A COMPRENDIUM OF ONGOING AQUATIC RESOURCE STUDIES

IN THE CLARK FORK/ LAKE PEND OREILLE BASIN

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A COMpendium of oNgoInG aQUATIC reSource sTUDIES
IN THE CLARK FORk/laKE PEND oREille BaSiN

JANUARY, 1986

PREPARED BY:
KEn KNudSON
CLARK FORK RIVER BASiN PROJeCT
Montana Governor's Office
Helena, Montana 59620

PaRtNERs:
[Names and organizations]

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STUDY NUMBER: 1.1

ORGANIZATION: Montana Bureau of Mines and Geology (MBMG)

TITLE OF STUDY: Hydrogeologic Monitoring of the Colorado Tailings Area, Butte, Montana (prepared for the Department of State Lands via contract).

CONTACTS: Ted Duaime - MBMG - 496-4157
Ben Mundie - MDSL - 444-2074

OBJECTIVE: Characterize the mobilization of heavy metals within the Colorado Tailings; determine the resulting impacts to surface and groundwater; prepare a rationale for reclamation needs and alternatives.

DURATION: 1982 - 1987

CURRENT STATUS: The Colorado Tailings are abandoned mine wastes, averaging about five feet in thickness and covering 30 acres of Silver Bow Creek and its floodplain. They are located just downstream from the Butte Metro Wastewater Treatment Plant.

Beginning in 1982, MBMG began collecting water quality and core samples near and within the tailings. Approximately 25 test wells were monitored monthly for numerous water quality parameters and static water levels from 1982 through early 1985. Comprehensive water quality sampling has been less frequent in recent months, although specific conductivity, temperature and static water levels are routinely monitored.
Quarterly reports, covering activities associated with the study, are available from the MBMG in Butte. In December 1984, the MBMG also published an interim report, "Hydrogeology of the Colorado Tailings Area, Butte, Montana." This report was summarized in a paper presented at the Montana Academy of Sciences meeting in Butte on April 19, 1985 (to be published in the proceedings of the MAS in the winter of 1986).

The above data and reports have provided a basis for the reclamation designs to be utilized by the Montana Department of State Lands at the Colorado Tailings (see Study 3.1).

Future Activities: Specific conductance, temperature and static water levels will continue to be monitored monthly. Two comprehensive water quality sampling episodes are planned for the winter and late spring of 1986. Monitoring will continue during, and up to 18 months after, any reclamation activities at the site.
STUDY NUMBER: 1.2

ORGANIZATION: Montana Bureau of Mines and Geology (MBMG)

TITLE OF STUDY: Intensive Butte Area Groundwater Monitoring

CONTACT: Ted Duaime - MBMG - 496-4157

OBJECTIVE: Assess the impacts to groundwater (quality and quantity) caused by shutdown of mining activities in Butte.

DURATION: 1984 - ?

CURRENT STATUS: Pumping of the underground mine workings on the Butte Hill ceased in April, 1982. Water is now flooding these areas and the Berkeley Pit at a rate of 3,000 to 10,000 gallons per minute.

Comprehensive water quality sampling for common ions and heavy metals was routinely conducted within the abandoned mine shafts, the Berkeley Pit (including vertical profiles) and from several shallow groundwater stations during the first year of the study. The most recent comprehensive water quality sampling of the mine shafts was conducted in October, 1985. However, monthly specific conductivity, temperature and static water levels have been monitored for the last two years. All monitoring efforts have been closely coordinated with the Anaconda Minerals Company, the US Geological Survey and Montana Department of State Lands. Data summaries can be obtained from the MBMG in Butte. No interim or final reports have as yet been published.
FUTURE ACTIVITIES: This project was originally funded by a grant from the 1983 Montana Legislature. No additional funding for comprehensive water quality sampling has been received, except for a small grant from the Butte Silver Bow City-County government. Consequently, future investigations will be limited. Two water quality sampling episodes will occur in the spring of 1986. Less expensive monitoring, like monthly specific conductivity, temperature and static water level measurements will continue.
STUDY NUMBER: 2.1

ORGANIZATION: Montana Department of Fish, Wildlife and Parks (MDFWP)

TITLE OF STUDY: Instream Flow Reservation Studies - Upper Clark Fork River

CONTACTS: Larry Peterman - MDFWP - 444-3888
          Gerhard Knudsen - MDNRC - 444-6601
          Dennis Workman - MDFWP, Missoula - 721-5808
          Glenn Phillips - MDFWP, Helena - 444-2406

OBJECTIVE: Quantify the year-round instream flow requirements for game fish in the upper Clark Fork River and prepare an application to the Board of Natural Resources to reserve these flows.

DURATION: January 1984--completion of instream flow reservation

CURRENT STATUS: Recreation, fish, wildlife and wetted perimeter information has been collected on the upper Clark Fork and its tributaries. Inflection points (minimum flows) have been calculated for several stream reaches utilizing wetted perimeter/stream discharge curves.

Extensive fish population monitoring has been conducted on all major tributary streams in the upper Clark Fork Basin. As assessment of water quality needs for trout populations in the mainstem has been prepared.

During the extremely low flows of the summer of 1985,
photo stations were established for several stream segments. Channel appearance was photographed at various stream flows.

Subcontract reports available from DFWP in Helena, include:

"Irrigated Land Assessment of the Upper Clark Fork Drainage" (October, 1984),

"Refinement of Recreational Value Estimates on the Upper Clark Fork River" (June, 1984).

**FUTURE STATUS:** A draft instream flow application is scheduled to be completed in the winter of 1986. This document will present the minimum instream flows needed to protect and enhance the trout fishery on four reaches of the upper Clark Fork and on all its major tributaries (excluding Rock Creek which is protected by earlier legislation). Completion of this application will trigger the EIS process, with the Montana Department of Natural Resources as the designated lead agency.
STUDY NUMBER: 2.2

ORGANIZATION: Montana Department of Fish Wildlife and Parks (MDFWP)

TITLE OF STUDY: Studies Associated with the Collection of Background Data for the Natural Resources Claims Lawsuit

CONTACTS: Jim Posewitz - MDFWP - 444-2603
          Stan Bradshaw - Attorney - MDFWP - 444-4594
          Frank Crowley - Attorney - MDHES - 444-2630

OBJECTIVE: Assemble data to quantify damages caused by the Anaconda Minerals Company to the upper Clark Fork River in preparation for a $50 million Natural Resource Claims lawsuit (as per Section 107 of CERCLA).

DURATION: November 1984--settlement of lawsuit

CURRENT STATUS: A consultant was hired by DFWP to substantiate the damages that have occurred and are continuing to occur to the recreational and fisheries resources of the river. Preliminary qualification of these damages are contained in a report which is available from the DFWP in Helena:

"A Preliminary Assessment of Impacts to the Trout Fishery Upper Clark Fork River, Montana" (July, 1984)

Further data collection is occurring as part of several ongoing water resource investigations in the upper Clark Fork Basin.
FUTURE ACTIVITIES: In the autumn of 1984, the State of Montana and the Anaconda Minerals Company agreed to a Stay of Proceedings in the lawsuit until: 1) the Butte-Silver Bow RI/FS (Superfund studies) are finalized, and 2) the US Department of Interior promulgates Natural Resource Damage Assessment Regulations pursuant to Executive Order Number 12316 (August 14, 1981).
STUDY NUMBER: 2.3

ORGANIZATION: Montana Department of Fish Wildlife and Parks (MDFWP)

TITLE OF STUDY: Evaluation of the Effects of Pulp and Paper Mill Effluents on the Fish Populations of the Middle Clark Fork River

CONTACTS: Pat Graham - MDFWP - 444-3186
Dennis Workman - MDFWP, Missoula - 721-5808
Rod Berg - Project Biologist - MDFWP, Missoula - 721-5808

OBJECTIVE: Obtain fishery and aquatic baseline data on the Clark Fork River and determine if present (or additional) quantities of treated pulp mill waste from Champion International's Frenchtown Mill is having (or will have) a detrimental effect on the river's trout populations.

DURATION: July, 1984 - July, 1986

CURRENT STATUS: Trout population estimates have been conducted at one section above the mill (from the Bitterroot to Harper's Bridge) and at one site below the mill (near Superior). The suitability of the intergravel environment for trout egg survival has been evaluated by water sampling (using standpipes) and in-site bioassays. The bioassays, using brown trout eggs, were conducted during the winter and early spring of 1984-85. Three sites were evaluated: Near the Council Grove area, below Champion International and near Cyr. Two progress reports, available from DFWP in Missoula, have been prepared:
"A Field Bioassay of Potential Effects of Champion Pulp Mill Effluents on Brown Trout Egg and Sac Fry Survival in the Clark Fork River" (April 15, 1985)

"Middle Clark Fork River Fishery Monitoring Study: Evaluation of the Effects of Pulp and Paper Mill Effluents on the Fish Population" (October 15, 1985)

In the autumn of 1985, fish population estimates were conducted at Harper's Bridge, Superior and two sites near Huson.

