Attachment B

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Ms. Rebecca Stevens, Coeur d'Alene Tribe Co-coordinator
Mr. Caj Matheson, Communications Specialist
Restoration Partnership
424 Sherman Ave,, Suite 306
Coeur d'Alene, ID 83814

Dear Ms. Stevens & Mr. Matheson, August 9, 2013

On behalf of the Mica Shore Property Owner's Association I would like to thank you for your recent presentation to members of our board. It was very professional and informative.

Our association has submitted a proposal through your web site for restoration of Mica Bay. I am taking the liberty of enclosing two discs which relate to that proposal. One is a comprehensive study done of Mica Bay which our association submitted in the lawsuit for the damages done to the bay during the construction on U.S. 95. The other are some pictures taken in January 2012, showing Mica Bay at low level and graphically showing the issues of water quality, fish habitat, recreational opportunities and access to the BLM Water Park, Kootenai County boat launch and residential docks.

Our association looks forward to working with Restoration Partnership in matters of mutual concern.

Please feel free to contact me if you have any questions.

Thank you for your consideration.

Sincerely,

Tad Leach

Tad Leach, President
Mica Shore Homeowners Association


PARKING
FOR
VEHICLES
WITH
TRAILERS
ONLY
TOW-AWAY
ZONE
RESERVED
PARKING

Final Report

Volume 1 of 3

U.S. 95, Bellgrove to Mica
Project No. DHP-NH-CM-5110(119)

Mica Bay and Mica Creek Final Impact Assessment

Prepared for

Idaho Transportation Department and Idaho Department of Environmental Quality

March 18, 2004

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Contents

Appendixes

Tables

Figures **Page**

Photos **Page**

Executive Summary

Background

The U.S. 95 Bellgrove to Mica project (the project) is located in Kootenai County, Idaho, between approximately mileposts 415.83 and 421.32. This Idaho Transportation Department (ITD) project extends from just north of the Fighting Creek bridge on the south to the Mica Creek Bridge on the north. U.S. 95 is the primary north-south highway in Idaho and is the major transportation and commercial link for northern Idaho. The purpose of the project is to improve the alignment of this segment of U.S. 95 to safely accommodate projected traffic and to maintain the viability of this route for commerce and tourism. The project involves widening, reconstruction, and realignment of the existing highway. The new highway is a four-lane divided roadway from the southern terminus to the South Fork Mica Creek canyon (milepost 418.3). The highway through the canyon is a four-lane undivided roadway.

Construction activities on the project commenced on June 25, 2001. The project was officially opened to traffic with a ribbon cutting ceremony on November 3, 2003.

As a result of stormwater and snowmelt runoff issues experienced during the 2001-2002 winter, ITD signed a Consent Order (CO) with the Idaho Department of Environmental Quality (IDEQ) on May 8, 2002. The CO included a requirement to determine whether adverse impacts have occurred to Mica Bay, Mica Creek and South Fork Mica Creek; and also implementation of action lists for erosion and sediment control and managing accumulated sediment on or near the project site. The CO required an assessment of the following:

- the sediment strata present in the bay to determine the extent of sediment contributions that may have come from the project, including quantity, depth, type, and metals content relative to other sediment sources
- the extent of any damages to Mica Bay including any damages to recreational uses of the bay and potential damage to domestic water supply systems in the bay as a result of sediment from the project
- the extent and duration of adverse effects to the fisheries resource and habitat, including without limitation stream morphology and any other physical characteristics of the stream that affect habitat for fish, macroinvertebrates or other aquatic life

In November 2003, the *Mica Bay Sediment Impact Assessment* report was submitted to IDEQ for review and comment. Subsequent to IDEQ's review of the bay report, multiple technical meetings between ITD and IDEQ were conducted to discuss and clarify the findings of the bay impact assessment as well as the biological studies conducted for the creek assessment. **This report documents the findings and conclusions of an integrated assessment of the bay and its upstream creeks and watershed to fulfill the assessment requirements of the CO.** A determination will be made from the findings and conclusions presented in this report whether corrective action is required; if so, the CO directs ITD to develop and implement a Corrective Action Plan.

Scope of the Mica Bay and Mica Creek Final Impact Assessment

A detailed *Impact Assessment Methodology* has been prepared and was approved by IDEQ on July 9, 2002. This methodology document is included in Appendix A.

The *Impact Assessment Methodology* was developed and organized based on the two resources of concern: the bay and the creeks. The scope of the Mica Bay sediment impact assessment focuses on potential impacts of project-related sediment/turbidity on Mica Bay, including fisheries, recreation, and water supply uses of the bay. The fish (or creek) impact assessment focuses on potential impacts to stream habitat quality and the fish and aquatic insect populations in Mica Creek and South Fork Mica Creek. These potential impacts were assessed using multiple lines of evidence, including:

- Conduct a detailed hydrographic survey to establish 2002 lake-bottom elevation and bathymetric (that is, depth) contours in the bay.
- Conduct physical and geochemical analyses of sediment cores collected from the bay to evaluate potential sediment sources.
- Review historical aerial photography to evaluate potential migration over time of the sediment delta in the bay and the course of the Mica Creek channel across the delta.
- Develop underwater video and still photography to see if there is direct evidence of recent sediment accumulation and to document the current condition of water supply intakes.
- Analyze frequency, duration and magnitude information for measured turbidity data that have been collected in Mica Creek and Mica Bay since fall 2001.
- Review relevant published information on Mica Bay watershed characteristics related to sediment and erosion conditions.
- Analyze historical data on seasonal lake levels.
- Conduct interviews with homeowners around Mica Bay to evaluate potential impacts of sediment/turbidity on water supply intakes and treatment systems.
- Collect available information on fish species that use the lake and Mica Bay.
- Conduct a literature review of sediment impacts on various fish species.
- Conduct a stream physical habitat survey in Mica Creek, South Fork Mica Creek (both upstream and downstream of the project) and North Fork Mica Creek.
- Conduct fish and macroinvertebrate surveys in Mica Creek, South Fork Mica Creek (both upstream and downstream of the project) and North Fork Mica Creek.

As identified in the Methodology, this impact assessment is primarily focused on potential impacts associated with erosion and sediment control issues during the time period from start up (June 25, 2001) of project construction through the summer of 2002. Additional information prior to start up and beyond the summer of 2002 is occasionally included in this assessment when it provided useful insights into potential project-related impacts (for example, historical aerial photos and lake level data, meteorological data, and turbidity data).

Findings of Mica Bay and Mica Creek Final Impact Assessment

Hydrographic Survey, Historical Aerial Photography, and Underwater Photography (Chapters 2, 4, and 5)

The hydrographic survey resulted in a detailed contour map of Mica Bay (Figure 2-1) that was used to select coring locations. The map was also used to compare the July 2002 geometry of the Mica Bay delta to the pre-project conditions visible in aerial photographs dating back to 1958. A review of the historical aerial photographs revealed several important findings: 1) between 1984 and 1999 the main channel across the delta was realigned to the north shore of the bay near the Kootenai County boat launch area; 2) the channel shift to the north had begun by 1984, become more defined by 1992, and by 1999 the channel to the north had become the primary channel across the delta; and, 3) the overall shape, size, and lateral extension of the delta into the lake is similar when comparing photographs from 2002 and 2003 to the 1999 pre-project photograph. This demonstrates that the project did not result in enough sediment deposition in Mica Bay to extend the delta farther out into the lake as evidenced by the aerial photographs.

The most pronounced change to the main channel across the delta (along the north shore) occurred between 1992 and 1999. The channel geometry across the delta evident in the 1999 aerial photograph very likely resulted from the February 1996 flood event which was the second highest flood event on record. At the onset of that major flood event the lake level was close to its lowest drawdown level for the year. This high-energy flood flow into the shallow waters of the delta environment likely resulted in both the delivery of sediment from the watershed to the delta and the redistribution of sediments that had been previously deposited in the delta. This flood also caused the lake to subsequently rise 11 feet during a 6-day period, which would have then created an environment conducive to settling of fine sediment across the delta.

The hydrographic survey also provided very accurate measurement of the elevation of the bottom of the main channel through the delta. Of particular significance is the bottom elevation of the point at the outer edge of the delta where it begins to slope steeply down into the bay (referred to as the "delta pivot point"). The measured elevation at this point during the July 2002 survey is the same as the lowest lake water surface elevation prior to the project. This lowest pre-project lake surface elevation occurred in January 2001 according to data published by the USGS. At this lowest lake level, the movement of Mica Creek water through the delta channel is more similar to a flowing creek than a calm lake environment. It is not coincidental, but in fact most logical, that the bottom elevation of the channel through the delta would be the same elevation as where the lake drawdown line was located. This provides evidence that the elevation of the delta at this point, where delta formation is most active, was established by movement of creek water through the delta during lake drawdown in January 2001. Had the project resulted in sediment deposition after January 2001, it would be expected that the elevation of the delta pivot point would be higher. This is not the case, providing strong evidence that the project did not result in adverse sediment deposition at this location.

Underwater video footage was recorded at nine different locations in Mica Bay in July 2002. Color still photographs were taken at five underwater locations by a diver in August 2003. The underwater video effort included areas along the outer edge of the delta near the mouth of the active channel paralleling the north shore of the bay. The video footage recorded many bottom features such as wood pilings, logs, tires, a sunken boat, water intake structures, and accompanying pipes that had been submerged before the project began. Dense stands of well developed rooted aquatic plants were observed that showed no signs of burial. The underwater photography conducted by the diver revealed that every water intake structure (conveyance piping and slotted or screened intake standpipe) was fully exposed on the lake bed. The video and color still photographs show that the project has not resulted in an observable accumulation of a recent sediment layer at the many locations photographed in Mica Bay.

Sediment Physical Characteristics and Geochemistry (Chapter 3)

Sediment cores up to 8.6 feet long were successfully extracted from 10 locations in Mica Bay. To help assess the potential for the project construction site to be a source of sediment to Mica Bay, sediment and soil samples were collected from the watershed. Sixteen different locations in the watershed were sampled to define soils from the dominant land use types, including the project construction site, as well as stream sediments from the South Fork Mica Creek (upstream and downstream of the project), North Fork Mica Creek, and main stem Mica Creek. The cores and watershed samples were extensively analyzed to define their physical and geochemical characteristics.

As a result of both visual and chemical analyses, Mount Saint Helens ash was identified in the cores. The Mount Saint Helens ash provides a means to estimate a post-May 1980 average sedimentation rate. Based on the thickness of sediments overlying the Mount Saint Helens ash, the estimated average sedimentation rate within the Mica Bay delta environment from 1980 to 2002 ranges from 0.8 to 2.4 inch per year. The upper end of this range becomes 1.7 inches per year when three cores with vegetative contents of up to 50 percent (by volume) are excluded from the calculation.

Based on media reports in late 2001 and early 2002, there was speculation that most if not all of the cores would show a distinct blanket of visually identifiable project-related sediments in the upper depth interval of the cores. After a thorough review of both physical and chemical data, this was not observed. The sediments throughout all the core depth intervals, as well as those overlying the Mount Saint Helens ash-dominant layer, exhibited highly variable physical and chemical characteristics. This indicates a complex history of both continuous and episodic deposition rates that have varied in both time and location. In other words, sediments forming a more uniform physical and chemical signature similar to the watershed soils and sediment and overlying the top of each core, as might be expected from a recent, singular and significant source of sediment, were not found.

Based on geochemical analyses to determine the relative contributions of sediment sources to the bay, the upper depth interval of the cores exhibit a strong lake signature. This means that these sediments have been in place long enough for the chemical and biological processes of the lake environment to dominate the sediment chemistry. This provides evidence that the project did not result in enough sediment deposition in the bay to alter the prevailing sediment chemistry of the upper-most sediments. This does not mean that there are no project-related sediments incorporated within the upper layer of some part of Mica Bay. It means that the clearly definable sediment layers in Mica Bay represent a mixture of sources from the watershed, the lake, and Mount Saint Helens ash, but there is an insufficient amount of project-related sediments accumulated within these layers to quantify project-related particles as a source within the mixture. Therefore, a thorough analysis of the core data concluded that there is an insufficient amount of project-related sediment deposition in Mica Bay to be quantified.

Ultimately, the roadway construction soil samples were not uniquely chemically separable from the forest soil samples, so the exact contribution of soils originating from the roadway project site could not be determined. However, the sediment source analysis did reveal that the agricultural soils contribute most of the finer-grained sediment in Mica Bay with lesser contributions from road construction and forest soils. Also, it was determined that the primary sources of coarser-grained sediments to Mica Bay are from the background locations in the South Fork Mica Creek and the North Fork Mica Creek.

Portions of certain sediment core samples were estimated to contain as much as 50 percent vegetation over depth intervals up to 6 feet deep. Even higher percentages of vegetation were observed in shorter depth intervals. These observations indicate that aquatic vegetation has been a significant component of the delta for many decades (at least). Collectively, all the analyses presented in this chapter support the conclusion that the project did not result in an adverse impact associated with sediment deposition in the bay.

Turbidity, Erosion and Watershed Information (Chapters 6 and 7)

Turbidity is a term commonly used to describe the appearance of water (cloudy, muddy, or colored). It is also a scientific unit of measurement quantifying the degree to which light traveling through a water sample is scattered by the suspended organic (including algae) and inorganic particles. The scattering of light increases as the concentration of particles increases. Turbidity is commonly measured in Nephelometric Turbidity Units (NTU). There are other ways to measure the concentration of soils and sediments in water. These include total suspended solids and suspended sediment methods. These are usually reported as milligrams of solids or sediment per liter of water (mg/L).

IDEQ criteria for turbidity restrict the increase to no more than 50 NTU above background on an instantaneous basis, and to no more than 25 NTU over background for 10 consecutive days or more.

There were 21 days from September 2001 through September 2003 on which instantaneous turbidity readings on South Fork Mica Creek exceeded upstream background conditions, at a minimum of one sampling station, by more than 50 NTU. On 10 individual days, instantaneous readings on Mica Creek exceeded background conditions of South Fork Mica Creek, at a minimum of one sampling station, by more than 50 NTU, and on 6 days the readings exceeded conditions of North Fork Mica Creek, at a minimum of one sampling station, by more than 50 NTU. In total, there were 25 days when readings at either South Fork Mica Creek or Mica Creek exceeded background conditions of either North Fork Mica Creek or South Fork Mica Creek. The greatest occurrence of values that exceed background conditions by more than 50 NTU was during fall 2001 through winter 2002 (17 days). There were fewer measured turbidity events in Mica Bay, with most data indicating that levels in Mica Bay tended to be about 25 percent of the values measured in the project-influenced reaches of the South Fork Mica Creek.

None of the monitoring sites within South Fork Mica Creek or Mica Creek had extended periods during which turbidity measurements that exceeded background conditions by more than 25 NTU lasted for more than 10 days. Available turbidity data also does not reveal any events of elevated turbidity in Mica Bay lasting 10 days or longer. This does not necessarily mean that there were no such exceedances in the creeks or bay because there were several periods prior to March of 2002 when there were more than 10 days without available turbidity data. ITD construction diaries and climatological information were examined to qualitatively evaluate the potential for prolonged elevated turbidity during periods without measured data. Considering all information, more than 10 days of elevated turbidity could likely only have occurred on one occasion (11 days from November 10 through November 20, 2001).

Based on measured turbidity data, elevated levels that were influenced by the project returned to levels that were comparable to pre-event or background conditions in no more than 9 days, and usually much sooner.

Information on watershed soils shows that soils from the project were similar in physical characteristics to other soils, and contained a much higher fraction of silt/clay (approximately 40 percent) than in-creek sediment samples (1 to 2 percent silt/clay). Most project area runoff samples tested for settleability showed very poor settleability.

In addition, turbidity data collected show that turbidity levels within the watershed naturally fluctuate and are influenced by factors other than construction activity such as agriculture, logging, and eroding stream banks. There were also occasions when turbidity levels at the sampling location in the bay were higher than upstream in the South Fork and North Fork Mica Creek and the mainstem Mica Creek; this generally occurred during the winter drawdown of Coeur d'Alene Lake.

Based on sediment loads reported in the 1999 Total Maximum Daily Load for Mica Creek, the primary source of sediment in the watershed historically has been logging, with agricultural activities being a secondary source. A substantial increase in logging activities in the watershed occurred in 2000. Streambank encroachment and erosion, as well as stream channelization also appear to have contributed sediment based on records of activities and observations of deeply cut banks. Alterations or disturbances to the streambanks are most apparent in the downstream reaches of the North Fork and South Fork Mica Creeks and essentially the entire length of Mica Creek.

Aquatic Species and Habitat within Mica Bay and Mica Creek (Chapter 8)

Mica Bay

Coeur d'Alene Lake supports a variety of game and nongame fish species. Average and maximum depths in the lake are 70 feet and 200 feet, respectively, and provide good habitat for deep water fish species including kokanee and chinook salmon. However, many bays in the lake, including Mica Bay, are vegetated and relatively shallow, and these conditions provide good habitat for bass and northern pike as well as good nursery areas for juvenile fish of various species.

Fisheries habitat and vegetative surveys were conducted within Mica Bay in the early and late 1990s that describe aquatic species, abundance, and depth of occurrence of aquatic vegetation. Qualitative comparisons of the early surveys were made with recent underwater video. These comparisons found no indication of a change in aquatic vegetation (fish habitat) based on species presence and densities or depth of occurrence, that could be attributed to an input of sediment from the project. Further, the hydrographic surveys conducted in 2002 indicated that no fish passage impediment to Mica Creek occurred across the delta resulting from the project.

Fish have a tolerance to brief periods of high sediment load—a trait that is essential to survival in environments with runoff and flood events; therefore, short exposures to high turbidities generally have no lasting effect. Information available on the magnitude, frequency, and duration of turbidity levels in Mica Bay during the project, along with what the scientific literature describes about turbidity and suspended sediment effects on fish (Appendix M), provide evidence that lethal effects (e.g., mortality) or sublethal effects (for example, physiological stress) on fish within the bay were not likely caused by the project.

Mica Creek

Habitat

The project area and the reference reaches upstream of the project have a history of land uses that have contributed to the existing stream habitat conditions. Stream channelization and subsequent downcutting have created unstable channel conditions within the lower portions of the South Fork and North Fork Mica Creeks. Heavy cattle use within the North Fork and lower South Fork Mica Creeks is currently contributing to bank erosion. Large sand bars within the North Fork suggest that a contributing source of sediment exists upstream of the surveyed reaches. Aerial photos of the watersheds depict riparian roads and stream crossings that contribute sediment into the creeks. Further, beaver activities within the South Fork have altered the sediment transport conditions to create large storage areas for natural and anthropogenic-derived sediments within the upper portions of the South Fork Mica Creek. This includes a large beaver dam complex both upstream and downstream of the project sediment basin breach. It is likely that a portion of the sediment delivered to the South Fork from the breach is being stored within this beaver dam complex.

Stream habitat index comparisons show that, on average, the stream reaches on the South Fork Mica Creek have higher habitat quality than either the lower mainstem Mica Creek or the North Fork Mica Creek. Both the North Fork and the mainstem showed substantially greater bank erosion than the South Fork. Both watersheds show evidence of high flow events, both annual and periodic flood events. Based on the comprehensive stream habitat survey there was no evidence of altered channel morphology due to the project..

Fish

The creeks support a diversity of species and age structures in fishes, including sculpin which are sensitive to sedimentation. The four species of fish collected were: cutthroat trout, sculpin, brown trout, and smallmouth bass. Cutthroat trout and sculpin were the dominant species and were collected at all sampling sites and their presence and age class structure is an indicator of successful spawning and incubation and that adequate spawning gravel is present within the surveyed areas. The stream fish indices (SFI) for the South Fork Mica Creek sites describe negligible differences between upstream (above project) and downstream (below project) sites. However, the mainstem Mica Creek site had a lower average fish index than all of the other sites, suggesting impaired conditions. This impairment is likely due to three factors: 1) the limited number of cutthroat trout and age classes throughout the three sample periods, 2) the presence of smallmouth bass captured at the site, and 3) degraded habitat including sloughing banks, limited instream habitat complexity, lack of large woody debris, and limited undercut banks. It is unlikely, given localized and above-project land uses, that the project played a decipherable role in the resulting fish indices.

Macroinvertebrates

Macroinvertebrates are bottom-dwelling aquatic organisms visible to the naked eye (including early life stages of important and sensitive insects such as certain mayflies, caddisflies and stoneflies). They are considered good indicators of environmental stress or impact because some are sensitive to and unable to avoid such stresses. Macroinvertebrate indices for sites upstream (unimpacted by the project) and downstream (potentially impacted by the project) both had similar averaged metric scores for riffle areas, with the exception of the North Fork site which had the lowest metric scores (that is, lower quality habitat) of all sites. The North Fork site also had the lowest averaged fine sediment biotic index score of any of the riffle sites. Overall, comparing the upper South Fork site (reference site) with the other South Fork and mainstem sites showed no statistical differences in individual index scores or overall index scores, showing that these sites are more similar to each other than dissimilar. This finding is further supported by the multivariate analysis, which also demonstrated that the communities both upstream and downstream on the South Fork and mainstem Mica Creeks are not noticeably different in the number of taxa, taxa diversity, or individual abundances. If the project would have had a noticeable impact on the macroinvertebrate community, it would be expected that the cluster analyses would show the disparity. Further, multivariate analysis describe the North Fork macroinvertebrate site as more dissimilar to the other sites.

Summary

It is likely that a portion of the sediment delivered to the South Fork Mica Creek from the project sediment pond breach is being stored within the beaver dam complex. Project related sediments also likely are present to some extent in other depositional areas of the lower South Fork Mica Creek and mainstem Mica Creek. From an ecological standpoint, the fish and macroinvertebrate data demonstrate that there are no statistical differences between the upstream and downstream sites throughout the watershed. Cutthroat trout and sculpin were collected at all sampling sites and their presence and age class structure is an indicator of successful spawning and incubation, and that adequate spawning gravel is present within the surveyed areas. For macroinvertebrates, comparing the upper South Fork site (reference site) with the other South Fork and mainstem sites showed no statistical differences in index scores, showing that these sites are more similar to each other than dissimilar. Based on the comprehensive stream habitat survey there was no evidence of altered channel morphology resulting from the project.

Water Supply Systems Around Mica Bay (Chapter 9)

Fifty-four property owners were identified around the bay. A one-page letter, with a one-page questionnaire attached, was sent to each of the identified property owners. Twenty-six responses were received; of these 18 used water from the bay. Twelve of the 18 indicated that their water system was affected in an out-of-the-ordinary way by sediment or turbid conditions in the bay sometime since fall 2001. Personal interviews were conducted with the homeowners who were successfully contacted. The interviews covered seven water systems serving 13 separate residences.

Mica Bay homeowners utilize both well water and lake water for domestic purposes. Some homeowners obtain their water supply from deep wells, whereas others get their entire water supply from Coeur d'Alene Lake. Some homeowners use a combination of well water and lake water, with the well water being used for indoor domestic purposes such as drinking and bathing, and the lake water being used for irrigation and lawns. Mica Bay homeowners that rely solely on Coeur d'Alene Lake filter and disinfect the water prior to consumption.

Most Mica Bay homeowners that draw water from Coeur d'Alene Lake have water intakes consisting of slotted standpipes or drum screens. For the homeowners participating in the interviews, the depth of submergence of the intakes ranges from 2 feet to 37 feet. Diving records and photographs of intakes indicate that many of the screen surfaces contain a thin layer of organic matter and sedimentary detritus, but otherwise appear to be functional and operating as intended. Diving records did not reveal the presence of deposited sediments on intakes or conveyance piping.

Some Mica Bay homeowners have noticed an increase in the frequency of operational problems associated with their water systems that draw water from the lake. Problems reported by homeowners during interviews included: 1) reduced water pressure, 2) mud-clogged filters and sprinkler heads, and 3) cloudy/muddy water.

Recreation in Mica Bay (Chapter 10)

Based on findings presented in other chapters, in addition to an analysis of historical lake water surface elevations, the project did not likely impact any recreational opportunities in the bay. If any impacts occurred, they would have been temporary and associated with elevated turbidity during the winter months when recreational activity on the lake is at a minimum.

Comments received during the course of this assessment have relayed concerns pertaining to difficult boat access during the late season resulting from sedimentation in Mica Bay. Lower water surface elevations during the more recent late season months has likely contributed to the concern of more difficult boat access at the Kootenai County boat ramp during the late season. The lateral movement of the primary channel location across the delta, which was a pre-project event, may have exacerbated this perception because it resulted in the area of active deposition being closer to the north shore near the County boat launch. A detailed analysis of the late season water surface elevations revealed that the lake levels in all three late season months has dropped since the 1950s and 1960s up to 5 feet. Since 1970, the water surface elevations during the month of October have remained relatively constant; however, since 2000 the levels have become progressively lower in November and December. With the exception of the 1950s and 1960s, the greatest difference between any two time periods analyzed occurred between the 1990s and the 2000 to 2002 data—with the 2000 to 2002 being the lowest lake levels during these months.

Overall Conclusions Regarding Impacts to Mica Bay, South Fork Mica Creek, and Mica Creek

Sediment Transport and Deposition Concepts Relevant to This Impact Assessment

As described above, project-related sediment was at times observed in the South Fork Mica Creek, mainstem Mica Creek and Mica Bay as measured by elevated turbidity relative to upstream or pre-event conditions. ITD has also estimated a volume of sediment delivered to the South Fork Mica Creek as a result of the sediment pond breach (135 cubic yards). It is likely that a portion of the sediment delivered to the South Fork from the breach is being stored within the beaver dam complex immediately downstream of the tributary where the breach occurred. Project related sediments also are likely present to some extent in other depositional areas of the lower South Fork and mainstem Mica Creeks. Multiple lines of evidence described above also have shown that the project did not result in an adverse impact to Mica Bay as a result of sediment deposition.

The above findings lead to logical questions: What was the ultimate fate of the sediment observed at times to be suspended in the creek water and as turbid plumes in the bay? Where did the sediment go? Understanding some of the fundamental concepts of sediment transport and deposition can help answer these questions.

The factors affecting sediment transport and the response of the receiving waters and their biological community are numerous, and interrelationships between these processes, environments, and communities are complex and vary considerably over time and space. Nonetheless, there are some basic concepts that help explain what likely occurred in the creeks and bay downstream of the project. Perhaps the most important of these basic concepts is the mode of transport and the importance of sediment "grain size" as described below:

- *Bed load* consists of the coarse sediment that moves on or near the bed of the stream by rolling, bouncing, or sliding
- *Suspended load* consists of finer material that moves by suspension in the water column
- *Wash load* is the finest portion of sediment, generally silt and clay, that is washed through the channel, with an insignificant amount of it being found in the bed

Figure ES-1 provides a schematic representation of the modes of sediment transport.

Note: Wash load can be transported in both the suspended load as well as the bed load component. In this schematic figure, wash load is depicted by the background shading.

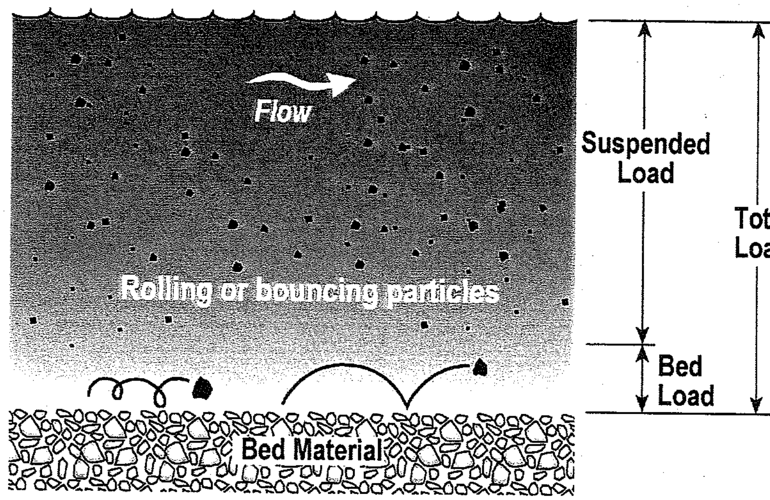

FIGURE ES-1
Schematic representation of sediment transport in a stream.

The soil samples collected from the various land uses in the Mica Bay watershed, including the project area, have an average clay and silt content of 41 percent by weight. The sediment samples collected in the watershed had a clay and silt content ranging from 0.3 to 2 percent, demonstrating that only a very small portion of the clay and silt particles settled in the creek. As described in Chapter 6, suspended sediment samples collected downstream of the project exhibited poor settleability. These data indicate that much of the sediment transported from the project into the South Fork Mica Creek was transported in suspension. Because of the poor settleability of this sediment, combined with the changing water levels and velocities in the lower Mica Creek and into Mica Bay, and the findings of this assessment, it is evident that nearly all of the wash load stayed in suspension as it was transported into the lake proper. This is supported by visual observations from Mica Bay homeowners reporting turbidity plumes in the bay.

A portion of the suspended load comprised predominately of sand particles likely settled into low-velocity environments such as low-gradient stream reaches, pools, and upstream of beaver dams. The larger grain-sized material, such as coarse sand and gravels, are typically transported as bed load. Bed load normally comprises less than a third of the total sediment load (Reid, 1993; Morris and Fan, 1998). Some portion of the bed load from the project was deposited in the floodplain of either a tributary or the South Fork Mica Creek, and was subsequently removed or stabilized by seeding in-place. That portion of the bed load that entered the South Fork Mica Creek likely deposited into the low-velocity environments of the creek.

Based on the findings presented in this assessment, the amount of sediment that did settle in the creek did not alter the biological community or stream habitat beyond conditions found within the watershed.

Overall Conclusions Regarding Impact Assessment

The multiple lines of evidence described above lead to the overall conclusion that the U.S. 95 Bellgrove to Mica project has not had an adverse impact on fish or recreation uses in Mica Bay. The project did not change the shape, size or lateral extent of the delta. Underwater video and photographs show no evidence of recent sediment deposition that has adversely impacted fish habitat, recreational opportunities, or water intake systems. Furthermore, an analysis of the sediment cores from the bay revealed no distinct blanket of visually identifiable project-related sediments in the upper depth interval of the cores. A thorough review of physical and chemical data from the cores revealed that there was an insufficient amount of project-related sediments accumulated within the core layers to quantify as a source within the mixture of sediments from the Mica Creek watershed, the lake, and Mount Saint Helens ash.

There were periods of project-related instantaneous turbidity exceedances in Mica Bay and the creeks. Turbidity data, construction diaries, and climatological information indicate that periods of elevated turbidity were not longer than 10 days and usually much shorter in duration. Some Mica Bay homeowners reported that they had noticed an increase in the frequency of operational problems associated with their water systems that draw water from the lake. Problems reported by homeowners during interviews included: 1) reduced water pressure, 2) mud-clogged filters and sprinkler heads; and 3) cloudy/muddy water.

It is likely that a portion of the sediment delivered to the South Fork Mica Creek from the project sediment pond breach is being stored within the beaver dam complex. Project related sediments also are likely present to some extent in other depositional areas of the lower South Fork Mica Creek and mainstem Mica Creek. From an ecological standpoint, the fish and macroinvertebrate data demonstrate that there are no statistical differences between the upstream and downstream sites throughout the watershed. Cutthroat trout and sculpin were collected at all sampling sites and their presence and multiple age classes are an indicator of successful spawning and incubation, and that adequate spawning gravel is present.

1.0 Background and Purpose

1.1 U.S. 95 Bellgrove to Mica Project Description

The U.S. 95 Bellgrove to Mica project is located in Kootenai County, Idaho, between approximately mileposts 415.83 and 421.32. The project extends from just north of the Fighting Creek bridge on the south to the Mica Creek Bridge on the north. U.S. 95 is the primary north-south highway in Idaho and is the major transportation and commercial link for northern Idaho. The purpose of the project is to improve the alignment of this segment of U.S. 95 to safely accommodate projected traffic and to maintain the viability of this route for commerce and tourism. The project involves widening, reconstruction, and realignment of the existing highway. The new highway is a four-lane divided roadway from the southern terminus to the South Fork Mica Creek canyon (milepost 418.3). The highway through the canyon is a four-lane undivided roadway.

