishing step will be critical for meeting metals and phosphorus removal requirements. Lagoons are also used by most of the other dischargers in the Valley so this demonstration project will be applicable to a number of systems.

This demonstration will provide critical information for both the Silver Valley dischargers as they try to meet the basin TMDL limits, as well as the EPA as it tries to determine what level of treatment is reasonable and cost effective.

This project will evaluate two experimental technologies for precipitation and removal of metals and phosphorus from wastewater treatment plant effluent at Page. The Page plant is located near Silverton, Idaho. The first process to be evaluated is *Vandal-Ion*. This process was developed locally at the University of Idaho and uses co-precipitation and adsorption of phosphorus (P) and metals onto iron oxide-coated sand (IOCS) in a moving bed active filtration (MBAF) system. The system uses chemical precipitation and filtering to bind and removal metals and phosphorus. These reactors are self-contained and modular to allow use on discharges of all sizes. Aqueous contaminants such as metals have been treated by precipitation processes; however, removal of dilute concentrations of metals in high-flow regimes requires a more efficient process to be cost-effective. Vandal-ION(tm), an emerging technology for contaminant removal, provides a more efficient solution. Through a unique process configuration, the removal mechanisms of co-precipitation and adsorption are both optimized with greatly reduced chemical addition requirements. This technology is not diffusion-limited, not equilibrium-limited, and not kinetically-limited unlike traditional precipitation processes. The result is high percentage removal of contaminants with a rapid flow-through time for expedient treatment of large volumes of water. The continuous backwash features make this process much more user friendly for small and medium sized municipalities. In summary, the vandal-ion process has had good success in removing phosphorus but has not been demonstrated at the pilot scale for removal of metals. This technology uses a moving bed active filtration system, which represents the most recent technology to be developed for water and wastewater treatment. This technology greatly improves removal efficiencies, costs, and plant size.

The second technology (Lime precipitation plus filtration) has been identified as the most cost effective process for metals removal from high strength mining waste. However, its effectiveness with low concentration metals is not well documented. Furthermore, conventional granular media filtration may not be able to meet very low effluent

metals requirements. Membrane filtration has the benefit of higher particle removal which will improve both metals and phosphorus removal. This has wide ranging applicability since the majority of the waste streams in the Silver Valley are low strength. The result of task will be to potentially identify a new use for an existing technology.

Ultimately, the demonstration will find ways to protect the water quality of the South Fork of the Coeur d'Alene River, the main Coeur d'Alene River, Lake Coeur d'Alene, and all downstream waters in a cost effective way for the residents of the Silver Valley and could be applicable to other dischargers in the valley, including the mining companies.

Implementing Agency: South Fork Sewer District

Deliverables: Deliverables from this project will include 1) vendor selection analysis for TLG review in late spring 2004; 2) two separate equipment vendors final reports will be summarized and evaluated for applicability to other treatment plants in the Silver Valley. As part of the evaluation, projected capital costs operation and maintenance costs, preliminary equipment sizing, ancillary processes, and useful media life will be evaluated; and 3) A final report detailing both treatment technologies, their applicability to lagoon and activated sludge processes, a discussion of removal efficiencies, and capital and O&M cost projections.

Date: December 2004 (final report)

Budget Requested: **$179,763**

Task 5: East Fork Pine Creek Revegetation Pilot Project

This revegetation trial project encompasses roughly 3 stream miles of the East Fork of Pine Creek, extending from the confluence of Gilbert Creek (at the Lower Constitution Millsite), downstream to the Denver Creek confluence. The East Fork of Pine Creek is 303d-listed for excessive bedload sediment, which results in channel instability, and metals, which have entered the system from past streamside mining operations. Large areas of the floodplain have been essentially devoid of vegetation for decades. Consequently, remobilization of floodplain deposits during moderate and high flows will continue to cause sedimentation problems downstream until streambank stabilizing vegetation is established. There are limited segments within the three-mile total where no planting would occur due to the existence of healthy vegetation, bridges, difficult access, etc. This reach is representative of many other tributary streams to the South Fork Coeur d'Alene River which may benefit from similar revegetation efforts should this trial be successful.

Project Description: Objectives of the demonstration project include testing and evaluating the effectiveness of several riparian revegetation techniques that may prove applicable and cost-effective for reducing sediment input from this stream reach. The key objective of this project is to study and identify the cost effectiveness of an emerging planting technology and variations on that technology compared to other more standard techniques. The emerging technology has been used at other sites, but the cost

effectiveness has not been evaluated compared to other techniques. Evaluating the cost effectiveness is the next step that is needed to determine the applicability of this emerging technology. Effectiveness monitoring will include vegetation survival rates and relative treatment costs, as well as channel and floodplain response; i.e., reduction in sediment loading. Specific methods to determine channel response will include Wolman pebble counts, channel cross-sections and longitudinal profiles. The proposed project would help identify practical and cost-effective methods to jump-start the natural revegetation processes, which are ultimately needed to stabilize many stream reaches within the Coeur d'Alene Basin. In Pine Creek, much of the project area has had some degree of channel of floodplain reclamation work since the 1996 flood, including rough grading and bank armoring. Revegetation has not been extensively trialed in this area. The project provide an on-the-ground demonstration of the effectiveness and feasibility of several mechanical planting methods on harsh sites where soil and fine sediment are in short supply. The project will evaluate an excavator with an expandable stinger to plant rooted willows in the cobbles and gravel areas along a steep high velocity stream system. Such streams are common in many of the tributaries to the South Fork of the Coeur d'Alene River. In addition, variations to the planting methodology would include expandable stinger planting of several rooted species (willow, dogwood, and cottonwood), as well as several unrooted species from cuttings (willow and cottonwood stems). A second method would be a small tracked excavator with a hydraulic hammer and traditional (i.e. non-expandable) stinger. The cost difference may be significant between the expandable versus traditional stinger methods. A third mechanical method would be to excavate narrow planting trenches, in various patterns, and compare relative growth rates and overall survival of planted willow and cottonwood cuttings between trenches back-filled with native material and back-filled with topsoil.

Monitoring will include percent survival and growth rates of the plantings, comparing methods, treatment and species.

Implementing Agency: BLM

Deliverables: The deliverables for this pilot project will include: 1) a construction completion report at the end of the first year (2004) that summarizes and compares each planting method along with cost estimates; 2) annual monitoring reports for an estimated three years that reports on the survival and growth rates of the various treatment methods and species; and 3) A final report to be completed at the end of the three-year post construction monitoring period. Each report will be provided to the TLG and reported to the Board (January 2008).

Budget Requested- **$61,624**

Task 6: Inventory and Evaluation of Private Lands for Potential Restoration of Wetland Habitats

Wetland habitat with lower soil/sediment lead concentrations needs to be provided for wildlife in order to reduce mortality and ecological risk in the lower Coeur d'Alene Basin. Healthy wetland environments also improve water quality by reducing sedimentation and

tying up metals. Many privately owned agricultural and wetland areas exist which may provide remediation and restoration opportunities for creation of low-risk habitat for waterfowl and other wildlife. In addition, improvement of wetland habitat on private lands could be supported with financial incentives such as conservation easements for the landowners. A comprehensive evaluation of these areas is necessary in order to determine landowner interest inn creating or enhancing wetland habitats.