FUTURE ACTIVITIES: Further evaluations of intergravel environment suitability will be conducted, along with measurement of physical parameters such as stream gradient, average channel width and development. The latter measurements will help identify differences between reaches which might in part explain anomalies in the fisheries (i.e., the almost complete absence of brown trout below Missoula). A final report on the fish egg bioassays will be prepared in spring of 1986.
STUDY NUMBER: 2.4

ORGANIZATION: Montana Department of Fish Wildlife and Parks (MDFWP)

TITLE OF STUDY: Evaluation of Management of Water Releases for Fisheries from Painted Rocks Reservoir, Bitterroot River, Montana (BPA Project 83-463)

CONTACTS: Pat Graham - MDFWP, Helena - 444-5686
Dennis Workman, MDFWP, Missoula - 721-5808
Mark Lere (Project Biologist) MDFWP, Missoula - 721-5808

OBJECTIVE: Evaluate the effects of dewatering on trout populations. Develop a water management plan to optimize the use of limited water through timed discharges from Painted Rocks Reservoir.

DURATION: 1983 - 1986

CURRENT STATUS: Spring and autumn fish population estimates have been conducted on three sections of the river. The physical characteristics of several study sections have been measured. Water temperatures have been continuously recorded at four stations. Stream discharges have been measured on the river and at major irrigation diversions. Test releases of water from Painted Rocks Reservoir have been completed.

Reports available from DFWP in Missoula include:

"Evaluation of Management of Water Releases for Fisheries from Painted Rocks Reservoir"
Annual Report (November, 1984)
Quarterly Report (April, 1985)
Quarterly Report (July, 1985)

"Draft Water Management Plan for the Proposed Purchase of Supplemental Water from Painted Rocks Reservoir, Bitterroot River, Montana" (June, 1984)

FUTURE ACTIVITIES:

An additional fish population estimate will be conducted at a section between Stevensville and Florence in the autumn of 1985. Stream channel configuration will be surveyed at 27 transects; minimum instream flows will be calculated using wetted perimeter/stream discharge curves. Brown trout spawning will be monitored.
STUDY NUMBER: 2.5

ORGANIZATION: Montana Department of Fish Wildlife and Parks (MDFWP)

TITLE OF STUDY:

Analyses of Metal Residues in Crayfish and Brown Trout from the Clark Fork River

CONTACT: Glenn Phillips - MDFWP, Helena - 444-2406

OBJECTIVE: To determine if heavy metals are accumulating in crayfish exoskeletons and brown trout liver tissues.

DURATION: August 1984--completion of study (determined by preliminary results and future need)

CURRENT STATUS: Crayfish were collected from eight locations below Milltown Dam in September 1984. The cadmium and copper content of these organisms was analyzed by the Gordon Laboratory at the University of Montana.

Brown trout were collected from eleven locations above Milltown Dam in August of 1984. Livers were dissected in the field, placed on ice and frozen the same day they were collected.

FUTURE ACTIVITIES: A report outlining the results of the crayfish analyses will be prepared in the winter of 1986.

The analysis of the brown trout liver samples has been delayed due to limited funds. Analysis may take place in
Additional crayfish and brown trout samples may be collected in the future, possibly following runoff in 1986.
STUDY NUMBER: 2.6

ORGANIZATION: Montana Department of Fish Wildlife and Parks (MDFWP)

TITLE OF STUDY: Middle Clark Fork River Instream Flow and Fishery Study

CONTACTS: Pat Graham - MDFWP, Helena - 444-5686
Dennis Workman - MDFWP, Missoula - 721-5808
Rod Berg - MDFWP, Missoula - 721-5808
Don Peters - MDFWP, Missoula - 721-5808

OBJECTIVE: Quantify the status of the trout fishery in the middle portion of the Clark Fork River (from the confluence of the Blackfoot River to the Flathead River) relative to present and projected water quality, habitat and instream flow conditions.

DURATION: 1983 - 1987

CURRENT STATUS: Trout population estimates have been conducted at sections below Milltown, above the Bitterroot River and near Superior. Brown trout spawning site surveys have been conducted in the autumn. Trout movement data has been generated using jaw tagging at the Superior section. This information, along with fish population estimates for 1983 and 1984 at Superior is contained in a DFWP job progress report:

Western Montana Fishery Investigation Project No.
F-12-R-31 Job: Ib (July, 1985)
FUTURE ACTIVITIES: Fish population estimates will continue to be collected at all sections. Wetted perimeter transects will be established at several locations along the river to allow determination of instream flow requirements for game fish. Additional spawning and trout movement surveys will be conducted.
STUDY NUMBER:  2.7

ORGANIZATION:  Montana Department of Fish Wildlife and Parks (MDFWP)

TITLE OF STUDY:  Middle Clark Fork River Tributaries Study

CONTACTS:  Pat Graham - MDFWP, Helena - 444-5686
Dennis Workman - MDFWP, Missoula - 721-5808
Rod Berg - MDFWP, Missoula - 721-5808

OBJECTIVE:  Determine the relative importance of tributaries as existing or potential sources of recruitment for trout populations of the middle Clark Fork River (between the Blackfoot and Flathead Rivers).

DURATION:  July 1984 - July 1986

CURRENT STATUS:  Fishery surveys are being conducted on all perennial tributaries (approximately 25 streams) to determine their potential importance for providing recruitment of rainbow, brown cutthroat and bull trout to the mainstem of the Clark Fork River. Photographic stations have been established on several streams to record habitat changes with different flow volumes.

FUTURE ACTIVITIES:  Instream flow requirements for migrant and resident fish will be determined. Factors which may be negatively affecting the fishery (barriers which may hinder or block migrant fish passage, water quality problems, etc.) will be assessed. A management plan will be formulated to maintain and improve the fishery values of tributary streams. A progress report on these activities will be
prepared in July of 1986. However, to adequately meet the goals of this study, additional funding will be needed to continue work for at least two additional years beyond July, 1986.
STUDY NUMBER: 2.8

ORGANIZATION: Montana Department of Fish, Wildlife and Parks (MDFWP)

TITLE OF STUDY: Western Montana Fishery Investigation, Inventories and Surveys of the Upper Clark Fork River (above Drummond)

CONTACTS: Dennis Workman - DFWP, Missoula - 721-5808
Wayne Hadley - DFWP, Deer Lodge - 846-3270

OBJECTIVE: Evaluate the condition, distribution and abundance of game fish in the upper Clark Fork drainage.

DURATION: 1969 - Indefinitely

CURRENT STATUS: Trout population estimates have been conducted on the upper Clark Fork River at the following locations:

- pH Shack (near Warm Springs) 1969 - present
- Sager Lane (near Dempsey) 1981 - 1982
- Williams-Tavener (below Deer Lodge) 1969 - present
- Phosphate (below the Little Blackfoot River) 1978 - present

Brown trout movement (jaw tagging) and recruitment studies have also been conducted near these stations.

Trout populations have been estimated for several years on the following tributaries: Warm Springs Creek, Gold Creek, Flint Creek and the Little Blackfoot River. Fishery
surveys have also been routinely conducted on Racetrack Creek, Lost Creek and Dempsey Creek to help determine their importance as sources of recruitment to the upper river. Trout populations in several other tributaries of the study area have also been recently monitored as part of the instream flow reservation studies.

Annual progress reports, outlining the results of these studies are available from DFWP's Missoula office.

FUTURE ACTIVITIES: Spring and fall trout population estimates will continue to be conducted at the pH shack and Williams-Tavener study sections. Yearly, single-season, estimates will be conducted at Phosphate and possibly at Sager Lane. Studies will continue on selected tributary streams.
STUDY NUMBER: 2.9

ORGANIZATION: Montana Department of Fish, Wildlife and Parks (MDFWP)

TITLE OF STUDY: Western Montana Fishery Investigation: Inventories and Surveys of the Upper Clark Fork River (Drummond to Milltown, Rock Creek and the Blackfoot River)

CONTACTS: Dennis Workman - DFWP, Missoula - 721-5808
          Don Peters - DFWP, Missoula - 721-5808

OBJECTIVE: Evaluate the condition, distribution and abundance of game fish in waters of the study area.

DURATION: 1967 - Indefinitely

CURRENT STATUS: Trout population estimates have been conducted at the following locations:

Clark Fork River
          Bearmouth (below Drummond) 1979 & 1985
          Bonita (above Rock Creek) 1979 - 1980
          Turah (above Milltown) 1979 - Present
          Milltown (below the dam) 1979 - Present

Blackfoot River
          Johnsrud Park (near mouth) 1979 - Present
          Lincoln 1972

Water temperatures have been periodically monitored (with recording thermographs) within the study section since 1976.
Three fish population study sections on Rock Creek have been periodically sampled since the early 1970's. Creel census data is available for Rock Creek since the mid 1950's. Fish movement (jaw tagging) and growth rate studies have also been conducted.