Construction activities on the project commenced on June 25, 2001 (see Figure 1-1). During the 2001 construction season, the Contractor worked on construction of the new southbound lanes south of the South Fork Mica Creek canyon, and worked on clearing, drainage, and earthwork activities in the South Fork Mica Creek canyon. The Contractor also started construction of retaining walls near the south end of the canyon, and the South Fork Mica Creek Bridge at the north end of the canyon. During this time, highway traffic remained on the existing highway.

A sediment basin was constructed near the south end of the South Fork Mica Creek canyon during the summer of 2001. As discussed in more detail in Chapter 6, the embankment of the sediment basin was breached in the fall of 2001. ITD subsequently removed the sediment basin from use, and the sediment basin site was restored to natural conditions during the 2002 construction season.

Limited construction activities continued through the winter of 2001/2002, primarily related to construction of the South Fork Mica Creek Bridge. During the 2002 construction season, work continued in the South Fork Mica Creek canyon on earthwork and construction of retaining walls. Work also continued on the South Fork Mica Creek Bridge. Highway traffic remained on the existing highway through the South Fork Mica Creek canyon. South of the canyon, the southbound traffic lanes were completed and traffic was routed onto the new southbound lanes. Construction then commenced on the northbound lanes in this area.

Earth-disturbing construction activities were suspended for the winter on October 16, 2002. Construction activities were allowed to resume approximately April 15, 2003, to complete construction of the project. The project was officially openend to traffic with a ribbon cutting ceremony on November 3, 2003.

Further discussion and assessment of the erosion and sediment control issues that have arisen in relation to the project are provided in Chapter 6.

Date	Activity
June 25, 2001	Construction begins on U.S. 95 Bellgrove to Mica Project
September 21, 2001	Turbidity monitoring initiated by ITD
October 22, 2001	Turbidity monitoring initiated by IDEQ
October 23, 2001	Sediment pond embankment breach due to piping at standpipe outlet
November 23, 2001	Sediment pond embankment breach at standpipe outlet
March 25, 2002	Turbidity monitoring program expanded by ITD
May 8, 2002	Consent Order between IDEQ and ITD
July 9, 2002	Methodology for Impact Assessment approved by IDEQ
July 8 – 19, 2002	Hydrographic survey of Mica Bay
August 27 – 28, 2002	Sediment cores collected from Mica Bay
September 18-22, 2002	Stream physical habitat survey and first fish and macroinvertebrate stream survey initiated
December 19 – 30, 2002	Soil and sediment samples collected from the Mica Bay watershed
January 26, 2003	Slope failure at south end of U.S. 95 project during rain-on-snow event
June 16-20, 2003	Second fish and macroinvertebrate stream survey initiated
September 15-20, 2003	Third fish and macroinvertebrate stream survey initiated
November 3, 2003	Officially open to traffic
November 12, 2003	Mica Bay Impact Assessment Report Submittal
March 19, 2004	Final Impact Assessment Submittal

FIGURE 1-1
Timeline of Activities Associated With the U.S. 95 Bellgrove to Mica Project and Impact Assessment
MICA BAY AND MICA CREEK
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1.2 Purpose of Impact Assessment

As a result of the stormwater and snowmelt runoff issues experienced during the 2001/2002 winter (see Chapter 6), ITD signed a Consent Order with the Idaho Department of Environmental Quality (IDEQ) on May 8, 2002, to assess the potential impacts of these events. The CO included a requirement to determine whether impacts have occurred to Mica Bay, Mica Creek and South Fork Mica Creek; and also implementation of action lists for erosion and sediment control and managing accumulated sediment on or near the project site. The CO required an assessment of:

- the sediment strata present in the bay to determine the extent of sediment contributions that may have come from the project, including quantity, depth, type, and metals content relative to other sediment sources
- the extent of any damages to Mica Bay including any damages to recreational uses of the bay and potential damage to domestic water supply systems in the bay as a result of sediment from the project
- the extent and duration of adverse effects to the fisheries resource and habitat, including without limitation stream morphology and any other physical characteristics of the stream that affect habitat for fish, macroinvertebrates or other aquatic life

1.3 Impact Assessment Methodology Overview

A detailed *Impact Assessment Methodology* has been prepared and was approved by IDEQ on July 9, 2002. This methodology document is included in its entirety in Appendix A (with the exception of foldout Figure 3).

The *Impact Assessment Methodology* was developed and organized based on the two resources of concern—the bay and the creeks. The scope of the Mica Bay sediment impact assessment focuses on potential impacts of project-related sediment/turbidity on Mica Bay, including fisheries, recreation, and water supply uses of the bay. The fish (or creek) impact assessment focuses on potential impacts to stream habitat quality and the fish and aquatic insect populations in Mica Creek and South Fork Mica Creek. These potential impacts were assessed using multiple lines of evidence, including:

- Conduct a detailed hydrographic survey to establish 2002 lake-bottom elevation and bathymetric (that is, depth) contours in the bay.
- Conduct physical and geochemical analyses of sediment cores collected from the bay to evaluate potential sediment sources.
- Review historical aerial photography to evaluate potential migration over time of the sediment delta in the bay and the course of the Mica Creek channel across the delta.
- Develop underwater video and still photography to see if there is direct evidence of recent sediment accumulation and to document the current condition of water supply intakes.

- Analyze frequency, duration and magnitude information for measured turbidity data that have been collected in Mica Creek and Mica Bay since fall 2001.
- Review relevant published information on Mica Bay watershed characteristics related to sediment and erosion conditions.
- Analyze historical data on seasonal lake levels.
- Conduct interviews with homeowners around Mica Bay to evaluate potential impacts of sediment/turbidity on water supply intakes and treatment systems.
- Collect available information on fish species that use the lake and Mica Bay.
- Conduct a literature review of sediment impacts on various fish species.
- Conduct a stream physical habitat survey in Mica Creek, South Fork Mica Creek (both upstream and downstream of the project) and North Fork Mica Creek.
- Conduct fish and macroinvertebrate surveys in Mica Creek, South Fork Mica Creek (both upstream and downstream of the project) and North Fork Mica Creek.

As identified in the Methodology, this impact assessment is primarily focused on potential impacts associated with erosion and sediment control issues during the time period from start up (June 25, 2001) of project construction through the summer of 2002. Additional information prior to start up and beyond the summer of 2002 is occasionally included in this assessment when it provides useful insights into potential project-related impacts (e.g., historical aerial photos and lake level data, meteorological data, and turbidity data).

As identified in the *Impact Assessment Methodology*, this assessment is primarily focused on potential impacts associated with erosion and sediment control issues during the time period from start up (June 25, 2001) of project construction through the summer of 2002. Additional information prior to start up and beyond the summer of 2002 is occasionally included in this assessment when it provided useful insights into potential project-related impacts (for example, historical aerial photos and lake level data, meteorological data, and turbidity data).

Note to Reader: The hydrographic survey was conducted using SI units and the lake bed was mapped using 1.5-meter contour intervals. Therefore, the descriptions of the hydrographic survey and the resulting map (see Figure 2-1) are presented in both SI and U.S. Standard units where appropriate. Dual units accompany information related to the hydrographic survey or map (for example, water surface elevation). Because it is assumed the reader is accustomed primarily to U.S. Standard units, only these units may be presented when the information is unrelated to the survey or map. Where the standard is to use SI units only, such as grain size dimensions in millimeters, dual units are not included.

1.4 Previous Report Submittals

Five reports have been submitted prior to this report. They are as follows:

- *Mica Bay Hydrographic Survey Report*, September 2002 (see Appendix B)
- *Mica Bay Interim Sediment Core Sampling Report*, November 2002 (see Appendix C)
- *Mica Creek September 2002 Fish and Macroinvertebrate Monitoring Results*, December 2002
- *Mica Creek June 2003 Fish and Macroinvertebrate Monitoring Results*, September 2003
- *Mica Bay Assessment Report*, November 2003
- Mica Creek September 2003 Fish and Macroinvertebrate Monitoring Results, December 2003

2.0 Hydrographic Survey and Historical Lake Water Surface Elevations

2.1 Background

Prior to initiating the *Mica Bay Sediment Impact Assessment* in 2002, the only published bathymetric map that could be identified for Mica Bay was a map of Coeur d'Alene Lake developed by the U.S. Geological Survey (USGS) around 1990 (Woods and Barenbrock, 1994).

The USGS bathymetric map, which covers the 50-square-mile surface area of Coeur d'Alene Lake (at full-pool elevation), was generated to support a nutrient-load/lake-response model. As described on the USGS map, bathymetric data were collected by two methods. A calibrated video depth sounder was used to measure depth at 340 locations during August 1989 and September 1991, and a narrow-beam echo sounder was used to measure depth at 221 locations during April 1991. A total of 561 depths and their latitudes and longitudes were digitized onto a base map generated from USGS 7.5-minute topographic maps. Depth contours were drawn manually to develop the bathymetric map with contour intervals of 10 meters (32.8 feet). Unfortunately, the 10-meter contour interval is too large to provide sufficient bathymetric data of Mica Bay to be used for baseline, or pre-project bathymetry.

A more detailed map with smaller contour intervals would be required to facilitate the *Mica Bay Sediment Impact Assessment*. The detailed map would be needed to describe the topographic features of the lake bottom in the bay during post-construction events, and provide the basis for selecting sediment coring locations (see Chapter 3, *Sediment Analysis*). Therefore, from July 8, 2002 through July 19, 2002, Mica Bay was surveyed during summer full-pool conditions.

At the conclusion of that effort, the *Mica Bay Hydrographic Survey Report* (CH2M HILL, 2002b) and bathymetric map were submitted in September 2002 to IDEQ (see Appendix B). In response to comments from IDEQ, the September 2002 bathymetric map has been revised for clarification purposes and presented here as Figure 2-1.

2.2 Survey and Mapping Methods

Two different surveying techniques were used to generate the bathymetric map of Mica Bay. A global positioning system (GPS) survey using a Leica SR530 GPS system and Geodetic Real Time Kinematic (RTK) methods recorded rod positions during the manual survey of the bottom of the bay in water depths up to 31.5 feet (9.6 meters). Depth-sounding surveys of the bottom of the bay were performed using a Reson Seabat 8101 multibeam sonar. The depth sounding work was conducted in water depths of approximately 3.3 feet (1 meter) to 93.9 feet (28.6 meters). Therefore, overlapping portions of the study area were surveyed using both techniques.

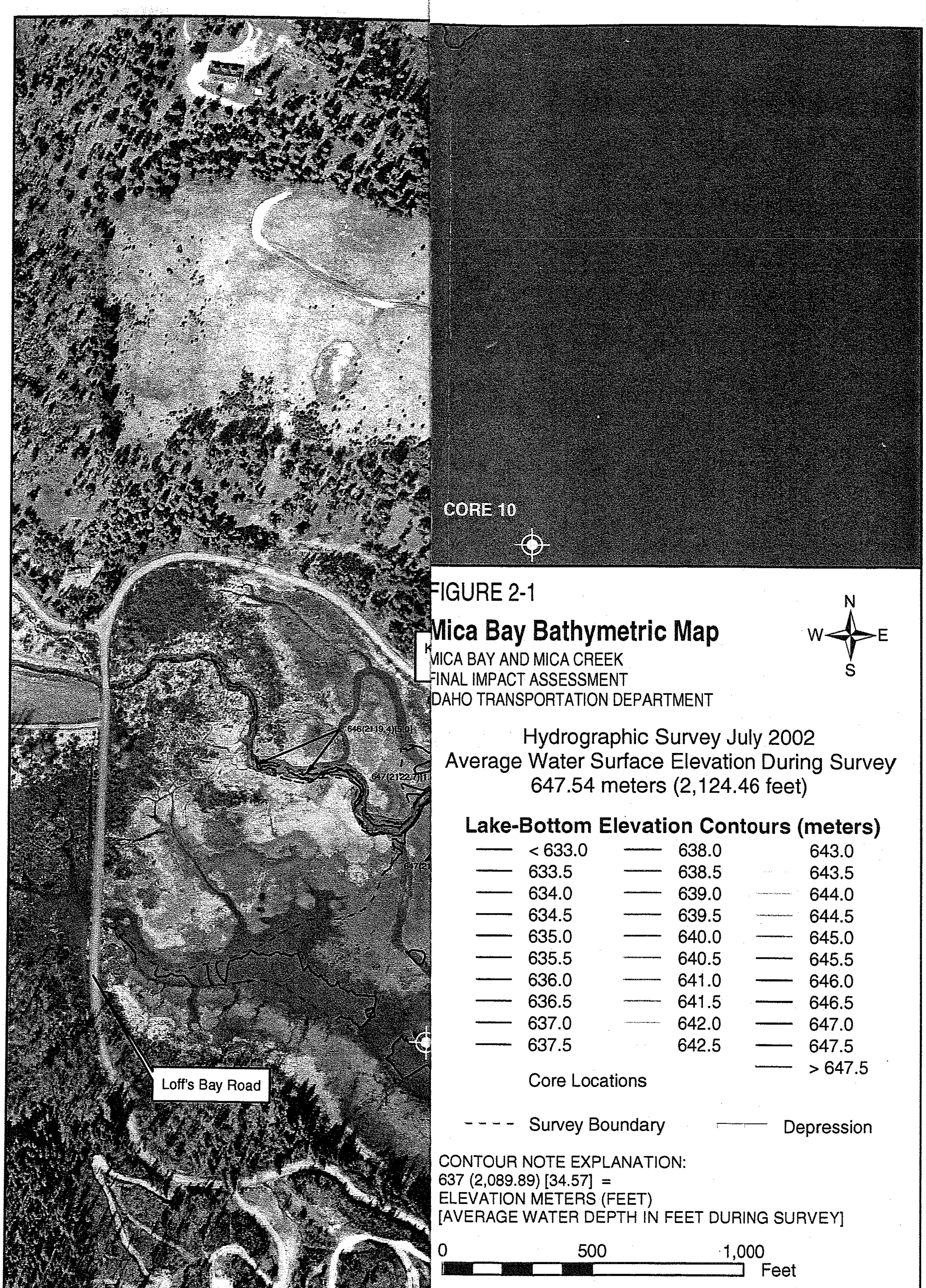

FIGURE 2-1
Mica Bay Bathymetric Map
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

N W E S

Hydrographic Survey July 2002
Average Water Surface Elevation During Survey
647.54 meters (2,124.46 feet)

Lake-Bottom Elevation Contours (meters)

< 633.0	638.0	643.0
633.5	638.5	643.5
634.0	639.0	644.0
634.5	639.5	644.5
635.0	640.0	645.0
635.5	640.5	645.5
636.0	641.0	646.0
636.5	641.5	646.5
637.0	642.0	647.0
637.5	642.5	647.5
		> 647.5

Core Locations

Survey Boundary

Depression

CONTOUR NOTE EXPLANATION:
637 (2,089.89) [34.57] =
ELEVATION METERS (FEET)
[AVERAGE WATER DEPTH IN FEET DURING SURVEY]

0 500 1,000 Feet

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Depth-sounding survey personnel incorporated a Trimble-based GPS system to track vessel locations during the depth-sounding surveys in deep water. The system consisted of a Trimble 4000SSE Surveyor base station set up on existing Mica Bay control monuments and a Trimble 4000SSE GPS rover collecting RTK positional data in the vessel. Survey personnel chose the Trimble system in order to gain efficiency by using equipment compatible with the experience of the depth sounding crew.

The manual survey equipment consisted of the Leica GPS SR530 Real Time Kinematic (RTK) System base station and remote rover unit with a GPS antenna attached to a fabricated survey rod consisting of interchangeable lengths of 1-inch-diameter electrical conduit mounted on a 4-inch-diameter foot. A 22-foot pontoon boat was used as the manual survey vessel because it was able to access water depths less than 1 foot. Conventional surveys, used to supplement the GPS system coverage, were conducted with a Leica TCA1101 Theodolite and Leica NA-2 engineer's level.

Except for equipment modifications described above, a detailed description of the depth sounding equipment and associated survey methodology, is provided in Appendix A. During the last day of manual surveying a high resolution black and white video camera and monitoring system was used to record underwater video in the bay. This effort and a subsequent effort to collect additional underwater images are described in Chapter 5, *Underwater Photography*.

2.2.1 Survey Control and Water Surface Elevation

The original Bellgrove to Mica Project (DHP-NH-CM-5110(119); Key No. 2815) horizontal survey control system is based on the NAD83 State Plane Coordinate System 1992 – West Zone (SPC) referenced to the High Accuracy Reference Network (HARN) point IDTD 1 COEU GPS. The horizontal survey control uses a combined scale factor (CSF) of 0.999910512 to project a project specific ground control datum. The basis of vertical control is NGS monument CL-2. CL-2 is a First Order Horizontal Control Station with an adjusted VERTCON elevation of 764.9 meters (2509.5 feet). The calculated VERTCON elevation was revised by a subsequent ITD conventional vertical control survey. Using the National Vertical Geodetic Datum of 1929 (NVGD29), ITD established an elevation of 764.783 meters (2509.13 feet) on CL-2 which became the basis of vertical control for both the project and the Mica Bay surveys.

The horizontal and vertical control systems used for the Mica Bay surveys are an extension of the project survey control used for the design and construction of U.S. 95. Five additional survey control monuments were set at inter-visible points around Mica Bay. The additional Mica Bay survey control monuments were used to control both the manual and depth-sounding surveys. An order A horizontal GPS station "STMA GPS" was used to correlate and check the horizontal control system.

Further checks on the vertical control included a conventional, closed level run from an existing project survey control monument to four of the five monuments set for the Mica Bay survey. The Mica Bay survey control points are summarized in Appendix B.

Water levels were monitored from one to three times per day using a single staff gage consisting of two sections of a fiberglass level rod attached to the southern most corner of the western pier at the Kootenai County public boat ramp. Conventional level techniques were used to set the gage at a true elevation corresponding to the graduated marks on the rod. This method provided a direct reading of the elevation of the water surface without additional calculation. The centrally located staff gage position on the Kootenai County pier was visible during a major portion of the manual and depth-sounding surveys.

Because of the central location of the staff gage and the density and visibility of the Mica Bay survey control, no additional staff gages were set. However, when the gage was not visible, water surface elevations were measured from different locations using conventional survey techniques. A summary of the water surface elevations is provided in Appendix B.

Water surface elevations measured both during the pre-survey mobilization period and during the time of the actual Mica Bay survey, show a steady increase in elevation during the course of the project. The elevations ranged from 647.47 meters (2,124.25 feet) to 647.60 meters (2,124.65 feet) over the 21 days from June 28 to July 18, 2002. These elevations correlate to the USGS elevations measured at the gaging station (USGS Station 12415500) southwest of 11th Street in Coeur d'Alene as 2,127.25 feet to 2,127.65 feet. **Elevations reported from the USGS gage datum are 3 feet higher than the Mica Bay elevation datum used to generate Figure 2-1.** (Note: water surface elevations from this point forward are based on the Mica Bay elevation datum unless otherwise specified.) A description of the USGS gage elevation datum is provided on page 6 of Appendix B (Note: in Appendix B, the USGS gage datum is referred to as the Washington Water Power datum).

The Mica Bay surveys were overlaid on a digital copy of an aerial photograph taken on April 19, 1999. The water surface elevation on this date, was 647.2 meters (2,123.23 feet) in the NVGD29 Mica Bay elevation datum.

2.2.2 Map Generation

Survey point data obtained from the depth-sounding surveys and the manual surveys were loaded into the Bentley MicroStation-based "SelectCAD" and "SelectSurvey" computer software for processing into a combined digital terrain model (DTM). The process for combining the two surveys is summarized in the following steps:

- A conversion of the depth sounding data from SPC Grid elevations to SPC project datum was accomplished by applying the CSF to the ASCII formatted coordinate point file (Mica_SPC_xyz.pts) using Microsoft Excel.
- The manual surveys were processed using Leica Ski-Pro Version 2.1 for the GPS data and Leica Survey Office Version 2.0 with output files directly compatible for import into Bentley's "SelectSurvey" and "SelectCAD" software (MICABAY2.dtm).
- The ASCII points, from the depth-sounding surveys, were then imported into a digital terrain model (DTM) along with the manual survey points as random points, and re-triangulated to form a DTM of the entire project (MB_Combined.dtm).

In order to check the contours generated from the MB_Combined.dtm, they were overlaid on the original contour maps generated from both the manual surveys and depth-sounding surveys for visual comparison. In two sections of the mapping, anomalies appeared between the two surveys, which warranted further checks.

An Isopach surface was created showing the difference between the depth-sounding surveys and the manual surveys that indicated a difference in elevation ranging from 0.013 meter (0.04 foot) to 0.340 meter (1.12 feet). This documents the good correlation between the data collected from the two survey methods. However, a cluster of points in the northeast corner of the survey and another in the southeast corner, near the break to deep water, indicated differences of up to 2 meters (6.56 feet). Further investigation indicated that the manual topographic shots taken in deep water were spaced too far apart to accurately catch the toe of slope into deeper water. In this case, the depth-sounding surveys complemented the manual surveys, because of overlapping coverage, and resolved the issue of differences between the surveys.

A contour map showing 0.5-meter (1.64-foot) intervals, created from MB_Combined.dtm, was combined with planimetrics from the manual surveys and overlaid on a scanned digital image of Mica Bay taken from an uncontrolled aerial photograph dated April 19, 1999 (see Figure 2-1).

The process utilized the Intergraph "IRAS\C" raster imaging software incorporated into MicroStation and ArcView 8.3. The aerial photograph was referenced to photo-identifiable control points on the ground (edge of boat docks, bridge abutment walls, culverts, etc.). The image reference process allowed the contours and survey planimetrics to be overlaid on the aerial photograph for a visual reference for locating the extent of the surveys.

It is important to note that the digital aerial photographic image shown in Figure 2-1 is used for visual reference only. Because the aerial photograph is uncontrolled and has not been rectified to actual ground elevations, distortion is present in the aerial image that intensifies from the center of the photograph to the outer edges. In this regard, the actual manual surveys and depth-sounding surveys cannot exactly overlay the topographic features shown in the aerial photograph. Rectification of the 1999 aerial photograph is further described in Chapter 4.

2.3 Results

2.3.1 Bathymetric Map

The combined bathymetric map covers an area of 277 acres (112 hectares). The combined total is based on 94 acres (38 hectares) mapped during the manual survey, and 232 acres (94 hectares) mapped during the depth-sounding survey (approximately 49 acres [20 hectares]overlap between the two surveys). The combined bathymetric map is based on 153,300 survey points, 6,500 using manual techniques and 146,800 using depth sounding.

Using the U.S. National Map Accuracy Standards for a 0.5-meter (1.64-foot) contour map, (no more than 10 percent of the elevations tested should be in error more than one-half the contour interval), a comparative analysis was performed on 82 point elevations within the area of overlap between the manual surveys and combined DTM. Comparative testing indicates that 14 percent of the points fall outside the 0.25-meter specification. However, the same comparative analysis of the combined DTM and depth sounding data demonstrates that only 1 percent of the elevations fall outside the map accuracy specification. In accordance with the Standard, spacing of the manual shots is a consideration when determining the apparent vertical error. In this regard, the depth-sounding survey enhanced the manual survey and produced a combined DTM (MB_Combined.dtm) that meets or exceeds National Map Accuracy Standards.

The extremely close fit of the July 2002 bathymetry survey to the pre-project delta features visible in the 1999 aerial photograph provides strong evidence that the project did not result in enough sediment deposition in Mica Bay to extend the delta farther out into the lake as evidenced by the aerial photographs. This is especially evident where the shape of the contours along the leading edge of the delta overlie the visible outline of the delta front in the 1999 pre-project image. The information provided below and in following chapters provides additional methods and results to support the conclusions of this assessment.

2.3.2 Field Observations During Manual Surveying

A major finding of the field survey was the water depth and accessibility of the Mica Creek channel into the bay. Survey personnel were able to navigate the 22-foot pontoon boat used for the manual survey all the way to Loff's Bay Road in both Mica Creek and the channel to the south that flows through a 5-foot by 4-foot oval culvert. Measured water depths in the Mica Creek channel, from the Loff's Bay Road Bridge to the County boat ramp parking area, ranged from 4.1 feet (1.2 meters) to 5.7 feet (1.7 meters). A more complete description of the physical characteristics of the bay are presented in Chapter 4, *Aerial Photography*.

Large gradients in suspended particulate matter concentrations can exist at the lake bottom sediment-water interface forming a type of "ghost" layer. This layer can form as extremely fine-grained (colloidal) particles are settling to the bottom. The colloidal particles are typically a mixture of inorganic and organic particulates that are slowly flocculating to a density that allows them to slowly descend to the lake sediment surface. This layer is typically less than 1 foot thick, but can range from several feet thick in very still water to less than 1 inch thick where currents or water movements prevent the accumulation of flocculating colloidal particles. Prior to the survey it was unknown whether or not an unconsolidated "ghost" layer would be present (and how thick) at the sediment-water interface; however, during manual surveying, much of the lake bottom was found to be relatively compact. The rod-handler could frequently see bottom to confirm whether or not the rod-footing penetrated the substrate. Occasionally, if a relatively soft bottom was encountered, some probing was conducted by pressing the rod as deep into the substrate as possible. The maximum depth of forced penetration was typically on the order of 6 to 12 inches (estimated). These areas of softer substrate were most commonly associated with dense, submerged aquatic vegetation (either growing, dormant, or decaying). Nowhere on the delta was a "ghost" layer observed that might be associated with an unsettled recent influx of sediment to the bay.

These observations, in addition to observing dense stands of well-developed rooted aquatic plants across most of the delta, suggested that evidence of a recent sediment depositional layer, in terms of thickness and lateral extent, was not visibly obvious in the field.

An attempt was made to locate water intake structures in the study area during the field survey from the boat. Although water clarity was good, with visibility estimated at approximately 10 to 12 feet (3.0 to 3.7 meters) (variable depending upon aquatic plant density), the survey personnel were unable to visibly identify the location of any water intake structures. In some areas near boat docks adjacent to the county boat ramp, segments of small diameter plastic pipes extending from the shoreline were visible in the shallow areas, but in all cases they extended into deep water where they were no longer visible from the surface. Therefore, the exact location of any intake structures could not be confirmed during the survey; however, a follow-up effort was successful in capturing underwater images of multiple water intake structures. The results of that effort are discussed in Chapter 5, *Underwater Photography*.

2.4 Historical Lake Water Surface Elevations and Regional Flood Data

To relate the bottom elevations in Mica Bay (see Figure 2-1) to the variable levels of the lake surface, a description of the historical Coeur d'Alene Lake water surface elevation data is presented here. Daily water surface elevation, or stage, has been recorded at Coeur d'Alene Lake since April 1903 at USGS Station 12415500. Although the lake basin was formed naturally, water is stored in the lake by regulation at Post Falls Dam for power generation at Post Falls, Idaho, and other plants on the Spokane River. Operation of the Post Falls Dam began in 1906 (Avista, 2003); however, based on a review of the daily stage data, regulation similar to current operations began in the early 1940s as evidenced by the controlled summer-pool elevation at approximately 2124.67 feet (647.6 meters) (using the Mica Bay elevation datum [see Section 2.2.1]). Winter stage averages about 6 feet (1.8 meters) below summer-pool.

A detailed analysis of the stage data since 1945 reveals that within any given month from October through June, the change in water surface elevation can be as much as 12.1 feet (3.7 meters), averaging 7.6 feet (2.3 meters). In contrast, during the months of July through September, these statistics are 2.8 feet (0.9 meter) and 1.7 feet (0.5 meter), respectively. As reported by the USGS, regulation of the lake is within the natural range of lake stage (Brennan, 2000).

2.4.1 Minimum and Maximum Lake Water Surface Elevations and Regional Flood Data

The magnitude, frequency, and timing of both flood and lake-drawdown events significantly influence delta morphology. Floods are high-energy events capable of transporting major sediment loads from the watershed to the lake. A wide range of particle sizes can be mobilized during floods such that both suspended and bed load transport occurs. "Suspended load" refers to the material moving in suspension and sustained in the water column by turbulence or in colloidal suspension. "Bed load" is the coarse material moving in continuous or intermittent contact with the bed. Typically, as the size of the flood increases, so does the sediment load transported to the lake. The water surface elevation in the lake at the time of the flood is also important. When a flood occurs during low lake levels, the inflowing sediment load is transported further into the lake (potentially even across the existing deltas depending on water surface elevation) during the rising-limb of the flood hydrograph. This would tend to elongate a delta at the mouth of the primary channel traversing the delta. As the lake level rises, the interface between the high-energy inflowing stream and the lake backwater moves inland, or further upstream. Therefore, the distal location of sediment (primarily bed load) deposition would be expected to regress toward the delta head. These sediments would then be prone to redistribution during lake drawdown by channel headcutting, channel avulsion, and or rainfall erosion if the sediments become exposed. Therefore, major floods, especially those followed by significant lake drawdown, have the potential to create significant and rapid changes to the delta site, shape, and channel alignment. As described below, both significant floods and lake drawdown occurred within 5.5 years prior to the initiation of the project.

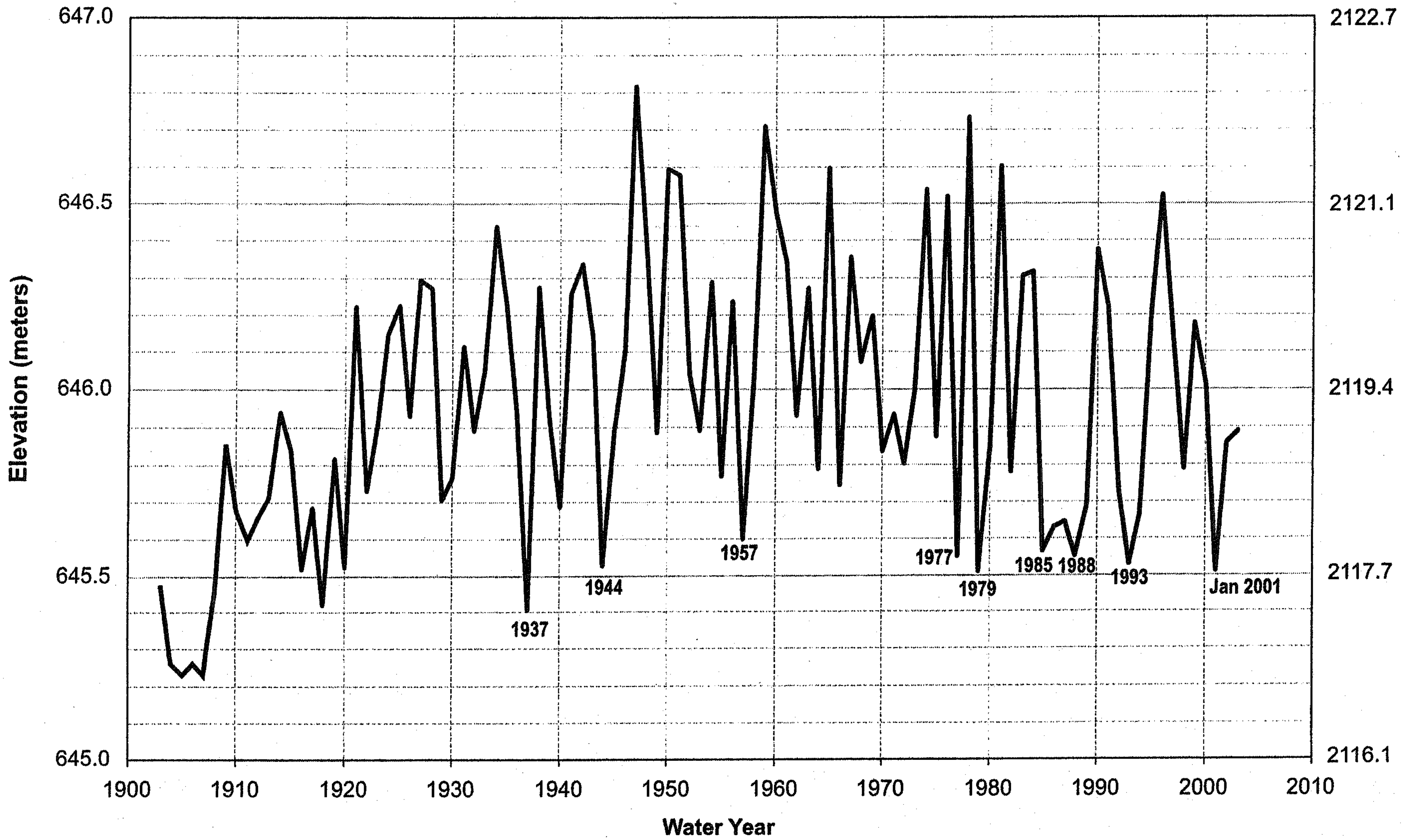
Coeur d'Alene Lake minimum and maximum annual water surface elevations for the period of record are shown in Figures 2-2 and 2-3, respectively. The annual time series shown in these figures are based on water years. A water year starts September 1 and ends October 31. For example, water year 1987 starts September 1, 1986 and ends October 31, 1987.