The goals of this assessment include:

1) Identifying willing landowners in the lower Coeur d'Alene Basin interested in wetland creation, enhancement, or restoration or their property.
2) To assess soil metal concentrations on private lands where contaminants may be of concern.
3) Identify and prioritize private lands available for wetland conservation through various federal and state grant and cost-share programs.

Project Description: Privately owned agricultural and wetland areas in the lower Coeur d'Alene Basin identified as having potential for creation or enhancement of wetland habitat will be inventoried. Landowners will be surveyed to determine interest in wetland creation or enhancement on their respective properties. Once land ownership has been identified and a preliminary evaluation of maps, aerial photos, etc has been conducted, each private landowner will be contacted by biologist to determine if he/she has an interest in having his/her property evaluated for potential remediation, creation, enhancement, or restoration of wetland habitat. Biologist will work with the landowner to further develop project objectives with respect to both ecological remediation goals and landowner interests, to ensure that compatible objectives are established and to promote continued landowner interest and participation. Biologists will assist landowners and stakeholders develop a preliminary restoration plan with cost estimates for restoration and assist in development of priority list of easements or acquisition based on ecological and physical suitability and the most cost-effective restoration.

Wetlands act to reduce many water-related contaminants. Metals can be incorporated into plant tissue to effectively remove them from the water fraction of the wetland. Dead plants decay into particulate and dissolved organic matter that bind dissolved metals and reduce the metal's bioavailability. This particulate and dissolved organic matter can influence metal bioavailability in moving streams and rivers when wetlands flood or where wetlands are connected to rivers. Wetlands with low habitat quality usually have lower functionality for bioremediation of metal-associated adverse effects. Wetlands with high habitat quality usually have higher functionality for bioremediation. Wetland restoration projects typically try to improve wetland habitat so that wetland function is also enhanced. In contaminated wetlands, improved wetland habitat can also improve the wetland's value to waterfowl and other species while the improved wetland function reduces the potential for adverse toxicological effects.

The proposed survey will inventory private wetlands and associated agricultural lands (1) to determine their value as wetland habitat, (2) to determine what modifications necessary to restore to optimal habitat, (3) to determine the landowner acceptance of

wetland restoration on the property, and (4) to determine the level of lead contamination on the property. For this project, landowners of wetland or wetland segments will be contacted as to their willingness to participate. Those acceptable properties will be assessed for their habitat quality. Consistent with the provisions of the CWA, we will conduct an investigation and survey of the extent of contamination relative to the known level of toxic effects to waterfowl in the CdA Basin. The survey will determine which wetlands or wetland segments exceed known effect levels, and thus are eligible for wetland remediation under EPA CERCLA authority. The survey will also identify wetlands and wetland segments that have sediment lead concentrations that are less than known toxic levels, and therefore are suitable for restoration without physical remediation. Designs for restoration of existing wetlands or creation of new wetlands will be prepared for those properties that have low toxicity to waterfowl, and that provide, or could provide, for high quality wetland function.

The expected outcome of the project is a list of properties suitable for remediation and then restoration, a list of properties that could benefit from restoration and require no physical remediation, and a list of properties that contain wetlands that require or need no further actions. The categorization of properties will be based on metal content in sediment, landowner willingness, and habitat quality (including wetland function). From that list of potential restoration properties, we anticipate the development of restoration plans to improve wetland function and habitat. Those restorations will then be considered for completion using funds outside the scope of the present proposed activity.

Monitoring will not be required until completion of the inventory and actual projects were implemented.

Implementing Agency: USFWS/Idaho Fish and Game/Ducks Unlimited

Deliverables: The deliverables for this pilot project will include: 1) a comprehensive report on what landowners were contacted and what property was preliminarily evaluated. In addition regular reports will be made to stakeholders on the progress in finding suitable tracts, willing landowners and make recommendations for easements/acquisitions subject to review and approval of stakeholders. Results of soil sampling will be reported to the TLG and landowners.

Quarterly reports and updates will be provided to the TLG and a final report will be presented to the Basin Commission in the fall of 2005.

Budget Requested- **152,406**

Task 7 - Monitoring Fish Response to Bank Stabilization

Resource management agencies are being asked to evaluate the impact of a rapidly increasing number of bank stabilization project proposals for the Coeur d'Alene River. Bank stabilization efforts will likely be proposed to treat more than 20 miles of the Coeur d'Alene River banks in coming years. It is imperative that individual and basin-wide design of bank stabilization projects not only meet erosion control goals, but also ensure

the negative impacts to fish utilizing river habitats are avoided or minimized. Bank stabilization projects should also utilize techniques to improve fish and wildlife habitat wherever possible. To date, the structure of the fish community in the lower Coeur d'Alene River is relatively unstudied, and thus, possible effects of large-scale bank stabilization is difficult for resource management agencies to define.

This monitoring effort will provide fish community information (fish diversity, age structure, and abundance) within the habitats potentially affected by bank stabilization projects in the lower Coeur d'Alene River. The study areas will include larger areas with relatively few implemented bank stabilization projects, areas potentially affected by implemented bank stabilization projects, and areas with proposed bank stabilization projects. We will evaluate fish species, age structure, relative abundance and population abundance within these study areas using electrofishing.

The overall goals of the project are to:

1. Assess the short- and long-term affects of bank stabilization treatments on fish community structure in the lower Coeur d'Alene River.
2. Provide recommendations for bank stabilization project designs with the least adverse impacts and most positive benefits to overall fish community structure.
3. Provide recommendations on what project-specific monitoring that would be required for individual bank stabilization projects.

Within these overall goals, several objectives must be met:

1. Determine baseline fish community structure in reaches of the Coeur d'Alene River that have the least habitat modifications from prior bank stabilization projects.
2. Determine seasonal and year-to-year variation in fish community structure in the same selected reaches of the lower Coeur d'Alene River.
3. Determine fish community structure in several completed bank stabilization project areas of the lower Coeur d'Alene River.
4. Determine fish community structure in several proposed project areas to determine site-specific baseline conditions.

This monitoring effort will (1) establish baseline fish community structures, (2) evaluate variability in fish community structures over time, (3) evaluate the effect of existing bank stabilization projects on fish communities, (4) determine appropriate monitoring strategies for future bank stabilization projects, (5) and recommend bank stabilization techniques that have positive effects or minimal adverse effects on fish communities.

Project Description: The project will utilize electrofishing to evaluate fish community structures in the lower Coeur d'Alene River. Electrofishing is well recognized and acceptable for fish community evaluation studies. Habitat structures will be selected as areas that can be assessed in relatively long transects (e.g., linear distances along a bank of greater than 100 meters). Each transect will be electrofished twice yearly (winter and late summer) for two years.

The project will require review of completed and planned bank stabilization project locations as well as an evaluation of basic habitat structures throughout the lower Coeur d'Alene River. This planning is necessary for study transect selection. Monitoring protocols and standard operating procedures (SOPs) will be developed and approved by agencies involved with the monitoring effort. No engineering activities are anticipated.