Annual progress reports, outlining the results of these studies, are available from DFWP's Missoula office.

FUTURE ACTIVITIES: The Bearmouth, Turah, Milltown and Johnsrud Park study sections will be monitored yearly. The Rock Creek sections will be periodically monitored. The monitoring station at Lincoln and a new station on the Blackfoot River near Ovando may be added. The Bonita Station will probably be dropped.
STUDY NUMBER: 2.10

ORGANIZATION: Montana Department of Fish, Wildlife and Parks (MDFWP)

TITLE OF STUDY: Fisheries Studies on Noxon Rapids and Cabinet Gorge Reservoirs

CONTACTS: Jim Vashro - DFWP, Kalispell - 755-5505
          Joe Huston - DFWP, Kalispell - 755-5505

OBJECTIVE: Evaluate the suitability of the reservoirs to support various species of game fish by documenting their distribution, abundance and reproductive success.

DURATION: 1952 - Indefinitely

CURRENT STATUS: Since the elimination of the free-flowing lower Clark Fork by dams in the 1950's, the DFWP has continuously attempted to establish a sport fishery in the reservoirs. Several different fish species have been planted. The success (or mainly lack of success) of these plantings has been monitored within the reservoirs by gill net and creel census surveys. Several tributaries have been studied to estimate their value as sources of recruitment to the reservoirs.

Progress reports, outlining the results of these efforts, are available from DFWP's Kalispell office. A summary of these reports is available from DFWP's Helena office:
"Thirty-two Years of Fish Management-Noxon Rapids and Cabinet Gorge Reservoirs" (March, 1985).

FUTURE ACTIVITIES: Diversified fish plantings and monitoring will continue. Burbot (freshwater codfish), brown trout, smallmouth bass and possibly Kamloops rainbow trout and bull trout will be planted during 1985, 1986 and 1987. DFWP will be working on an agreement with the Washington Water Power (the dam's owner) to reduce or eliminate large-scale drawdowns on the reservoirs. This spring "drafting" is believed to be severely impacting the ability of the reservoirs to sustain a viable sport fishery.
STUDY NUMBER: 3.1

ORGANIZATION: Montana Department of State Lands (MDSL) - Abandoned Mine Reclamation (AML) Bureau

TITLE OF STUDY: Colorado Tailings Reclamation Design Studies

CONTACTS: Dick Juntunen - MDSL - 444-2074
Ben Mundie - MDSL - 444-2074

OBJECTIVE: Design reclamation alternatives and implement a preferred design that will mitigate heavy metal impacts to surface and ground water caused by the Colorado Tailings.

DURATION: 1984 - 1987

CURRENT STATUS: Based upon data collected by the Montana Bureau of Mines and Geology (Study 1.1) and the Hydrometrics, a consulting firm hired by the Anaconda Minerals Company, the need for reclamation of the Colorado Tailings was presented to the Office of Surface Mining (OSM). In August, 1984, OSM made available $1,000,000 to MDSL to proceed with reclamation. Delta Engineering, a consulting firm from Great Falls, was hired to evaluate the reclamation potential of the site and to prepare site-specific designs. These studies were completed in the spring of 1985.

The Colorado Tailings are within the Butte/Silver Bow Superfund site. Upon completion of the reclamation designs, concerns were raised by the EPA, the Solid and Hazardous Waste Bureau of MDHES and others about potential liabilities that the state might incur if MDSL were to proceed with reclamation before completion of the Superfund investiga-
tions. Some concerns were also raised about the viability of the proposed reclamation design. During the summer of 1985, some modifications were made in the reclamation design, and the various parties agreed to delay reclamation at the site until the Superfund Feasibility Studies (FS) are completed. To expedite the process, it was agreed the Colorado Tailings will be designated as a separate "operable unit" within the Butte/Silver Bow study area, and the FS for this unit will be completed in May, 1986.

FUTURE ACTIVITIES: It is anticipated that actual reclamation activities at the Colorado Tailings will commence in the summer of 1986. All activities will be closely coordinated with the Superfund activities at the site (see Study 4.3).
STUDY NUMBER: 3.2

ORGANIZATION: Montana Department of State Lands (MDSL)

TITLE OF STUDY: Aquatic Resource Studies Associated with ASARCO's Rock Creek Project

CONTACTS: Terry Grotbo - MDSL, Helena - 444-2074  
Kit Walther - MDSL, Helena - 444-2074
Jim Vashro - MDFWP, Kalispell - 755-5505

OBJECTIVE: Establish baseline water quality, water quantity, fishery and other biological conditions for Rock Creek, Sanders County, Montana.

DURATION: 1984 - 1987

CURRENT STATUS: ASARCO is proposing to develop a silver-copper deposit in the Cabinet Mountains, approximately five miles northeast of Noxon. The site is beneath the Cabinet Mountains Wilderness Area near St. Paul and Chicago Peaks. Mining, and most of the crushing and ore concentrating would occur underground within a room-and-pillar excavation. Tailings would be slurred to a tailings dam, located one quarter mile from the Clark Fork River.

In April, 1985, WESTTECH, a consulting firm hired by ASARCO, finalized a study plan for the collection of baseline aquatic resource data within the Rock Creek Drainage. Sampling began in the spring of 1985. Ten surface water stations will be sampled seasonally (biweekly during spring) for the analysis of 33 major water quality parameters, including common ions, nutrients and heavy metals.
achieve maximum detection limits, carbon furnace techniques will be utilized for the heavy metal analysis.)

At least eleven groundwater monitoring wells will be installed; several of these will be monitored quarterly for the same water quality parameters analyzed during the surface water collections. All presently existing wells and springs within the project area will be sampled for their water quality and water yield.

Seven aquatic invertebrate and periphyton stations will be sampled three times per year, during pre-runoff, summer low flow and autumn. Species present and their abundance will be reported. Diversity indices will be calculated.

The Montana Department of Fish, Wildlife and Parks will conduct baseline fishery resource investigations on Rock Creek and on the Clark Fork River above and below the confluence of Rock Creek. Fish population estimates will be conducted on five stations on Rock Creek. Spawning migrations from the Clark Fork River will be monitored. The tissue from twenty-five game fish, collected from each of three locations on Rock Creek, will be analyzed for their heavy metal content. Gill net sampling and snorkeling observations will be conducted in the Clark Fork River near Rock Creek.

FUTURE ACTIVITIES: The above monitoring will continue for two and possibly three, field seasons. Upon completion of the baseline studies, ASARCO will likely apply for an operating permit from MDSL. This will trigger the EIS process, which may require the collection or analysis of additional aquatic resource information.
[NOTE: Other terrestrial, wilderness, recreation and wildlife (especially grizzly bear) studies are being conducted or will be conducted, some under the auspices of the US Forest Service. For a description of these non-aquatic studies, please contact the MDSL in Helena or the Cabinet Ranger District in Trout Creek.]
STUDY NUMBER: 3.3

ORGANIZATION: Montana Department of State Lands (MDSL) - Hard Rock Mining Bureau

TITLE OF STUDY: Studies Associated with Montoro's German Gulch Project

CONTACTS: Terry Grotbo - MDSL - Hardrock Bureau - 444-2074
Kit Walther - MDSL - EIS Team Leader - 444-2711
Jerry Wells - MDFWP, Bozeman - 586-5419

OBJECTIVE: Establish baseline water quality and biological conditions and determine instream flow needs for trout on German Gulch.

DURATION: May-September 1984 (plus additional studies, if needed, in the future)

CURRENT STATUS: The Montoro Gold Company of Reno, Nevada, has proposed to develop a surface mine and ore processing plant and tailings disposal facility in the German Gulch drainage (a tributary of Silver Bow Creek near Gregson). In anticipation of an EIS for this project, this study collected water quality, macroinvertebrate, periphyton and trout population data at three sites on the stream:

Below Edward Creek (Headwaters)
Below Beefstraight Creek
Near the mouth

Wetted perimeter/stream discharge relationships were plotted for each station, with minimum flows determined by
inflection points on the curves (as per the wetted perimeter methodology).

The University of Montana genetics laboratory has determined that trout inhabiting German Gulch are a pure strain of westslope cutthroat trout. This a unique situation for western Montana streams. They state, "Available data indicate that the westslope cutthroat is in danger of extinction. In order to ensure the continued existence of this native species, it is important to preserve all populations that are identified."

A report summarizing the results of the above studies is available from the Department of State Lands in Helena and/or the Department of Fish, Wildlife and Park's Bozeman office: "Aquatic Evaluation and Instream Flow Recommendations for Selected Reaches of German Gulch Creek, Silver Bow County, Montana" (December, 1984).