The following observations, significant to the morphology of the delta environments in Coeur d'Alene Lake, can be made from Figure 2-2:

- A significantly low water surface elevation (2,117.48 feet [645.4 meters]) was reached in 1937
- The water surface elevation came within 1 foot (0.3 meter) of the 1937 minimum stage during only 3 years (1939, 1944, and 1957) of a 39-year period beginning 1938
- The water surface elevation came within 1 foot (0.3 meter) of the 1937 minimum stage during 10 years of a 25-year period beginning 1977
- The longest duration between significantly low water surface elevations following 1937 was 20 years between 1957 and 1977. Note: the Kootenai County boat ramp at Mica Bay was extended in 1977 (Robinson, 2003).
- The top of the Mica Bay delta front, or pivot point where the delta sediments begin to slope downward into deeper water (see Figure 2-1), is at the same elevation, or within 0.1 meter, of the lowest water surface elevations of the last 65 years (occurrences in: 2001, 1993, 1988, 1985, 1979, 1977, 1957, and 1947)

In January 2001, the minimum water surface elevation in the lake was 2,117.81 feet (645.5 meters). The fact that the minimum water surface elevation and the 2002 lake bed elevation at the delta pivot point are the same, provides strong evidence that the vertical and lateral extent of the delta front was established by the minimum lake drawdown. For comparison, during the winter of 2001 and the spring of 2002, when the project could have influenced the bay (but prior to the hydrographic survey), the water surface elevations ranged from 2118.96 feet (645.9 meters) to 2129.58 feet (649.1 meters). The steep slope of the delta lobe at the mouth of the active channel suggests that these sediments are coarse-grained, which is indicative of a high-energy event such as channel headcutting during lake drawdown. The analysis presented in Chapter 3, *Sediment Analysis*, shows that the sediments at this location are in fact coarser grained.

Table 2-1 lists the largest flood events on record at two USGS gage sites near Coeur d'Alene Lake in both a large (1,223 square miles) and small (22 square miles) drainage basin. Long-term historical discharge data is unavailable for Mica Creek or any of the Coeur d'Alene Lake tributaries along the west side of the lake; therefore, stream discharge data from



Note: Elevations plotted using Mica Bay elevation datum. The following water years are missing one or more days of data: 1903, 1904, 1906, 1911, 1918, 1923, 1993, 1994, 1996, 1998. Provisional data used for water year 2003.

FIGURE 2-2
Annual Minimum Water Surface Elevations in Coeur d'Alene Lake for Water Years 1903-2003
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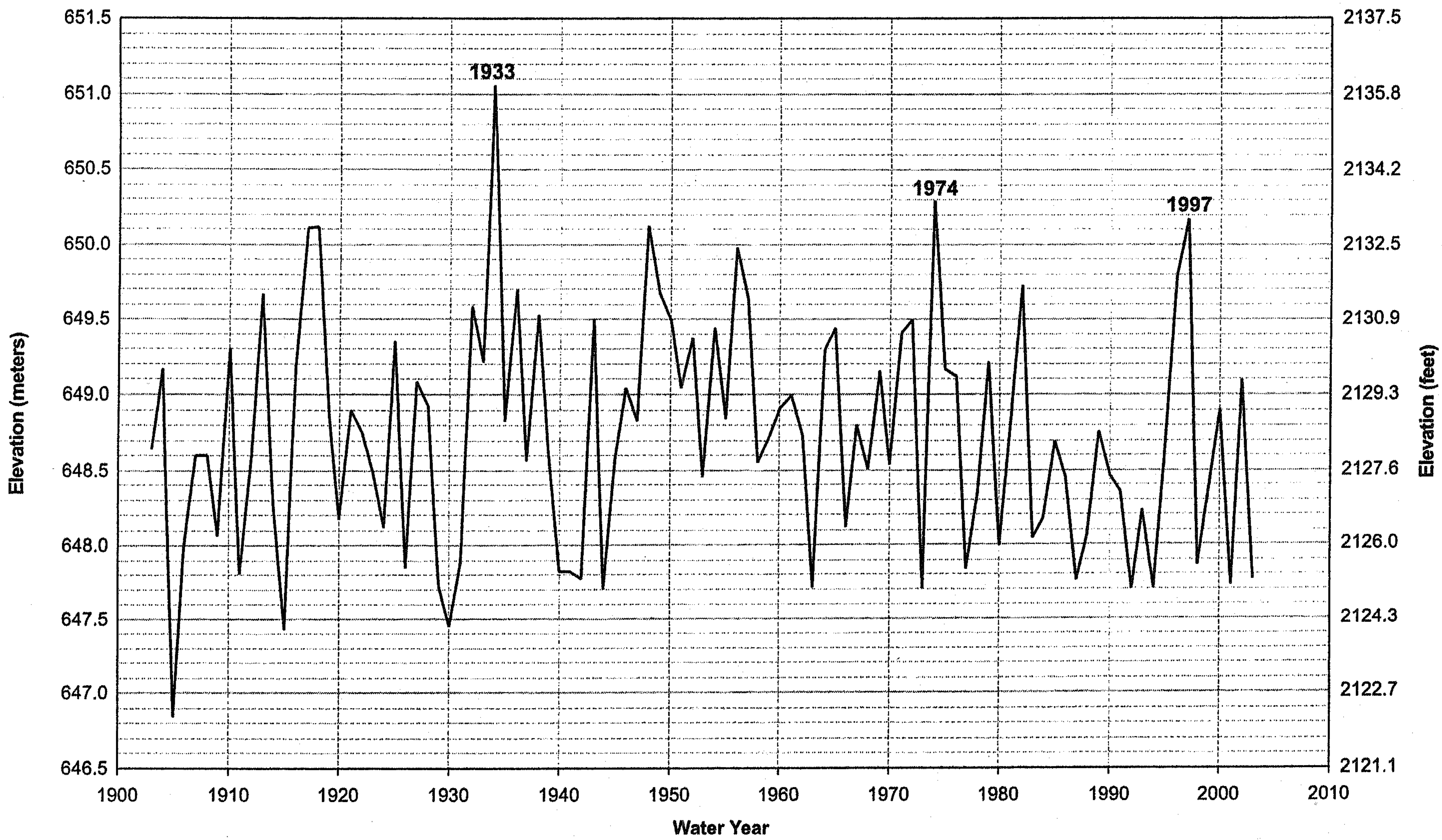

Note: Elevations plotted using Mica Bay elevation datum. The following water years are missing one or more days of data: 1903, 1904, 1906, 1911, 1918, 1923, 1993, 1994, 1996, 1998. Provisional data used for water year 2003.

FIGURE 2-3
Annual Maximum Water Surface Elevations in Coeur d'Alene Lake for Water Years 1903-2003
MICA BAY AND MICA CREEK
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nearby locations are used to represent regional, historical flood conditions. The February 1996 event was the second largest flood on record at both sites—nearly a 100-year event in the Coeur d'Alene River and nearly a 50-year event in Hayden Creek. This flood was the result of 1.0 inches of snow followed by two large rain-on-snow events totalling 0.87 inch over 2 days with air temperatures well above freezing. These data were measured at the Coeur d'Alene airport. The event measured 3.51 inches at Kellogg. The peak discharges in the Coeur d'Alene River during 1997 and 2000 approached a 5-year flood event, while the 2002 peak discharge approached a 10-year event.

TABLE 2-1
Historical River Floods in the Vicinity of Coeur d'Alene Lake

Coeur d'Alene River Near Cataldo, Idaho (USGS 12413500)[a,b,c]		Hayden Creek below North Fork near Hayden Lake, Idaho (USGS 12416000)[d,e,f]	
Date	**Discharge (cfs)**	**Date**	**Discharge (cfs)**
January 16, 1974	79,000	February 21, 1982	1,280
February 9, 1996	70,000	February 9, 1996	1,250
December 23, 1933	67,000	March 20, 1997	933
April 19, 1938	55,600	December 23, 1964	790
December 23, 1964	47,200	March 18, 1950	774
February 22, 1961	41,400	March 14, 1972	770
April 15, 2002	37,600		

[a]10-year flood = 37,800 cfs; 25-year flood = 50,000 cfs; 50-year flood = 60,400 cfs; 100-year flood = 71,800 cfs (USGS, 2003a).
[b]Annual maximum discharge reported for: 1911-1912, 1921-1972, 1974, 1987-2002 (USGS, 2003b).
[c]Drainage area = 1,223 square miles (USGS, 2003b).
[d]10-year flood = 763 cfs; 25-year flood = 1,050 cfs; 50-year flood = 1,290 cfs; 100-year flood = 1,560 cfs (USGS, 2003a).
[e]Annual maximum discharge reported for: 1948-1953, 1959, 1962-1997 (USGS, 2003c).
[f]Drainage area = 22 square miles (USGS, 2003c).

Table 2-2 lists the highest water surface elevations recorded in Coeur d'Alene Lake. The fourth highest elevation on record occurred May 20, 1997 (see Table 2-2 and Figure 2-3) after the high runoff in 1996 and early 1997 (see Table 2-1).

TABLE 2-2
Highest Water Surface Elevations in Coeur d'Alene Lake (NWS, 2003)

Date	Stage* (meters) [feet]
December 25, 1933	651.1 [2,136.15]
May 31, 1894	650.6 [2,134.51]
January 20, 1974	650.3 [2,133.53]
May 20, 1997	650.2 [2,133.20]
January 1, 1918	650.1 [2,132.87]

*Converted to the Mica Bay elevation datum.

It is important to note that the largest floods occurred during winter when the water surface elevation in Coeur d'Alene Lake was low relative to summer-pool and typical spring elevations. As described above, floods of these magnitudes are capable of moving significant quantities of sediment into the lake and redistributing existing deposits. During the 1974 flood, the Coeur d'Alene Lake water surface elevation rose 10.8 feet (3.3 meters) above a 60-day minimum elevation (2,122.77 feet [647.0 meters]) in just 6 days. Similarly, during the 6-day period from February 6 to February 12, 1996, the lake rose 10.7 feet (3.3 meters) from an elevation of 2,121.14 feet (646.5 meters). During the 1996 flood, the lake rose approximately 10 feet (3.0 meters) from an elevation of 2,123.56 feet (647.3 meters) in 35 days.

The fact that the second highest flood event on record occurred in 1996, and was followed by additional flooding in 1997 and 2000, and a minimum lake drawdown in January 2001, the Mica Bay delta would have been subject to significant sediment loads and transport forces within 5 years prior to the project start-up. Based on the principles of fluvial processes and geomorphology, the most influential factors governing the size and shape of the delta in Mica Bay are the effects of large floods like the 1974 and 1996 events, the relatively frequent and recent occurrence of a common minimum lake elevation, and the long-term sediment supply to this natural lake basin. This topic is addressed further in Chapter 4, *Aerial Photography*.

2.4.2 Lake Water Surface Elevations during U.S. 95 Bellgrove to Mica Construction

To provide supporting data for subsequent chapters, and to allow for a more complete interpretation of the bathymetric data in Figure 2-1, the lake water surface elevations during construction of the project are shown in Figure 2-4. A comparison to Figures 2-2 and 2-3 reveals that the minimum and maximum lake stages during construction were neither uncommonly low or high. The minimum stage during construction was approximately 1.3 feet (0.4 meter) above the minimum stage that occurred the previous winter (January 2001). The maximum stage during the spring of 2002 was approximately 4.6 feet (1.4 meters) above the maximum stage in the spring of 2001.

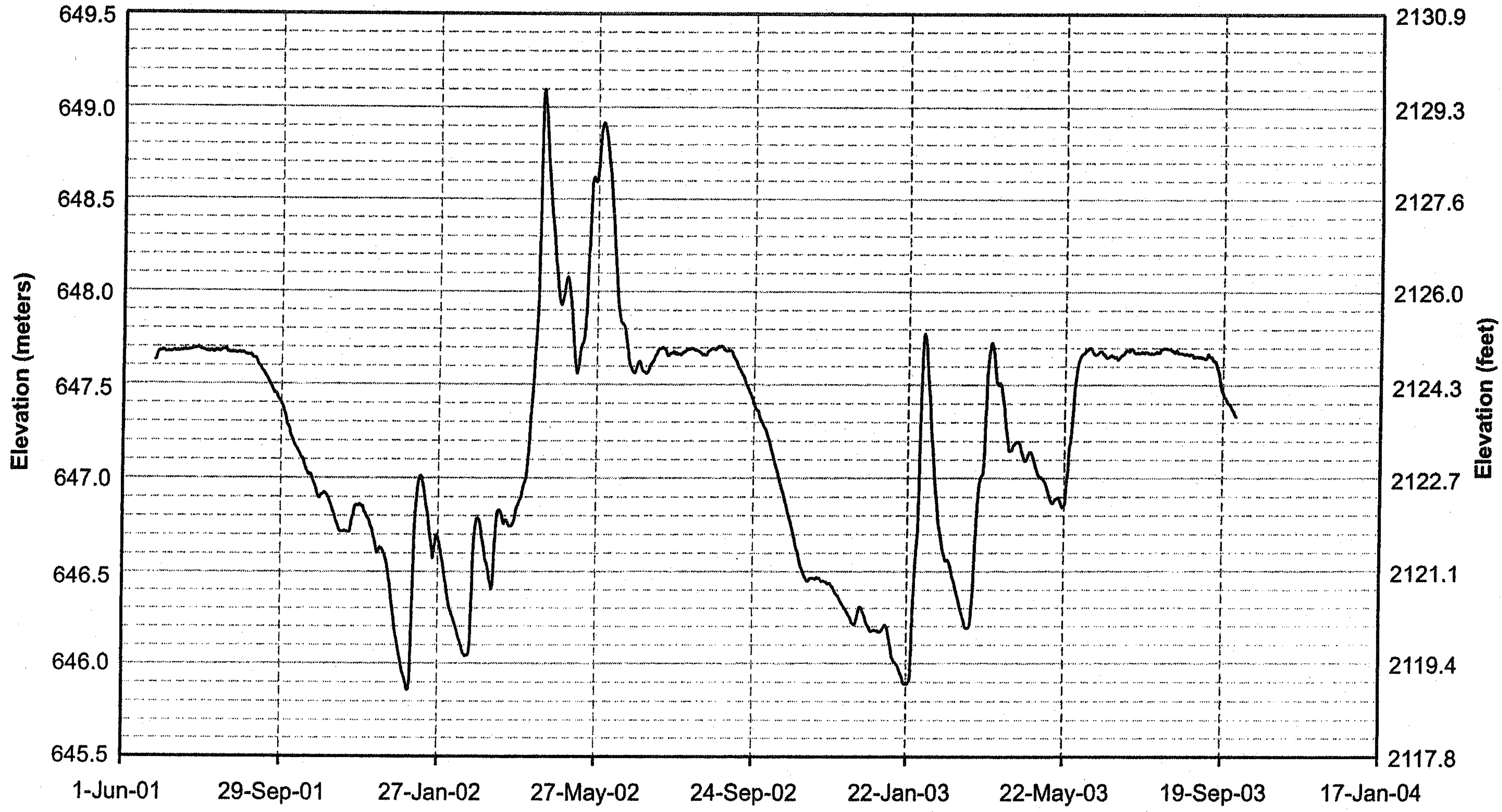
Figure 2-5 presents photographs depicting various water surface elevations in Mica Bay during the course of construction as well as other significant time periods.

2.5 Conclusions

There is extremely close agreement between the location and shape of the leading edge of the delta measured during the July 2002 hydrographic survey and its location in the 1999 pre-project aerial photograph. This demonstrates that the project did not result in enough sediment deposition in Mica Bay to extend the delta farther out into the lake as evidenced by aerial photgraphs.

The minimum lake water surface elevation and the 2002 lake bed elevation at the delta pivot point are the same, providing strong evidence that the vertical and lateral extent of the delta front was established by the minimum lake drawdown.

The Mica Creek channel remains relatively deep (approximately 4 to 6 feet deep in summer) through the delta upstream as far as Loff's Bay Road.



Note: Elevations plotted using Mica Bay elevation datum.
Data is provisional beginning October 1, 2002.

FIGURE 2-4
Coeur d'Alene Lake Water Surface Elevations during U.S. 95 Bellgrove to Mica Project Construction
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

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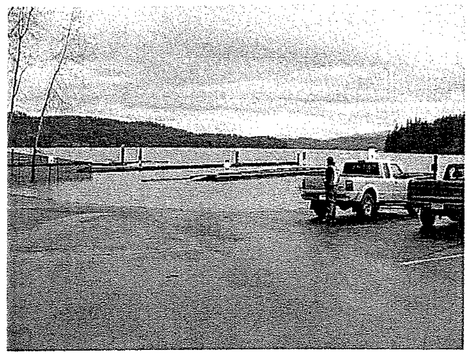
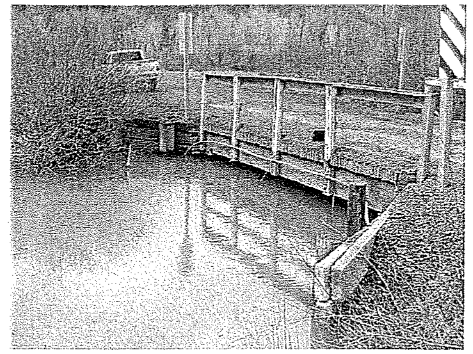
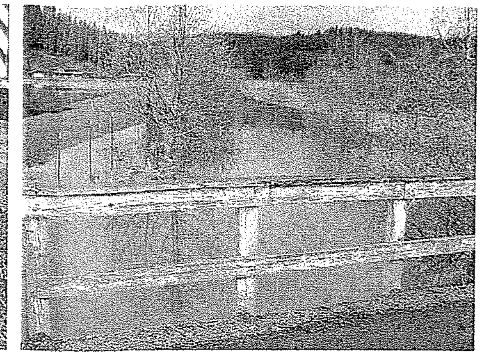


Kootenai County boat launch on April 16, 2002 (stage = 2129.43 ft [649.1 m])

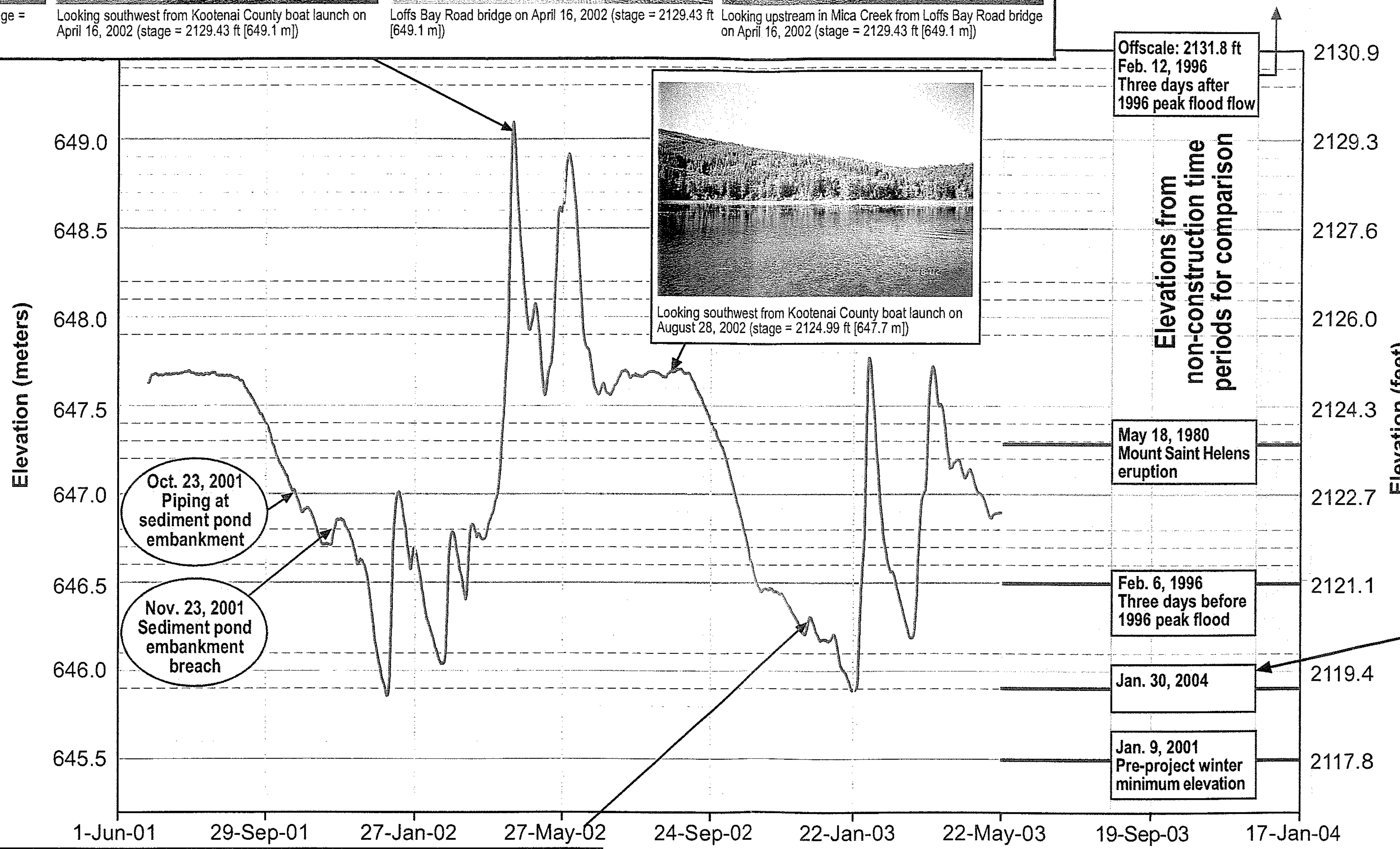
Looking southwest from Kootenai County boat launch on April 16, 2002 (stage = 2129.43 ft [649.1 m])



Loffs Bay Road bridge on April 16, 2002 (stage = 2129.43 ft [649.1 m])



Looking upstream in Mica Creek from Loffs Bay Road bridge on April 16, 2002 (stage = 2129.43 ft [649.1 m])



Looking south across Mica Bay from Tall Pines Road on January 30, 2004 (provisional stage = 2119.08 ft [645.9 m])

Looking east at channel across Mica Bay delta at the Kootenai County boat launch on January 30, 2004 (provisional stage = 2119.08 ft [645.9 m])

Looking southwest (upstream) at channel across Mica Bay delta at the Kootenai County boat launch on January 30, 2004 (provisional stage = 2119.08 ft [645.9 m])

Looking north across Mica Bay toward the Kootenai County boat launch on December 19, 2002 (provisional stage = 2120.38 ft [646.3 m])

Looking northeast across Mica Bay on December 19, 2002 (provisional stage = 2120.38 ft [646.3 m])

Note: Elevations plotted using Mica Bay elevation datum. Data is provisional beginning October 1, 2002.

FIGURE 2-5
Coeur d'Alene Lake Water Surface Elevations during Project Construction and Other Time Periods
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

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An unconsolidated ghost layer was not present at the sediment-water interface in Mica Bay.

Field observations during manual surveying revealed no evidence of a recent sediment depositional layer in terms of thickness and lateral extent across the delta.

Significant flooding and lake drawdown occurred within 5.5 years prior to the project start-up. The magnitude of the 1996 flood event measured in the Coeur d'Alene River near Cataldo, Idaho, (just upstream of the lake) was nearly equivalent to a 100-year event. A flood of this magnitude would be capable of contributing significant sediment loads to bays in Coeur d'Alene Lake, including Mica Bay.

3.0 Sediment Analysis

3.1 Sample Collection Methods

3.1.1 Mica Bay Cores

Core samples were collected in Mica Bay on August 27 and 28, 2002, during a week-long effort to collect the cores, describe their physical attributes, and process them. A pair of cores were collected at each of the 10 locations shown in Figure 2-1. One core from each location was analyzed and the other was archived.

Using the bathymetric map and 1999 aerial photograph of the bay (see Figure 2-1), the coring locations were selected to be representative of the sediment on and beyond (east of) the delta. The locations were selected in agreement with IDEQ. Table 3-1 lists the coordinates for each core-sampling location.

TABLE 3-1
Mica Bay Core Locations[a]

Core Location Number[b]	Northing	Easting
1	659572.624	716487.022
2	659717.621	716523.844
3	659843.658	716592.366
4	659465.394	716857.420
5	659681.474	716742.238
6	659827.128	716663.113
7	659905.122	716725.408
8	660004.312	716726.618
9	659782.213	716910.167
10	660058.867	717707.956

[a]See Chapter 2 for a description of the coordinate system.
[b]See Figure 2-1.

Each core was collected using an electric vibracorer fitted with a 4-inch-outside-diameter core barrel that housed a transparent, rigid cellulose acetate butyrate (CAB) core liner tube (3.6-inch inside diameter). Sampling was done from a 20-foot pontoon barge equipped with GPS equipment to position over the coring locations. Each core was collected, extracted from the vibracorer, capped, and transported in the core liners for either processing or archiving.

Cores were transported in a 16-foot-long truck with a closed trailer from Mica Bay to ITD's supply yard for processing. During transport, the core tubes were kept vertical if less than 7 feet long (some tubes with shallow recovery were cut in the field), or on an angle as close to vertical as possible.

Processing of the cores in the field consisted of removing half of the core liner (lengthwise) and then scraping away the very thin layer of sediment that was in contact with the liner. Based on visible characteristics, descriptions of sediment color, grain size, composition, and layering (if apparent) were then noted. If odor was detected, it was also noted. Each core was photographed for documentation (see Appendix D).

Based on the visible physical characteristics, each core was divided into discrete layers. The individual layers were noted based on their depth interval relative to the top of the core. Special features within discrete layers, such as large bark fragments or roots and degree of particle angularity were also noted by depth. Up to four discrete samples per layer were extracted from each core and shipped to analytical laboratories for grain size analyses (sieving and hydrometer), specific gravity, nutrients, and inorganic chemistry. The individual samples were collected from the full length (representing a composite) of each core layer unless otherwise noted.

Table 3-2 lists the core-number designation, vibracorer penetration depth, core recovery depth, and whether the core was processed or archived.

TABLE 3-2
Mica Bay Core Sample Inventory and Field-Collection Data

Core Number[a]	Penetration Depth (feet)	Recovery Depth (feet)	Processed	Archived
1A	10	5.8	—	Yes
1B	10	7.4	Yes	—
2A	6	4.7	Yes	—
2B	7	4.1	—	Yes
3B extra [b]	10	3.2	—	Yes
3 redo A	8	5.9	—	Yes
3 redo B	7	6.3	Yes	—
4A	10	8.1	Yes	—
4B	10	8.6	—	Yes
5A	10	7.9	Yes	—
5B	12	7.0	—	Yes
6A	12	5.6	Yes	—
6B	10	5.7	—	Yes
7A	10	2.1	—	Yes
7B	10	2.9	Yes	—

TABLE 3-2
Mica Bay Core Sample Inventory and Field-Collection Data

Core Number[a]	Penetration Depth (feet)	Recovery Depth (feet)	Processed	Archived
8A	10	7.4	—	Yes
8B	10	7.6	Yes	—
9A	10	8.1	Yes	—
9B	10	7.2	—	Yes
10A	10	4.3	—	Yes
10B	10	7.2	Yes	—
10 redo A[c]	10	7.3	—	Yes

[a]Because only one core from each location was processed, the cores will be referenced by number only (for example, Core 1B will be referred to as Core 1) for the remainder of the report unless otherwise specified.

[b]Significant boat drift occurred from wind and wave action during the first attempt to core this location; resulting in coring outside of the proposed location (and outside the targeted submerged channel). The first core outside the proposed location was discarded because of lack of recovery; however, the second (3B extra) was archived. The proposed location was re-sampled (denoted as "3 redo A" and "3 redo B") after conditions improved.

[c]10 redo A was collected in an attempt to attain a recovery depth more similar to 10B (as compared to 10A).

3.1.2 Watershed Sample Collection

Soil samples and stream sediment samples were collected from the Mica Bay watershed and analyzed to characterize and identify potential sediment sources to Mica Bay. The watershed samples were analyzed for the same suite of parameters as were the Mica Bay core samples: grain size (sieving, but no hydrometer test), specific gravity, nutrients, and inorganic chemistry.

Figure 3-1 shows the watershed sampling locations. The soil sample locations were selected to be representative of the major land uses (forest and agriculture) in the watershed, including samples from the project construction site. Sediment sampling locations were spatially distributed throughout the South Fork Mica Creek both upstream and downstream of the adjacent project construction site. Sediment samples were also collected from the North Fork Mica Creek and main stem Mica Creek. The North Fork Mica Creek sediments are uninfluenced by the project.

Because the Mica Bay sediments are predominantly fine-grained, similar grain-sizes were targeted for collection in the streams. The stream sediment samples were collected from the top 4 to 6 inches (approximately) of depositional areas within the active channel. Under elevated discharge conditions, such as spring or storm-event runoff, sediments from these locations would be subject to downstream transport. The stream sediment samples were collected using a stainless steel cylinder and hand trowel. The stainless steel cylinder was pushed into the stream substrate with the top protruding above the water surface. The cylinder eliminated flow-through The sample was extracted from within the cylinder where effects of water velocity were negated. This technique was used to minimize the loss of fine silts and clays (if present) to the water column. The soil samples were collected using a hand trowel.