The activity will require an Endangered Species Act section 10 permit for the possible take of a listed species, and a state-issued biological sampling permit. Bull trout are likely present in the lower Coeur d'Alene River at various times of the year, and an incidental take may occur during electrofishing activities.

This proposed project is a monitoring activity that could assist in the design of future bank stabilization projects and to help define the required monitoring activities associated with future bank stabilization projects. This proposed activity represents a two-year monitoring effort. The project is designed to answer questions regarding habitat use by fish and should assist in expediting monitoring concerns for future bank stabilization projects. This proposed activity will likely reduce agency concerns and requirements when considering approval of required permits because much of the baseline for monitoring will be completed by this proposed activity, and monitoring activities to evaluate bank stabilization projects will be defined by this proposed activity.

Implementing Agency: Idaho Fish and Game/USFWS

Deliverables: Quarterly interim data reports will be provide bi-annually. A final report, documenting the results and interpretations, along with recommendations will be prepared and submitted to the TLG for review prior to presentation to the Basin Commission. The final report will be completed by December 2005.

Budget Requested: **$107,550**

Task 8: Computer Models to Assess Sediment Transport and Bed Evolution in the Lower Coeur d'Alene River.

Over one hundred years of mining in the Coeur d'Alene Basin has resulted in large quantities of metal-enriched sediments being transported to, and deposited within the Lower Coeur d'Alene River and its floodplain. Since much of the contaminated sediments have been shown to be deposited in the bed, banks, and floodplain of the Coeur d'Alene River between Cataldo and Harrison, this river reach is the focus of several mitigative efforts aimed at preventing these sediments from being remobilized and carried downstream. The project will result in the development of predictive tools capable simulating the hydraulic and sediment transport characteristics of the river over a wide range of streamflow and lake elevation conditions. The models would be used to test proposed projects prior to implementation with the goal of improving their design and avoiding unanticipated and costly mistakes.

Project Description: The goal of this project is to develop a set of tools that can be used by resource managers for evaluating proposed projects designed to minimize the

transport of metal contaminated sediments in the Lower Coeur d'Alene River. Objectives include the utilization of existing data and collection of additional data to develop and calibrate computer models of the river between Cataldo and Coeur d'Alene Lake. These models would be capable of simulating the hydraulic and sediment transport characteristics of the river over a wide range of streamflow and lake elevation conditions.

Task 1 – Data Acquisition and Compilation

Data will be compiled from all known sources including work done on the previously mentioned studies. These data will include bathymetry, topography, suspended and bedload sediment, bed material, streamflow, stage, and velocity data. Additional bathymetric, topographic, and stream velocity data will be collected as required using survey grade RTK/GPS equipment and a variety of acoustic devices (echosounder, sidescan sonar, ADCP). All surveys will be performed using NAD 83 as the horizontal datum and NAVD 88 as the vertical datum. Additional sediment data will be collected using standard USGS sediment sampling equipment and methods.

Task 2 – 1-D Model Development, Calibration, and Validation

The 1-D sediment transport model will be constructed for the Coeur d'Alene River between the towns of Cataldo at the upstream end of the reach and near Harrison at the downstream end where the river flows into Lake Coeur d'Alene. The construction of the model will involve generating cross sections at approximately 0.5 km intervals throughout the study reach, characterizing the bed material makeup of the channel, and developing relations that define the sediment transport characteristics of the river. Suspended sediment transport curves will be developed from existing sediment and streamflow data. Bedload transport curves will be developed from a combination of existing data and through analysis of bed material samples using appropriate bedload transport equations. The hydraulic component of the model will be calibrated and validated to measured river stages at Cataldo, Rose Lake, and Harrison, while sediment transport components will be calibrated and validated with suspended and bedload sediment data collected at these same locations.

The project workplan would be finalized by March 2004. Task 1, data acquisition and compilation would begin in May and continue through October 2004. Task 2, 1-D model development, calibration, and validation would begin in October 2004 and would be completed by September 2005. Publication of final project report would occur in December 2005.

Implementing Agency: USGS

Deliverables: Quarterly progress reports will be prepared and presented at the Basin Information Forum. Annual technical presentations will also be made to acquaint potential model users with progress on model development, calibration, verification, and simulations. A formal USGS series report will be published that will describe all aspects of the study including the development, calibration, and verification of the hydraulic and sediment models.

Budget Requested: **$193,706**

Task 9: Simulation Model to Evaluate Coeur d'Alene Lake's Response to Watershed Remediation.

Eutrophication and metal contamination issues in North Idaho's Coeur d'Alene Lake have been the impetus for numerous investigations of the 130-km2 natural lake and its 9,700-km2 watershed. Several of the more significant investigations were conducted under Federal legislation; namely sections of the Superfund Act related to Remedial Investigation/Feasibility Studies (RI/FS), Natural Resources Damage Assessments (NRDA) and sections of the Clean Water Act (CWA) related to lake restoration, total maximum daily loads, and non-point source pollution. The Coeur d'Alene Basin RI/FS resulted in a Record of Decision that implements a long-term remediation of metal contamination within Coeur d'Alene Lake's watershed. A concurrent Lake Management Plan is to be implemented by a consortium of state, tribal, federal and local governments in order to control watershed-derived nutrient inputs to the lake.

Predicting the limnological response of Coeur d'Alene Lake to reduced nutrient and metal inputs is complicated by the interaction of eutrophication and metal contamination within the lake's water column and lakebed sediments. Zinc concentrations are known to inhibit phytoplankton growth in the lake; therefore zinc's suppressive effects will be reduced as watershed remediation reduces zinc inputs to the lake. As such, it may be necessary to reduce nutrient inputs to the lake in order to avoid extensive phytoplankton blooms that could then consume oxygen and lead to anoxic conditions in the hypolimnion with release of zinc and nutrients from lakebed sediments. The nutrient and metal supplies to the lake have their origin in the watershed and fluxes from its lakebed sediments. The in-lake water quality and ecological effects from these two sources of nutrients and metals result from a complex interaction of highly variable watershed inputs; lake hydrodynamics; and geochemical processes among nutrients, metals, ligands, and redox conditions.

Project Description: The goal of this project is to provide the entities responsible for management of Coeur d'Alene Lake with a sophisticated computer modeling system with which to simulate the lake's responses to a wide range of remediation strategies to be implemented under the Record of Decision and the Lake Management Plan. The project objective is to utilize existing, or to develop as needed, physical, chemical, and biological data in an existing suite of well-proven one, two, and three-dimensional lake models capable of simulating the limnological complexity of Coeur d'Alene Lake.

Much of the data necessary for simulation of limnological processes in Coeur d'Alene Lake is available from studies of the lake conducted by the U.S. Geological Survey (USGS) between 1987 and 2002. That extensive database will be augmented by a three-year study recently implemented to evaluate the interaction of metals, nutrients, and lake productivity over a range of spatial and temporal conditions. Limnological data generated by that study will be complementary to another project concurrently generating

concentration and load data for sediment, nutrients, and metals at the lake's two primary inflows, the Coeur d'Alene and St. Joe Rivers, and the lake's outlet to the Spokane River.