FUTURE ACTIVITIES: Montoro has decided to reassess development of this project. Unless or until a decision is made by the company to reactivate their application for an operating permit, no further studies are planned.
STUDY NUMBER: 4.1

ORGANIZATION: Montana Department of Health and Environmental Sciences (MDHES) - Water Quality Bureau

TITLE OF STUDY: Lower Clark Fork River Monitoring

CONTACTS: Loren Bahls - Water Quality Project Leader - 444-2406
Steve Pilcher - Water Quality Bureau Chief - 444-2406
Gary Ingman - Water Quality Specialist - 444-2406

OBJECTIVE: Establish a chemical, physical and biological water quality baseline for the Clark Fork River below Rock Creek. Utilize this information, in part, during preparation of an EIS for Champion International's Wastewater Discharge Permit.

DURATION: 1984 - 1987

CURRENT STATUS: From March 1984 to August 1985, a total of twenty five monitoring runs were conducted (an approximate frequency of once every three weeks) at the following sixteen sampling stations:

01 Clark Fork at Turah
02 Blackfoot River at mouth
03 Clark Fork below Milltown Dam
04 Clark Fork above Missoula WWTP
05 Missoula WWTP discharge
06 Clark Fork at Sheffield's
07 Bitterroot River near mouth
Fifteen additional mainstem sites were sampled three to four times per year, including surface and bottom samples from deepwater pools and reservoirs.

Parameters that were routinely analyzed included: Heavy metals (total recoverable): Cu, Zn, Fe, Mn, As, Cd. Algal Nutrients: total phosphorus, orthophosphorus, nitrate, kjeldahl nitrogen. Other: Temperature, total suspended solids, volatile suspended solids. Several additional parameters were collected on a seasonal basis including: Hardness, specific conductance, BOD, COD, dissolved oxygen, color, and aquatic macroinvertebrates (kick-net composites). Seasonal algal bioassays have also been conducted. Thirty-day chronic bioassays of lower Clark Fork River water and Champion International effluent using juvenile rainbow trout and "water fleas" (ceriodaphnia) were completed (see Study 6.2).

FUTURE ACTIVITIES: A data report, outlining the results of the above monitoring will be completed in October of 1985. An EIS concerning re-issuance of Champion's Wastewater Discharge Permit will be completed in early 1986.
Monthly sampling will continue at the aforementioned stations with the following modifications: The "near St. Regis" station will be replaced by a station at Superior. Two additional stations will be established—-at Alberton and above the Flathead River.

The "routinely analyzed" parameters listed above will continue to be monitored, along with the addition of alkalinity and hardness. The "additional" parameters and stations will no longer be monitored, except macroinvertebrates and periphyton once per year at all eighteen stations.

This monitoring program will continue through June, 1987, with funding provided by the 1985 Legislature.
STUDY NUMBER: 4.2

ORGANIZATION: Montana Department of Health and Environmental Sciences (MDHES) - Water Quality Bureau

TITLE OF STUDY: Upper Clark Fork River Monitoring

CONTACTS: Steve Pilcher - Water Quality Bureau Chief - 444-2406
Loren Bahls - Project Leader - 444-2406
Erich Weber - Water Quality Specialist - 444-2406

OBJECTIVE: Assess the effectiveness of the Warm Springs Ponds treatment system and evaluate water quality conditions through reaches of the Clark Fork River above confluence of Rock Creek.

DURATION: 1976 - Indefinitely

CURRENT STATUS: The Clark Fork River station at Deer Lodge (STORET 1=2MTHDWQ 35260917) is the principal DHES ambient water quality station on the river and the only comprehensive long-term water quality station in Montana operated exclusively by the State. Parameters at this station include: discharge, TSS and turbidity, lab pH, alkalinity, hardness, field pH, temperature, specific conductance, common ions, algal nutrients, and selected metals (As, Cd, Cu, Fe, Mn, Pb, and Zn--"total recoverable"). Samples have been collected sporadically since March, 1976 and monthly since January, 1978.

The following five stations have been sampled monthly since December, 1982: Clark Fork River above the Little
Blackfoot River; Clark Fork River below Warm Springs Creek; Anaconda Company Warm Springs Ponds 2 Discharge; Warm Springs Creek at mouth; Mill-Willow Creek Bypass at mouth. Parameters include turbidity, temperature, and pH, specific conductance, sulfate, Cd, Cu and Zn (total recoverable).

Silver Bow Creek at the Frontage Road above the Warm Springs Ponds has been sampled monthly since January, 1984, for the same parameters as the five stations in the paragraph above.

**FUTURE ACTIVITIES:** Monthly monitoring will continue at all of the above stations. Starting in August, 1985, five additional stations will also be sampled for a total of twelve stations:

01 Silver Bow Creek below Colorado Tailings
02 Silver Bow Creek at Ramsey
03 Silver Bow Creek at Frontage Road
04 Warm Springs Pond 2 Discharge
05 Mill-Willow Bypass near mouth
06 Warm Springs Creek near mouth
07 Clark Fork below Warm Springs Creek
08 Clark Fork near Dempsey
09 Clark Fork at Deer Lodge
10 Clark Fork above Little Blackfoot
11 Clark Fork at Gold Creek
12 Clark Fork at Bonita (just above Rock Creek)

Parameters to be analyzed at each station will also be expanded to include: Heavy metals (total recoverable) Cu, Zn, Fe, Mn, As, Cd. Algal nutrients: Total phosphorus, ortho phosphorus, nitrate, kjeldhal nitrogen. Other: Total
suspended solids, volatile suspended solids, hardness, alkalinity, pH, and stream discharge. Macroinvertebrate and qualitative periphyton composite samples will be collected once annually at each station.

The above stations and parameters will be monitored through at least June, 1987.
STUDY NUMBER: 4.3

ORGANIZATION: Montana Department of Health and Environmental Sciences (MDHES) - Solid Waste Management Bureau

TITLE OF STUDY: Butte-Silver Bow Creek Remedial Investigation (Superfund)

CONTACTS: Mike Rubich - (Superfund) Project Manager - 444-2821
Duane Robertson - Bureau Chief - Solid and Hazardous Waste Management Bureau - 444-2821
Lee Shanklin - EPA Montana Office - 449-5414

OBJECTIVE: Accurately identify surface water, groundwater, tailings and point source problem areas; evaluate potential remedial actions and, eventually select a preferred alternative to rectify contamination in the Silver Bow Creek/upper Clark Fork System.

DURATION: 1983 - 1987

CURRENT STATUS: With the designation of Silver Bow Creek as a Superfund site in 1982, the Anaconda Minerals company and their consultants began collecting preliminary information on the extent and severity of contamination in the area. This information, in part, was used to develop a work plan for the Silver Bow Creek Remedial Investigation (RI), which began in September, 1984. Water quality, soils and biological data were collected until December, 1985. Among other things, the RI will identify pathways of contamination within the Silver Bow Drainage and project the remaining life of the Warm Springs Treatment System.
FUTURE ACTIVITIES: The Silver Bow RI will be completed in early 1986. The FS will then commence, with a scheduled completion date of September, 1986. The work plan for the Butte Hill portion of the RI/FS should be completed sometime in early to mid 1986, with work commencing shortly thereafter.

In November, 1985, the EPA announced that the site's study area will be expanded to include the upper reaches of the Silver Bow Creek drainage including parts of the Butte Hill.

In the autumn of 1985, the Solid Waste Management Bureau began screening applicants to conduct the Silver Bow FS.
STUDY NUMBER: 4.4

ORGANIZATION: Montana Department of Health and Environmental Sciences (MDHES) - Solid and Hazardous Waste Management Bureau

TITLE OF STUDY: Milltown Superfund Site Studies

CONTACTS: Barbara Jones - Solid and Hazardous Waste Management Bureau - MDHES - 444-2821
Jim Knoy - EPA Montana Office - 449-5414
Duane Robertson - SHWMB Bureau Chief - 444-2821

OBJECTIVE: Evaluate alternatives (and select a preferred alternative) to rectify impacts to human health, the aquatic environment and groundwater which have resulted from contamination of reservoir sediments by arsenic and heavy metals.

DURATION: 1983 - 1986

CURRENT STATUS: In May, 1981, four community wells in Milltown were tested by health officials and found to be contaminated by arsenic. Subsequent studies by the University of Montana suggested that the contamination source was heavy metal deposits within the reservoir's sediments. The reservoir was designated as a Superfund site and a Remedial Investigation (RI) was begun in July, 1983 to confirm the source and extent of groundwater contamination. The RI was completed in July, 1984: "Arsenic Source and Water Supply Remedial Action Study, Milltown Reservoir."

Concurrent with the RI, a Focused Feasibility Study was conducted to determine the most efficient way to provide safe...
water for Milltown residents. Construction of a new central water system for Milltown was begun in the fall of 1984 and completed in June, 1985.