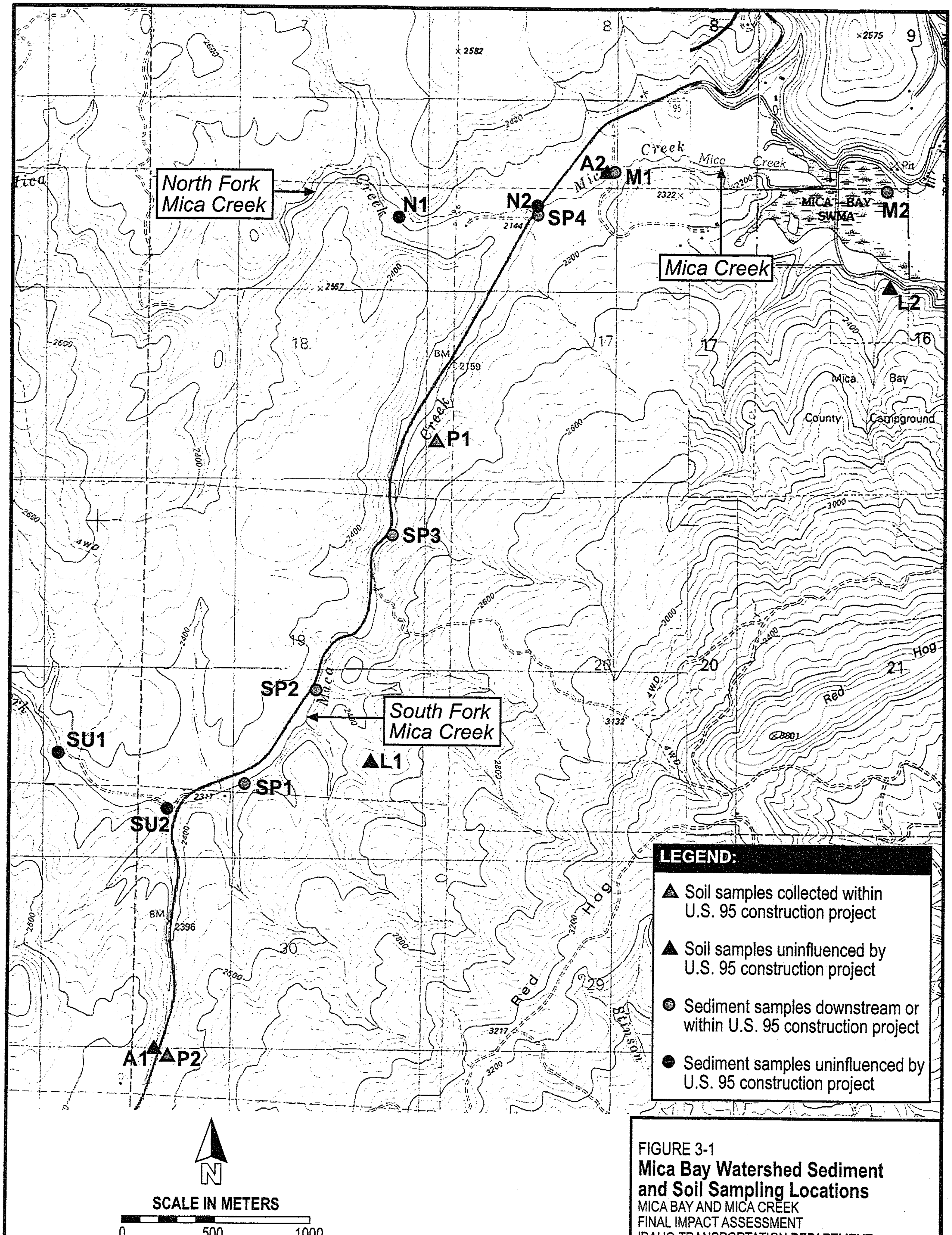


FIGURE 3-1
Mica Bay Watershed Sediment and Soil Sampling Locations
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

Table 3-3 provides a description of the watershed sample locations, names and dates.

TABLE 3-3
Watershed Sample List

Location[a]	Name	Description	Subject to Runoff Emanating from U.S. 95 Construction Site?	Collection Date
South Fork (S.F.) Mica Creek – upstream of project	SU1	Background stream sediment	No	12/30/2002
S.F. Mica Creek – upstream of project	SU2	Background stream sediment	No	12/30/2002
S.F. Mica Creek – downstream of project	SP1	Stream sediment near U.S. 95 centerline station 348+90	Yes	12/19/2002
S.F. Mica Creek – downstream of project	SP2	Stream sediment near U.S. 95 centerline station 354+90	Yes	12/19/2002
S.F. Mica Creek – downstream of project	SP3	Stream sediment near U.S. 95 centerline station 365+40	Yes	12/19/2002
S.F. Mica Creek – downstream of project	SP4	Stream sediment near U.S. 95 centerline station 383+90	Yes	12/19/2002
North Fork (N.F.) Mica Creek	N1	Background stream sediment approximately 0.5 mile upstream of the S.F. Mica Creek confluence	No	12/30/2002
N.F. Mica Creek	N2	Background stream sediment near the S.F. Mica Creek confluence	No	12/19/2002
Mica Creek	M1	Stream sediment approximately 0.25 mile downstream of N.F. and S.F. Mica creeks confluence	Yes	12/30/2002
Mica Creek	M2	Stream sediment from the Mica Creek channel in Mica Bay (collected during winter drawdown)	Yes	12/30/2002
Agricultural land	A1	Soil sample from pasture land in the upper S.F. Mica Creek drainage	No	12/19/2002
Agricultural land	A2	Soil sample from crop land adjacent to Mica Creek	No	12/19/2002
Forest land	L1[b]	Soil sample from logged forest land upgradient and near U.S. 95 centerline station 354+60	No	12/19/2002
Forest land	L2[b]	Soil sample from logged forest land near the south shore of Mica Bay	No	12/19/2002

TABLE 3-3
Watershed Sample List

Location[a]	Name	Description	Subject to Runoff Emanating from U.S. 95 Construction Site?	Collection Date
Project (U.S. 95 construction site) land	P1	Soil sample from cleared and grubbed forest land within the U.S. 95 construction limits near centerline station 370+70	Yes (source material from the construction site)	12/19/2002
Project (U.S. 95 construction site) land	P2	Soil sample from a cut face within the U.S. 95 construction limits near centerline station 334+30	Yes (source material from the construction site)	12/19/2002

[a]See Figure 3-1.
[b]Forest land samples are denoted with an "L" because they were collected from recently logged areas within the forest.

3.2 Analytical Methods

3.2.1 Physical Data

For the purpose of describing grain sizes, samples were wet sieved using the geometric sieve series listed in Table 3-4. A standard hydrometer test was conducted on the silt/clay fraction (minus 230-mesh) of the core samples to determine the individual percentage of silt and clay particles. In addition to grain size analyses, the specific gravity of the core and watershed samples was measured using a pycnometer.

TABLE 3-4
Sieve Sizes used to Determine Sediment Grain Sizes

Grain Size Class	Sieve Opening (millimeters)	U.S. Standard Sieve Number
Fine gravel (FG)	4	5
Very fine gravel (VFG)	2	10
Very Coarse Sand (VCS)	1	18
Coarse Sand (CS)	0.5	35
Medium Sand (MS)	0.25	60
Fine Sand (FS)	0.125	120
Very Fine Sand (VFS)	0.062	230
Silt and Clay (silt/clay)	$\leq$ 0.062	Pan

3.2.2 Chemistry

For this investigation, the major rock-forming elements were analyzed by both x-ray fluorescence (XRF) and inductively coupled plasma-mass spectroscopy (ICP-MS), while the trace elements were analyzed by ICP-MS to accurately determine elements at very low concentrations. Samples analyzed by ICP-MS analysis underwent almost total dissolution by a four-acid digestion. Those for XRF underwent total dissolution by lithium-borate flux. A comparison between major rock-forming elements analyzed by both XRF and ICP-MS indicates that the concentrations determined by ICP-MS average 92 percent of their respective XRF concentrations. Individual elements range from 82 percent (titanium) to 100 percent (aluminum) of their respective XRF concentrations.

All 16 watershed samples and 13 samples from five cores were analyzed (major rock-forming and trace-element chemistry) on both a total (unsieved) sample and on the minus 230-mesh fraction only. The term "minus 230-mesh" refers to the silt/clay size class, which are those particles that can pass through a U.S. Standard sieve Number 230 (Table 3-4).

Analyzing the finer material separately was done for two reasons: 1) because the watershed samples are much more coarse than the core samples (average of 16 percent silt/clay while the cores average 67 percent silt/clay); and 2) because the chemistry of the coarser material (total sample) is different than the chemistry of the finer material. Analysis of the minus 230-mesh material was performed to represent the silt/clay-sized sediments deposited in Mica Bay. The total sample was analyzed to represent the mixture of coarse and fine-grained (including silt/clay) sediments. Some elements, including most metals, tend to sorb to the finer grain sizes in the soils and sediments. This results in the concentrations of those elements being higher in the finer fractions of the soils and sediments compared to the parent bedrock in the watershed. Other elements, however, do not sorb to the finer material and are generally more representative of the parent bedrock in the watershed. For these reasons, concentrations of the elements dominant in the parent bedrock are higher in the total sample than in the minus 230-mesh samples. Because of these differences, the chemical analyses were run on both the total and minus 230-mesh samples.

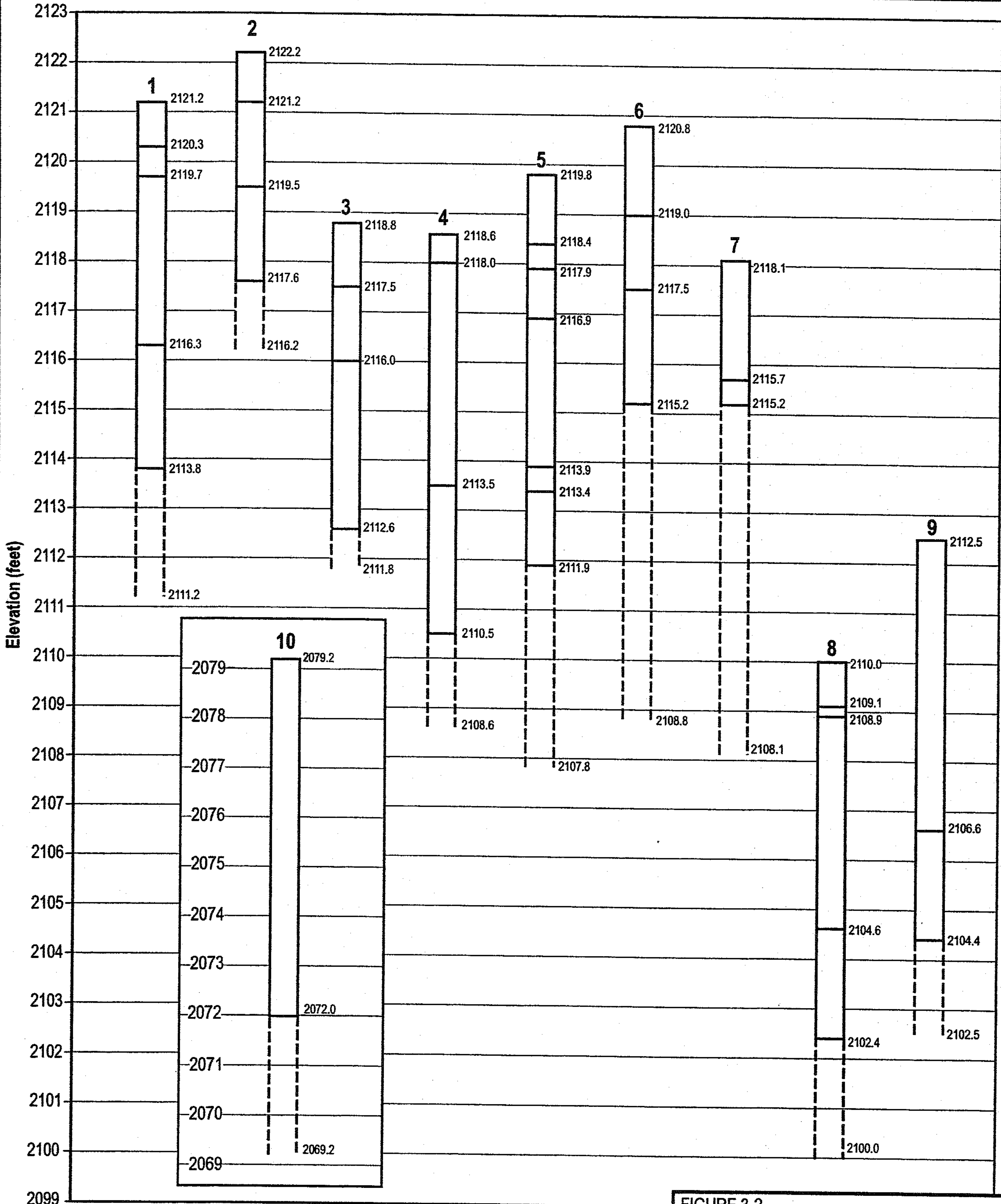
Nutrient concentrations and percent total organic carbon (TOC) were also measured in all samples. A description of methods for the nutrient tests are presented below in Section 3.4.3.

3.3 Results—Physical Description of Sediments

3.3.1 Observations of the Mica Bay Cores

Schematic diagrams depicting elevations and field descriptions of the visible physical characteristics of each core are included in Appendix C. Photographs of the cores are included in Appendix D. Figure 3-2 shows the elevation of the cores and core layers, as well as the depth of vibracorer-sampler penetration and recovered-sediment depths.

A wide variety of physical conditions were observed when comparing all 10 cores collectively. None of the cores appeared to exhibit multiple thin bands of sediment that often exist in a calm, deep-water core sample; however, this is not unusual in a deltaic environment with varying water levels and inflows. Although multiple thin bands were not



Notes:

1. Solid lines represent visible changes identified in recovered core sediments.
2. Dashed lines indicate penetration depth.
3. Elevations are based on the Mica Bay datum (see Chapter 2).

FIGURE 3-2
Schematic of Mica Bay Cores Depicting Elevations of Visible Core Layers
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

observed, distinct layers were identified in all cores except Core 10. Layers within the cores were typically distinguished by changes in color, grain size, and or composition (for example, vegetation, bark, organic debris, etc.). It is difficult to define exactly during what time frame all the layers were built; however, as described below, Mount St. Helen's ash was detected in the cores. The ash is useful because it provides a benchmark in time such that any sediments below the ash were deposited prior to May 1980, and those above were post May 1980. In an active delta environment such as Mica Bay, however, it must be recognized that previously deposited sediments can be redistributed and mixed with more recently deposited sediments.

During the visual assessment of the cores, a relatively thick and distinct layer that appeared to be ash was observed in five of the cores (Cores 1, 2, 3, 5, and 6). This layer is generally characterized as light colored, relatively dry, dense, very-fine-grained sediment containing little if any organic matter. This material breaks with somewhat of a conchoidal habit, and when a piece is rubbed between the fingers until dry, it becomes almost white and has a somewhat gritty chalk-like texture (see Appendix C). The visible ash layer in Core 6 is shown in Photo 3-1.

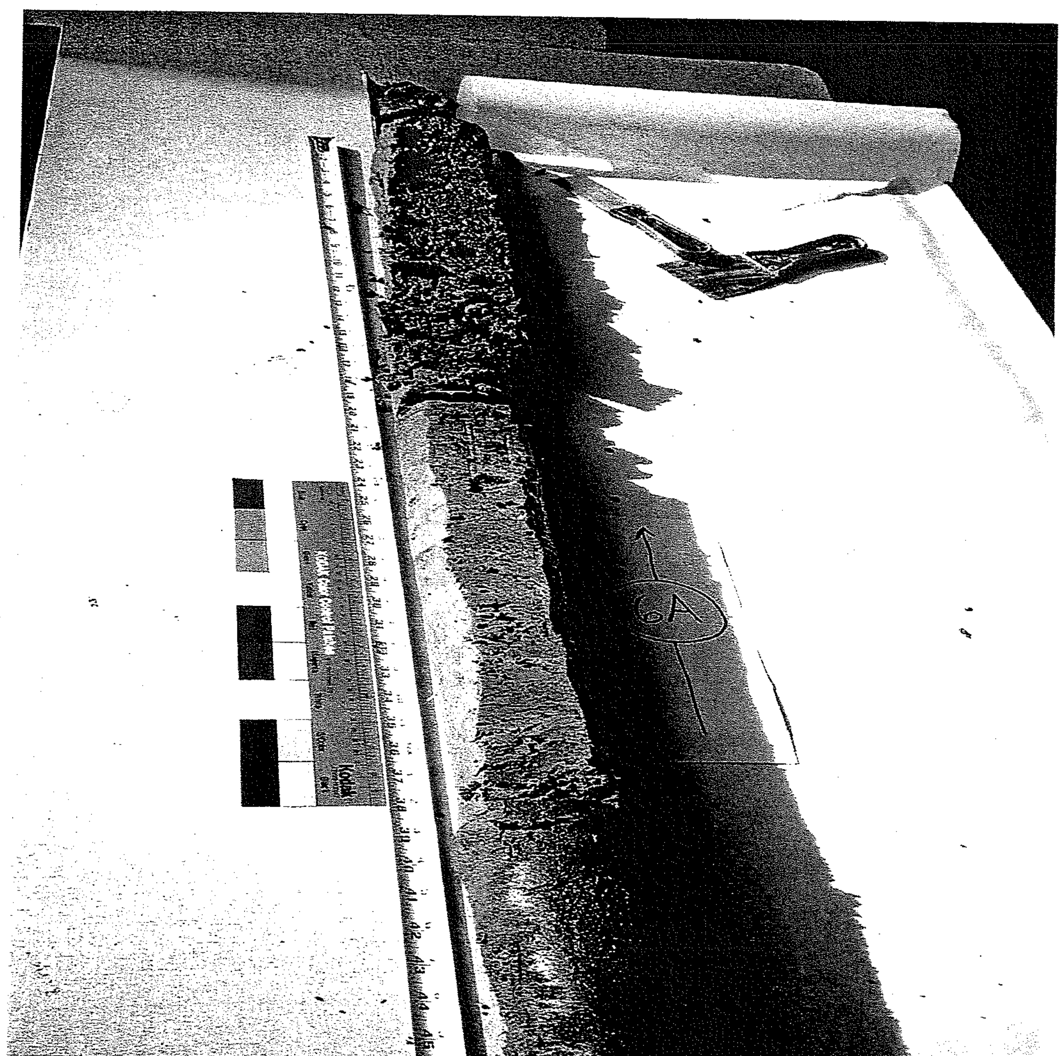


Photo 3-1 Ash layer (located adjacent to the color scale) within Core 6

The thickness of the transition zone from the underlying layer into this ash layer varied. In Core 6, an abrupt transition indicates a sudden change in the depositional characteristics at this location, such as the influx of a significant supply of ash to the bay. This abrupt contact also indicates that this depth interval (at the contact point) has not been reworked over time. In Cores 2 and 3, however, the transition zone from the underlying layer into the ash layer was more gradual (greater than 2 inches in Core 2 and approximately 4 inches in Core 3). This could result from a number of causes at these locations, including variable settling characteristics, a reworking/mixing of sediments, and/or chemical or biological diagenesis of the ash.

Table 3-5 lists the core layers in which ash was apparent based on the visible physical characteristics of the cores. The chemical confirmation and location of ash within the cores are further described in Section 3.4.

TABLE 3-5
Layers where Ash was Identified based on the Visible Characteristics of the Cores

Core Number	Core Layer[a] feet (inches)
1	1.5 to 4.9 (18 to 58.5)[b]
2	1.0 to 2.8 (12 to 33.6)
3	1.3 to 2.8 (15.6 to 33.6)
5	1.9 to 2.9 (22.8 to 34.8)
6	1.8 to 3.3 (21.6 to 39.6)

[a]Measured from the top of the core.
[b]There was a portion (from 2.7 to 4.1 feet [32.4 to 49.2 inches]) within this core layer where the ash characteristics were especially visible (analytical results from both the larger core layer and the subsection within this layer are included in chemical analysis described in Section 3.4).

Based on the data in Table 3-5, without considering the effects of compaction and assuming a constant rate of deposition since May 1980, the average annual deposition rate equates to 1.8 inches per year in the areas of Mica Bay represented by these cores (minimum = 1.5 inches per year; median = 1.6 inches per year; maximum = 2.6 inches per year). For comparison, Horowitz et al. (1995) reported an average sedimentation rate of 0.8 inch per year during 1980 to 1990. This sedimentation rate was based on data from one core located in the main body of Coeur d'Alene Lake in approximately 50 feet (15 meters) of water (estimated using bathymetric map in Woods and Barenbrock [1994]).

Because the physical settling characteristics at any given location within the bay is a function of the variable water depth (see Chapter 2), the relationship between water depths and core elevations is important. Between the initiation of construction (June 25, 2001) and core sampling (August 27, 2002), there were periods of time when the lake level receded below the top elevation of four cores (Cores 1, 2, 5, and 6). Table 3-6 summarizes the water depths over each core during this time period.

TABLE 3-6
Lake-Water Depth over the Mica Bay Core (Top) Elevations During Construction and Prior to Coring (June 25, 2001 through August 26, 2002)

Core Location Number	Minimum Water Depth Over Core Top	Number of Days Top of Core was Exposed	Dates of Exposure
1	**Exposed** up to 2.2 feet (0.67 meter)	48	Dec. 20 – Jan. 8; Feb. 1 – Feb. 23; Mar. 7 – Mar. 11
2	**Exposed** up to 3.3 feet (1.00 meter)	136	Nov. 7 – Jan. 10; Jan. 19 – Mar. 30
3	Submerged at least 0.1 foot (0.04 meter)		
4	Submerged at least 0.3 foot (0.10 meter)		
5	**Exposed** up to 0.8 foot (0.25 meter)	18	Dec. 28 – Jan. 7; Feb. 15 – Feb. 21
6	**Exposed** up to 1.9 feet (0.57 meter)	38	Dec. 23 – Jan. 8; Feb. 4 – Feb. 23; Mar. 10
7	Submerged at least 0.8 foot (0.25 meter)		
8	Submerged at least 8.9 feet (2.73 meters)		
9	Submerged at least 6.4 feet (1.96 meters)		
10	Submerged at least 39 feet (12 meters)		

Sediment could only deposit at a given location during periods of submergence. Although Core 2 was exposed for as many as 136 days, that was 32 percent of the time period (427 days) between the initiation of construction and coring. Therefore, even this most shallow core location was subject to deposition during construction, albeit not for the same duration as the deeper locations.

If the project resulted in a significant volume of sediment deposition in the bay, the uppermost core layer at the majority (if not all) of the core locations would be expected to share some similar physical characteristics indicative of a sediment "blanketing" effect. Also, if significant sediment loading occurred during the relatively short time period between the 2002 spring runoff (when the sediment loading to the bay would be expected to be elevated because of higher stream discharges), and the date the cores were extracted, vegetation at the surface of any core would not be expected. In fact, organic matter was observed in the top layer of every core except Core 7. In many cases roots were apparent in the top core layer, indicating these sediments have been in place long enough under favorable conditions, such as low turbidity to allow sunlight penetration, for plant establishment and growth to occur. Observations pertaining to the presence of organic matter in the cores are presented in Table 3-7. These excerpts are copied from the core descriptions shown on the schematic diagrams in Appendix C.

TABLE 3-7
Observations Pertaining to Vegetation and Organic Material in the Mica Bay Cores

Core Number	Observation by Core Layer*
1	0" to 10": Organic debris of grasses, twigs, bark; chaotic distribution of organics.
	10" to 18": *No mention of vegetation or organic material.*
	18" to 58.5": Organic-rich nodules in upper 6" of this segment; abundant roots toward base (53" to 58.5"); 47" to 53" – 6" long root.
	58.5" to 88.5": One black grain at 79" was carbonized wood; no vegetation is present in sand, but vegetation is present in above clay.
2	0" to 12": Lots of roots; no (grass) blades; vegetation is not matted; no layering; very top has some vegetation growth; fine pieces of woody debris, some occasional bladed grass.
	12.5" to 33.5": Only occasional woody fragment.
	33.5" to 56": *No mention of vegetation or organic material.*
3	0" to 16": Only upper 4" seem to contain vegetation; very top is woody debris and twigs.
	16" to 34": No aquatic/grassy vegetation; thin, hair-like roots only.
	34" to 75": Scattered organic debris of grass/roots; debris up to 1 cm across; debris, not in-place growth.
4	0" to 8": *No mention of vegetation or organic material.*
	8" to 61": Highly organic rich; partially carbonized at it's base; transitions to light brown, like dry vegetation; bottom 12" to 18" of this segment is carbonized, approximately 60 to 70 percent vegetation, above that is 40 to 50 percent vegetation; uniformly distributed organic matter in both roots and leaves/stem throughout; in lower section the carbonized zone seems more densely dominated by root mass rather than grass.
	61" to 97": Organic debris less than 10 percent.
5	0" to 16": Varying amounts of vegetation, more prevalent in upper 7"; clay increasing toward bottom of segment as vegetation decreases; less than 5 percent vegetation.
	16" to 23": Organic rich of bladed vegetation; 60 to 70 percent vegetation in clay matrix.
	23" to 34.5": Less then 5 percent broken vegetation.
	34.5" to 71": Occasional vegetation throughout length of segment and woody debris particularly near base; high abundance of twig debris and other woody fragments up to 0.5" diameter concentrated in 37" to 50" and 63" to 71"; very distinct wood debris layer from 43" to 44.5" with large wood fragments up to 0.5" to 0.75" diameter.
	71" to 77": *No mention of vegetation or organic material.*
	77" to 95": Organics do not appear to be present; at 91" one large wood chip found in center of core, approximately 1" x 0.5" rectangular shape.
6	0" to 22": Uniform root-organic rich; vegetation not matted; large wood chip at 17", 3" x 2" in size.
	22" to 39.5": No visible vegetation.
	39.5" to 67.5": 39.5" to 44" – fine-grained roots; 50" to 51" – wood present; 60" - piece of wood; 64.5" to 67.5" – coarse sand with wood.
7	0" to 29": No organic matter of any nature is visible, except one twig at 22".
	29" to 35": Color differential (*compared to upper layer*) looks to be reduced condition due to organic matter at that point (more woody debris at layer differential between 0" to 29" and 29" to 35").

TABLE 3-7
Observations Pertaining to Vegetation and Organic Material in the Mica Bay Cores

Core Number	Observation by Core Layer*
8	0" to 10"/12": Fine-hair roots, well distributed; very few green grass blades are present, but could be mixing from core tube walls; very, very fine hair-like, fibrous material, 0.5" to 1" max length, organic fiber, possibly agriculturally derived; at approximately 6" depth, 1" x 1/8" x 1/2" bark fragment in center of core.
	10"/12" to 12"/14": Approximately 2" thick, significant layer of 1" to 1.5" max. dimension of bark fragments.
	~14" to 65": Larger blades of grass up to 1" length; up to 30 to 50 percent of total material; blade width ≤ 0.25"; matted; evenly distributed within silt and clay; large twig at ~33" (from core top), 1.25" long and 0.25" diameter, rough surface indicating travel.
	65" to 91": Decreasing presence of vegetation; more silt and clay; smaller fragments of vegetation look more tubular and hair-like; less than 20 percent; look more like debris rather than matted layering, longest dimension ~3/8"; evidence of hair-like fibers splitting off of larger grass blades is apparent; so, difference in the top layer is absence of blades.
9	0" to 71.5": Mixture of silt / clay / vegetation; vegetation up to 50 percent; consistently mixed well; bladed/grassy; no layering.
	71.5" to 97.5": Dispersed fragments of vegetation less than 5 percent; no visible layering; throughout segment, amount of vegetation decreases with depth as mica increases.
10	0" to 86": Random but rare organic fragments.

*From Appendix C.

Cores 4, 8, and 9 contained extensive vegetation. From 8 to 61 inches, which is a 4.5-foot-long layer, the vegetation content was visually estimated at 40 to 70 percent (variable within the layer). Core 8 contained up to 30 to 50 percent vegetation from approximately 14 to 65 inches (4.3-foot-long layer). Core 9 contained up to 50 percent vegetation in the top 71.5 inches (6-foot-long layer). These observations indicate that aquatic vegetation has been prevalent at these locations for quite some time.

3.3.2 Specific Gravity and Grain Size

The analytical reports containing the specific gravity and grain size (sieve) results are included in Appendix E.

Specific gravity is the ratio of specific weight (weight per unit volume) of a given material to the specific weight of water at 39.2 degrees Fahrenheit (4 degrees Celsius). The average specific gravity of sediment is 2.65 (Yang, 1996). Table 3-8 presents a statistical summary of the specific gravity data for the core samples and watershed samples.

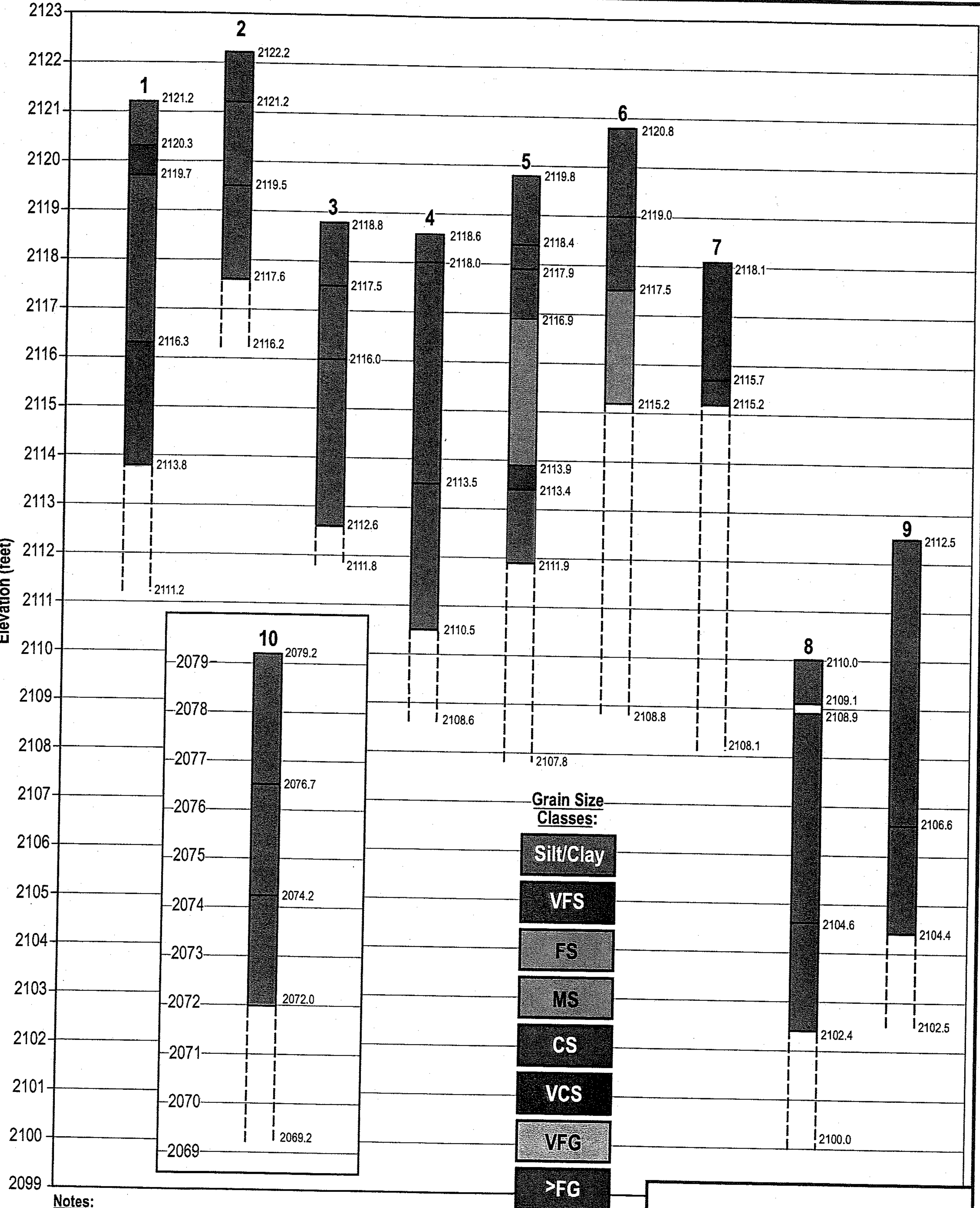
TABLE 3-8
Specific Gravity of the Mica Bay Core and Watershed Samples

Statistic	Core Samples	Core Samples (Top Layer Only)	Watershed Samples	Watershed Samples (Sediment Only)	Watershed Samples (Soil Only)
Sample size	32	10	16	10	6
Minimum	1.90	2.08	2.42	2.56	2.42
Average	2.35	2.39	2.60	2.64	2.52
Maximum	2.65	2.61	2.73	2.73	2.60
Standard deviation	0.21	0.15	0.09	0.05	0.09

The watershed sediments had an average specific gravity of 2.64, which is very typical of waterborne stream sediments. The average specific gravity in the watershed soil samples was slightly lower at 2.52, while the core samples were even lower at 2.35. The lower specific gravities are reflective of a higher organic content in these samples. The average specific gravity of the top layer from each core (n = 10) was almost identical to the average of the full suite (n = 32) of core samples. In both the bay and watershed samples, the lower specific gravities are associated with higher organic contents. For example, the layer from 8 to 61 inches in Core 4, estimated to be 60 to 70 percent vegetation, had a specific gravity of 1.90. Similarly, the watershed soil samples have higher organic contents than the stream sediments. This is reflected in the specific gravity data as well.