The modeling tools to be used as part of this study were developed by and are maintained by the Center for Water Research of the University of Western Australia. The three models include: DYRESM – Dynamic Reservoir Simulation Model is a one-dimensional lake hydrodynamics model that will be used for long-term scenario assessment. DYRESM has over 700 users in more than 60 countries. ELCOM – Estuary and Lake Computer Model is a three-dimensional lake hydrodynamics model that will be used for event-type scenario assessments. ELCOM has been applied in many countries, including a recent application to Brownlee Reservoir in Idaho. CAEDYM – Computational Aquatic Ecosystem Dynamics Model is an aquatic ecology and water quality model that runs coupled to either DYRESM or ELCOM. This model will be adapted to simulate the suppression of phytoplankton production in the Coeur d'Alene Lake, and will include the dominant phytoplankton groups. The model will also be adapted to simulate sediment release of metals and nutrients in Coeur d'Alene Lake under oxic and anoxic conditions.

Task 1--Coeur d'Alene Lake Data Synthesis

Data from the contributing programs detailed above will form an excellent set of boundary conditions for the proposed model application as well as providing sufficient data for a first pass at adapting the models to the metal and nutrient cycles operating in Coeur d'Alene lake. The additional algorithms needed to adapt the models to Coeur d'Alene Lake relate to zinc suppression of phytoplankton growth and the geochemistry of the lakebed's benthic flux. The bioassays conducted by the USGS during the early-1990's lake study will be repeated and enhanced in order to produce a more robust dose-response curve. Benthic flux studies have been performed on several occasions in the lake using diffusion-controlled samplers (peepers) or a benthic-flux chamber (lander). Data from these studies will be evaluated by several research chemists in order to develop benthic-flux algorithms for the lake model.

Task 2--Coeur d'Alene Lake Intensive Validation Study

In order to validate the three-dimensional hydrodynamics model ELCOM, an intensive validation study will be conducted on the in-lake routing of the Coeur d'Alene and St. Joe Rivers during a period of snowmelt–runoff inflow. This will consist of an intensive field experiment of several weeks duration, in which a large number of physical, biological and chemical parameters will be measured at scales ranging from the basin scale to the scales at which turbulence mixes the water. This experiment will be carried out under joint Australian-US funding and complement the long-term investigations under the Coeur d'Alene Lake Study. Results from the field study will provide a process-oriented dataset for intensive three-dimensional model validation.

The project workplan would be finalized by March 2004. Task 1, data synthesis, would begin in April 2004. Task 2, the intensive field experiment would occur in May and June 2004. The project would be completed by September 2006.

Implementing Agency: USGS

Deliverables: Quarterly progress reports will be prepared and presented at the Basin Information Forum. Annual technical presentations will also be made to acquaint potential model users with progress on model development, calibration, verification, and simulations. A model application manual will be prepared so interested parties may design and implement their own remediation scenarios.

Budget Requested: **$190,406**

Task 10: North Fork Coeur d'Alene River - Hydrologic and Sediment Yield Studies to Support Project Effectiveness of a Sediment TMDL Implementation Plan.

In response to the Clean Water Act §303(d) list for Idaho (1994/96 list), in which 34 stream segments of the North Fork subbasin were listed as "water quality limited", DEQ prepared and published the report Subbasin Assessment and Total Maximum Daily Loads of the North Fork Coeur d'Alene River (DEQ 2001). The report was submitted to the U.S. Environmental Protection Agency, and in February 2002, EPA approved sediment TMDLs developed for the North Fork subbasin, along with metals TMDLs for the Beaver Creek, Prichard Creek, and East Fork Eagle Creek watersheds. Idaho Code §39-3601 et. seq. establishes the requirement for DEQ to initiate the next step in the TMDL process, which is development and ultimate implementation of TMDL Implementation Plans.

By design, the sediment TMDL for the North Fork subbasin addressed current loading of the §303(d) listed pollutant of concern (i.e. sediment). The DEQ SBA and TMDL report stated, "the implementation plan that is drawn up to achieve the sediment allocations of the TMDL, can and should address other identified problems in a more holistic manner." A TMDL Implementation Plan aimed at restoration of in-stream channel conditions and ultimately the salmonid populations, will represent a considerable monetary investment. The current degree of uncertainty on causative agents, both legacy and current, may well result in ineffective solutions (e.g. restoration projects, BMPs, policy changes) without an improved understanding of the watershed dynamics. This funding will be utilized to study the various causative sources, gain a better understanding of heir loading, and position the development of a targeted TMDL implementation plan to address these sources.

From the assessment proposed under this task, a revised plan will be developed that will incorporate the strategy that management and reduction of upland nutrients and sediment in forested watersheds is best accomplished through the process of TMDL Implementation Plans as the required next step following EPA approval of TMDLs. Finally, the end result of this proposed grant project will be judged in the light of whether a more cost effective TMDL Implementation Plan is produced than otherwise would have been without the additional, focused, field investigations. If judged successful, than this approach may be desirable for the EPA approved sediment TMDLs of the South Fork Coeur d'Alene River, and watersheds of the St. Joe - Saint Maries Rivers.

Project Description: The underlying purpose of this grant proposal is that there is insufficient knowledge, and considerable debate, concerning the combination of root causes, both legacy and current, that have led to the observed channel condition and biological impairment in the North Fork Coeur d'Alene River. At this point in time, development of a sediment TMDL Implementation Plan may simply target improvements of the current unpaved road network (e.g. obliteration's, surfacing, culvert upgrades). It seems that there is little assurance that expenditures in this area will produce the desired restoration of the channel and biological conditions. A focused field investigation on the link between impairment and root causes should lead to an Implementation Plan with a more holistic approach and improved chance of cost effectiveness.

The goal of this project is to characterize and determine the existing hydrologic and in-stream conditions within the North Fork Coeur d'Alene River subbasin stream system, and attempt to determine the impact of past and current management actions on the observed stream function and ecological conditions. In turn, the above scientific assessment would lead to specific identification of restoration projects, BMPs, and land use policy changes aimed to restore proper hydrologic functions and the impaired cold water aquatic life beneficial use (i.e., salmonid populations). This grant proposal does not address the metals TMDL for the Beaver Creek, Prichard Creek, and East Fork Eagle Creek watersheds.

Phase 1: Study Approach Development

DEQ will convene a Technical Advisory Team (TAT) from staff of the U.S. Forest Service, U.S. Bureau of Land Management, Idaho Department of Fish and Game, and the Idaho Department of Lands, to develop a study design and detailed work plan for the North Fork Coeur d'Alene River - Hydrologic and Sediment Yield Study. There will be three general subtasks of the TAT:

1. Develop an approach that will lead to a summary document of what scientifically is known about the existing hydrological and in-stream condition of the North Fork Coeur d'Alen River system, and the impact of past and current management actions on the observed stream function and ecological condition. The purpose of this subtask is to summarize and concur what is confidently known about the watershed system. This effort is to avoid duplication of existing and documented knowledge during the work conducted under the CWA grant

2. Develop a study approach for Phase 2 that fulfills the intent of the CWA 104(b) grant proposal. That is, gather the most useful scientific data of what is not known, or uncertain, about the observed ecological condition, and along with the results of Task 1 above, will lead to specific identification of restoration projects, BMPs, and land use policy changes aimed to restore proper hydrologic functions and the impaired cold water aquatic life beneficial use (i.e., salmonid populations). The results of this subtask would only be to design a study approach to further define and identify significant contributors to the currently observed impairment of channel conditions, instream habitat, and biological

condition. By putting together the results of subtasks1 and 2, it is anticipated that a Watershed Advisory Group (WAG) will have an improved set of information to establish the restoration projects, BMPs, and land use policy changes that will comprise the TMDL Implementation Plan. The CWA grant project will not be used to establish these implementation plan components.