With the immediate, pressing problem of the Milltown water supply corrected, a more extensive Feasibility Study (FS) was initiated to address ways to:

- minimize down gradient/down stream release of contaminants originating at Milltown Reservoir, and
- minimize ingestion of contaminants originating at the Milltown site.

The FS, which is being conducted by Harding Lawson Associates, is currently in progress. Additional groundwater monitoring and limited groundwater modelling is being conducted below the reservoir. Thus far, the FS has narrowed the list of clean up options to six potential alternatives, ranging from no action to complete dam retirement (with stabilization of sediments and reestablishment of a free-flowing river). Other alternatives include excavation, "institutional controls," chemical stabilization of sediments and channel isolation (with the reservoir left in place).

FUTURE ACTIVITIES: The FS, including selection of a preferred alternative, will be completed in the winter of 1986. After a 30 day review period, public hearings will be conducted to allow comment on the preferred alternative. Following selection of the preferred alternative, design and implementation of clean-up could begin sometime in 1986. The Superfund activities have a significant bearing on the Montana Power application to the Federal Energy Regulatory Commission for relicensing the dam. (See Study 14.1)
STUDY NUMBER: 5.1

ORGANIZATION: United States Forest Service (USFS)

TITLE OF STUDY: Stream Sediment Monitoring on National Forest Lands

CONTACTS: Mike Goggin, Region I USFS, Missoula - 329-3039
          Mike Johnson, Region I USFS, Missoula - 329-3516
          Don Bartschi, Region I USFS, Missoula - 329-3511
          Greg Munther, Lolo, Deer Lodge and Bitterroot National Forests, Missoula - 329-3793

OBJECTIVE: Monitor sediment deposition impacts to fish and other aquatic life resulting from National Forest construction and development activities.

DURATION: 1975 - Indefinitely

CURRENT STATUS: All or a portion of seven national forests are within the Clark Fork River Basin. Forest fishery biologists and hydrologists routinely collect bottom sediment and some suspended sediment samples from streams where forest-permitted activities like logging and road construction have occurred or are planned to occur. Various sediment deposition measurements are utilized, including core sampling, embeddedness, surface visual analysis and washed sediment buckets. The latter method involves placing washed gravel and cobbles in a sampling device of known surface area and volume; this method is particularly useful in evaluating upstream versus downstream impacts resulting from instream activity. Benthic macroinvertebrates are also usually collected at the sediment sampling sites.
The largest amount of information, particularly regarding biological populations, has been gathered on streams in the Lolo, Deer Lodge and Bitterroot National Forests. During the summer of 1985, approximately 150 macroinvertebrate samples were collected on streams in these three forests. Some fish population data was also gathered during 1985 in cooperation with the Montana Department of Fish, Wildlife and Parks.

FUTURE ACTIVITIES: According to the draft Forest Plans recently prepared by all seven national forests in the basin, the frequency of sediment and biological monitoring activities will increase over the next decade. The Clark Fork River Basin Project and Region I of the U. S. Forest Service are working on a Memorandum of Understanding to better coordinate the methods and objectives of state and federal sediment monitoring activities in the basin.
STUDY NUMBER: 6.1

ORGANIZATION: Environmental Protection Agency (EPA)

TITLE OF STUDY: Anaconda Smelter Superfund Studies

CONTACTS: Mike Bishop - Project Manager - 449-5414
Doug Skie - EPA, Helena - 449-5414
Jim Windorski - Anaconda Company - 723-4311

OBJECTIVE: Identify the nature and extent of heavy metal contamination in the Anaconda area, evaluate risks to public health and the environment and present alternatives to correct the problem.

DURATION: 1983 - 1987

CURRENT STATUS: The Anaconda Smelter and surrounding area, including the Opportunity Treatment Ponds, was designated as a Superfund site in December, 1982. Throughout 1983, the Anaconda Minerals Company (AMC) and their consultants conducted studies of contaminants at the site. In October, 1984, AMC agreed to carry out a complete Remedial Investigation/Feasibility Study (RI/FS) of the area with EPA. Sources, pathways and the extent of heavy metal contamination will be identified and alternative(s) for cleanup prescribed.

Due to the complexity of the site, the final work plan for the Anaconda Smelter RI/FS includes several "focused" remedial investigations within the overall plan, including studies of the beryllium disposal areas on Weather Hill and at the B2 portion of the Opportunity Ponds, the granulated slag pile, the flue dust disposal and/or storage areas, the
Arbiter Plant, and the "Smelter Hill" investigation.

As part of the total RI, the Center for Disease Control conducted a urinary arsenic study in the Anaconda area. This study determined that children residing in the small community of Mill Creek have elevated urinary arsenic levels. The AMC and EPA are proceeding with plans to minimize or eliminate sources of contamination in the Mill Creek area as a first step in the total corrective action at the site. (Other reclamation efforts will proceed following completion of the RI/FS.)

FUTURE ACTIVITIES: Some of the focused remedial investigations, such as the beryllium disposal areas and the flue dust disposal and/or storage areas, will be completed in early 1986. Others are not scheduled to be completed until later in the year. The RI at Smelter Hill must wait until demolition by the Cleveland Wrecking Company is complete. Feasibility studies which will develop actual alternative solutions for clean up, will begin upon completion of the remedial investigations.
STUDY NUMBER: 6.2

ORGANIZATION: Environmental Protection Agency (EPA)

TITLE OF STUDY: Chronic Bioassays of Champion International's Effluent

CONTACTS: Dick Montgomery - EPA - 449-5486
Loren Bahls, DHES, WQB - 444-2406

OBJECTIVE: Determine the toxicity of Champion International's effluent to juvenile rainbow trout and Ceriodaphnia (water "fleas").

DURATION: 1985 - ?

CURRENT STATUS: From May 13 to June 12, 1985, thirty-day flow-through bioassays were conducted using recently emerged (button-up stage) rainbow trout. Dilutions of Champion wastewater that were tested ranged from 2.0% (1:50 dilution) to 0.2% (1:500 dilution), plus controls (0.0% effluent). Two separate dilution sources were used for the trout tests—river water and local well water. Mortality to trout in both tests was very low (10% or less). There were significant differences in "condition coefficients"—determined by dividing wet weight by length—but there was not a clear dose-response relationship with the various wastewater dilutions.

A seven-day Ceriodaphnia test was conducted using the same dilutions of Champion wastewater as with the trout bioassay, plus the addition of a 4.0% (1:25) dilution. Only river water was used in these bioassays; daphnid survival in
the well water control was 40 percent. Mortality was 10 percent or less in all of the river water/effluent dilutions. However, reproduction of the daphnids in the 4.0 percent effluent was noticeably less. Only 3.4 offspring were produced per female compared to 10.6 in the control.

An additional seven-day *Ceriodaphnia* test was also conducted using the Clark Fork River water from nine locations--three above and six below Champion's discharge. There were no statistical differences between stations with respect to survival (all greater than 90 percent). The only difference in reproduction among the stations was at Huson (below Champion) where the number of offspring produced per female was significantly greater than at all other stations.

**FUTURE ACTIVITIES:** A report outlining the results of the above studies will be prepared in the autumn of 1985.

The EPA suggests that additional trout studies should be conducted using only river water for dilution. A greater number of test fish per dilution could, therefore, be measured giving better detection of subtle effects on growth.
STUDY NUMBER: 6.3

ORGANIZATION: Environmental Protection Agency (EPS)

TITLE OF STUDY: Chronic Bioassays of Upper Clark Fork River Water

CONTACTS: Dick Montgomery - EPA - 449-5486
           Loren Bahls - DHES, WQB - 444-2406

OBJECTIVE: Evaluate the toxicity of upper Clark Fork River water to three life stages of rainbow trout.

DURATION: 1985 - ?

CURRENT STATUS: Flow-through bioassays were conducted with rainbow trout green eggs, eyed eggs and fingerlings. Test water was collected from the Clark Fork River near Deer Lodge. Dilution water was obtained from Taylor Creek, a nearby perennial stream. A two-bank dilution system was utilized. Tests were conducted from May 7 through June 6, 1985. All tests were conducted at 10 ± 2° C. The egg tests were conducted for the full thirty days. Fingerling tests were conducted for 13 days.

The tests were timed to coincide with spring runoff, when high concentrations of heavy metals are normally present in the upper Clark Fork River. Normal spring runoff did not occur during 1985 and resulting metal concentrations did not produce significant mortalities in any of the tests.

Rain events during the last half of the study produced sharp, brief increases in metal concentrations. These
increased concentrations exceeded calculated chronic and acute levels of copper that would protect aquatic life. However, the fluctuations in copper and zinc were neither high enough nor long enough in duration to produce significant mortalities during the test period.