The dominant grain size class (based on percent by weight) in each layer of the Mica Bay cores is shown in Figure 3-3. This data is also shown in Figure 3-4 to reflect the spatial distribution of the cores within the bay. The watershed sample data is included in Figure 3-4 for comparison. The grain size classes shown in these figures are defined in Table 3-4. Figures 3-3 and 3-4 illustrate that the sediments in Mica Bay are primarily silts and clays. Of the 32 individual core layers analyzed, the average percentage of silt/clay was 67 percent (minimum = 1 percent; median = 81 percent; maximum = 99 percent). Excluding Core 10, located in a deep-water environment relatively far from the delta, the average percentage of silt/clay percent was 63 percent (median = 77 percent).

Although silt/clay dominates, all grain size classes from silt/clay through fine gravel were present in 26 of the 32 core layers. The six core layers that did not have all grain sizes present lacked only fine gravel and, in one case, very fine gravel. Therefore, the full suite of sand-size classes was present in every core layer, although in varying amounts. Seven of the core layers were dominated by either medium sand or coarse sand (see Figure 3-3). Note that Core 7, which is located at the mouth of the active channel across the delta, was composed primarily of coarse sand (see Figure 3-4). This is indicative of the high-energy environment at this location, especially during floods and winter drawdown conditions when this becomes more like a riverine environment. Particle size distributions (PSDs) for all of the individual core layers and watershed samples are included in Appendix F.



Notes:

1. Solid lines represent visible changes identified in recovered core sediments.
2. Dashed lines indicate penetration depth.
3. Although visible layers were not evident in Core 10, it was subsampled for analytical work.
4. Elevations are based on the Mica Bay datum (see Chapter 2).

FIGURE 3-3
Dominant Grain Size Classes in Mica Bay Cores
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
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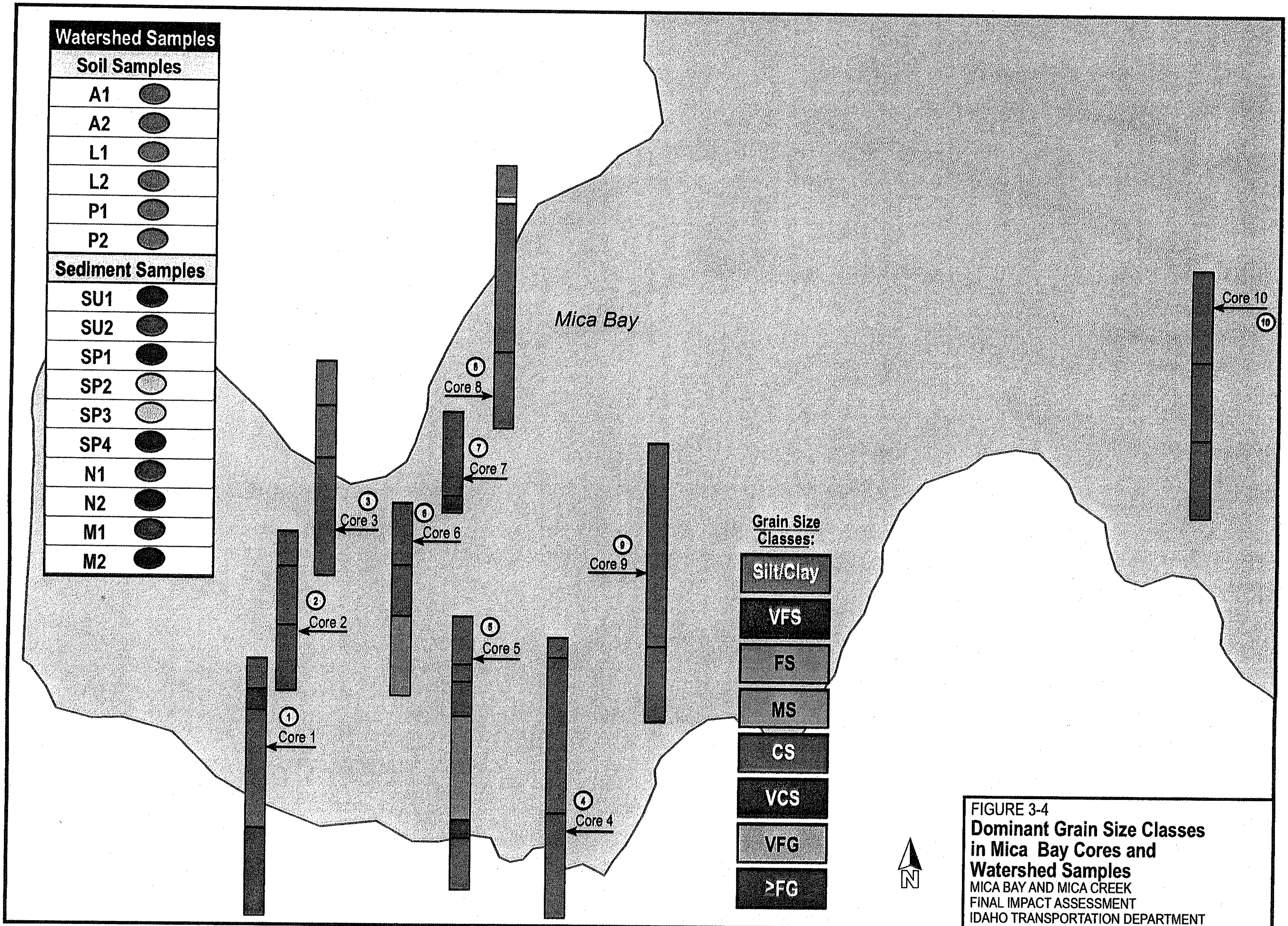

FIGURE 3-4
Dominant Grain Size Classes in Mica Bay Cores and Watershed Samples
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
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The watershed sediment samples were dominated by coarse sands through at least fine gravel (gradations larger than fine gravel were not measured). The median grain size class for each watershed sample is listed in Table 3-9. Although the watershed sediment samples were dominated by coarser-grained sediments, every sample also contained the sand size classes and the silt/clay class. In the watershed soil samples, the most prevalent grain size class was silt/clay (see Figure 3-4); however, the median grain size class ranged from silt/clay through medium sand (see Table 3-9).

TABLE 3-9
Median Grain Size Class in the Mica Bay Watershed Samples

Sample	Median Grain Size Class
L1 – Forest land soil	VFS
L2 – Forest land soil	FS
A1 – Agricultural land soil	MS
A2 – Agricultural land soil	Silt/clay
P1 – U.S. 95 Bellgrove to Mica Project site soil	Silt/clay
P2 – U.S. 95 Bellgrove to Mica Project site soil	MS
SU1 - Upper S.F. Mica Creek sediment	VCS
SU2 - Upper S.F. Mica Creek sediment	CS
SP1 - S.F. Mica Creek sediment downstream of the project	VCS
SP2 - S.F. Mica Creek sediment downstream of the project	VFG
SP3 - S.F. Mica Creek sediment downstream of the project	VCS
SP4 - S.F. Mica Creek sediment downstream of the project	VCS
N1 – N.F. Mica Creek	CS
N2 – N.F. Mica Creek	VCS
M1 – Mica Creek	≥ FG
M2 – Mica Creek	VCS

Figure 3-5 illustrates the variability in the silt/clay content among the Mica Bay core and watershed samples. The percentage of silt/clay comprising the core samples was variable, ranging from 1 to 99 percent. Figure 3-5 illustrates the silt/clay variability in terms of percent composition (based on quartile percentages) and spatial distribution among the samples. This figure shows that all four quartile-percent ranges occurred in the top layer of at least one of the nine cores located on or near the delta. This exhibits a differential settling action of the silt/clay-size class across the delta. Cores 2, 3, 5 and 9 had the highest percent silt/clay composition in the top layer. Cores 2, 5, and 9 were located approximately in the center of the delta along an east/west transect (see Figure 2-1). Core 3 was located in the active delta channel, although further upstream of Core 7 where the coarsest delta sediments were

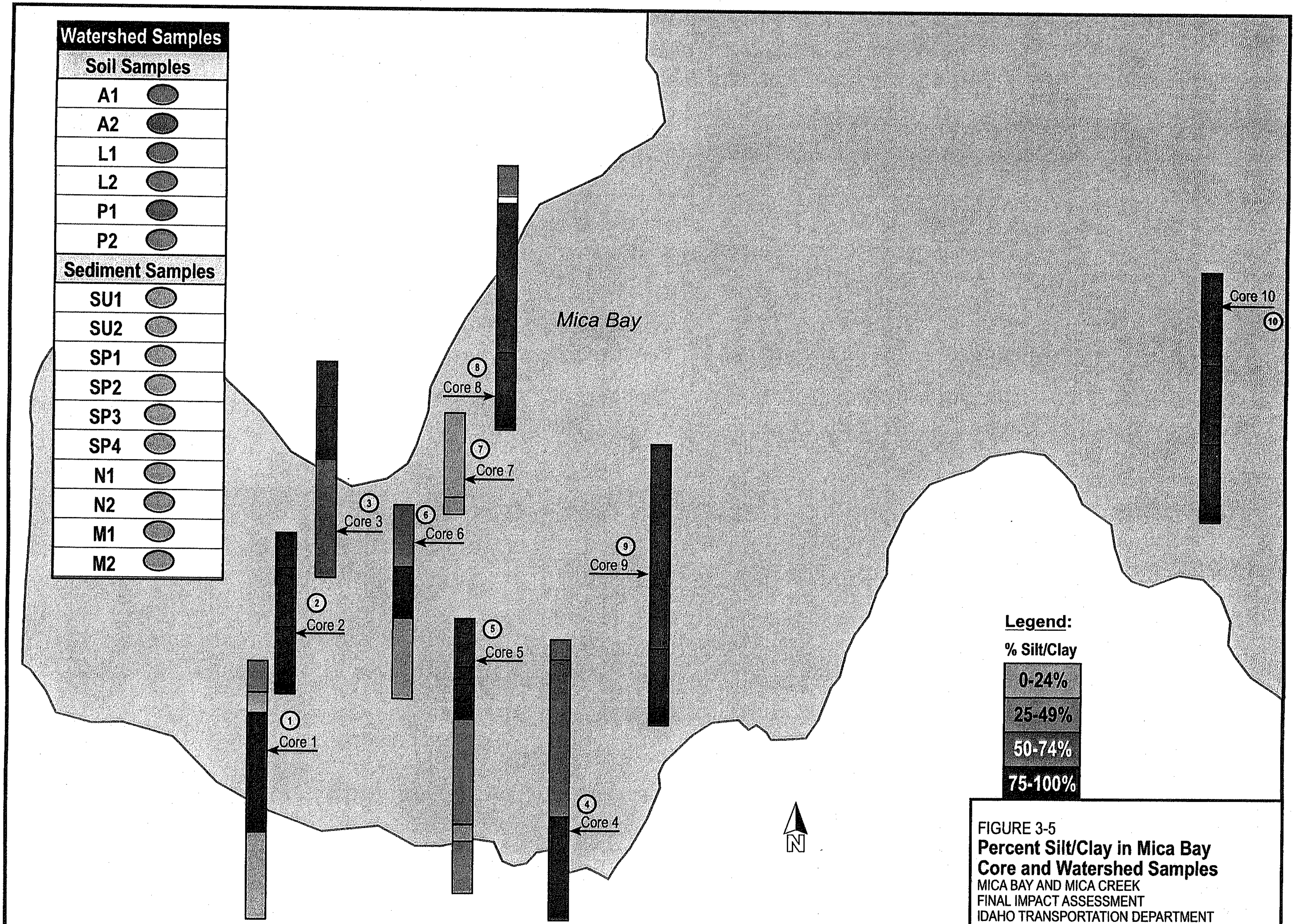

FIGURE 3-5
Percent Silt/Clay in Mica Bay Core and Watershed Samples
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
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found. It is possible that the channel has incised at this location, exposing underlying fine sediments in the absence of coarse-grained deposition over the top. The second layer from the top of Core 3 contained a high silt/clay content of 96 percent.

Figure 3-5 illustrates the relatively low (and uniform) percentage of silt/clay in the watershed sediment samples (average = 0.9 percent by weight). The soil samples contained an average of 41 percent (ranging from 27 to 54 percent) silt/clay. The low silt/clay percentage in the stream sediments is likely a function of the relatively steep stream gradients and the flashy hydrology which easily transports these fine-grained particles out of the stream channels. The disparity in the silt/clay content of the stream sediment samples versus those in Mica Bay is the reason that the analytical chemistry evaluation was conducted on both the total (composite) sample and the minus 230-mesh samples as described above in Section 3.2.2.

The hydrometer test results provide the relative percent of silt versus clay in each core layer. The dominant grain size within the silt/clay fraction is illustrated in Figures 3-6 and 3-7. Of the 28 core layers in or near the delta for which hydrometer results are available, 17 layers contained more silt than clay. The median silt percentage in these layers was 66 percent. Where clay was present in a higher percentage than silt, the percentage of median clay was 57 percent. In Core 10, which was further into the lake, the percentage of silt versus clay was nearly even. The three samples in Core 10 had clay percentages of 54, 52, and 52 percent from top to bottom, respectively.

When evaluating the silt and clay content in the surficial core layers, silt was more prevalent in six of the eight delta cores for which data are available (see Figure 3-7). The median silt content in these six surficial core layers was 67 percent. In Cores 3 and 9, the top layer contained 51 and 57 percent clay, respectively. Overall the Mica Bay delta cores contain more silt than clay; however, as Figure 3-7 illustrates, variability in the spatial distribution of these particles exists within the bay.

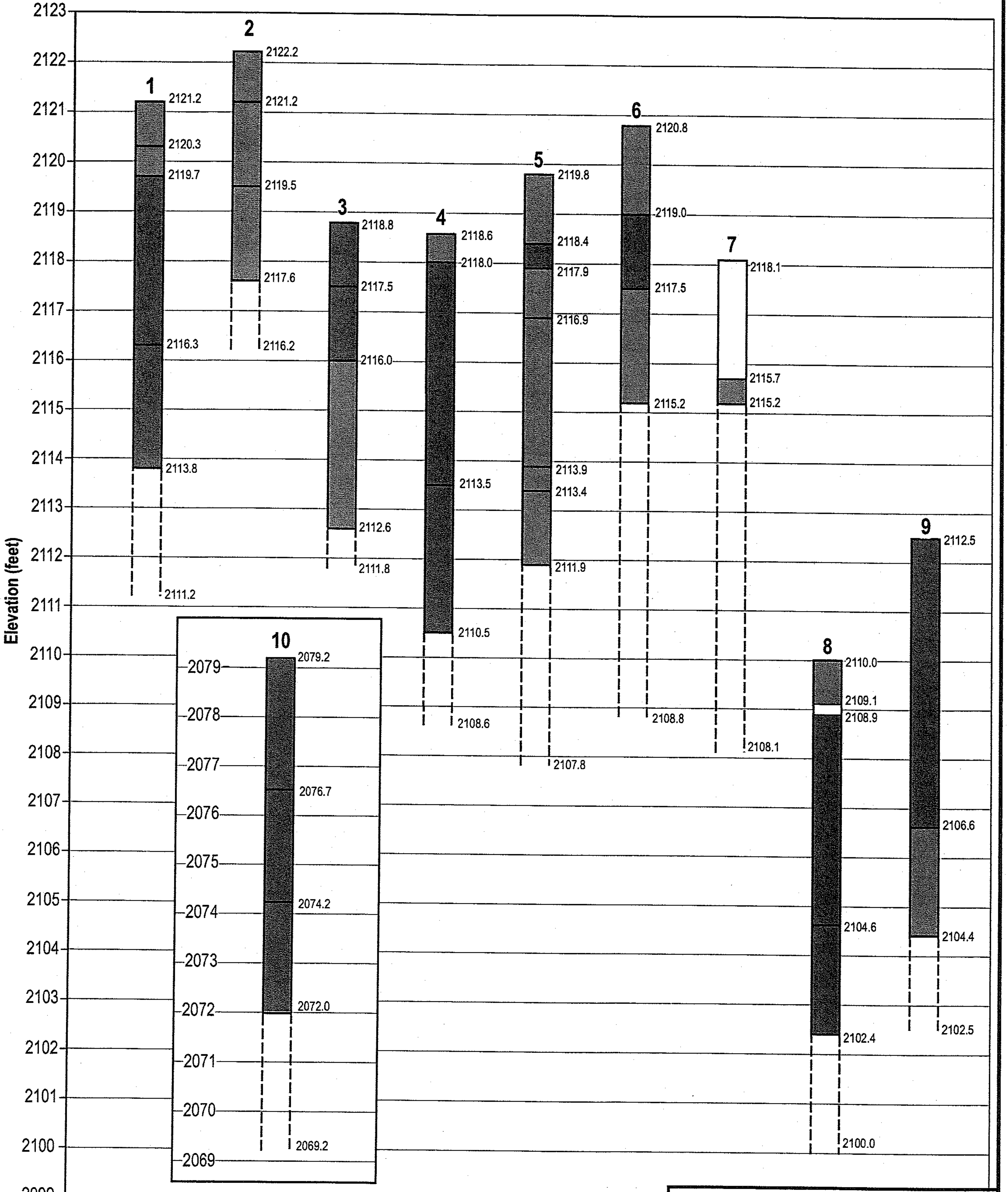
3.4 Results—Chemical Description and Source(s) of Sediments

The analytical data for the multiple watershed and bay samples collected during this investigation, along with the shallow lake bed sediment samples collected by the USGS (Horowitz et al., 1993) are included in Appendix E.

3.4.1 Background

A comparison of the soil and sediment chemistry among the multiple watershed and bay samples was conducted to identify the primary source(s) of sediment to the bay, and the relative contribution of the project to sedimentation in the bay. The analysis presented in this section uses chemical properties as the primary means of identifying sediment from various sources.

Multiple sources within the watershed contribute sediment to Mica Bay. In addition to the watershed sources sampled as described above, two additional sources of sediment are: 1) Mount Saint Helens air-transported ash from 1980; and 2) mining-related sediments transported within Coeur d'Alene Lake (Horowitz et al., 1993). In addition, nutrients from human-induced sources have impacted the bay.



Notes:

1. Solid lines represent visible changes identified in recovered core sediments.
2. Dashed lines indicate penetration depth.
3. Insufficient sample volume for the top layer of Core 7.
4. Elevations are based on the Mica Bay datum (see Chapter 2).

Legend:

- % Clay > % Silt
- % Silt > % Clay

FIGURE 3-6
Distribution of Silt and Clay in Mica Bay Cores
MICA BAY AND MICA CREEK
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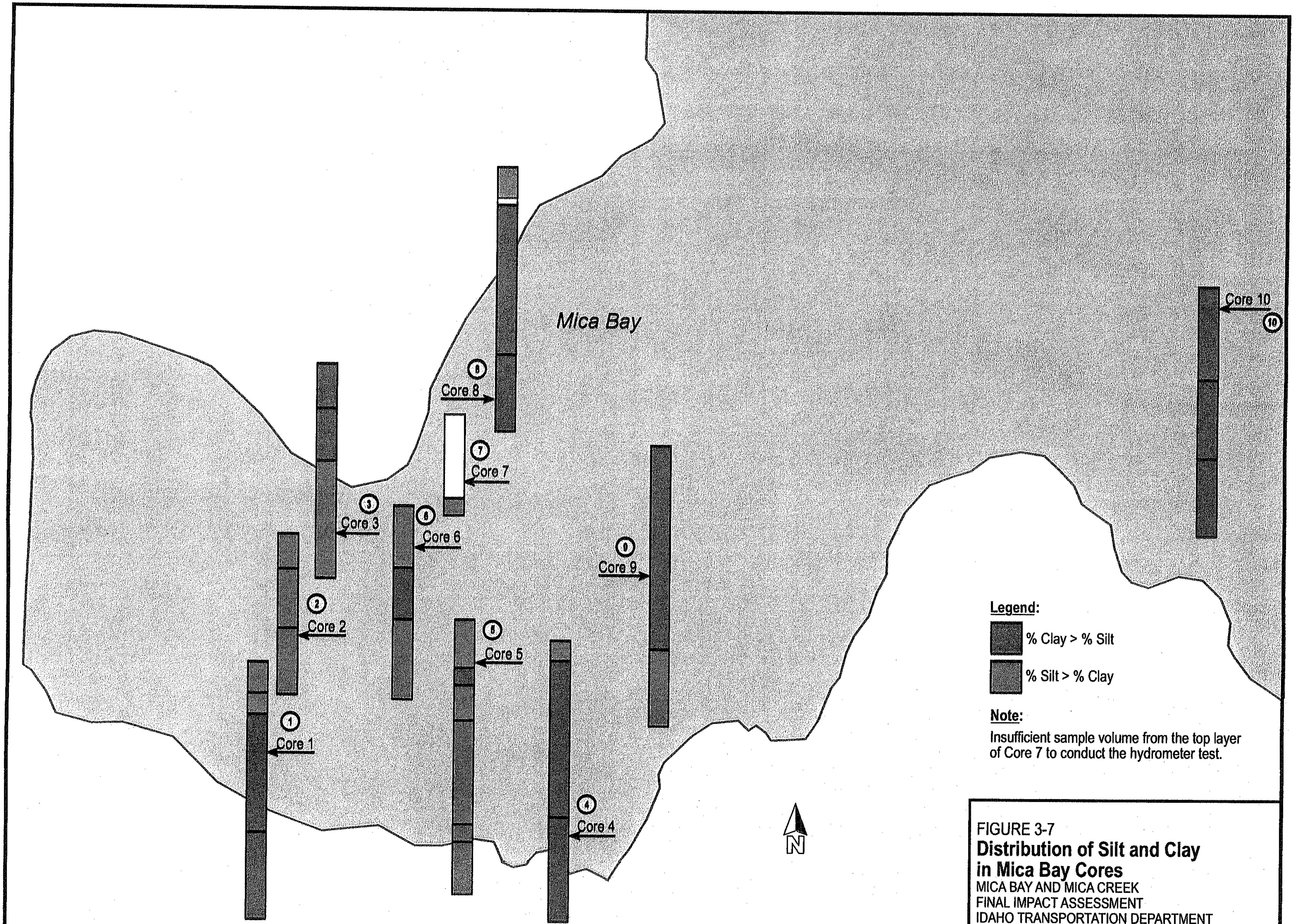

FIGURE 3-7
Distribution of Silt and Clay in Mica Bay Cores
MICA BAY AND MICA CREEK
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3.4.1.1 Mount Saint Helens Ash

Mount Saint Helens ash commonly forms a time marker of minus 230-mesh ash layers in soils and lake sediments downwind of Mount Saint Helens. The ash resulted from five significant eruption events in 1980. The Mica Bay sediments contain variable, but relatively thick, depth intervals representing this air-transported ash variably mixed with watershed soils and sediment. The chemical analyses of Mount Saint Helens ash were compiled from two sources: Fruchter, et al. (1980) and Sarna-Wojcicki (1981). Chemical data from Fruchter, et al. (1980) are the averaged air-transported Mount Saint Helens May 18, 1980, ash deposited in Spokane, Rosalia, and Pullman, Washington, and Missoula, Montana. Chemical data from Sarna-Wojcicki et al. (1981) are the average of two bulk air-transported ash samples deposited May 18, 1980, in Moscow, Idaho. The May 18 event deposited the bulk amount of ash of the five eruption events: May 18, May 25, June 12, July 22, and August 7. Therefore, all the chemical data used in this investigation represent ash from the earliest most significant event.

3.4.1.2 Mining-Related Sediments from Coeur d'Alene Lake

In 1989, the USGS collected surface bed sediment samples (uppermost 2 centimeters) from multiple locations within Coeur d'Alene Lake, including five locations within the Mica Bay area (Horowitz et al., 1993). Horowitz et al. (1993) document the significant impact that mining and related activities have on the metals chemistry of surface sediments of Coeur d'Alene Lake, including Mica Bay. Two of their samples were near cores taken for this study. USGS sample CDA 51 was near the Core 3 location and USGS sample CDA 50 was near the Core 10 (see Appendix E). Data from those samples have been used in this analysis to help define the mining-related metals concentrations in Mica Bay.

3.4.1.3 Nutrients from Anthropogenic Sources

Nutrients from anthropogenic (human-induced) sources from the watershed have had a significant effect on the bay sediment. The USGS has also described the relatively significant effect of nutrients and trace elements, principally zinc, enrichment in the Coeur d'Alene Lake water column and lake bed sediment (Woods and Beckwith, 1997). Considerable nutrient enrichment is evident in the sediment chemistry of Mica Bay as well.

3.4.2 Inorganic Elements and Sediment Sourcing

3.4.2.1 Background

The purpose of this investigation is to define the sources of sediment to Mica Bay so that the impact of the project site as a potential source of sediment can be assessed. Therefore, the elements with the highest concentrations and lowest concentrations in each of the sources, regardless of grain size, were compared with each other and the Mica Bay sediments to select the elements with the best potential for estimating the relative contribution from each source. The "highest" and "lowest" elements were selected based on standard statistical ranking methodology. Table 3-10 lists the highest and lowest elements in each of the potential sources within the Mica Bay watershed, based on sampling.

TABLE 3-10
High and Low Concentration of Elements in Potenti…

Recently logged forest land soils	**SiO_2**, **K_2O**, As, Rb, Tl, Zr		…e, …n
Agricultural soils	**Al**, Ag, **Ba**, Cd, Li…		
Road construction soils	Hf		
Upper South Fork Mica Creek sediments	Ca, Mg, **Ce**, Co, Cr, …		
South Fork Mica Creek sediments (downstream of the road construction)	Na, **Ce**, **La**, Nb, Sr,	…, K, Li, Pb, Sb	
North Fork Mica Creek sediments	**Ce**, **La**, Fe, Mn, **Ba**, Ge, Se, …a, Ti, U, Y	**Al_2O_3**, As, Hf, Nb, Zr	

Note: **Bold** type indicates the primary constituents used to estimate probable contributions from each source

As described in Section 3.2.2, the minus 230-mesh watershed samples were used in addition to the total (unsieved) samples for this analysis. As expected, the chemistry data revealed that the mean concentrations of most metals were higher in the minus 230-mesh samples than in the total samples. This is because the finer-grained material has a greater surface area available for sorption. In the minus 230-mesh samples, concentrations of silver, antimony, arsenic, barium, cesium, lead, sulfur and tungsten ranged from 14 percent (lead) to 82 percent (tungsten) higher than the total samples. Most were no higher than 31 percent (antimony). However, concentrations of cerium, lanthanum, germanium, tantalum, yttrium, selenium and zirconium were lower in the minus 230-mesh samples than in the total samples (ranging from 24 percent [selenium] to 69 percent [cerium] lower). The elements with lower concentrations in the minus 230-mesh samples than the total samples are representative of the parent bedrock in the watershed.

3.4.2.2 Source Determination by Marker Constituents

Summary: Considerations for Road Construction Source Identification in Mica Bay Sediments

- Discrete single depth interval with road construction (P1 and/or P2) source chemistry
- Because such a depositional event must be very recent, the layer should be the uppermost or include the uppermost depth interval at any core location.
- Mixing is expected and should include South Fork Mica Creek Stream Sediment sources (SP1, SP2, SP3, and/or SP4) chemistry because they are downstream of road construction and also have the potential to contain road construction soils and sediments.
- Mainstem and South Fork Stream Sediment sources may or may not be identified with

the road construction and lower South Fork watershed mixture.

- Background Upper South Fork Mica Creek and Upper North Fork Mica Creek may be identifiable but of lesser significance than the road construction sources chemistry.
- Mount Saint Helens ash chemistry (1980 event) and lake-derived high metals concentrations, organics, and/or nutrients should be absent.

This section summarizes the following:

- Specific sources of sediment to Mica Bay
- Physical and chemical characteristics that need to be present to identify a specific event resulting in a layer within Mica Bay
- Constituents that were selected as markers to distinguish among the various sources contributing sediments to, or modifying existing sediments, within Mica Bay.

Sources

The three major sources that contributed sediment to Mica Bay are the following:

- Watershed
- Lake-derived
- Mount Saint Helens ash

Table 3-10 lists the six discrete sources that form the watershed sources. Road construction soils and the South Fork Mica Creek stream sediments downstream of the background South Fork stream sediments represent those sources that are most likely to contain sediment that is project-related (particularly SP1, but including P1, P2, SP-2, SP-3, and SP4). Lake-derived (lacustrine) sources include metals originating from up-lake mining-related sources that are described by the U.S. Geological Survey in several reports (for example, Horowitz et al. 1993 and 1995, and Woods and Beckwith 1997). Although not a major contributor of sediment volume, the metals precipitates from the lake water have a significant impact on the chemistry of the sediments within Mica Bay, particularly the shallowest sediments. Finally, the Mount Saint Helens ash is a significant event resulting in the deposition of ash within Mica Bay.

Significant Sediment Contributing Event

The Mount Saint Helens ash represents an event that occurred at a specific time (1980). Surface water moved a considerable amount of the ash deposited on the watershed surface into Mica Bay where it formed a discrete, well-defined layer. In this regard, most of the physical and some chemical characteristics of the Mount Saint Helens ash layer within the Mica Bay sediment cores would be expected from any significant source of sediment contributed to Mica Bay. These characteristics are the following:

- Sediments from the event should form a discrete layer proportional to the sediments generated by the event.
- The layer should have a chemical composition that is characteristic of the specific source generating the sediment. If the event is sufficiently significant to form a layer, the chemistry should document the specific source by indicating very limited mixing with

other watershed sources. All the layers within the Mica Bay sediments are mixtures of sources but a significant event sufficiently able to form a layer of sediment within Mica Bay will retain characteristics of that source even when mixed with other sources during transport to the bay (that is, marker dilution would be limited or non-existent). If sufficiently as significant as the Mount Saint Helens ash event (which deposited a layer from 1 to several feet thick), the source's physical and chemical characteristics decrease, but persist, within sediments deposited a long time after the event.

- The sediments from the event should have very limited or no lacustrine marker chemistry because the sediments would not be exposed to lake water for a sufficient time during deposition of the layer to acquire a lacustrine marker chemistry.

Selection of Marker Chemistry

The following are the characteristics of chemical markers:

- The most important characteristic for a chemical marker is that it should be sparingly soluble. Sparingly soluble elements tend to stay with soil and sediment particles during the weathering, transport, and geochemical processes occurring after deposition in Mica Bay.
- The element should tend to remain with chunks of bedrock broken into small enough particles to be transported as a stream sediment to Mica Bay.
- The element should remain, and even increase in concentration, as the rock reacts to form soil particles (weathering) and also with soil particle transport to Mica Bay.
- The element should have its highest concentration in one or two similar sources and lowest concentrations in other dissimilar sources to Mica Bay sediments.
- The element should have a large range in concentration between its highest and lowest concentration in sources.
- The group of elements forming markers should discriminate between sources when compared, for example, by plots of x-y scatter diagrams or plots from statistical methods.

Watershed Markers Silica, Alumina, and Potassium Oxide

Silica, alumina, and potassium oxide form marker chemicals for watershed sources.

Sparingly soluble silica, alumina (aluminum oxide), and potassium oxide form discrete minerals that remain with stream sediments. Silica forms the mineral quartz, the dominant mineral in beach sands. Silica and alumina are the major rock-forming elements for clays and other minerals present in stream sediments and beaches. Potassium oxide plus silica and alumina form the mineral mica, the abundance of which lead to the well-deserved name "Mica Bay." In addition, as shown in Table 3-10, the highest and lowest concentration of these rock-forming oxides occur in discrete sources within the watershed. For example, silica is highest in recently logged forest land soils and lowest in agricultural soils while alumina is highest in agricultural soils (clays) and lowest in background North Fork Mica Creek stream sediments. Potassium oxide is also highest in forest soils and lowest in the background upper South Fork Mica Creek stream sediments.

Watershed-Ash Marker Barium

Barium discriminates ash from all watershed sources.

Sparingly soluble barium is highest in agricultural soils and background North Fork Mica Creek stream sediments. It is lowest in the background upper South Fork Mica Creek stream sediments. Barium is a good marker for discrete watershed sources because, as the agricultural soils attest, barium tends to be retained within minerals forming even very small particles. Although not listed in Table 3-10, Mount Saint Helens ash contains significantly lower barium than any of the watershed sources.