3. Based on subtasks 1 and 2 above, the TAT would work with IDEQ contractor TerraGraphics to develop a Request For Proposal (RFP) to solicit contract bids to conduct Phase 2. Subtask 3 would include a committee review of submitted proposals, select contractor, and develop the contract.

Phase 2 - Conduct Hydrologic and Sediment Yield Study

Phase 2 will be to implement the work plan developed under Phase 1. This is envisioned to be a 2 year field investigation within the North Fork CDA River watershed. The results of this study will help guide the development of a TMDL implementation plan.

Implementing Agency: Idaho DEQ

Deliverables: Deliverables from this project will include 1) a detailed work plan developed under Phase 1. This will be presented to the TLG for review and comment prior to implementation. During Phase 2, annual updates on results and findings from the watershed investigation will be presented to the TLG and Basin Commission. A final report, summarized methods, procedures, results and recommendations will be presented to the Basin Commission. The final report will be complete in April 2007.

Budget Requested: **$165,810**

Task 11 - Mica Bay Nutrient Reduction Project

Land use changes and development pressures in the Coeur d'Alene Lake watershed have greatly accelerated nutrient enrichment of the lake. The presence of heavy metals on the lake bottom necessitate that nutrient enrichment be minimized to prevent the formation of anoxic conditions. This strategy will insure metals stay chemically bound to bottom sediments, protecting lake water quality.

This project is a demonstration and training project for other wetland delta landowners that otherwise idle unusable lands that can be altered in a fashion to provide a public benefit of lowering nutrients to the near shore areas of Coeur d'Alene Lake. Right now these landowners have no information on if a project such as this would work, how to design it, its cost, and its collateral affects on their land. This project is not a routine restoration job. This is a 50 square mile lake fed by mountain streams. The lake is artificially flooded then dropped many feet to generate electricity. There are also rain-on-snow events that can fill the lake periodically during the winter. The fluctuating water levels create many design challenges. By tackling the many difficult design aspects offered by this unique site, we can have some answers about projects costs , project

success AND have a project on paper and to observe to educate and train interested landowners that will hopefully overcome the obstacles to their participation.

Nutrients enter the lake often attached to sediment particles; thus reducing sediment will reduce nutrient pollution also. Effects of sedimentation and nutrient enrichment are apparent in the shallower bays, such as reduced water depth, increased aquatic weed growth and loss of fish spawning habitat. These things happen naturally over time, but are often greatly accelerated due to human activity. Since there are many sources of nutrients and sediment, an extensive array of measures must be utilized to prevent accelerated aging of a lake. This proposal, to re-activate one of nature's natural water cleansing systems, is one measure to slow down that aging process. It is a non-regulatory approach, utilizes simple construction techniques, and provides for protection of strategically located wetlands and should be easily reproducible for other interested landowners.

Most of the nutrient and sediment loading to the lake occurs during peak flow events. Historically, extensive wetland deltas filtered stream water during out-of-bank flows, settling sediments, utilizing nutrients and recharging groundwater. Due to a variety of human caused impacts, such as the channelization of Mica Creek and subsequent channel entrenchment, floodwaters can no longer reach much of their floodplain. If this function could be restored in an economic fashion, it could be implemented at the mouth of similar lake tributaries to help protect bays from nutrient enrichment and reduce sedimentation. Due to the artificially regulated lake levels, bank stability is also a problem in channels that receive lake backwater. The project will address what is necessary to stabilize these areas.

Project Description: This project will demonstrate for training and education purposes a means of reducing nutrient and sediment pollution to Coeur d'Alene Lake in accordance with the implementation of the Coeur d'Alene Lake Management Plan. It will also accomplish some TMDL implementation goals for the recovery of beneficial uses in Mica Creek.

The proposed project involves stabilizing the lower 900 feet of Mica Creek and restoration of the adjacent 17.6 acres, mostly wetlands. The goal is to filter out sediment laden spring flows by better utilization of adjacent wetlands and to prevent further bank sloughing caused by lake pool elevation changes and stream channelization. A conservation easement would insure that these improvements to protect lake water quality would remain in place. If successful, this technique could be used in similar tributaries with poorly functioning wetland deltas, as part of an overall nutrient and sediment reduction program.

Specifically, the project consists of a diversion that would be constructed to allow flood waters from Mica Creek to access adjacent wetlands. An irregularly shaped sedimentation/wildlife pond would be excavated to receive the flood waters. Runoff from the pond would sheet flow over the remaining wetland area and returned to the creek through an existing meandered secondary channel. This secondary channel is probably the original channel before the stream was straightened. The banks of Mica

Creek would be stabilized with riprap and additional woody vegetation. The bed of the creek would have grade control structures placed in it to prevent further down cutting of the channel. A minimally restrictive conservation easement would be developed to insure wetland functions are protected.

Monitoring will consist of permanently anchored marked stakes, placed in the new pond at various locations so sediment accumulation can be easily recorded each year after runoff. For the first three years, marked photo points will record spring flows over critical areas of the project to insure they are functioning properly. Photos will also be taken during low flow conditions to assess the stability of the project. After the first three growing seasons, turbidity will be monitored above the diversion and at the outlet of the overflow channel just before it enters the mainstem of Mica Creek. This will be repeated for three years, once per month, during spring runoff. Yearly reporting of these monitoring efforts will be conducted by the contractor or the landowner and housed at DEQ. The final report will be used to train and educate landowners on the potential for similar projects on their property to improve water quality in Lake Coeur d'Alene.Implementing Agency: Idaho DEQ

Deliverables: A project design will be prepared and submitted to the TLG for review and comment. A post construction report will be provided to the Basin Commission along with annual monitoring results summaries.

Budget Requested: **$142,386**

Task 12: Lower Lakes Aquatic Vegetation Survey

The Coeur d'Alene Lake Management Plan contains lists of proposed, generallized, management actions put together by several advisory workgroups. The South Lake Workgroup, in particular, produced a list, which focuses attention to sediment and nutrient loading from tributary streams and rivers. This list also includes one in-lake action; that of reducing nutrient loading by harvesting macrophytes (submersed aquatic vegetation). This action is given a top priority but no progress has been made on this to date.