FUTURE ACTIVITIES: In order to accurately measure the success of reclamation and restoration activities planned for the upper river, there is a need to assess the toxicity of the upper Clark Fork River's waters to trout and other sensitive aquatic organisms during "normal" runoff conditions. Hopefully, the bioassays conducted at Deer Lodge in 1985 will be repeated, either by the EPA or other researchers, at a time when critical water quality conditions are present in the river.
STUDY NUMBER: 7.1

ORGANIZATION: Idaho Fish and Game Department (IFG)

TITLE OF STUDY: Lake Pend Oreille Fisheries Investigations

CONTACT: Ned Horner - Regional Fishery Manager, Coeur d'Alene - (208) 664-9236

OBJECTIVE: Evaluate the suitability and contribution of Lake Pend Oreille tributaries as spawning and rearing areas; monitor the success of juvenile fish (fry) releases from the Cabinet Gorge Fish Hatchery.

DURATION: 1982 - Indefinitely

CURRENT STATUS: For the past three years, inventories have been conducted on the major spawning tributaries of Lake Pend Oreille. Redd counts and intergravel composition studies have been conducted. Estimates of smolt (stream-bred fish that return to the lake) production have also been made. Major species of concern are bull trout, Kamloops rainbow trout and westslope cutthroat trout. The primary purpose of these inventories has been to collect information that can be used to make fisheries management changes for the tributaries. These changes are expected to be reflected in the 1988-89 fishing regulations. Another benefit, of course, has been to ascertain the value of the tributaries for perpetuating trout and char species within Lake Pend Oreille. The IFG now has important baseline fisheries data so the impacts of land use and fishing pressure can be better monitored and, if needed, better regulated.
Another portion of this study, initiated in 1985, is evaluating the success of Kokanee fry from the new Cabinet Gorge Fish hatchery. A joint project of the IFG, Bonneville Power Administration and the Washington Water Power Company, this new facility is capable of producing up to 20 million fry per year to a lake impacted by shoreline water level fluctuations (Albini Falls Dam), loss of Clark Fork River spawning sites (Cabinet Gorge Dam) and past introductions of Mysid shrimp.

FUTURE ACTIVITIES: The tributary inventories are nearly completed, but will be updated as funding permits and/or as function of local citizen interest (much of the funding for the tributary work was provided by local recreationists). Monitoring of hatchery-bred Kokanee is expected to continue for several years.
STUDY NUMBER: 8.1

ORGANIZATION: Idaho Department of Health and Welfare (IDHW) - Water Quality Bureau

TITLE OF STUDY: Clark Fork River/Lake Pend Oreille Water Quality Study

CONTACTS: Mike Beckwith, Idaho Division of Environment (IDHW-DOE), Coeur d' Alene - (208) 667-3524
Ed Tulloch, Idaho Division of Environment (IDHW-DOE), Coeur d' Alene - (208) 667-3524

OBJECTIVE: Define baseline flow, sediment, nutrient and heavy metal contributions to Lake Pend Oreille by the Clark Fork River; assess ambient limnological conditions within the lake.

DURATION: July 1984 - ?

CURRENT STATUS: Sampling has been conducted at two river stations--the Clark Fork River near its mouth at Cabinet Gorge Dam (lake inlet) and the Pend Oreille River near Dover, Idaho (lake outlet). Three lake stations have been sampled--within the Clark Fork River delta and at mid-points within the southern and northern "arms."

Sampling frequencies have been:

River stations--weekly May-July and monthly during rest of year
Lake stations--biweekly July-September and monthly during rest of year
Parameters analyzed include:

Heavy metals (total recoverable): Cu, Zn, Fe, Mn, As, and Cd

Nutrients: ammonia, nitrate, kjeldahl nitrogen, total phosphorus, orthophosphorus

Others: Ca, Mg, alkalinity, hardness silica, turbidity, total suspended solids, volatile suspended solids and fecal coliforms.

Additional parameters for the lake samples include chlorophyll-a and secchi disk transparency and profiles (down to 50 meters) for temperature, dissolved oxygen, pH and specific conductivity. Algal assays have also been conducted on lake samples.

FUTURE ACTIVITIES: A report, outlining the results of the above monitoring, will be published in early 1986. A proposal for a more comprehensive study of the lake has been prepared. Hopefully, this proposal will be jointly submitted with the State of Montana's Clark Fork Basin proposal to secure funding from the U. S. Environmental Protection Agency. A likely avenue of funding is the recent amendments to the Clean Water Act, which call for a comprehensive water quality study of the Lake Pend Oreille/Clark Fork System.
STUDY NUMBER: 9.1

ORGANIZATION: U.S. Geological Survey (USGS)

TITLE OF STUDY: Analysis of Clark Fork River Bottom Sediment and Biota for Trace Metal Content

CONTACTS: USGS Research Staff in Denver, Colorado
Ned Andrews - USGS, Denver - (303) 236-5004
Sam Luoma - USGS, Menlo Park, California - (415) 323-8111

OBJECTIVE: Determine the longitudinal distribution of trace metals in the sediment and macroinvertebrates of the Clark Fork River; develop field methods for collecting representative sediment samples and methods for processing samples which will ensure their chemical stability; investigate the relationship of fluvial mechanics to metal concentrations in the river.

DURATION: 1984 - ?

CURRENT STATUS: During 1984, bottom sediment samples were collected from 44 sites at 3 to 5 mile intervals between Warm Springs and St. Regis. Benthic macroinvertebrates were also collected at fifteen of these sites. During the normal runoff period of 1985, depth and width integrated samples were collected once every three days from three sites on the Clark Fork River (near Deer Lodge, Gold Creek and Missoula) as well as from major tributary streams. These large volume samples (30 to 40 liters) were centrifuged and preserved in the field. Particle size distribution and heavy metal analyses (for lead, zinc, copper, cadmium and arsenic) have
begun on all sediment and water column samples. The benthic macroinvertebrates have also been analyzed for their heavy metal content.

**FUTURE ACTIVITIES:** Work is anticipated to begin on modeling the fluvial mechanics of the upper river's channel and floodplains; e.g. determining the rate of channel meander migration which has a major influence upon the concentration of heavy metals present in the river during runoff.
STUDY NUMBER: 9.2

ORGANIZATION: U.S. Geological Survey (USGS), Montana Office

TITLE OF STUDY: Ground Water in Shallow Aquifers along the Upper Clark Fork, Southwestern Montana

CONTACTS: Tom Brooks - USGS, Helena Office - 449-5263
           Joe Moreland - USGS, Helena Office - 449-5263

OBJECTIVE: Assess the quality and quantity of shallow ground water and its relationship to surface water at selected sites within the Clark Fork Basin from Warm Springs to Milltown.

CURRENT STATUS: The Helena Office of the USGS has recently received funding to initiate this study. A work plan is being developed according to the following general procedures:

Up to thirty wells will be established at varying depths to establish characteristics and seasonal changes of ground water flow systems within the shallow aquifers. Water quality samples will be collected at least annually for analysis of common constituents, dissolved metals and several field parameters. Static water levels will also be collected periodically from the wells. Seepage runs will be conducted to determine relationships between ground water and surface water.

Using data collected during this study and other existing data from state and federal agencies, geochemical models, such as WATEQF and WATEQ2 will be used to determine equilibrium relationships in water. Potentiometric-surface
maps will be prepared for the shallow aquifer. During installation of the test wells, lithographic samples will be obtained for analysis of mineralogy and selected metal concentrations.

FUTURE ACTIVITIES: A final work plan will be completed in early 1986. Installation of wells and sampling will commence shortly thereafter and will continue through FY 88.
STUDY NUMBER: 9.3

ORGANIZATION: U.S. Geological Survey (USGS), Montana Office

TITLE OF STUDY: Historical and Current Streamflow and Water Quality Data for the Clark Fork and the Mouths of Major Tributaries

CONTACTS: Joe Moreland - USGS, Helena - 449-5263
          Roger Knapton - USGS, Helena - 449-5263
          John Lambing - USGS, Helena - 449-5263

OBJECTIVE: Monitor stream discharge and water quality parameters at selected stations in the Clark Fork Basin.

DURATION: 1907 - Indefinitely

CURRENT STATUS: The USGS is presently collecting continuous stream discharge measurements at twenty four stations in the Clark Fork Basin. Two of these stations, the Clark Fork River below Missoula and the Flathead River at Perma, are also being monitored for selected water quality parameters. Physical, chemical and biological samples are being collected at the Missoula station. Physical and chemical samples are being collected at Perma.

During the period from April, 1985 - July, 1986, daily suspended sediment samples are being collected from the Clark Fork River at Deer Lodge and Turah. Heavy metal samples are also being collected at these stations as well as from Rock Creek, Flint Creek, the Little Blackfoot River and the Blackfoot River during high stream discharge conditions and storm events. (Funding for this work was provided, in part,
by the 1985 Montana Legislature through a water development grant.)