Watershed-Ash Markers Cerium and Lanthanum

Cerium and lanthanum are good markers for discriminating between watershed sources. Because both cerium and lanthanum are significantly lower in Mount Saint Helens ash than in all watershed sources (similar to barium), cerium and lanthanum are also good markers for discriminating between watershed sources and ash.

Sparingly soluble rare earth elements cerium and lanthanum are significantly higher in the Mica Bay bedrock than normal crustal rocks. Rare earth elements are commonly used in geochemical investigations, the purpose for which is to determine specific sources of sediment (Sinha, 1983). These elements are highest in the background upper North Fork Mica Creek stream sediment (above the upper detection limit of 500 ppm). The South Fork Mica Creek stream sediments below the upper background South Fork Mica Creek stream sediments have the highest laboratory-reported concentrations of both cerium and lanthanum. These are the stream sediments that have the highest potential to contain road construction material. Cerium, as a single marker, is also very high in the upper background South Fork Mica Creek stream sediments. Cerium is lowest in forest soils, and lanthanum is lowest in agricultural soils.

Lacustrine Marker Zinc

Zinc was selected as the lacustrine (lake) marker.

Specific metals are mining-related elements documented by Horowitz, et al. (1993) as impacting Coeur d'Alene Lake sediments. Five of these USGS analyses of shallow lake sediments are within and near Mica Bay, documenting that zinc, lead, antimony, cadmium, and silver are elevated in lake sediment as a result of mining-related sources (Appendix E).

Zinc, although not a sparingly soluble element, is a lake-wide marker of the lacustrine environment. Because zinc is the metal with the highest concentration, it is also of ecological importance (Woods and Beckwith 1997). Similar to barium, zinc concentrations are not only consistently low in all watershed samples but also lowest in Mount Saint Helens ash. Therefore, zinc was selected as the lacustrine marker. Zinc concentrations in Mica Bay core depth intervals increase with the length of time that the depth interval took to deposit in the bay.

3.4.2.3 Source Chemical Markers

Each of the following sections discuss the marker definition of each of the three source impacts on sediment chemistry within core depth intervals from all 10 core locations. Conclusions reached for each of the major markers are summarized as bullets within a box at the beginning of each marker description. Three combinations of the elements described above are plotted on x-y scatter plots documenting the relative contribution of each of the sources to Mica Bay sediments: silica, aluminum, and potassium oxide ratios; barium versus zinc; and cerium versus lanthanum.

3.4.2.3.1 Silica, Alumina, and Potassium Oxide Markers

Conclusions: X-Y Scatter Plot for Silica/Alumina and Silica /Potassium Oxide Ratios

- Mount Saint Helens ash is a discrete and significant event resulting in the deposition of a discrete sediment layer within Mica Bay sediments.
- Mount Saint Helens ash forms a discrete layer in Cores 1, 3, 5, 6, and 10, establishing a 1980 time line within the Mica Bay sediments
- Because core depth intervals beneath the Mount Saint Helens ash were deposited during or prior to 1980, these depth intervals cannot be affected by road construction soils and sediments.
- Agricultural soil watershed sources dominate over all other watershed sources in Mount Saint Helens ash.
- With the exception of agricultural soils, all other watershed sources cluster together with other mica-rich core depth intervals.
- Quartz-rich depth intervals from Cores 4, 8, and 9 most strongly reflect sediment transport characteristics within the lacustrine environment, probably contain a high ash content, and do not cluster with any watershed sources.

As described above, silica, alumina, and potassium oxide are major rock-forming elements for quartz, clays, and micas, respectively. In addition to quartz, silica is present in both clays (along with aluminum and other elements) and mica (along with aluminum and other elements). Therefore, by forming a ratio of silica to alumina and a ratio of silica to potassium oxide, quartz increases independently of both clays and mica. In other words, based on surface water transport of quartz, clay, and mica, the soils and sediments can be separated from any of the watershed sources as stream sediment particles into Mica Bay sediment layers. This watershed transported marker is then a mineralogical indicator of watershed sources.

The silica to alumina (SiO_2/Al_2O_3) and silica to potassium oxide (SiO_2/K_2O) ratios are plotted against one another with sample designations in Figure 3-8a and showing just the sample points in Figure 3-8b. Three clusters of sample points exist in the diagram:

- Cluster 1—the mica-rich cluster includes almost all of the watershed samples plus some core depth intervals
- Cluster 2—the clay-rich cluster includes the agricultural soils, Mount Saint Helens ash, several core depth intervals, and crustal average
- Cluster 3—a dispersed quartz-rich cluster that includes only Mica Bay core depth intervals

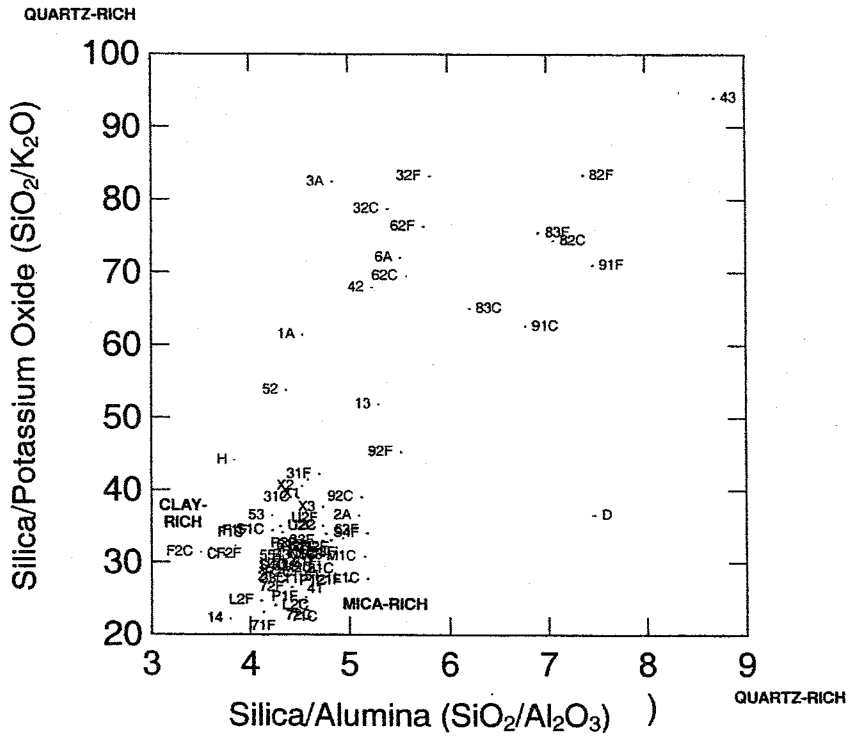


Figure 3-8a. Silica to alumina ratio versus the silica to potassium oxide ratio. These ratios are equivalent to quartz to clay versus quartz to mica.

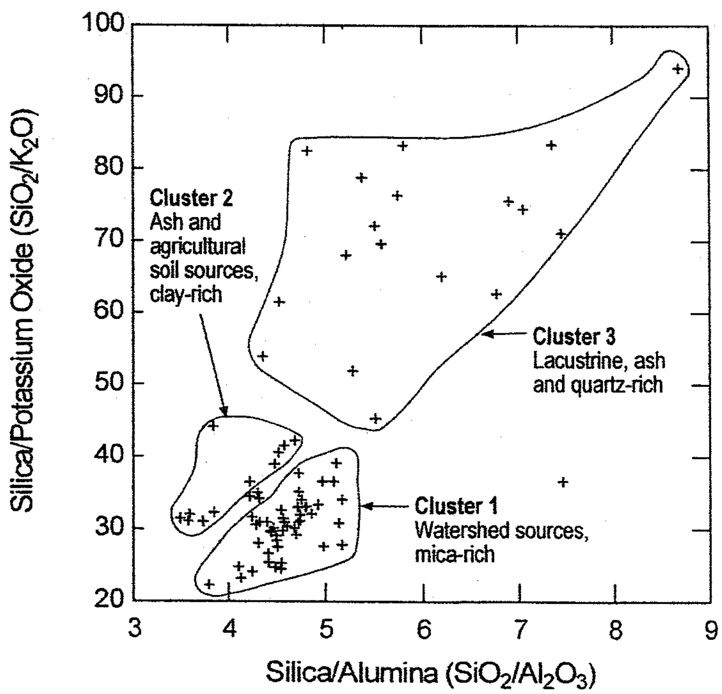


Figure 3-8b. Silica to alumina and silica to potassium ratios for all the data.

Watershed sources and core depth intervals cluster so tightly in Cluster 1 that most are not separable into individual samples. However, the bottom depth interval of Core 1 (14) and the fines (silt plus clay size fraction) of the uppermost depth interval of Core 7 have the highest amount of mica relative to quartz of all other samples within Cluster 1. This suggests that they both have similar watershed sources and were deposited from a similar (but not the same) depositional event. Although this mica-rich Cluster 1 does not discriminate between watershed sources, it certainly distinguishes all except agricultural soils in the watershed sources from several core depth intervals that are not related or have minimal relationships to a specific watershed source. In other words, core depth intervals in Clusters 2 and 3 have minimal to no relationship with individual watershed sources, except agricultural soils in Cluster 2.

The clay-rich Cluster 2 includes not only the most clay-rich watershed material, both the coarse plus fines and the fines samples of both agricultural soils (F1C, F1F, F2C, and F2F) but also Mount Saint Helens ash (H). The Mica Bay watershed soils are quite unique, particularly compared with the geometric mean U.S. Soils ratio (D) (date from Helmke, 2000), which plots separately on the other side of Cluster 1. This suggests that the soils have a significant ash component within their soil watershed-derived particles. Both the coarse plus fine and fines depth interval samples of the upper most layer of Core 3 (31C and 31F), third layer from the surface in Core 5 (53) and both the upper (X1) and middle (X2) layers of Core 10 are included in this cluster. These relationships indicate that these core depth intervals are mainly ash but include a significant component of agricultural soils, but no road construction-related soils or sediment.

Because ash layers represent a time line of 1980, core depth intervals beneath the ash-dominated core depth intervals were deposited in 1980 or earlier. They could not have been affected by road construction soils and sediments. Therefore, all core depth intervals of Core 3, the third through the sixth (bottom) core depth intervals of Core 5 (53, 54, 55, and 56) and all three core depth intervals of Core 10 could not have been affected by road construction soils and sediments.

Three coarse plus fine watershed samples plot between Clusters 1 and 2: upper background South Fork Mica Creek sediment (U2C) and two South Fork Mica Creek sediment samples that are potentially related to road construction (SP1 and SP2). Background South Fork Mica Creek stream sediment U2C was collected upstream of SP1. South Fork sediment sample SP1 is just downstream of the retention pond that breached and SP2 is the next downstream sampling point below SP1. Even though these are the coarse plus fines samples, they may have a sufficient component of Mount Saint Helens ash and soil that separates them from the watershed Cluster 1 and approach the ash-agricultural soil Cluster 2.

The quartz-rich dispersed Cluster 3 represents a lake-related (lacustrine) process of preferentially separating quartz from clay and micas by transportation into the lake water of Mica Bay. Clays would have a tendency to remain in suspension and be transported farther out into the lake (Core 10) unless so mixed with other grain-size particles that it becomes incorporated into the matrix of coarser-grained particles. This tendency is illustrated by the inclusion of depth intervals from Cores 8 and 9 within the cluster. Selected core depth intervals from Core 4 (43), 8 (82C, 82F, 83C, and 83F), and 9 (91C, 92F, and 92F) are quartz-rich—probably from fine-grained quartz winnowed from variable watershed sources transported into the lake from Mica Creek. However, these core depth intervals probably also include variable amounts of Mount Saint Helens ash.

Except for depth intervals from Cores 2, 7, and 10, selected depth intervals from all the other cores occur to the left of Cores 8 and 9 within Cluster 1. With the exception of the second depth interval of Core 4 (42) and third depth interval of Core 5 (53), the depth intervals from Cores 1 (1A and 13), 3 (3A, 32C, and 32F), and 6 (6A, 62C, and 62F) on the left side of Cluster 1 have all the physical characteristics of Mount Saint Helens ash. These relationships suggest that the dispersed group of core depth intervals are a combination of depth intervals dominated by Mount St. Helens ash (left side) and quartz-rich derivatives of watershed sources mixed with variable amounts of Mount Saint Helens ash (right side). These relationships indicate that all the core depth intervals of Core 1 and the second and third (bottom) depth intervals of Core 6 could not be affected by road construction soils and sediments.

In most cases, the coarse plus fines and fines fraction of depth intervals are within the same clusters. When they are separated they separate with the fines fraction being more quartz-rich than the coarse plus fines. This indicates that the finer-grained fraction contains more quartz than the coarse-plus-fines fraction and supports the conclusion stated above that fine-grained quartz is being winnowed from the watershed sources and transported farther into the lake than mica.

3.4.2.3.2 Barium and Zinc Markers

Conclusions: X-Y Scatter Plot for Barium and Zinc

- Elevated barium concentrations represent watershed sources.
- Elevated zinc concentrations represent lake-derived metals.
- Uppermost depth intervals from Cores 1, 2, 4, 5, 6, 8, 9, and 10 are dominated by lake-derived metals with no apparent watershed source input.
- Core depth intervals dominated by lake-derived metals were deposited slowly enough for lake-derived metals to become incorporated within the sediments. Therefore, these depth intervals cannot have been affected by road construction soils and sediments.
- Core depth intervals beneath these uppermost depth intervals are, therefore, not affected by road construction soils and sediments because these sources, if present, would have been deposited within the uppermost core depth interval.
- Barium-zinc relationships in core depth intervals for Cores 1, 3, 4, 8, and 9 confirm the ash layer conclusion in the silica, alumina, and potassium oxide x-y scatter plot analysis. The high zinc uppermost depth intervals from almost all cores as well as the uppermost depth intervals of Core 7 may be related to the 1996 flood.

Barium is commonly present in soils and sediments as barium-sulfate (barite), barium-carbonate (witherite), or generally in much lower concentrations as impurities in micas, feldspars, clays, and other silicate minerals. Barium is very sparingly soluble in any of its naturally occurring mineralogical phases. Crustal abundance is 390 mg/kg (Rudnick and Fountain 1995) and the geometric mean for U.S. soils is 440 mg/kg (Helmke 2000), indicating the tendency for barium to be retained under weathering. Barium in soils and sediments of the Mica Bay watershed are considerably higher than these with an average of 629 mg/kg and a reasonably wide range from 470 to 950 mg/kg. Therefore, barium is an excellent marker to represent watershed sources.

Although zinc is generally considered one of the more soluble metals, it is this characteristic that disperses zinc throughout the Coeur d'Alene Lake waters from up-lake mining sources resulting in enrichment of lake and bay (Mica Bay) sediments down-lake of the mining sources. The crustal abundance for zinc is 73 mg/kg, while the geometric mean for U.S. soils is only 48 mg/kg, indicating that zinc is significantly lost during weathering of a rock to form a soil. However, the five USGS shallow core depths in and near Mica Bay have an average zinc concentration of 4,800 mg/kg and range from 2,200 to 7,100 mg/kg (Horowitz et al. 1993 and 1995). These relationships indicate that zinc is significantly enhanced in lake sediments by a factor of 100 times that of the geometric mean of U.S. Soils. On the other hand, zinc in the watershed sources averages only 85.3 mg/kg, with a range from 63 to 118 mg/kg. The average zinc for the watershed samples is close to the crustal abundance and, because the watershed sources include the soils, zinc is an excellent marker for lake-related elements.

Figure 3-9a is an x-y scatter plot comparing barium with zinc concentrations for all samples. Zinc concentrations overwhelm the barium concentrations at this zinc scale. The watershed samples of both all the watershed and most of the core depth intervals are clustered along the base of the scatter plot. The uppermost depth interval of Core 4 (41) has the highest zinc concentration (4,050 mg/kg) and approaches the average for the five USGS shallow cores (4,800 mg/kg). Nine of the visible samples are uppermost core depth intervals from six of the 10 Mica Bay cores : Core 1 (11), Core 2 (21), Core 5 (51), both coarse plus fines and fines splits of Core 6 (61C and 61F), Core 8 (81C and 81F), and Core 10 (X1). These are the samples most significantly affected by lake-derived metals concentrations. These high zinc concentrations indicate that the sediments deposited in these uppermost depth intervals were exposed to the lake water for a considerable time both prior to and following deposition. Therefore, these depth intervals are not impacted by road construction soils or sediments.

Because the uppermost core depth intervals for Cores 1, 2, 5, 6, 8, and 10 are not affected by road construction soils or sediments, core depth intervals beneath these uppermost depth intervals in these cores cannot be impacted either. Road construction soils and sediments would have been the most recent sediment depositional event and, if present, would be recognizable in the chemistry of the uppermost depth interval.

Figure 3-9b reduces the zinc concentration scale an order of magnitude to 500 mg/kg on the Y-axis. Again, as in Figure 3-9a, all the watershed samples and most of the core depth intervals accumulate at zinc concentrations of less than 120 mg/kg. Four more samples are added to the most heavily lake-derived metals: the third depth interval from Core 1 (13), the second depth interval of Core 5 (52), and the second depth interval of Core 7 (72C and 72F). The third depth interval of Core 1 is the ash layer at that core location. Therefore, these depth intervals are also not impacted by road construction soils or sediments.

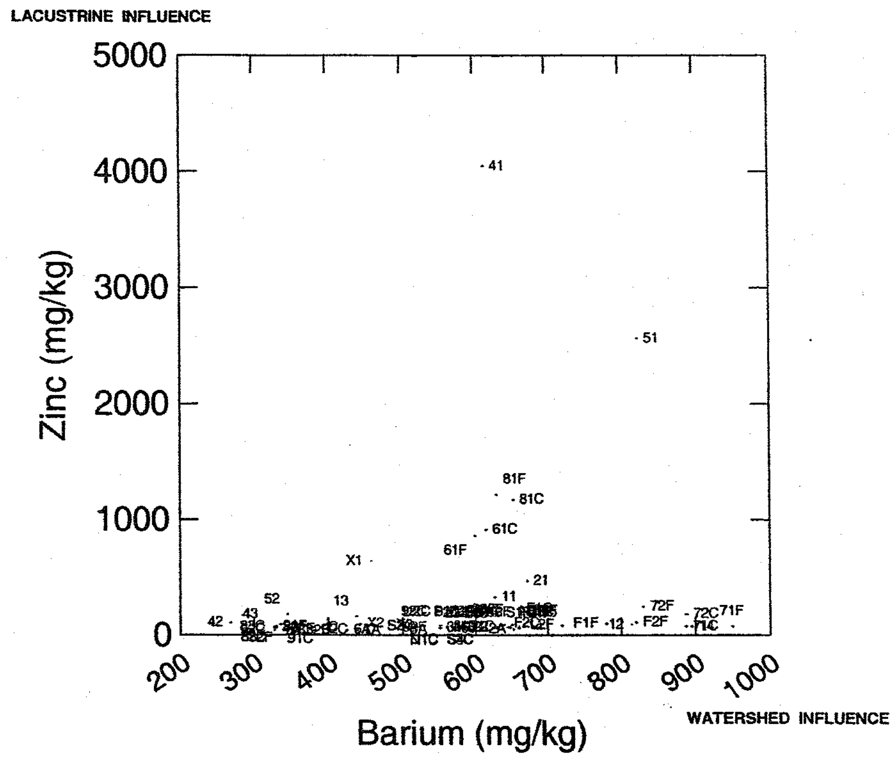


Figure 3-9a. Barium versus zinc for all the data illustrating the strong influence of the lacustrine environment on the upper most depth intervals of the core.

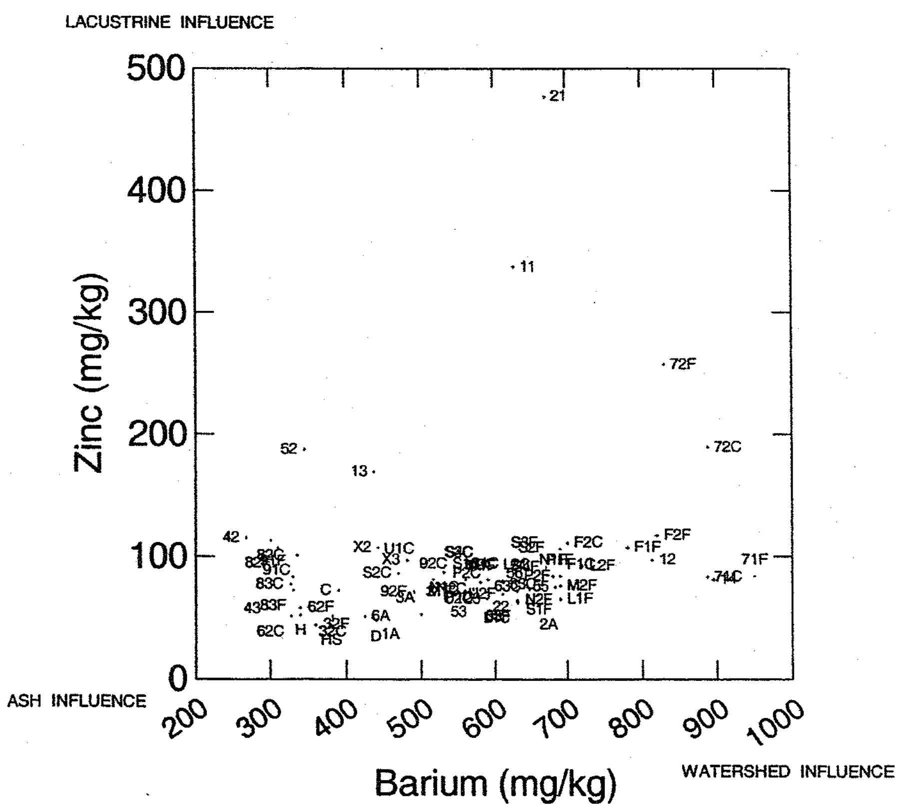


Figure 3-9b. Barium versus zinc after reducing the maximum zinc concentration to 500 mg/kg showing the three-fold influence of Mount Saint Helens ash source, watershed sediment sources and lake sources on Mica Bay core depth intervals.

Zinc is also a good indicator metal to represent cadmium, silver, lead, and antimony in the Mica Bay sediments. Table 3-11 presents a comparison of the average metals concentrations in these high-zinc core depth intervals (above 150 mg/kg) with other metals in both the watershed sources and the lower-zinc concentration core depth intervals (less than 150 mg/kg). The average zinc concentration of the high-zinc group is 12 times the average watershed source zinc concentration and 6.8 times the low-zinc core depth intervals. The average cadmium concentration of the high-zinc group is 90 times the watershed source average and 11 times the lower-zinc core depth interval average. Silver, lead, and antimony have difference factors between those of zinc and cadmium. These relationships indicate that the high-zinc group has been significantly affected by metals derived from the lake water. The high-zinc group of core depth intervals could not have been affected by a recent significant depositional event from the very low zinc (and other metals concentrations) in watershed sources. Therefore, this high-zinc group of core depth intervals could not be affected by road construction soils and sediments.

TABLE 3-11
Metals in Core Depth Intervals Containing Zinc Concentrations Higher than 150 mg/kg

Parameter	Watershed (mg/kg)	Mica Bay Core Depths <150 Zn	Mica Bay Core Depths >150 Zn	Difference Factor Watershed	Difference Factor <150 Zn
Number	31	39	13		
Zinc (Zn)	85.3	148	1006	12	6.8
Cadmium (Cd)	0.13	1.04	11.7	90	11
Silver (Ag)	0.08	0.21	0.57	7.1	2.7
Lead (Pb)	20.1	51.2	204	10	4
Antimony (Sb)	0.31	0.67	2.68	8.6	4

Figures 3-9c and 3-9d reduces the zinc concentration scale to a maximum of 150 mg/kg. All watershed sources and the remaining core depth intervals are now visible. Two groups cluster within this barium-zinc x-y scatter plot: one to the left and somewhat beneath the cluster on the right. Visual inspection and review of watershed data indicates that all watershed sources cluster at barium concentrations equal to or above 470 mg/kg and a zinc concentration of 63 mg/kg. A secondary x-y axis is established within the barium-zinc scatter plot of Figure 3-9d to show where watershed sources begin and extend to higher barium and, to a lesser extent, higher zinc concentrations.

The cluster of core depth intervals to the left and lower than the watershed sources includes the average Mount Saint Helens ash (H) (Sarna-Wojcicki, et al. 1981) and Mount Saint Helens ash deposited in Spokane, Washington (Fruchter et al. 1980). A second x-y axis in Figure 3-9d reflects this ash-dominated source. Crustal abundance and especially U.S. soil concentrations are close to ash concentrations. Core depth intervals that are aligned with the ash axes are dominated by ash. The ash axis for this barium-zinc scatter plot confirms the same core depth intervals that the silica-alumina-potassium oxide scatter plot indicated as ash: core depth intervals from Core 1 (1A equivalent to 13), Core 3 (32 C and 32F), Core 4 (42

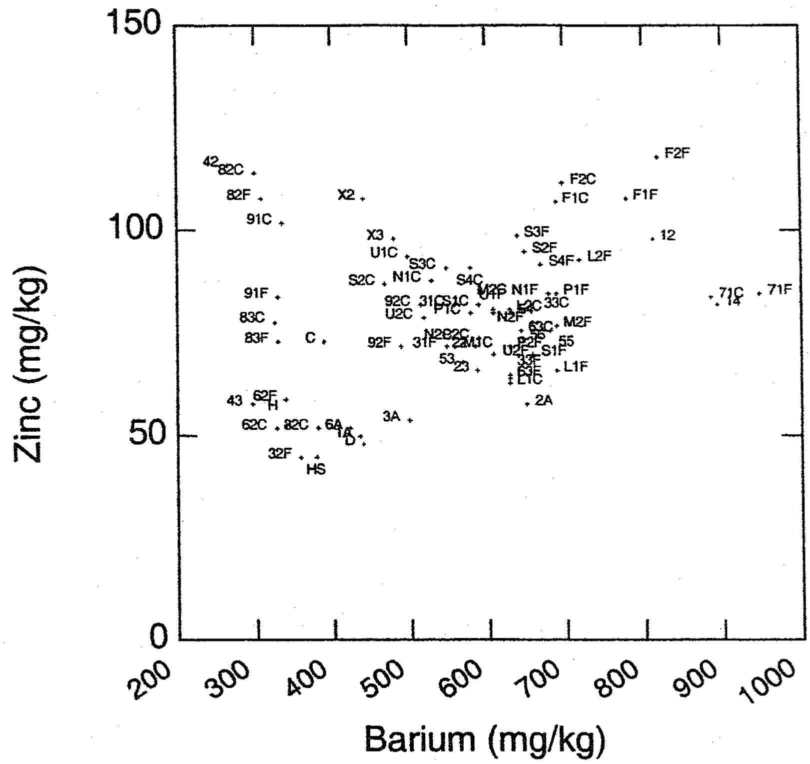


Figure 3-9c. Barium versus zinc with a maximum zinc concentration less than 150 mg/kg to limit the lacustrine source on the Mica Bay core depth intervals thereby showing the relative influence of the Mount Saint Helens ash source and watershed sources on the remaining depth intervals.

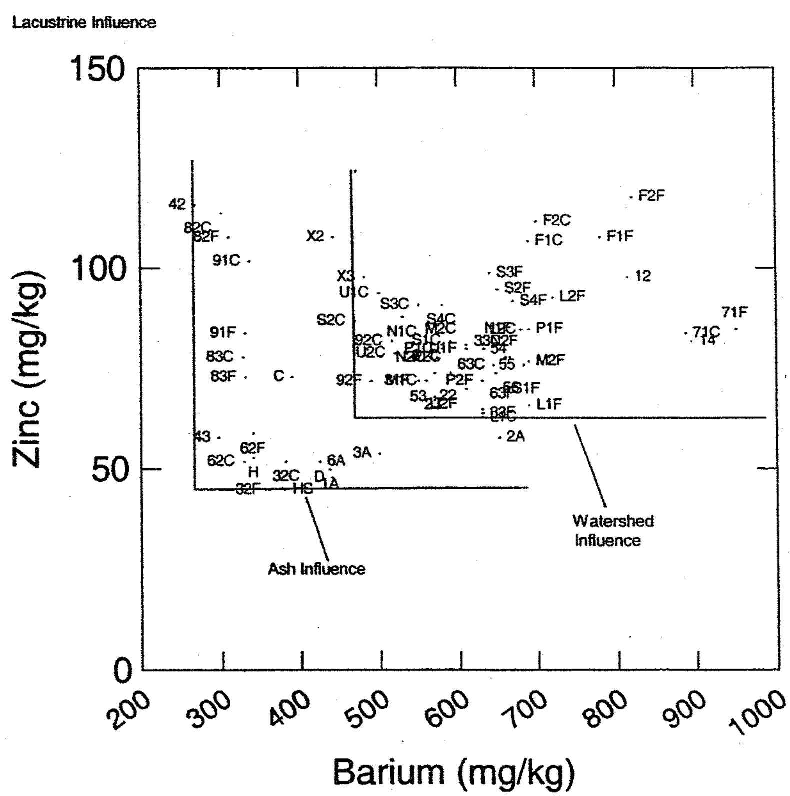


Figure 3-9d. Barium versus zinc concentrations with the maximum zinc concentration at less than 150 mg/kg showing the principle axes for the Mount Saint Helens ash influence versus the principle axes for the watershed sediment influence on the Mica Bay core depth intervals.

and 43), Core 8 (82C, 82F, 83C, and 83F), and Core 9 (91C and 91F). Even though these core depth intervals contain some significant amount of watershed source sediment, these core depth intervals and deeper core depth intervals were deposited in or prior to 1980 and are, therefore, not affected by road construction soils and sediment. For example, even though the third core depth interval for Core 3 (33) and for Core 10 (X3) fall within the watershed barium-zinc axes they are beneath an ash or ash dominant layer.

The uppermost coarse plus fines and fines samples of Core 7 (71C and 71F) contain higher barium concentrations than all the watershed sources. However, they share this distinction with the fourth depth interval of Core 1 (14), which is beneath the 1980 ash layer in Core 1. Therefore, the watershed source(s) and depositional conditions that lead to the deposition of the upper depth interval of Core 7 are essentially the same as those that lead to the deposition of the pre-1980 depth interval in Core 1. Appendix G deals with Core 7 analyses. Suffice it to say that these relationships indicate that the uppermost core depth interval of Core 7 is not affected by road construction soils or sediments. The closest watershed source is the fines fraction of agricultural soil samples A1 and A2 (F1 and F2 in Figure 3-9d).

Combining the high zinc (metals) concentrations in the uppermost depth interval of almost all cores with the coarse-grained high barium concentrations in the uppermost depth interval of Core 7 suggests that these uppermost depth intervals were probably initially deposited as part of and subsequent to the 1996 flood event. The flood affected all tributaries to Coeur d'Alene Lake carrying coarser-grained sediment loads through major flow paths into the bays. The Coeur d'Alene River that carries metals from the mining sites would likely have carried a larger-than-normal load of dissolved metals that dispersed into the lake and then into Mica Bay.

3.4.2.3.3 Cerium Lanthanum X-Y Scatter Plots

Conclusions: X-Y Scatter Plot for Cerium and Lanthanum

- Exceptionally high cerium and lanthanum concentrations represent specific watershed sources. Mount Saint Helens ash contains the lowest cerium and lanthanum concentrations.
- The linear relationship between the cerium and lanthanum concentrations indicates that sediment transport and deposition is a mixing process without a dominance of any individual watershed source.
- Cerium and lanthanum confirm the dominantly Mount Saint Helens ash depth intervals, particularly Core 10, previously identified in the other two scatter plot analyses.
- Mount Saint Helens ash dominates in core depth intervals from Cores 1, 3, 4, 5, 6, 8, 9, and 10.
- Agricultural soils are the dominant watershed source that mixes with the Mount Saint Helens Ash dominant depth intervals.
- Mount Saint Helens ash is a decreasing but significant contributor to the uppermost high-zinc (lake-derived) core depth intervals that intermix with increasing forest watershed sources and decreasing agricultural soils.