A related issue in the Coeur d'Alene Lake area is the potential for infestation by the noxious, invasive plant Eurasian watermilfoil (Myriophyllum spicatum). This plant has been found in most of the nearby lakes in Idaho and Washington (Hayden, Spirit, Pend Oreille, Liberty and Newman Lakes in particular) and is known to be introduced into un-infested waters via fragments which can be carried on boats and boat trailers. This plant represents a significant threat to lake beneficial uses including fish and wildlife habitats. Once this plant becomes established it is virtually impossible to eradicate and with continued spreading, control can be routine and costly.

Project Description: The proposed project has been designed to address significant data gaps on aquatic vegetation present in the three lakes which surround the mouth of the St. Joe River at the south end of Coeur d'Alene Lake: Benewah, Chatcolet and Round Lakes.

These lakes are each shallow systems with considerable potential to support submersed plant communities. This study is warranted by the following needs:

• need for biomass and distribution data on which to base harvest plans and effectiveness assessments,
• need for species-specific nutrient content data to develop estimates of nutrient release (loading) to the three lake systems and CDA Lake proper (this also would effect harvest plans), and
• need for surveillance to document the presence or absence of invasive, noxious aquatic species such as Eurasian watermilfoil.

These needs are also apparent for Coeur d'Alene Lake as well, where little data on aquatic vegetation exists, let alone a comprehensive lake-wide database. Once completed, the proposed study is expected to allow development of sampling protocols that can be expanded to the larger lake system.

The primary purpose of this study is to develop baseline data on submersed aquatic plant species distribution and biomass in Benewah, Chatcolet and Round Lakes. The secondary purpose is to estimate nutrient (primarily phosphorus) release from the existing plant beds into the water column of these lakes and, subsequently into Coeur d'Alene Lake. The tertiary purpose is to inspect these lakes for the presence of invasive, noxious aquatic species.

Specific objectives are to perform diver collection of submersed aquatic vegetation species along set transects, and to perform additional sampling at randomly selected grid intersections using remote (rake-on-a-rope) techniques. All diver-collected samples shall be sorted by species and each species sample dried to obtain a standard biomass estimates. Subsamples of diver-collected plants shall be analyzed to determine nutrient (primarily phosphorus) content. Samples collected at grid intersection sites shall be sorted to identify species present. Based on the nutrient content data and published literature on species specific nutrient release rates, estimated nutrient loading from submersed plants will be calculated.

1) Survey transects: The proposed transect survey will be performed during the mid-July to mid-August period (the time of the expected seasonal maximum plant biomass). The quantitative sampling proposed for this study is a modification of a "line intercept" method (APHA, 1992) where samples are collected along a fixed line which is oriented from a start point on shore by a compass heading. Along this line samples will be collected using SCUBA techniques at fixed intervals using a "quadrat"; a fixed-corner, three-sided frame that defines a standard sampling area (likely 2.0 feet square which equals four square feet or 0.37 square meters). At each designated sampling location along the transect line, the quadrat is placed on the lake bottom under and around any plants present and said plants are collected by hand and
placed in a mesh bag. The mesh bag is then taken to the surface and given to a boat attendant who transfers the sample to a plastic bag labeled with the site identifiers and water depth. The diver will also collect a separate sample of each species present for nutrient content analysis. At an onshore location, all collected plant materials will be

rinsed to remove silt and foreign material, sorted by species and placed in additional bags for weighing, drying and reweighing by a contract laboratory. Biomass and nutrient content analyses (for phosphorus and nitrogen compounds) will be performed following standard methods (APHA 1992 or more recent).

This study is planned as a two-year effort. There are 21 transects planned for the first year. For the second year several (up to five) transects will be re-sampled as an effort to determine variability. Up to 16 new transects will be laid out and sampled, based on the species distribution seen in the initial 21 transects. Data from the transect sites will be tabulated and described in a project completion report.

2) Grid sampling: For this effort a grid with 100 meter intervals each way will be set up across the lower three lakes using GIS mapping techniques. Grid intersections (nodes) that fall on land will be deleted and numerical identifiers will be designated for the remaining nodes. 360 randomly selected nodes will be sampled and a list of coordinates for all sites (nodes) to be sampled will be developed. Using GPS equipment, each site to be sampled will be located and two tosses made with a weighted "rake-on-a-rope" (i.e. off each side of the boat). Species present in each toss at each sample site will be recorded. This sampling is to be performed following the transect surveying (i.e. mid August to mid-September). During the second year of the survey a second set of 360 grid nodes will be selected and sampled using the rake-on-a-rope method. Data from the grid sites will be tabulated and described in a project completion report.

3) Milfoil inspection: This will be a one-time effort which will involve using SCUBA techniques to inspect the area around (within 100 meters radius) of the three existing boat launches (Chatcolet, Rocky Point, Benewah Lake) for presence of EWM or other nuisance species. Two divers and a support boat / operator with GPS capabilities will be complete this work in six days. A sample of any suspect plants will be collected and submitted to expert review if there is any doubt of the specific species.

4) Nutrient Release research: A literature search and communications with university researchers and others will be performed to collect available information on nutrient release from aquatic plant species. This will be performed following the first years sampling and will focus on those species that are found to be present.

Implementing Agency: CDA Tribe

Deliverables: A project completion report will be prepared at the end of year 2 that includes a summary of materials and methods, summary of plant biomass seen for each species collected with year-to-year variations, summary of grid node survey findings, calculation of release of phosphorus and nitrogen from existing population as lake-wide loadings and appropriate statistical analyses. Any identified EWM will be discussed and mapped.

Budget Requested: **$143,275**

Task 13: Canyon Creek Groundwater Metal Source Characterization

Location and Ownership Woodland Park Area of Canyon Creek.
Hecla Mining Company has ownership in this area. Initial contact with Hecla's legal department indicated that access would likely be granted for this project.

Project Description
Purpose:
The purpose of the work proposed herein is to begin characterizing the alluvium of Canyon Creek in terms of total metals loadings, and the role the alluvium plays as a source or sink for metals in surface water entering the South Fork of the Coeur d'Alene River. This investigation will give priority to characterizing the mass and potential release rates of zinc, cadmium and lead in these sediments. The project will focus on the Canyon Creek alluvium upstream from an anticipated water treatment facility (Woodland Park) near the confluence of Canyon Creek and the Coeur d'Alene River. The premise of the proposed work is that the exchange of metals between alluvium and groundwater serves as an important regulator of the metal concentrations in the groundwater that feeds Canyon Creek and thus the metal concentrations within the creek. Understanding the geochemical conditions of the alluvium and the exchange mechanisms of metals between the groundwater and the alluvium particles will be important for possible surface water treatment as proposed in the ROD (Section 12.2.1, pp 2-25 & 26). Information from this project will also provide valuable information for the five-year review process in the 30-year period outlined in the ROD. The ROD states that the Selected Remedy (Alternative 3) will focus on identifying cost-effective technologies for improving downstream water quality. Table 12.2.1 of the ROD describes the remedial action as "Cost-effective approaches for Canyon Creek which may include pilot and demonstration projects for treatment of creek water and groundwater near the mouth such as permeable reactive barrier or other technology, potentially including active technology components."