A report, summarizing historical USGS water quality monitoring efforts, is available from their Montana Office in Helena: "Historical Water Quality Data for the Clark Fork River and the Mouths of Selected Tributaries, Western Montana" (April, 1985).

FUTURE ACTIVITIES: The above outlined monitoring efforts will continue. The Montana Office has also prepared a proposal to monitor twenty two stations in the basin for physical and chemical parameters. The earliest possible date for funding of all or part of this proposal appears to be FY '87.
STUDY NUMBER: 10.1

ORGANIZATION: University of Montana (UM)

TITLE OF STUDY: Development and Application of Synthetic/Predictive Water Quality Modeling for the Clark Fork River System

CONTACT: Vicki Watson - University of Montana, Botany/EVST Department, Missoula - 243-5153

OBJECTIVE: Utilize a suite of models to evaluate the impacts of organic loading, nutrients and heavy metals upon the water quality and the biological organisms of the Clark Fork River.

CURRENT STATUS: Most of the water quality information to be used in these modelling efforts has already been collected or is presently being collected by the Montana Water Quality Bureau or the U.S. Geological Survey. However, a survey of river morphometry and turbulence will be conducted during low flow and during the falling hydrograph (following high flow) to provide a better estimate of the physical reaeration potential of the river and to help select the range of models to be used.

Variation of the QUAL II model will be used to assess the impacts of organic loading upon the river's dissolved oxygen levels. Potential impacts of changing nutrient loads upon the trophic status of the lower river reservoirs and Lake Pend Oreille will be estimated using modifications of the Vollenweider input-output model. Metal species equilibria will be assessed using the MINEQL model developed, in part, by the Battelle Pacific Northwest Laboratory.
FUTURE ACTIVITIES: Water quality data for use in the various models will be compiled. Stream morphology measurements will continue. Actual modelling will be performed on the University of Montana's DEC 20 computer system.
STUDY NUMBER: 10.2

ORGANIZATION: University of Montana (UM) - Department of Geology

TITLE OF STUDY: Determination of Heavy Metal Contamination in Reservoir Sediment Along the Clark Fork River, Missoula to Heron, Montana

CONTACTS: Johnnie Moore - Department of Geology - U of M - 243-2341  
Carolyn Johns - Department of Geology - U of M - 243-2341

OBJECTIVE: Determine the concentration of heavy metals--arsenic, copper, cadmium, iron, lead, manganese and zinc--in the lower river reservoir sediments and compare these to values found in Milltown Reservoir.

DURATION: 1984 - 1986

CURRENT STATUS: During the summer of 1984, grab samples of reservoir sediments were collected from Milltown (27 samples), Thompson Falls (7 samples), Noxon Rapids (14 samples) and Cabinet Gorge (7 samples). Additionally, core samples, averaging 25 cm in length were collected at Thompson Falls (3 cores) and Noxon Rapids (5 cores). Six cores, approximately 150 cm in length, were collected at Milltown. Two heavy metal extraction techniques were utilized: acetic acid (25% v/v) and total, which involves a four-hour digestion in hot aqua regia.

Preliminary results from the acetic acid extractions
indicate that copper and zinc sediments concentrations in the lower river reservoirs are about ten times lower than those found in the Clark Fork arm at Milltown. However, sediment concentrations of copper and zinc are still elevated over background levels—four to eight times higher than the control stations in the Blackfoot arm of the Milltown Reservoir. Arsenic concentrations from the acetic acid extractions ot not appear to be significantly elevated in sediments of the lower river reservoirs.

A report of the findings of this study, including total extractable heavy metal values, will be published in the proceedings of the 1985 Montana Academy of Sciences (winter of 1986): "Heavy Metals in Bottom Sediments of Clark Fork River Reservoirs."

FUTURE ACTIVITIES: Depending upon the availability of funds, additional field work may be conducted during 1986.
STUDY NUMBER: 10.3

ORGANIZATION: University of Montana (UM)

TITLE OF STUDY: Groundwater Use and Management: A Sole Source Aquifer Study, Missoula Valley, Montana

CONTACT: William Woessner - UM Geology Department, Missoula - 243-2341

OBJECTIVE: Evaluate the long-term quantity, quality and availability of the natural groundwater system in the Missoula Valley; begin a long-term monitoring program and develop a predictive tool to evaluate the consequences of current and future groundwater management practices.

DURATION: 1985 - 1987

CURRENT STATUS: In the summer of 1983, the City of Missoula's Rattlesnake Creek water supply system was closed because of giardia contamination. The city now relies solely on groundwater for their drinking water. Approximately 7.6 billion gallons of water are withdrawn annually from the underlying aquifer.

The Missoula Valley Aquifer is directly connected to the land surface with only sporadic layers of silt and clay to protect it from downward infiltrating pollution. Improperly installed septic tanks and the "French Drain" system of stormwater disposal utilized by the City of Missoula are major sources on contamination to the aquifer.

This study is monitoring withdrawals from and discharges
into the Missoula Valley Aquifer by: 1) conducting surface
water discharge rates on the Clark Fork and Bitterroot River,
2) measuring water level changes at six monitoring wells, and
3) evaluating the discharge rates of two stormwater drain
systems and three septic tank disposal fields. Water quality
parameters are also being collected at all of these monitor-
ing sites.

FUTURE ACTIVITIES: The above monitoring program will
continue for two years. At that time, a numerical ground-
water model will be developed to predict the effects of
existing and proposed development and disposal practices on
the aquifer system.
STUDY NUMBER: 11.1

ORGANIZATION: Montana State University (MSU), Chemistry Department

TITLE OF STUDY: Chemical Reactions Controlling Copper Transport in the Upper Clark Fork River

CONTACT: Gordon Pagenkopf - MSU, Department of Chemistry - 994-4801

OBJECTIVE: Identify the sources and transport mechanisms of copper in the upper river. Evaluate the metal complexation capacity of the river.

DURATION: 1984 - 1986

CURRENT STATUS: Bimonthly water quality samples have been collected at several station between Warm Springs and Garrison since the autumn of 1984. Samples are collected in mid-channel, approximately 30 cm below the surface. A portion of each sample is filtered in the field through a 0.22 micron filter and acidified to pH 2. Parameters analyzed on all samples include specific conductivity, pH, calcium, magnesium, sodium, bicarbonate, carbonate, sulfate and copper. Copper species equilibria are calculated for all samples.

The results of samples collected during late 1984 and early 1985 (winter conditions) were presented at the Montana Academy of Sciences meeting in Butte on April 19, 1985, and will be published in the Proceedings of the meeting in early 1986.
Data from these initial, winter low-flow conditions indicated that the most toxic species of copper constituted about 6.3 percent of the total amount of copper in the river. During winter, there also appears to be a significant inhibition factor (buffering) provided by relatively high hardness levels.

**FUTURE ACTIVITIES:** Bimonthly sampling will continue through the summer of 1986. Some additional analyses and species equilibria calculations for metals other than copper are also planned to be conducted. Samples collected during runoff 1986 will be of special interest. A model or models will be developed to interpret copper toxicity and the transport of copper through the study area.
STUDY NUMBER: 12.1

ORGANIZATION: Anaconda Minerals Company/Chadwick and Associates

TITLE OF STUDY: Benthic Invertebrate Studies on the Upper Clark Fork River

CONTACTS: Jim Windorski - Anaconda Minerals Co. - 723-4311
Steve Canton - Chadwick and Associates - (303) 798-7708
Loren Bahls - DHES, WQB - 444-2406

OBJECTIVE: Annually monitor the benthic invertebrate communities in Silver Bow Creek, Mill-Willow Creek and the upper Clark Fork River.

DURATION: 1972 - Indefinitely

CURRENT STATUS: Benthic invertebrate samples are collected yearly during autumn at eleven stations. Five of these stations are on Silver Bow Creek (from Butte to Opportunity) two are on the Mill-Willow bypass channel (one above the Warm Springs Ponds and one below the confluence with the Pond 2 discharge) and three are on the Clark Fork River (at Warm Springs, Deer Lodge and Phosphate). Three separate quantitative samples are collected at each station using a modified Hess sampler. Organisms are identified to the lowest practical taxonomic level using available keys. Wet-weight biomass is determined for major groups (i.e. insect orders). Analysis of the invertebrate community includes calculation of the ShannonWeaver Diversity Index.
Annual progress reports are available from the Anaconda Minerals Company and/or Chadwick and Associates: "Aquatic Biological Survey of Silver Bow Creek and the Upper Clark Fork River".

FUTURE ACTIVITIES: Yearly monitoring as outlined above will, hopefully, continue.
STUDY NUMBER: 13.1

ORGANIZATION: Champion International Corporation

TITLE OF STUDY: Alternative/Additional Methods of Treatment to Improve the Quality of Discharge from Champion International's Frenchtown, Montana Kraft Paper Mill

CONTACT: Larry Weeks - Technical Director - Champion International, Missoula - 626-4451

OBJECTIVE: Identify and evaluate alternative state-of-the-art waste treatment technologies available for pulp and paper mill effluents.