- Forest soils are also major contributors to pre-1980 depth intervals.
- The possibility of project-related soils in the shallowest part of the uppermost depth interval is remote because their presence is not supported by the fines fraction of stream sediments that are also potentially project-related.
- Pre-1980 depth intervals are closely associated with watershed stream sediments suggesting that except for the uppermost depth interval of Core 7, the post-1980 sediments deposited in Mica Bay were a mixture of Mount Saint Helens ash, agricultural soils, and forest soils.

Cerium and lanthanum are sparingly soluble, light rare earth elements used worldwide to characterize and document sediment sources in regional studies (Sinha 1983). These elements tend to be retained by source sediments even under significant changes in their mineralogical composition resulting from processes involving significant heat and pressure (metamorphism). The crustal abundance of cerium and lanthanum is 42 and 18 mg/kg, respectively (Rudnick and Fountain 1995). Their respective geometric mean concentrations in U.S. soils are 63 and 48 mg/kg (Helmke 2000), reflecting their retention in soil particles as rock is transformed into soils (weathering).

The average concentrations of cerium and lanthanum in the watershed sources are 150 and 78.4 mg/kg, respectively. These concentrations are significantly higher than either crustal abundance and U.S. soils concentrations. In fact, the upper background North Fork sediment (N1) is higher than the upper laboratory detection limit of 500 mg/kg and, therefore, neither are quantified nor included in the cerium-lanthanum x-y scatter plot. Core depth intervals likewise have a significantly elevated average cerium concentration of 90.8 mg/kg, but an average lanthanum concentration of 46.1 mg/kg that is very close to that of U.S. soils. Therefore, cerium and lanthanum averages indicate that a significant dilution occurs between the watershed sources and the sediments in Mica Bay.

Figure 3-10a is a cerium-lanthanum x-y scatter plot that includes all the quantified data. A strong linear relationship exists between the two rare earths, but some scatter exists along the linear trend and four samples have very high cerium and lanthanum concentrations. Coarse plus fine upper background North Fork (N2C), upper background South Fork (U2C) and downstream South Fork stream sediment SP2 (S2C), and Mainstem Mica Creek (M2C) have cerium concentrations higher than 200 mg/kg and lanthanum concentrations higher than 100 mg/kg. Most of the remaining data are compressed below these respective concentrations.

The strongly linear association between the cerium and lanthanum concentrations is better shown in Figure 3-10b where the labeling for each sample has been eliminated. The close fit of almost all points to the linear square fit line indicates that there is a regular progression of all samples from watershed sources to bay sediments. This fit indicates that no extraneous sources or physicochemical processes affect either one watershed or core-depth interval from any other in the Mica Bay drainage.

Figure 3-10c reduces the maximum cerium and lanthanum concentrations to 200 and 100 mg/kg, respectively, halving the maximum respective concentrations in Figures 3-10a and 3-10b. Labels on most of the points are now largely visible. The two points that indicate

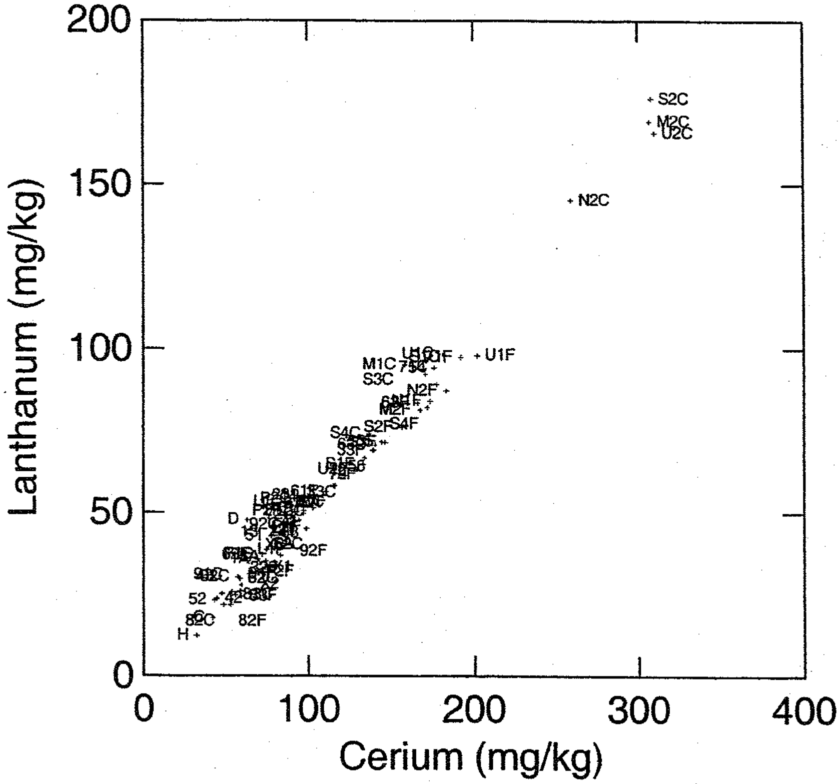


Figure 3-10a . Cerium versus lanthanum for all of the data within the upper limits of detection. This excludes only the watershed upper North Fork sediment sample that contained both cerium and lanthanum concentrations higher than 500 mg/kg..

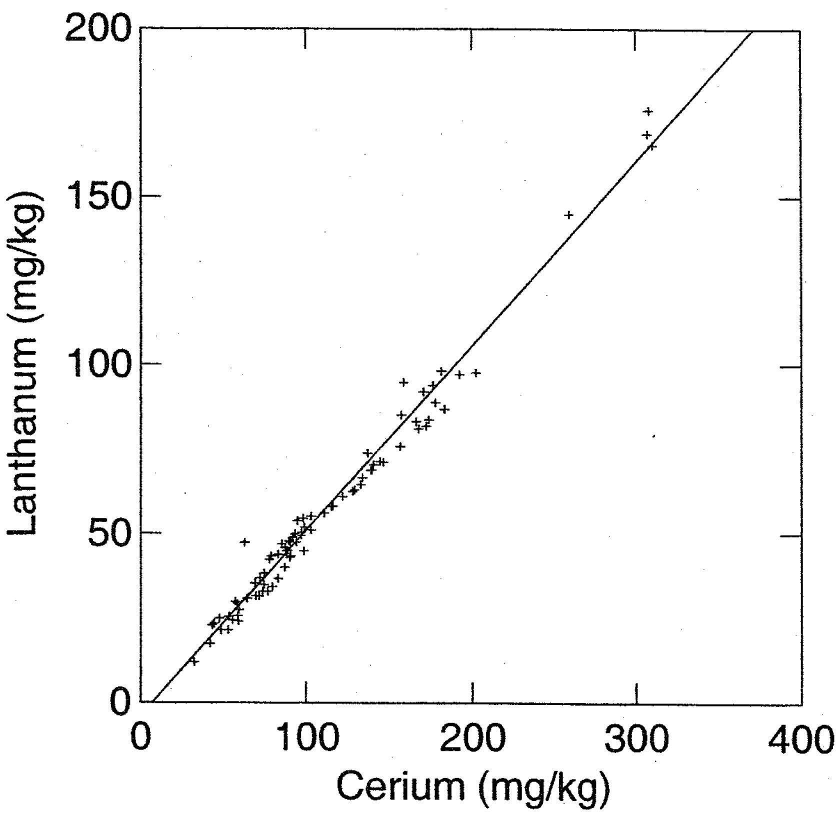


Figure 3-10b. Cerium versus lanthanum for all quantified samples with its linear least square fit line.

higher lanthanum or lower cerium are the Main Stem Mica Creek soil M1C and the geometric mean of U.S. soils (D). Figure 3-10d shows that the linearity of the cerium and lanthanum relationship continues unabated through even the lowest concentrations. However, there is a broadening of the relationship at and below approximately 100 mg/kg cerium and 60 mg/kg lanthanum that suggests that mixing between two major sources occurs below these concentrations.

Figure 3-10e reduces the maximum concentrations of cerium to 120 mg/kg and lanthanum to 60 mg/kg lanthanum to investigate this potential mixing. The suite of sample points within this cerium and lanthanum range is the mixing zone between watershed sources and Mount Saint Helens ash. Ash dominates all core depth intervals with cerium concentrations less than approximately 80 mg/kg and lanthanum concentrations less than approximately 40 mg/kg. The dominance of ash in depth intervals from Cores 1 (1A and 13), 3 (3A, 32C, and 32F), 4 (42 and 43), 5 (52), 6 (6A, 62C, and 62F), 8 (82C, 82F, 83C, and 83F), 9 (91C and 91F), and 10 (X1, X2, and X3) supports the previous conclusions in the silica-alumina-potassium and barium-zinc x-y scatter plot analysis that these core depth intervals are dominantly ash.

Three core depth intervals from Core 10 group closely with one another rather than being spread out as they are by the lake-derived zinc in the barium-zinc analysis and to a lesser extent as they are by transport in the silica-alumina-potassium oxide scatter plot. The cerium-lanthanum scatter plot clearly shows that these three core depth intervals are deposited from a single dominant source and that source is ash. Furthermore, as concluded in the silica-alumina-potassium oxide analysis, agricultural soils (F1C, F1F, and F2C) are by far the dominant watershed sources mixing with the Mount Saint Helens ash in all these ash dominant depth intervals. The only other watershed source that approaches this mixture is the fine-grained project-related soil P1F that is also a forest soil. Forest soils increase as a contributor of sediments in the uppermost high zinc depth intervals.

As in the other scatter plot analyses, the ash-dominant depth intervals indicate that the sediments were deposited in 1980 or shortly thereafter. Core depth intervals beneath these ash-dominant depth intervals were, therefore, deposited either in or prior to 1980. The ash-dominant core depth intervals and those depth intervals beneath them cannot have been impacted by road construction soils and sediments.

Above this Mount Saint Helens ash dominant group, the ash content and agricultural soil contributions decrease but are still significant to a cerium concentration of approximately 120 mg/kg and lanthanum concentration of approximately 60 mg/kg. The core depth intervals in this decreasing ash/agricultural soil content suite include the uppermost depth intervals of the high zinc group identified in the above barium-zinc scatter plot analysis. This suite apparently mixes with project-related soils (P1 and P2) and forest soils (L1 and L2). However, this decreasing ash content suite also includes pre-1980 depth intervals from Cores 1, 5, and 9 as well as the coarse-plus-fine lower-depth-interval from Core 7.

The mixing between ash and forest soils in the high-zinc uppermost depth intervals is explainable from the logging that has occurred from the 1990s (and prior years) to the present. Project-related soil P1 is also a forest soil. The inclusion of pre-1980 depth intervals would further support forest soils as a probable source. The possibility that an insignificant, but perhaps detectable, amount of project-related soil may also be included in the

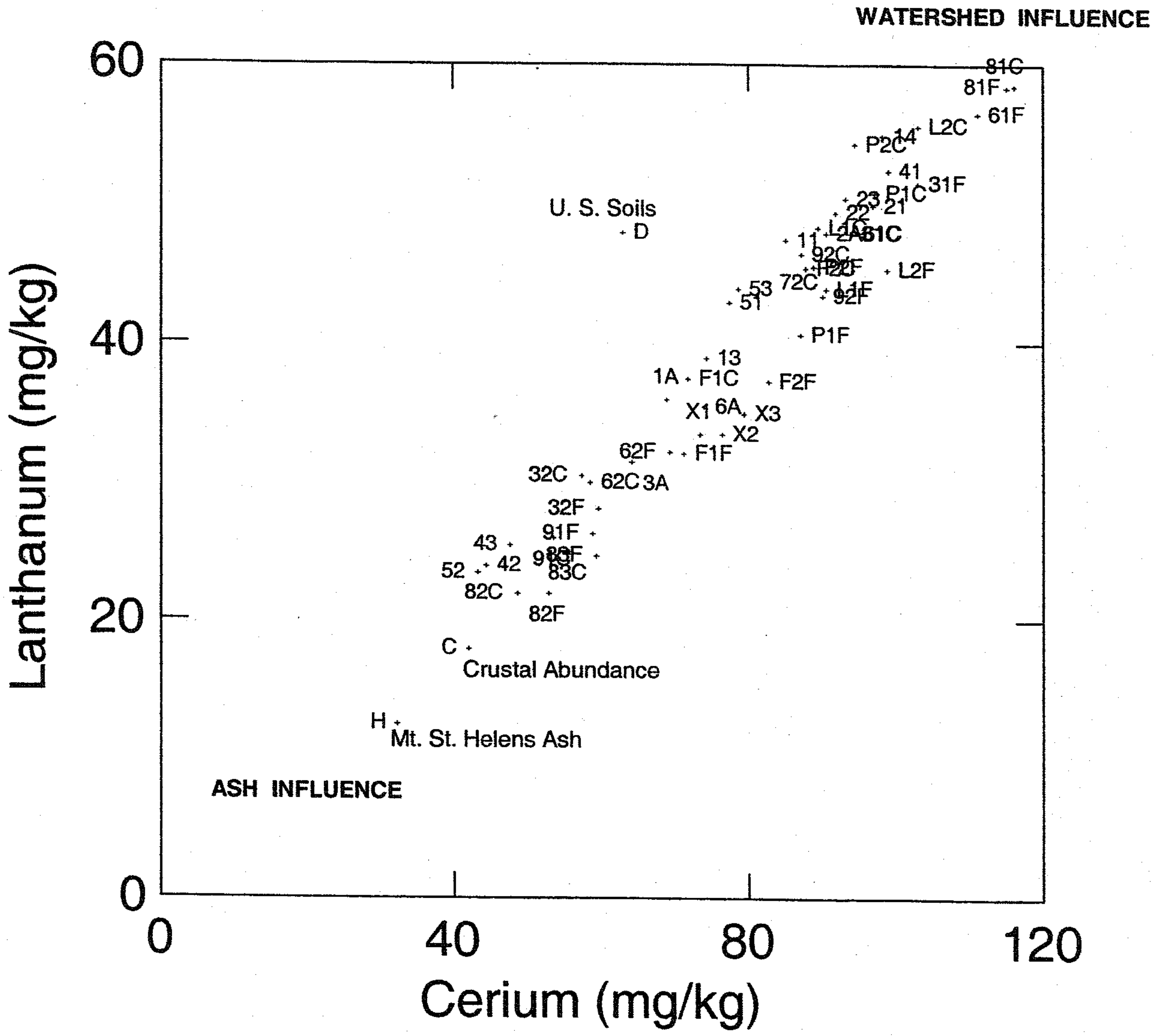


Figure 3-10e. Cerium versus lanthanum for cerium concentration less than 120 mg/kg and lanthanum concentrations less than 60 mg/kg.

shallowest part of these upper depth intervals has to be considered. This possibility would be likely if this decreasing ash group included the fines (or certainly coarse plus fines) fraction from either the lower South Fork stream sediments SP1, SP2, SP3, and/or SP4 or even from the mainstem South Fork stream sediments (M1 and M2). The absence of these or any other fines fraction watershed sources makes the possibility of road construction soils remote. The presence of wood debris in the uppermost depth interval of Cores 1, 2, 3, 6, and 7 as well as pre-1980 depth intervals support the forest soil contribution to this decreasing ash/agricultural soil content group.

The depth intervals above a cerium concentration of approximately 100 mg/kg and a lanthanum concentration of approximately 60 mg/kg (Figure 3-10c) include only pre-1980 depth intervals, the uppermost coarse plus fines and fines fractions of Core 7, and the fines fraction of the lower depth interval of Core 7. These pre-1980 depth intervals are associated with the majority of the watershed sources and specifically stream sediment sources. These relationships suggest that, with the exception of the upper depth interval of Core 7, sediment supplied to Mica Bay has been dominated by agricultural and forest soils since approximately 1980. Core 7 is the subject of the next section but the uppermost depth interval sediments in Core 7 were likely deposited as a result of the 1996 flood.

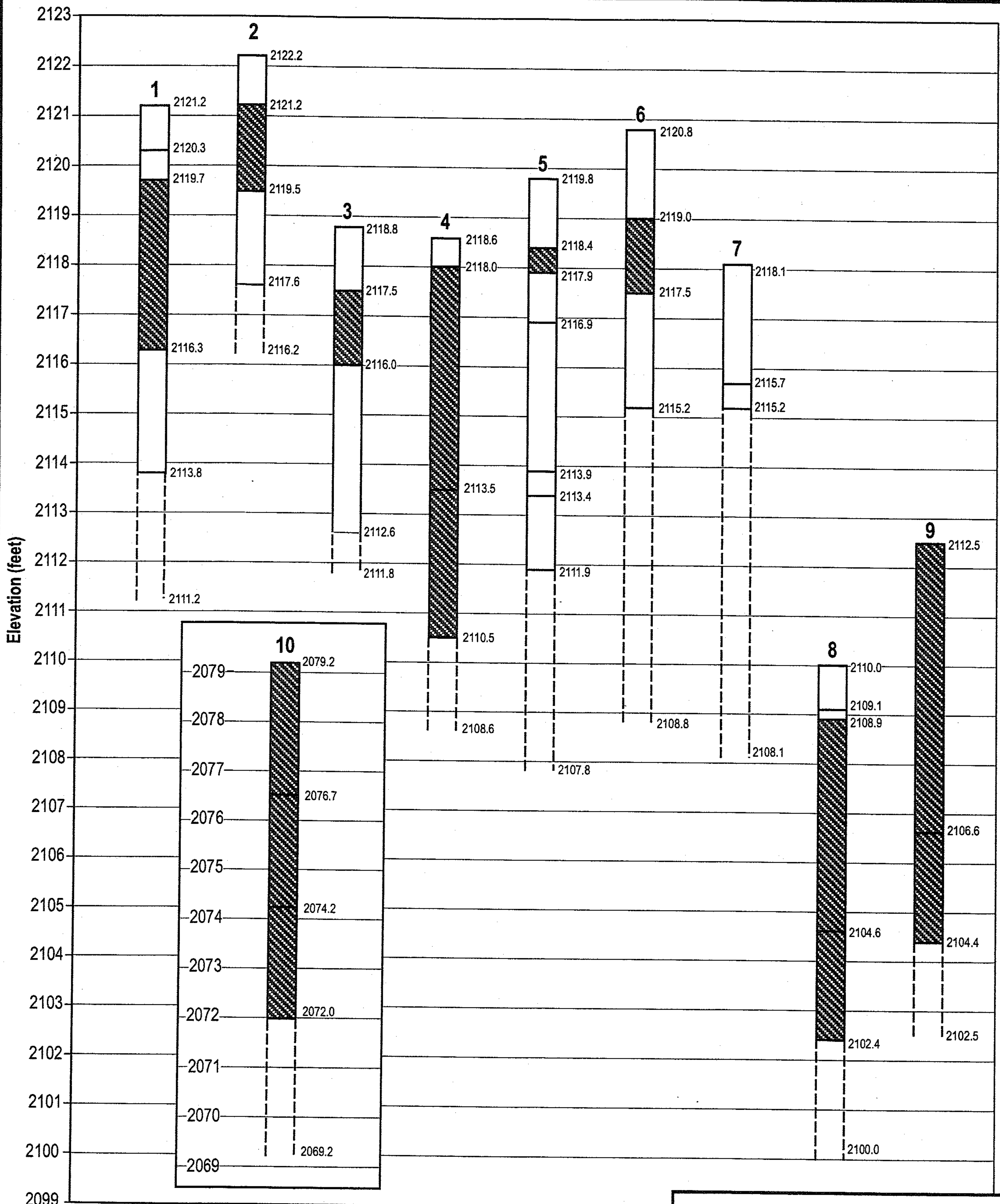
3.4.2.4 Core Depth Intervals Above the 1980 Ash Dominant Layer

Figure 3-11 illustrates the core depth intervals where Mount Saint Helens ash was detected based on the above analyses. There are 10 core depth intervals at eight core locations that are above the ash-dominant core depth interval:

- Core 1: 0 to 10 inches and 10 to 18 inches
- Core 2: 0 to 12.5 inches
- Core 3: 0 to 16 inches
- Core 4: 0 to 8 inches
- Core 5: 0 to 16 inches
- Core 6: 0 to 22 inches
- Core 7: 0 to 29 inches and 29 to 35 inches
- Core 8: 0 to 11 inches

These eight core locations have a post 1980 mean sediment thickness of 17.3 inches with a standard deviation of 8.4 inches. Their physical and chemical characteristics were highly variable. Grain-sizes included dominantly coarse-grained (less than or equal to 5 percent minus 230-mesh) in depth intervals from Cores 1 and 7 as well as dominantly fine-grained (greater than 65 percent minus 230-mesh) in depth intervals from cores 2, 3, 5, and 6. They include the depth intervals with very high and very low metals concentrations. For example, zinc concentrations ranged from as low as 82 mg/kg in Core 1 (0 to 18 inches) to 4,050 mg/kg in Core 4 (0 to 8 inches). These relationships indicate that these sediments represent complex variable depositional characteristics over the 22 years since the deposition of the Mount Saint Helens ash rather than one single very recent depositional event.

Pg 3-38 Vol 1 Nov 2003



Notes:

1. Solid lines represent visible changes identified in recovered core sediments.
2. Dashed lines indicate penetration depth.
3. Elevations are based on the Mica Bay datum (see Chapter 2).

Legend:

Ash

FIGURE 3-11
Mica Bay Core Depth Intervals Containing Mount Saint Helens Ash
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

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Using the mean sediment thickness of 17.3 inches overlying the Mount Saint Helens ash depth interval, and given the 22 years believed to be represented by this sediment thickness, the overall average depositional rate within the Mica Bay deltaic sediments is about 0.8 inch per year. If the sediment thickness is calculated from the bottom of the depth intervals containing Mount Saint Helens ash, then the average depositional rate is 2.4 inches per year. The later depositional rate of 2.4 inches per year may be an overestimate because much of the thickness associated with the ash-dominated depth intervals may have developed over a short time period when large amounts of ash, shortly after the Mount Saint Helens eruption, became fully saturated and sank relatively rapidly. In addition, it should be noted that the longest core depth intervals (up to 6 feet in Core 9) in which ash appears to be present (based on chemistry) have significant amounts of aquatic vegetation (up to 50 percent); therefore, as much as 50 percent of the thickness in the relatively long depth intervals in Cores 4, 8, and 9 is composed of vegetation. This results in a higher computed depositional rate than if only the sediment accumulation were considered. If these three cores are excluded from the later computation, the resulting average sedimentation rate equals 1.7 inches per year (rather than 2.4 inches per year). In any case, the highly variable physical and chemical characteristics of the sediments indicate a complex history of both episodic and continuous depositional rates, varying with time and location within the bay. Even the shallow depth intervals exhibit this complexity.

3.4.3 Metals Characterization of the Mica Bay Cores

Concentrations of cadmium, chromium, copper, nickel, lead, and zinc within the Mica Bay core depth intervals are listed in Table 3-12. Concentrations shaded in Table 3-13 are equal to or exceed a conservative, lower-threshold concentration that might be associated with an adverse biological affect. These conservative threshold values are from the National Oceanic and Atmospheric Administration (NOAA) *Screening Quick Reference Tables* (Buchman, 1999). The NOAA values do not represent established sediment quality criteria, nor do they necessarily predict toxicity (Buchman, 1999). They are intended for screening purposes only (Buchman, 1999).

As shown in Table 3-12, many of the Mica Bay core depth intervals have concentrations of cadmium, copper, nickel, lead, and zinc that equal or exceed the conservative NOAA screening levels. None of the depth intervals have concentrations of chromium that exceed the conservative NOAA screening level; although, all but two depth intervals in Core 4 exceed background concentrations listed for chromium in the NOAA screening table for freshwater sediment. Of the six metals listed in Table 3-12, high lead and zinc concentrations are the most prevalent. Sixteen of the 32 depth intervals exceed the NOAA concentration for zinc. Twenty-three of the 32 depth intervals exceed the NOAA concentration for lead. The cumulative metals concentration by depth interval reveals the highest metal concentrations are located in the uppermost depth interval of every core except Core 7. Core 7 is located in the active channel across the delta and therefore is subject to more recent sedimentation in addition to cycles of scour and deposition. Enriched concentrations of cadmium, lead, and zinc in Coeur d'Alene Lake sediments have been well documented by the USGS (Woods and Beckwith, 1997). The Mica Bay cores contain high enough concentrations of cadmium, lead, and zinc, such that if disposal requirements of the sediment were required, a metals toxicity leachate test would be advisable to determine whether or not they exhibit characteristics of toxicity that require hazardous waste disposal.

TABLE 3-12
Metals Concentrations in Mica Bay Core Sediments Compared to NOAA Screening Concentrations for Freshwater Sediment[a]

Core Number	Top of Depth Interval (inch)	Bottom of Depth Interval (inch)	Cd ppm	Cr ppm	Cu ppm	Ni ppm	Pb ppm	Zn ppm
1	0	10	2.28	28	28.2	19.0	40.0	338
	10	18	0.30	31	20.4	19.0	20.0	98
	18	58.5	1.92	27	27.8	24.0	66.5	170
	58.5	88.5	0.14	32	23.4	26.4	18.5	82
2	0	12.5	3.80	31	33.6	22.2	125.5	478
	12.5	33.5	0.04	29	27.0	20.4	18.5	72
	33.5	56	0.06	31	28.6	19.2	16.0	66
3	0	16	0.06	28	29.0	22.0	18.5	82
	16	34	0.04	22	26.0	21.0	14.0	52
	34	75	0.10	31	25.2	22.6	14.5	78
4	0	8	52.8	30	48.9	24.8	440.0	4050
	8	61	1.08	12	27.4	16.4	21.5	116
	61	97	0.16	13	23.0	16.0	10.0	58
5	0	16	29.8	28	40.6	23.0	271.0	2570
	16	23	1.90	15	25.6	17.8	98.0	188
	23	34.5	0.20	26	28.8	21.0	16.0	68
	34.5	71	0.14	33	24.4	23.0	14.5	80
	71	77	0.10	31	22.8	22.8	15.0	76
	77	95	0.08	29	21.0	21.2	14.0	74
6	0	22	12.15	27	32.2	21.4	102.5	920
	22	39.5	0.20	20	21.6	17.4	16.5	52
	39.5	67.5	0.14	35	23.6	23.2	13.5	76
7	0	29	0.22	33	17.0	20.6	19.0	84
	29	35	1.20	27	19.4	19.6	29.0	190
8	0	11	14.15	31	37.6	22.0	305.0	1180
	13	65	0.60	15	24.0	18.2	28.0	114
	65	91	0.24	16	26.4	19.6	15.0	78
9	0	71.5	0.54	15	23.2	17.8	26.0	102
	71.5	97.5	0.16	25	29.4	21.4	15.0	82
10	0	30	4.14	23	41.4	24.8	712.0	648
	30	60	0.36	22	34.8	24.2	30.5	108
	60	85	0.22	25	37.4	26.0	22.5	98
NOAA Freshwater Sediment Conc.:			0.583	36.3	28.0	19.5	37.0	98.0

[a]Shaded cells indicate equal to or exceedance of the NOAA Screening Quick Reference Table concentrations for the "Lowest Assessment and Remediation of Contaminated Sediments *H. azteca* Thresholds Effects Level."

Reference:
National Oceanic and Atmospheric Administration (NOAA) Screeing Quick Reference Table. *HAZMAT Report 99-1.*

3.4.4 Nutrients and Total Organic Carbon (TOC)

Based on an analysis of the data with regard to nutrients and TOC described below, the following conclusions are drawn:

- Nitrogen dominated the nutrients within the Mica Bay core depth intervals.
- Organic nitrogen dominated the Mica Bay depth interval nutrients.
- Phosphorus was contributed by the watershed soils and sediments, but less than 5 percent of the total phosphorus is available.
- Nitrogen was dominantly contributed by an anthropogenic source unrelated to watershed soils and sediments.
- Analytical values for TOC includes both aquatic vegetation and microbes in the Mica Bay sediments. Wood fragments/debris and the larger aquatic vegetation were sieved out.
- Although not included in the TOC concentration, wood fragments are variably abundant in discrete Mica Bay depth intervals both above and below ash dominant depth intervals.

3.4.4.1 Nutrient Forms, Averages and Analytical Methods

Nutrients include both phosphorus and nitrogen species and TOC as listed in Table 3-13. The nutrient and TOC concentrations were determined on a dried and variably digested minus 2-millimeter fraction of each sample.

TABLE 3-13
Average Nutrient Concentrations in the Mica Bay Cores and Watershed Samples

Parameters	Watershed Sediments and Soils	Mica Bay Sediments
Available phosphorus (mg/kg)	53	11
Total phosphorus (TP) (mg/kg)	1,120	613
Nitrate nitrogen (NO_3N) (mg/kg)	1.0	1.1
Ammonia nitrogen (NH_3N) (mg/kg)	1.0	114
Organic nitrogen (mg/kg)	3.0	2,450
Total nitrogen (TN) (mg/kg)	5.0	2,565
Total organic carbon (TOC) (%)	0.65	3.26

Phosphorus

The laboratory determined available phosphorus data using an analytical method designed to represent and typify the amount of phosphorus, including organic phosphorus, available

P 3-41

to plants for a 1-year growing season. Total phosphorus is calculated from the XRF determination (P_2O_5) and includes the sum of all phosphorus forms present in the sample.

Nitrogen and Total Organic Carbon

Nitrate nitrogen is the oxidized form of nitrogen and ammonia nitrogen is the reduced form of nitrogen. The organic form of nitrogen is calculated by subtracting the ammonia from the total Kjeldahl Nitrogen (TKN) and dominantly represents amino-group organic compounds generated by microbial activity. Total nitrogen is the sum of nitrate, ammonia and organic nitrogen concentrations. The nutrient concentrations are expressed as mg/kg while total organic carbon (TOC) concentrations are expressed as percentages.

TOC and nitrogen species are generally associated with the silt/clay fraction of sediments while phosphorus species are generally associated with coarser-grained sand and gravel. From the lithological descriptions of the core sediments, TOC and nitrogen would be expected to be very high in core depth intervals containing large percentages of vegetative debris. However, the analyzed samples were sieved to minus 2 millimeters prior to their digestion and analysis at the laboratory. As a result, most of the vegetative debris and essentially all of the relatively abundant timber fragments in several depth intervals of the core sediments were removed and may have resulted in lower TOC and nitrogen concentrations than if all organic material had remained in the sample.

Timber fragments included broken twigs, bark, and irregular chips/pieces suggesting sediment contribution from the logged areas. This woody debris was particularly abundant in the shallowest depth intervals (less than 24 inches) of cores 1, 2, 3, 6, 7, and 8. There was a discrete 2-inch layer of mostly bark fragments at 10- to 12-inch depth in Core 8 while woody debris was variably distributed in the other shallow core locations. Woody debris was variably present but in much lesser amounts to depths of about 35 inches in cores 2, 7, and 8. Twigs and other woody fragments were present in Core 5 between depths of 37 and 71 inches as well as in two discrete layers in Core 6 between depths of 50 and 67.2 inches. No woody debris was identified in cores 4, 9 or 10.

3.4.4.2 Total Phosphorus

Total phosphorus was higher in the sediment and soil samples than in the Mica Bay core sediments. Because the total phosphorus correlates with the coarser-grained sediments (minus 10 to plus 35 mesh [Table 3-4]), and less than 5 percent of the total phosphorus is available phosphorus, most of the total phosphorus is tied up in relatively insoluble minerals (apatites and probably rare earth phosphates). Total phosphorus was highest in the South Fork Mica Creek stream sediment sample and background North and South Fork Mica Creek stream sediment samples with an average of 1,360 mg/kg. The rare earth elements were also highest in the background North and South Fork stream sediment samples.

In addition to the rare earth element phosphates in the background North and South Fork Mica Creek stream sediment samples, Mount Saint Helens ash contains 1,620 mg/kg phosphorus. As described in previous text on major and trace element chemistry, Mount Saint Helens ash has had a strong influence on the sediments in the Mica Bay drainage area.

The two background stream sediment samples from upper South Fork contained 2,050 and 873 mg/kg total phosphorus while the two background stream sediment samples from the

North Fork contained 1,528 and 1,004 mg/kg. As expected from the background total phosphorus, the South Fork Mica Creek stream sediment samples contained 830 (SP1) to 1,920 mg/kg total phosphorus. The two road construction soil samples contained total phosphorus concentrations of 567 and 742 mg/kg.