The products of the proposed work will provide information to assist with evaluation of effectiveness and the necessary duration of alternative treatment strategies rather than focus on water treatment technologies per se. The rate of release of zinc and other metals from the source materials in the alluvium controls the mass of metals in the water and impacts the long-term costs of water treatment. Understanding the mechanisms and rates of release from the source into surface water and groundwater will allow evaluation of effective management strategies for groundwater/surface water interactions or options for enhancing or reducing leaching prior to water treatment.

Background:
Metals leached from mine wastes in the Coeur d'Alene Basin have increased zinc and cadmium concentrations in the South Fork of the Coeur d'Alene River and its tributaries far above ambient water quality standards. Canyon Creek contributes the greatest load of zinc and cadmium into the South Fork upstream of the "Box". The ROD and the Five-Year Plan for Basin remediation recommends water treatment at the mouth of Canyon Creek as a means of reducing metal loading into the South Fork.

The hydrology of Canyon Creek area is characterized by an alluvial aquifer with a high degree of interconnection between the groundwater and surface water. The USGS

described a reach of Canyon Creek through the Woodland Park area where the groundwater discharging into the stream contributed about 150 pounds of zinc per day during low flow conditions (Barton, 2002).

Barton explains that sources of dissolved metals in groundwater and surface water could include dispersed tailings, contaminated flood-plain deposits, and contaminated sediments in active and abandoned stream channels. Water moving through these contaminated sediments enters valley-fill aquifers and transports dissolved metals along ground-water flowpaths to gaining stream reaches. Barton's study shows that, "At Canyon Creek at Woodland Park, the predominance of ground-water loading of dissolved zinc occurs along a surprisingly short subreach between stations A-4 and A-6, length roughly 2,800 feet".

The conclusions of Barton's study are consistent with those in the Box et al, (1997) report in which they say that about 80% of the dissolved metal load to the South Fork is derived from historic floodplain deposits of river borne tailings that commonly contain several percent each of lead and zinc and are 1-6 feet thick. Box et al. (1997) go on to say that "Dissolved metals are leached into the underlying floodplain aquifer by percolating rainfall and snowmelt or rising groundwater. The permeable floodplain aquifer rapidly routes water from losing stream reaches to gaining stream reaches, efficiently transferring dissolved metals from floodplain soils to the stream". The materials comprising the permeable floodplain aquifer that contains metals previously leached from mine waste are described by Paulsen et al., 1996 as alluvium and reworked tailings below the floodplain tailings.

Analysis done for the Feasibility Study Report (EPA, 2001a) concludes that the expected value of dissolved zinc loading from Canyon Creek is 556 pounds per day or about 19% of the dissolved zinc load in the South Fork at its confluence with the North Fork. More than 50% of the dissolved zinc load from the Canyon Creek watershed comes from the Woodland Park subreach. The Feasibility Study identified two potential significant sources in the subreach, the Hecla-Star tailings pond and the impacted floodplain sediment.

Over 90% of visibly contaminated sediments (about 472,000 cubic yards) from the floodplain were removed by the Silver Valley Natural Resource Trustees (SVNRT) in 1996-1997. The material removed by the SVNRT was likely what Paulson describes as floodplain tailings. The reworked tailings and contaminated alluvium below the floodplain tailings that were characterized by Paulson were not removed.

The Feasibility Study describes an unpublished analysis by Box (2000) of MFG data suggesting a decrease in zinc concentrations in groundwater to a range of 3,000 to 30,0000 µg/L from the removal of sediments by the SVNRT. Analysis of surface water by Harvey (2000) shows a decrease in zinc load during high flow events following the removal of floodplain tailings.

By mechanisms of desorption or other processes, the reservoir of metals in the remaining alluvium and reworked tailings (particularly the fine fraction) serves as a source of metals

to the groundwater (Paulson, 1996). Column leaching tests of the composite samples generally showed pH conditions between 4 and 5 in alluvium and between 5.5 and 6.5 in reworked tailings. Average dissolved zinc concentrations ranged from 42,500 µg/l in leachate from the reworked tailings to 58,100 µg/l in leachate from the alluvium. It is the mechanism of this release of metals from the alluvium and reworked tailings that will be investigated through this proposal.

A cursory look at the mechanism of zinc transfer between sediment and water is provided in the Remedial Investigation Report, Appendix G (EPA, 2001b). Based upon a comparison between aqueous concentrations of zinc predicted by a published soil adsorption relationship with the measured concentrations in the surface water of the Coeur d'Alene Basin, EPA concluded that adsorption was not expected to control aqueous concentrations of zinc. Although adsorption is not the mechanism expected to control aqueous concentrations of zinc, URS calculated K_d values from corresponding zinc concentrations in sediment and dissolved concentrations in water. The median K_d value was determined to be 53 mL/g with a range of 1 mL/g to 21,009 mL/g.

Objectives

This study is designed to provide key information about the loadings and capacity of Canyon Creek alluvium for zinc, cadmium and other metals, the rates at which the metals can be removed from two major source materials in Canyon Creek, reworked tailings and alluvium, and what natural or engineered conditions will affect metal leaching. This understanding is necessary to assess the effectiveness of water-treatment options and to estimate the duration of treatment that will be necessary for source depletion regardless of whether the groundwater is withdrawn by natural discharge to the creek or by active pumping. In addition, knowledge of the mechanisms of source depletion may provide insight to potential methods for modifying the leaching rate through engineering means. Acceleration of the leaching rate may be desirable in the early phases of water treatment to increase the mass of metals removed. After much of the source is removed, reducing the leaching rate may allow termination of costly water treatment. Alternatively, knowing what types of natural or engineered events could lead to metal release to Canyon Creek could help avoid exceeding the design capacity for water treatment.

The leach rate and source depletion terms will be available to hydrologists and engineers to construct models to estimate the mass balance of metals as a function of input, outputs, and residence time within the sediments. Predictive box models will require reasonable estimates of the mass of metals in the sediments, equilibrium partitioning between contact water and sediments, and a comparison between the rates of leaching and rates of water movement through the sediments. Such models could be used to examine the influence of residence time and to provide additional basis for making informed decisions on remediation strategies, such as continuous or pulsed extraction to help minimize the operational costs of water treatment.

Project Approach/Methodology

Design/Engineering:

The subject of this proposal is the alluvial material and reworked tailings and sediment currently in contact with the groundwater. Sampling of the sediment and laboratory

analysis will be conducted to evaluate material characteristics in terms of known biogeochemical processes that affect metal mobility and the specific properties. A detailed sampling plan will be prepared for open review as the first phase in this effort.

Locations for INEEL sampling will be proximate to the sample points between A4 and A6 in Barton (USGS, 2002) so that the foundation of understanding of the source of metals to the surface water can be built upon. This investigation is designed to 1) provide information on the mechanisms of metal exchange between alluvium and groundwater and 2) begin characterization of the alluvial materials and the subsurface geochemical conditions. Spatial characterization and estimating the overall mass of metals in the reservoir of the alluvium could be achieved as a follow-up effort, but the extent of sampling in the currently proposed effort is not sufficient for those purposes.