DURATION: 1984 - 1986

CURRENT STATUS: Champion International hired WESTON, an engineering consulting firm, to review all available waste treatment technologies that could potentially reduce the color, BOD, TSS and nutrient content of their mill's effluent. Starting with 240 title and abstract citations, WESTON screened this list down to eleven potential methodologies. (Other treatment systems were eliminated primarily because they did not have proven records with full-scale application in the pulp and paper industry.) A detailed evaluation of these eleven technologies was then conducted as to their estimated installation, operation and maintenance costs and their ability to improve the quality of the mill's effluent, i.e. an estimate of the effluent quality expected from these technologies versus the present treatment system. A draft report summarizing WESTON's findings was published in April, 1985: "Evaluation of Alternative Technologies for Wastewater
Treatment, Champion International Corporation, Frenchtown Mill, Missoula, Montana."

FUTURE ACTIVITIES: Pending the status of permit limitations which may be prescribed during the renewal of the mill's MPDES Permit in the spring of 1986, additional review or design of treatment technologies may be necessary.
STUDY NUMBER: 13.2

ORGANIZATION: Institute of Paper Chemistry/Champion International Corporation

TITLE OF STUDY: Benthic Invertebrate Studies on the Middle Clark Fork River

CONTACTS: Larry Weeks - Champion International - 626-4451
Loren Bahls - DHES, WQB - 444-2406
Gary Ingman - DHES, WQB - 444-2406

OBJECTIVE: Annually monitor the benthic invertebrate communities in the Clark Fork River above and below a major pulp and paper mill located at Frenchtown.

DURATION: 1956 - Indefinitely

CURRENT STATUS: Benthic invertebrate samples are collected yearly during late summer at nine to eleven stations. The study area extends from the outskirts of Missoula to Lozeau (near the confluence of Nine Mile Creek) with the most intensive coverage given to a twenty mile river reach encompassing the Frenchtown Mill. At each station, four replicated Surber samples are collected in riffle areas less than twelve inches deep. All taxonomic work is conducted at the laboratories of the Institute of Paper Chemistry in Appleton, Wisconsin. Identification of specimens is carried out to the genus and species levels as feasible. Various diversity and biotic indices are calculated to ascertain changes in community composition between controls and areas influenced by the mill's effluent.
Annual progress reports, which presently number thirty-three volumes, are available from the Institute of Paper Chemistry: "A Benthic Invertebrate Water Quality Survey of the Clark Fork River in the Vicinity of Missoula, Montana."

FUTURE ACTIVITIES: Yearly sampling is expected to continue.
STUDY NUMBER:  14.1  

ORGANIZATION: Montana Power Company (MPC)  

TITLE OF STUDY:  Study of Alternatives for Milltown Dam  

CONTACTS:  Frank Pickett - Montana Power Company, Butte - 723-5421  
           Don Sprague - Montana Power Company, Butte - 723-5421  

OBJECTIVE: Evaluate feasible alternatives for the reconstruction or retirement of the Milltown Dam structure.  

DURATION:  1984 - 1986  

CURRENT STATUS: Originally constructed in 1907, Milltown Dam is an aging structure in need of reconstruction or retirement. During 1984, the Montana Power Company conducted studies leading to engineering designs for three potential alternative actions:  1) rehabilitation of the existing dam,  
2) partial retirement, or 3) complete dam retirement. These data are contained in a September, 1984 report, "Milltown Hydroelectric Project Engineering Evaluation."  

Subsequent to this work, the company conducted additional review and study at the Milltown site, leading to an application to the Federal Energy Regulatory Commission, "Application for Amendment of License," submitted in September, 1985. In this application, Montana Power provides supporting information for reconstruction of the dam, their preferred alternative.
FUTURE ACTIVITIES: Following a technical review of the application by FERC, public hearing will be held, possibly as early as the winter of 1986.
STUDY NUMBER: 15.1

ORGANIZATION: Washington Water Power Company (WWP)

TITLE OF STUDY: Biological Studies on Noxon Rapids and Cabinet Gorge Reservoirs

CONTACTS: Roger Woodworth - WWP, Spokane - (509) 489-0500
Joe Huston - MDFWP, Kalispell - 755-5505

OBJECTIVE: Evaluate the effects of reservoir management upon the biological populations of Noxon Rapids and Cabinet Gorge Reservoirs.

DURATION: 1958 - Indefinitely

CURRENT STATUS: From 1958 through the early 1970's, WWP provided a summer field assistant to work closely with the Montana Department of Fish, Wildlife and Parks (MDFWP) during their fishery studies on the reservoirs. Since the late 1970's, WWP has supported several student projects relating to aquatic biology research on the reservoirs, the most recently published (1984) being "Studies of Micropterus (Bass) Species in Two Impoundments in Western Montana." This, and all other student research work, has been closely coordinated with the DFWP's Kalispell Office. WWP biologists have also assisted DFWP during field work and in determining goals for reservoir management. The Company is also contributing $10,000 per year to supplement the fish stocking efforts presently being conducted by DFWP.

FUTURE ACTIVITIES: Negotiations are presently underway between WWP and MDFWP to 1) limit the maximum annual spring
drawdown at Noxon Rapids to ten feet and 2) jointly fund a biological field assistant to work exclusively on the reservoirs and their tributary streams. This person will monitor the benefits to the fishery that may be derived from the drawdown limitation. Studies to be conducted would likely include mapping of shallow shoreline (littoral) zones, monitoring the success of various fish plantings (see Study 2.10) as well as limited bottom organism and plankton studies.
STUDY NUMBER: 16.1

ORGANIZATION: Confederated Salish and Kootenai Tribes (CSKT)

TITLE OF STUDY: Lower Flathead River Fisheries Study

CONTACTS: David Cross - CSKT, Pablo, Montana - 675-4600
Jim Paro - CSKT, Pablo, Montana - 675-4600

OBJECTIVE: Assess the effects of Kerr Dam operations on the fisheries of the lower Flathead River by evaluating the aquatic habitat of the river and its tributaries, including the size, distribution and abundance of sport fish.

DURATION: 1983 - 1987

CURRENT STATUS: Fish population estimates and habitat evaluations are being conducted at five study sections on the mainstem: near Buffalo Rapids, near the Sloan Bridge, above Dixon (Agency section), below Dixon (weed section) and near Perma. Spawning, creel census and fish movement surveys are also being conducted at these sites. Water temperatures are being continuously monitored at the Sloan, Dixon and Perma bridges.

Fish study sections have also been established on five major tributaries:

Jocko River (7 sections)
Mission Creek (5 sections)
Post Creek (4 sections)
Little Bitterroot River (4 sections)
Crow Creek (1 section)
Fish wiers have been established on the Jocko River and Mission Creek to assess spawning runs of trout from the main river. Annual progress reports for 1983, 1984 and 1985 are available from the CSKT's office in Pablo.

FUTURE ACTIVITIES: Preliminary findings indicate a lack of successful spawning by trout species in the lower Flathead river. Field studies as outlined above will continue. Instream flow determinations will be conducted on the mainstem during the autumn of 1985, utilizing the Instream Flow Incremental Methodology. Progress reports will be prepared for work conducted during 1986. By 1987, an array of fishery management options will be prepared to mitigate the impacts of present hydroelectric operations (demonstrating under each option how fish populations and hydroelectric generation capabilities would be modified).
STUDY NUMBER: 17.1

ORGANIZATION: Headwaters Resource Conservation and Development Project Area

TITLE OF STUDY: Reclamation Techniques for Heavy Metal Contaminated Pasturelands in Deer Lodge, Powell and Silver Bow Counties

CONTACTS: Ted Dodge - Headwaters Resource Conservation and Development Area Coordinator - Butte - 782-7333
Tom Osborne - MBMG - 496-4337

OBJECTIVE: Develop reclamation techniques for heavy metal contaminated pasturelands, while ensuring that changes in land use do not negatively impact the surface and groundwater resources of the area.

DURATION: August 1984 - October 1987

CURRENT STATUS: Test plots which will evaluate the success of various combinations of tillage techniques, liming rates and plant (forage) species, have been established at the Hazel Spangler Ranch near Gregson. All plots established in 1985 were in dry pasture areas. Soil chemistry measurements, including extractable metal concentrations, were conducted prior to and after the lime applications. The survival and growth rate of various plant species were measured, but severe drought conditions during the spring and summer of 1985 had a definite impact upon interpretation of the results.
FUTURE ACTIVITIES: Reseeding of the drought-impacted plots may be conducted in the autumn of 1985. Additional test plots may be established in irrigated pasturelands in 1986. Additional core samplings will be conducted within the contaminated soils, along with expanded soil water sampling.
## ATTACHMENT 1
### STUDY CONTACTS

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