It is thought that the most effective location is one with significant and consistent groundwater recharge to the stream such as slightly downstream of Barton's A4 location, which is near the upstream end of where the stream channel begins to narrow. This area is also downstream of the Hecla-Star tailings ponds and the SVNRT tailings repository so that any and all impacts from these sources are integrated in the groundwater that interacts with the alluvium. There is no intention of investigating contributions to the metal load in Canyon Creek from specific sources such as the Hecla-Star tailings ponds or the SVNRT tailings repository.

The precise sampling locations will be selected after a site visit with the Water Treatment Project Focus Team (PFT) and other interested parties. In addition, selection of sampling locations and depths will draw upon information in well logs and data from groundwater monitoring wells installed in this area. The data from coincident sediment and water samples collected from the varying depths by URS in 1998 will be useful for developing the sampling plan. Sampling should be done under low flow conditions to capture steady-state relationships between the chemistry of the groundwater and the solid material. Although available groundwater data collected from wells in Canyon Creek will be compiled and used as a resource in selecting the exact locations and depths for sample collection this effort will not address the temporal and spatial groundwater concentrations represented by the history of data from groundwater monitoring wells.

Selection of the most appropriate sampling equipment and tools is still under consideration. The goal is to recover relatively undisturbed sediment samples from known depths. INEEL is drawing upon corporate resources and experience to develop a sampling recommendation. Depending upon the costs and logistics, it is envisioned that samples may be taken from 3-5 locations to depths down to 8 feet. Samples of groundwater in contact with sediment samples will also be collected.

Most laboratory tests and data reduction will be conducted at the Idaho National Engineering and Environmental Laboratory unless subcontracting routine analysis or involvement of collaborators is a more cost-effective approach.

Sample And Metal Characterization Methods:

It is anticipated that the laboratory phase will be a combination of carefully constructed column and batch leaching tests that will be used to simulate leaching under pumping and non-pumping conditions. Experiments will be conducted on different size fractions of material. Analysis of the leachate and the solid material will provide data to calculate kinetic factors and to estimate changes in the source concentration and leach rate through time. Analysis of the leachate will include metals and other constituents, measurement of geochemical parameters and indicators of specific microbial activities. Analysis of solid material will likely include bulk analysis, x-ray diffraction, and electron microprobe. Analysis using an x-ray synchrotron may be available at no cost for beam time to look at oxidation states and speciation of mineral phases.

As discussed, the primary characterization requirements in this project are: 1) the mass loadings of metals in a selection of sediment samples, 2) the state of partitioning of the metals between the pore fluids and solids, 3) operational definitions of metal speciation that are linked to the extractability and potential leaching rates for the metals, and 4) a measure of the rates of release of metals to the infiltrating solutions. The characterization methods that follow are well established and designed to provide an appropriate level of practical information that is appropriate for the goals of this project.

***Sample preservation techniques**:* Sample preservation techniques will conform to standard practices. pH, conductivity, and redox potentials of pore fluids, when taken, will be performed on site. Sediment samples will be preserved at 0'C for transport to the INEEL in order to inhibit microbial growth. Samples of pore fluids will be treated by filtration on site and preserved near 0'C for transport.

Total metals: Total metal concentrations can be analyzed using total digests of sediment samples and inductively coupled plasma emission spectroscopy. This can be performed either at the INEEL or by subcontract if deemed more cost effective. Metal concentrations in pore fluids can be determined using the same methods.

***Sediment characterization**:* Information on sediment characterization is available in previously published reports. This information will be used as a guide for additional characterization needed to establish variability in the collected samples, and for correlation to characterization of the metal partitioning and leachability. The basic information that will be collected includes grain size distributions, and general mineralogical composition. Established methods will be applied, and include sieving/settling analysis, electron microprobe analysis (elemental analysis and mineral composition), and standardized sequential extractions.

Analysis of metals by extraction methods: The primary emphasis in this project will be a practical measure of metal speciation that can be related to observed leaching rates and leachability under field conditions. For this purpose, a graded extraction approach will be used. The actual extraction steps used may be modified based on the preliminary sample characterization and additional methods, however the steps that are anticipated include: 1) ammonium exchange (weakly bound, exchangeable metals), 2) citrate extraction (sensitive to amorphous iron oxide), 3) DCB (dithionite, citrate, bicarbonate) extraction (sensitive to crystalline iron oxides), 4) Acid volatile sulfides, 5) Total reduced inorganic sulfur, and 6) Total digests for elemental analysis.

***Leachability and leaching rates**:* Batch studies will be used to measure the rates of release of metals in response to variations in pH, Na/Mg/Ca as exchangeable cations,

pore waters collected from the sediment sample sites with and without additional dissolved metals, and artificial groundwaters that are representative of conditions expected in the Canyon Creek system.
Column extraction tests: Results from the series of characterization methods will provide the information needed to predict the number of pore volumes, and flow rates, that should result in the removal of specific quantities of metals from the sediments. To verify how reasonable the predictions are, column tests will be conducted using equivalent samples from Canyon Creek with infiltrating fluids that represent the groundwater properties.

In some cases, simple chemical solubilities and adsorption do not adequately predict the actual leachability of a metal from its matrix. The activity of bacteria that colonize tailings at densities as high as one million cells per gram can alter leaching kinetics, causing models to inaccurately predict leaching loads and rates. The activities of key bacterial groups will be examined in this study to determine if modified rate terms for some reactions are appropriate.

The outcome of these tests will be the values of parameters that, when combined with knowledge of the hydrologic system, will make it possible to estimate the long-term impact of the Canyon sediments on metal concentrations in the surface water. The parameters will be those that quantify the rate and extent of exchange of metals between pore water and sediments.

Permitting Considerations: No permits are anticipated for this study, however the sampling will be done in compliance with State and Local best management practices for subsurface disturbances in the floodplain.

Construction & Contracting Plan: A contract with INEEL will be developed for overall project responsibility, laboratory testing and data evaluation. A specialized contractor will be selected to provide appropriate sampling equipment and labor.

Monitoring: Field monitoring is not anticipated for this study although samples of groundwater will be collected. Data will be collected through laboratory tests designed to reproduce the leaching mechanisms characteristic to the Canyon Creek alluvium.

Reporting: INEEL will prepare progress reports and a final report. The reports will present the laboratory data and its interpretation. In addition, the reports will review related information developed in previous studies such as those by Bureau of Mines, University of Idaho, IDEQ, Silver Valley Natural Resource Trustees, and EPA.

Projected Benefits
Information on the rate of source depletion will improve the estimates of duration of water treatment and the long-term O&M costs. In addition, information on the geochemical mechanisms of metal leaching provides opportunity to modify the leaching rate to improve the cost-effectiveness of a water treatment system or maybe even eliminate the need for long-term treatment.

Proposed Schedule
Project planning would commence in the spring of 2004. Sampling would be planned for late summer 2004. Laboratory testing and the final report would be completed approximately 9 months after the samples are obtained.

Implementing Agency: Idaho National Engineering and Environmental Lab

Budget Requested: **$190,253**

Other Potential Funding Sources or Leveraging Opportunities
Opportunities are being explored for leveraging other geochemical research funds to enhance the breadth of this proposed study. It is likely that the budget can be augmented by $40,000 - $50,000 from the Superfund Technical Support funds. The additional funds would allow the collection of more samples and their analysis.