Mica Bay core sediments have an average of 613 mg/kg total phosphorus, ranging from 349 (bottom depth interval from Core 4) to 1,620 mg/kg. The vegetation-rich 16- to 23-inch depth interval from Core 5 contained almost exactly the same total phosphorus (1,620 mg/kg) as the Mount Saint Helens, ash confirming that this depth interval is mostly composed of Mount Saint Helens ash. The next highest total phosphorus concentration was 961 mg/kg in the vegetation-rich middle depth interval of Core 4. The third highest total phosphorus concentration was 830 mg/kg in the upper coarse-grained depth interval from Core 7. Depth intervals in Core 7 were generally coarser-grained than other cores and did not contain any visible vegetation with the exception of one 22-inch-long twig. This depth interval was sprinkled with dark (black) mineral particles that may well be rare earth heavy minerals containing elevated amounts of phosphorus.

Total phosphorus concentrations in samples from the Mica Bay area suggest that rare earth minerals in the background stream sediments, highly supplemented by Mount Saint Helens ash, are the probable sources of phosphorus in the Mica Bay core sediments.

3.4.4.3 Available Phosphorus

Available phosphorus is generally the limiting factor to aquatic organic life in lacustrine environments. Given the relatively high total phosphorus in the Mica Bay drainage basin, the available phosphorus might be expected to also be relatively high. However, on average, less than 5 percent of the total phosphorus in the stream sediment and soil samples was available phosphorus. Furthermore, less than 2 percent of the total phosphorus in the Mica Bay sediment cores was available phosphorus. These low available percentages support a minimally soluble phosphate mineralogy source.

Available phosphorus ranged from 7.7 (upper main stem Mica Creek, M1) to 287 mg/kg (southern road construction sample, P2). Available phosphorus in the road construction site material averaged 177 mg/kg available phosphorus followed by forest and agricultural soils averaging 92 mg/kg and ranging from 8.7 to 215 mg/kg. South Fork Mica Creek stream sediments ranged from 10 to 20 mg/kg.

Available phosphorus in the Mica Bay core sediments ranged from 1.0 (bottom depth interval of Core 10) to 34 mg/kg (23- to 34-inch depth interval in Core 5). Available phosphorus had a poor correlation coefficient to total phosphorus (correlation coefficient of only 0.14). Therefore, even though total phosphorus is highly elevated, the amount of available phosphorus is relatively limited in Mica Bay core sediments.

3.4.4.4 Total Nitrogen

In sharp contrast to total phosphorus, total nitrogen was relatively limited in the watershed sources. Agricultural soils had the highest total nitrogen concentration containing 10 and 11 mg/kg. Forest soils and sediments contained concentrations of total nitrogen concentrations of 4.9 and 9.1 mg/kg. Road construction samples contained 7.4 and 9.0 mg/kg total nitrogen. Upper background stream sediment from the South and North

Forks Mica Creek, South Fork Mica Creek stream sediments, and main stem Mica Creek stream sediments contained total nitrogen concentrations ranging from only 1.8 to 3.4 mg/kg.

Total nitrogen was considerably elevated in the Mica Bay sediments with an average of 2,560 mg/kg. The vegetation-rich 16- to 23-inch depth interval from Core 5 contained 1.17 percent (11,700 mg/kg), and the similarly vegetation-rich middle depth interval from Core 4 contained 1.05 percent total nitrogen (10,500 mg/kg). The remaining majority of the Mica Bay sediments, however, also contained elevated total nitrogen. Total nitrogen in the majority of the core sediments ranged from 200 mg/kg (both depth intervals from Core 7) to 5,000 mg/kg in the 13- to 65-inch depth interval from Core 8.

According to Woods and Beckwith (1997) Coeur d'Alene Lake sediments retain a large percentage of influent phosphorus but only a small percentage of influent nitrogen. The elevated total nitrogen concentrations in the Mica Bay core sediments, therefore, indicate that there is a source of total nitrogen to the bay sediments—much to most of which probably comes from anthropogenic sources other than the watershed stream sediments and soils. The most obvious probable anthropogenic source is septic systems. The total nitrogen concentration were comprised mostly of organic nitrogen with much lesser amounts of ammonium nitrogen and particularly low nitrate nitrogen concentrations.

3.4.4.5 Nitrate Nitrogen

Nitrate (NO_3-) nitrogen had a relatively low concentration in all samples from the Mica Bay watershed. South Fork Mica Creek and North Fork Mica Creek stream sediments averaged only 0.4 mg/kg nitrate nitrogen. Forest and agricultural soils and the road construction sediment samples had the higher average concentrations of 2.0 and 2.5 mg/kg. However, the southern road construction sample (P2) (with a concentration of 4.29 mg/kg) had the highest nitrate nitrogen concentration of the watershed sources.

Similarly, nitrate nitrogen concentrations were relatively limited in the Mica Bay core sediments with only a slightly higher average (1.1 mg/kg) than the watershed sources. However, considering that the sediments are under a lacustrine environment which is usually a reducing redox environment, there are depth intervals in the various cores that contained nitrate concentrations similar to the watershed samples. Mica Bay sediments ranged from non-detect (less than 0.4 mg/kg) to 4.6 mg/kg (middle section of Core 4). Nine of the 32 depth intervals from various cores had concentrations less than 0.4 mg/kg.

Although the highest nitrate concentration is in the vegetation-rich Core 4, the similarly vegetation-rich 16- to 23-inch depth interval from Core 5 contained less than 0.4 mg/kg nitrate nitrogen. These differences are probably related to redox conditions of the depth intervals. The Core 5 depth interval is probably less oxidized than the Core 4 depth interval.

3.4.4.6 Ammonia Nitrogen

Ammonia nitrogen (NH_3) is probably present in the form of ammonium (NH_4^+) ion in the sediments. Ammonium typically replaces other ions in exchangeable positions on finer-grained sediments, particularly clays. The ammonia nitrogen concentrations had a significant correlation with the minus 230-mesh material supporting this probable exchangeable position.

As expected from the oxidized watershed environment, ammonia nitrogen was present at low concentrations in the stream sediment, soils, and road construction samples. Ammonia ranges from 0.3 mg/kg (upper South Fork Mica Creek stream sediment, SP1) to 1.9 mg/kg (agricultural soil, A1). Ammonia nitrogen averages about 1 mg/kg in the South and North Fork Mica Creek stream sediments and road construction sediments and averages only 1.4 mg/kg in the forest and agricultural soils.

The Mica Bay core sediments have a much higher ammonia nitrogen concentration with an average of 114 mg/kg, almost two orders of magnitude higher than stream sediments and watershed soils. Ammonia nitrogen ranges from 5.0 (top depth interval from Core 7) to 432 mg/kg (bottom depth interval from Core 8). Depth intervals with ammonia nitrogen concentrations over 100 mg/kg include Cores 4, 5, 6, 8, 9, and 10. In other words, higher ammonia nitrogen concentrations occurred in core depth intervals located with increasing distance into the lake from Mica Creek. The farthest core from Mica Creek is Core 10 with ammonia nitrogen concentrations ranging between 132 to 180 mg/kg. These relationships indicate and support the conclusion that most of the nitrogen originates within Mica Bay and near-bay shoreline. Unlike the organic nitrogen, the ammonia nitrogen has no prevalent trend with depth in the individual cores. Higher concentrations can be in any depth interval.

3.4.4.7 Organic Nitrogen

Organic nitrogen, with an average concentration of 3.0 mg/kg, ranged from 1.0 to 7.1 mg/kg (agricultural soil A1) in the watershed samples. Organic nitrogen from agricultural and forest soils, road construction samples, and upper South Fork Mica Creek background sample SU1, range from 3.6 to 7.1 mg/kg. The upper South Fork background sample SU2, South Fork stream sediments, North Fork background samples and main stem Mica Creek stream sediment samples contained less than 1.8 mg/kg organic nitrogen. These relationships indicate that only small amounts of organic nitrogen are contributed by these watershed sources to Mica Bay core sediments.

Organic nitrogen is by far the most dominant form of nitrogen in the Mica Bay sediments with an highly elevated average of 2,450 mg/kg. Concentrations ranged from an elevated 192 mg/kg in the bottom depth interval from Core 7 to 11,408 mg/kg (1.14 percent) in the vegetation-rich 16- to 23-inch depth interval of Core 5. The similarly vegetation-rich middle depth interval from Core 4 contained 10, 256 mg/kg (1.03 percent) organic nitrogen. Even with the two highest organic nitrogen depth intervals removed, the organic nitrogen ranged between 1,000 and 4,624 mg/kg (13- to 65-inch depth interval from Core 8).

The higher organic nitrogen concentrations in the Mica Bay core depth intervals generally increased in concentration in cores farther from Mica Creek, but are more variable than the ammonia nitrogen concentrations. For example, depth intervals from Core 10, located farthest into the lake from the mouth of Mica Creek, contained intermediate organic nitrogen concentrations ranging from 1,820 to 2,768 mg/kg. Organic nitrogen concentrations in the three depth intervals increased in concentration from the bottom to the top depth interval. This trend of increasing organic nitrogen concentration from the lowest concentration in the bottom depth interval to the highest concentration near or at the shallowest depth interval is a typical trend in the Mica Bay cores. This relationship may suggest that the amount of organic nitrogen has an increasing concentration trend with time.

The organic nitrogen relationships indicate that little of the organic nitrogen is introduced from the watershed stream sediment, soils, or road construction samples. This leaves the anthropogenic sources near and within the perimeter of the Mica Bay shoreline.

3.4.4.8 Total Organic Carbon

TOC is highest in the Mica Bay sediments with an average of 3.26 percent ranging from non-detected at 0.05 to 15.4 percent (Table 3-14). Non-detect TOC concentrations were determined in only two samples: the bottom depth interval of Core 1, and the 0- to 29-inch depth interval of Core 7. In four of the ten cores, TOC ranged from high to low from the upper core layer to the bottom layer. In the remaining six cores the highest and lowest TOC occurred at variable depth intervals.

TABLE 3-14
Average Grain-Size Fractions and Nutrient Concentrations

Parameter[a, b]	South Fork Mica Creek Stream Sediments	Road Construction	Background Stream Sediments	Forest and Agricultural Soils	Mica Bay Sediments
Number	4	2	4	4	32
VFG	27	5.5	2.8	8.8	2.1
VCS	34	9	30	8.5	4.0
CS	18	10	37	7.8	6.5
MS	8.3	9	19	8	7.4
FS	2.8	8	3.8	11	8.2
VFS	1.2	10	1.2	12	4.6
Silt/clay	1	43.5	1.0	40.2	66.7
% Moisture	5.2	7.45	6.58	12.4	
TOC	0.025	1.0	0.2	1.77	3.26
TP	1,360	655	1,360	1,060	613
Available P	12	177	15	92	11
PO_4P	0.5	6.4	0.34	1.0	
TN	2.7	8.2	3.1	9	2,560
NO_3N	0.4	2.5	0.4	2.0	1.1
NH_4N	0.95	1.0	0.9	1.4	114
TKN	2.3	5.8	2.8	7	2,560
Organic N	1.4	4.8	1.8	5.6	2,450

[a]Refer to Table 3-4 for the definition of the grain-size class acronyms (VFG through silt/clay). Units of grain size are percent.
[b]Refer to Table 3-13 for the units associated with the nutrient parameters.

The 16- to 23-inch depth interval of Core 5 contained 15.4 percent TOC and the middle depth interval of Core 4 contained 14.7 percent TOC. These are the two depth intervals with the higher vegetative content. The remaining Mica Bay sediments ranged from non-detect to 6.02 percent (bottom depth interval of Core 4).

Forest and agricultural soils, with an average of 1.77 percent, contained the highest TOC in the watershed samples. South Fork Mica Creek stream sediment samples had nondetectable TOC; upper North and South Fork Mica Creek stream sediment samples had an average of 0.2 percent; and the road construction soils samples, 1.0 percent.

It is obvious from the these relationships that, in addition to timber fragments, TOC is generated within Mica Bay principally from decaying aquatic vegetation and microbial activity converting the vegetation to TOC in the sediment column. Given the lacustrine environment and high TOC concentrations one would assume that the sediments are under reducing redox conditions. Reducing conditions may occur within some depth intervals of some cores; however, the nitrate concentrations of various cores and lack of any hydrogen sulfide odor during the processing of the cores indicate that the lacustrine environment of Mica Bay does not get sufficiently reduced to produce sulfide minerals. Aquatic vegetation and microbial activity is promoted within the Mica Bay sediments by nutrients.

3.5 Conclusions

Sediment cores up to 8.6 feet long were successfully extracted from 10 locations in Mica Bay. To help assess the potential impact of the project site as a source of sediment to Mica Bay, sediment and soil samples were collected from the watershed. Sixteen different locations in the watershed were sampled to define soils from the dominant land use types, including the project construction site, as well as stream sediments from the South Fork Mica Creek (upstream and downstream of the project), North Fork Mica Creek, and Main Stem Mica Creeks.

The physical characteristics of the core contents were described and documented based on a visual inspection during processing of the cores in the field. Sediment samples were extracted from these visible core depth intervals for laboratory analysis. Samples collected from the watershed were analyzed for the same physical and chemical parameters as the core samples. The physical analyses included grain size and specific density. The chemical analyses included both major-rock forming and trace element chemistry as well as an evaluation of nutrient and total organic carbon concentrations. In addition to providing quantitative descriptive information of the Mica Bay and watershed samples, the chemical data were analyzed in an attempt to define the relative contributions of sediment sources to Mica Bay.

As a result of these analyses, Mount Saint Helens ash was identified in the cores. The Mount Saint Helens ash provides a means to estimate a post-May 1980 average sedimentation rate. Based on the thickness of sediments in core depth intervals that are above the ash-dominant depth interval, the estimated average sedimentation rate within the Mica Bay delta environment ranges from 0.8 to 1.7 inch per year.

The sediments throughout all the core depth intervals, as well as those overlying the Mount Saint Helens ash dominant layer, exhibited highly variable physical and chemical characteristics. This indicates a complex history of both continuous and episodic deposition rates that have varied in both time and location. In other words, sediments forming a more uniform physical and chemical signature overlying the top of a series of cores, as might be expected from a recent, singular, and significant source of sediment was not found. This finding, along with the relatively shallow sediment depths to ash leads to a conclusion that the project has not resulted in an adverse impact as a result of sediment deposition in Mica Bay.

This conclusion is further supported by the x-y scatter plot analyses conducted to determine the relative contributions of watershed soil and sediment sources to the Mica Bay sediments. These analyses utilized the major rock-forming elements silica, alumina, and potassium oxide; and the trace element pairs barium versus zinc and cerium versus lanthanum to evaluate the probable watershed sources to core depth intervals in Mica Bay. Table 3-15 summarizes the results of the these scatter plot analyses. No depth interval was found to be unequivocally associated with project-related soils or stream sediments that potentially contain project-related soils and/or sediments.

TABLE 3-15
Results of the x-y Scatter Plot Analyses to Determine if There is Road Construction Soil or Sediment Sources in Each Core Depth Interval

		Scatter Plot Analysis		
Core Depth Interval	Graph Notation	Silica Alumina Potassium	Barium Zinc	Cerium Lanthanum
1B 0-10	11		N	
1B 10-18	12		N	
1B 18-58.5	13	N	N	N
1B 33-49	1A	N	N	N
1B 58.5-88.5	14	N	N	N
2A 0-12.5	21		N	
2A 12.5 -33.5	22		N	
2A 12.5 -33.5	2A		N	
2A 33.5-56	23		N	
3B 0-16 CF	31C	N		
3B 0-16 F	31F	N		
3B 16-34 CF	32C	N	N	N
3B 16-34 CF	3A	N	N	N
3B 16-34 F	32F	N	N	N
3B 34-75 CF	33C	N	N	N
3B 34-75 F	33F	N	N	N
4A 0-8	41		N	
4A 8-61	42	N	N	N
4A 61-97	43	N	N	N
5A 0-16	51		N	
5A 16-23	52	N	N	N
5A 23-34.5	53	N	N	N
5A 34.5-71	54	N	N	N
5A 71-77	55	N	N	N
5A 77-95	56	N	N	N

TABLE 3-15
Results of the x-y Scatter Plot Analyses to Determine if There is Road Construction Soil or Sediment Sources in Each Core Depth Interval

		Scatter Plot Analysis		
Core Depth Interval	**Graph Notation**	**Silica Alumina Potassium**	**Barium Zinc**	**Cerium Lanthanum**
6A 0-22 CF	61C		N	
6A 0-22 F	61F		N	
6A 22-39.5 CF	62C	N	N	N
6A 22-39.5 F	62F	N	N	N
6A 22-39.5 CF	6A	N	N	N
6A 39.5-67.5 CF	63C	N	N	N
6A 39.5-67.5 F	63F	N	N	N
7B 0-29 CF	71C		N	
7B 0-29 F	71F		N	
7B 29-35 CF	72C		N	
7B 29-35 F	72F		N	
8B 0-10.5 CF	81C		N	
8B 0-10.5 F	81F		N	
8B 14-65 CF	82C	N	N	N
8B 14-65 F	82F	N	N	N
8B 65-91 CF	83C	N	N	N
8B 65-91 F	83F	N	N	N
9A 0-71.5 CF	91C	N	N	N
9A 0-71.5 F	91F	N	N	N
9A 71.5-97.5 CF	92C		N	N
9A 71.5-97.5 F	92F	N	N	N
10B 0-30	X1	N	N	N
10B 30-60	X2	N	N	N
10B 60-85	X3	N	N	N

CF = Coarse plus Fines Fraction; F= Fines Fraction
Y = Yes
N = No
A blank means neither yes or no

If project-related material were present, the most likely depth interval that would be expected to contain identifiable amounts of the soil or sediment would be the uppermost depth interval of any core location. Metals concentrations in all the watershed sources are quite small. However, except for the uppermost core depth interval of Core 7, uppermost depth intervals are significantly enriched with metals. Zinc is used as an indicator for the metals present in these uppermost depth intervals. The metals originate from mine sources up-lake of Mica Bay and their high concentrations require that the sediments be exposed for a considerable time to the lake waters to acquire and retain such high metals and particularly zinc concentrations. On the other hand, a recent release of project-related soil or sediment would be expected to have a very low metals concentration reflecting the low metals concentrations of the watershed sediments. Except for the uppermost depth interval of Core 7, none of the uppermost core depth intervals exhibited this characteristic. The uppermost depth interval of Core 7 has the average watershed source zinc concentration of 85 mg/kg. However, it also has the highest barium concentration of both watershed and core depth intervals and it shares these characteristics with a pre-1980 core depth interval from Core 1. These relationships indicate that the watershed source(s) and depositional conditions of this uppermost depth interval of Core 7 and the pre-1980 core depth interval from Core 1 were essentially the same. In other words, the uppermost core depth interval of Core 7 is not unique and does not indicate a project-related sediment deposition in Mica Bay.

Ultimately, the project construction soil samples were not uniquely chemically separable from the forest soil samples, so the exact contribution of soils originating from the project site could not be determined. However, as stated above, the sediment source analysis did reveal that the agricultural soils contribute most of the finer-grained sediment in Mica Bay with lesser contributions from road construction and forest soils. Also, as stated above, it was determined that the primary sources of coarser-grained sediments to Mica Bay are from the background locations in the South Fork Mica Creek and the North Fork Mica Creek.

Some conclusions derived from the nutrient and total organic carbon (TOC) data provide further insight to the Mica Bay delta environment. Both the visual assessment of the cores and the analytical chemistry data reveal that aquatic vegetation is a very significant component of many depth intervals within the cores. During the visual assessment of the cores, certain depth intervals were estimated to contain as much as 50 percent vegetation over depth intervals up to 6 feet long. Even higher percentages of vegetation were observed in shorter depth intervals. These observations indicate that aquatic vegetation has been a significant component of the delta for many decades (at least). The conclusions related to the analytical nutrient and organic data are as follows:

- Nitrogen dominates the nutrients within the Mica Bay core depth intervals.
- Organic nitrogen dominates the Mica Bay depth interval nutrients.
- Phosphorus is contributed by the watershed soils and sediments but less than 5 percent of the total phosphorus is available.
- Nitrogen is dominantly contributed by an anthropogenic source unrelated to watershed soils and sediments.
- Analytical values for TOC includes both aquatic vegetation and microbes in the Mica Bay sediments. Wood fragments/debris and the larger aquatic vegetation were sieved out.
- Although not included in the TOC concentration, wood fragments are variably abundant in discrete Mica Bay depth intervals both above and below ash-dominant depth intervals.

Collectively, all the analyses presented in this chapter support the conclusion that the project did not result in an adverse impact as a result of sediment deposition in Mica Bay.

4.0 Aerial Photography

4.1 Methods

Numerous aerial photographs of Mica Bay taken from 1958 through 2003 were compared to identify similarities and differences in pertinent physical features that have occurred through time. As listed in Table 4-1, 19 photographs were obtained from various sources spanning the 46 years from 1958 through 2003. These photos are included in Appendix H.

TABLE 4-1
List of Mica Bay Aerial Photos

Date of Photo	Scale of Original Photo	Water Surface Elevation[a] meters (feet)	Photo Number in Appendix H[b]
August 5, 1958	1:24,000	647.7 (2,124.9)	1958-1-A, 1958-1-B
August 5, 1958	1:24,000	647.7 (2,124.9)	1958-2-A, 1958-2-B
July 4, 1959	1:24,000	647.5 (2,124.2)	1959-1-A, 1959-1-B
July 4, 1959	1:24,000	647.5 (2,124.2)	1959-2-A, 1959-2-B
August 18, 1965	1:15,840	647.7 (2,124.9)	1965-1-A, 1965-1-B
August 18, 1965	1:15,840	647.7 (2,124.9)	1965-2-A, 1965-2-B
August 18, 1965	1:15,840	647.7 (2,124.9)	1965-3-A, 1965-3-B
July 3, 1968	1:15,840	647.7 (2,125.0)	1968-1-A, 1968-1-B
July 3, 1968	1: 15,840	647.7 (2,125.0)	1968-2-A, 1968-2-B
July 6, 1970	1:15,840	647.7 (2,124.9)	1970-1-A, 1970-1-B
July 6, 1970	1:15,840	647.7 (2,124.9)	1970-2-A, 1970-2-B
July 6, 1970	1:15,840	647.7 (2,124.9)	1970-3-A, 1970-3-B
August 3, 1979	1:40,000	647.7 (2,124.9)	1979-1-A, 1979-1-B
July 1984	1:6,000	647.7 (2,124.9)	1984-1-A, 1984-1-B
July 1984	1:6,000	647.7 (2,124.9)	1984-2-A, 1984-2-B
July 1984	1:6,000	647.7 (2,124.9)	1984-3-A, 1984-3-B
June 22, 1992	1:24:000	647.7 (2,124.9)	1992-1-A, 1992-1-B
June 6, 1998	1:40,000	647.6 (2,124.6)	1998-1-A, 1998-1-B
September 23, 1998	1:18,000	647.4 (2,124.2)	1998-2-A, 1998-2-B
April 19, 1999	1:18,000	647.2 (2,123.2)	1999-1-A, 1999-1-B
May 16, 2002	1:12,000	647.7 (2,125.0)	2002-1-A, 2002-1-B
June 13, 2002	1:9,000	648.0 (2,125.8)	2002-2-A, 2002-2-B
October 14, 2002	1:12,000	647.0 (2,122.8) [c]	2002-3-A, 2002-3-B
June 4, 2003	1:12,000	647.7 (2,124.9) [c]	2003-1-A, 2003-1-B

[a]Based on the Mica Bay elevation datum (see Chapter 2).
[b]The "B" photos are an enlargement of the corresponding "A" photos.
[c]Provisional data

The original format of the photographs varied from hard copy scans (for example, 1958) to high-resolution digital scans of the negative (1965, 1968, and 1970). Except for the 1998 photo, all aerial photos were collected in non-rectified formats. The Idaho Department of Lands ortho-rectified the 1998 aerial photo. The 1998 photo was then used to rectify the following photos: 1965 (1965-2-A, 1965-2-B); 1984 (1984-2-A, 1984-2-B); 1992 (1992-1-A, 1992-1-B); 1999 (1999-1-A, 1999-1-B); 2002 (2002-3-A, 2002-3-B); and 2003 (2003-1-A, 2003-1-B). For each photo rectification, 12 to 14 physical features were identified as control points on the source photo. These control points were matched with the same physical features on the 1998 photo. Adjustments were based on a 2nd order polynomial equation. Residual error is the distance between the control points and the 1998 photo features after rectification. Residual error is used to compute the root mean square (RMS) error which describes the overall consistency (statistical deviation) of the transformation. Table 4-2 identifies the range of residual error and the RMS error for the control points in each of the three photos.

Consistency in rectification is based on statistical analysis. When comparing physical changes in channels based on two aerial photos from different times, any change greater than the sum of the RMS error for both photos can be considered significant. For example, any changes between the 1965 and 1999 photos greater than 8 meters (26.2 feet) would be considered significant.

Accuracy is measured based on visual comparison. If the accuracy of the rectification is high, digitized features from multiple rectified photos should overlap. For example, the digitized centerlines of many distributary channels in the 1965, 1984, and 1999 aerial photos overlap (see Figure 4-1). The digitized channels that do not overlap indicate the alignment of this feature has changed sometime between the dates of the images being compared. In addition to comparing overlapping features, consideration must be given to photo clarity, which is influenced by post-processing image/reproduction quality as well as site conditions during the original photograph such as water transparency, sunlight reflection, and water surface turbulence. Other factors to be considered include scale, water depth, and the time of year the photo was taken (for example, late summer photos may indicated more aquatic vegetation than early summer photos because of a longer growing season).

TABLE 4-2
Residual Error and RMS Error from Photo Rectification

Photo Date and Number	Residual Error Range (meters)	Residual Error Range (feet)	RMS Error (meters)	RMS Error (feet)
August 18, 1965 (1965-2-A, 1965-2-B)	1.4 – 10.0	4.6 – 32.8	6.1	20.0
July 1984 (1984-2-A, 1984-2-B)	0.6 – 5.5	2.0 – 18.0	2.4	7.9
June 22, 1992 (1992-1-A, 1992-1-B)	0.1 – 2.7	0.3 – 8.9	1.4	4.6
April 19, 1999 (1999-1-A, 1999-1-B)	0.2 – 2.7	0.7 – 8.9	1.9	6.2
October 14, 2002 (2002-3-A, 2002-3-B)	1.9 – 8.4	6.2 – 27.6	4.8	15.7
June 4, 2003 (2003-1-A, 2003-1-B)	0.2 – 9.1	0.7 – 29.9	6.4	21.0

Source: Idaho Transportation Department
Date: April 19, 1999
Water Surface Elevation: 647.2 m (2,123.2 ft)

FIGURE 4-1
Mica Bay Aerial Photography
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
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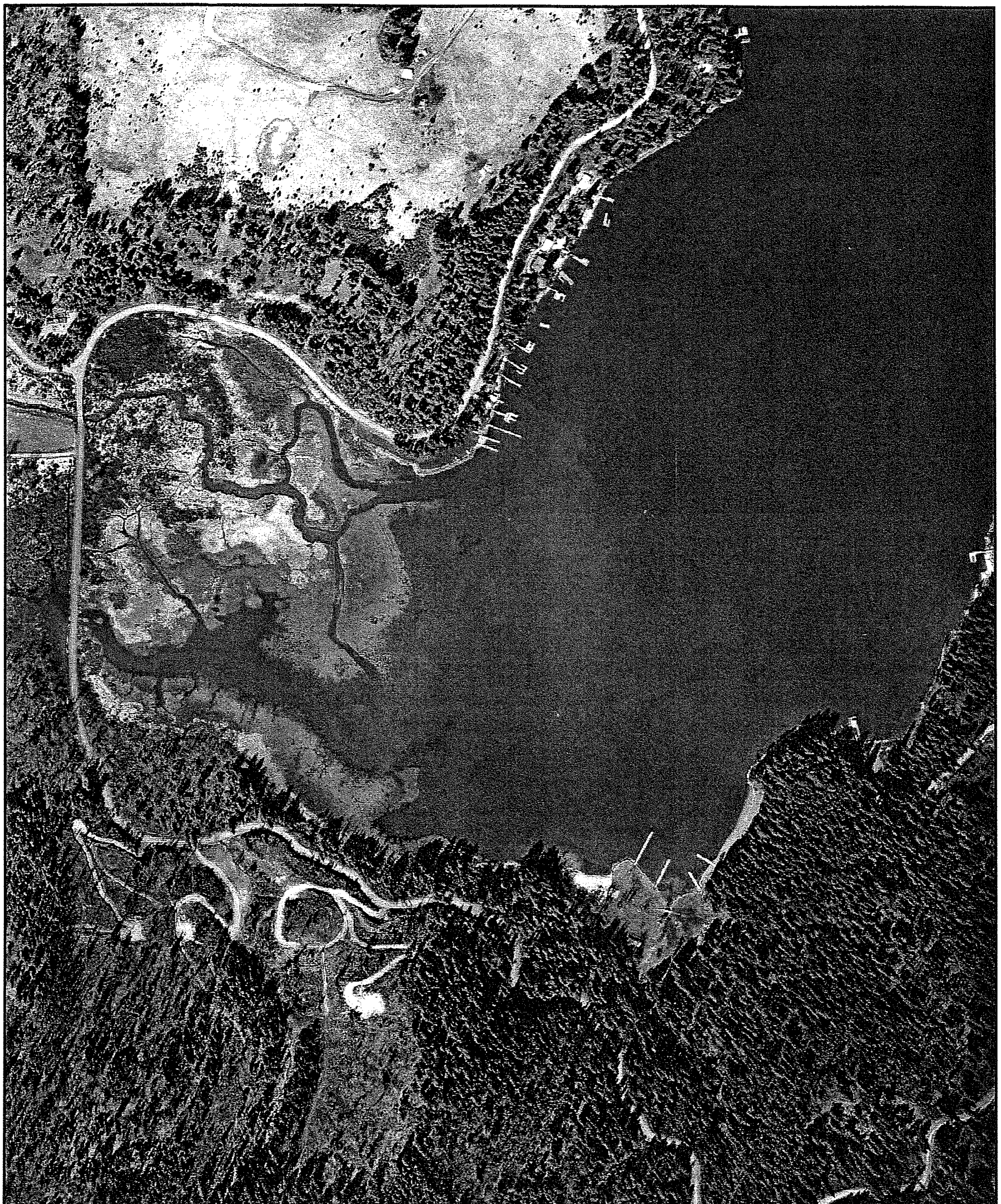
4.2 Results

The 1999 aerial photograph (see Figure 4-2) depicts conditions in Mica Bay approximately 27 months prior to startup of the project. It is the most recent, and, therefore, the most useful pre-project photograph; however, an 8-year low water surface elevation occurred in Coeur d'Alene Lake approximately 2 years after the photo and 5 months prior to project construction. Therefore, it is possible that conditions just prior to the project construction may have been different than those shown in the 1999 photograph. The most significant of the differences, if any, may have been the movement of sediment to the distal part of the delta if delta-head cutting and or channel incision occurred during lake drawdown. As mentioned in Chapter 2, *Hydrographic Survey and Historic Lake Water Surface Elevation*, however, the close fit of the July 2002 bathymetry data (see Figure 2-1) overlying the 1999 image suggests any changes to the delta margin or distributary channel alignment between these 2 years appears to be minor.

The 2002 and 2003 photos are shown in Figures 4-3 and 4-4, respectively. These photographs were taken after the sediment and erosion control problems on the project occurred during the winter of 2001 and early spring 2002. The water surface elevation in these photos is approximately 0.5 meter (1.6 feet) higher than the 1999 photograph. Although the 2002 photo is the least clear of the three, the delta margin is visible. A comparison of these photos reveals the similar lateral extent and shape of the delta. Similarly, the continuity of shape and alignment in the main stem and distributary channels of Mica Creek are also significant. It is not possible to quantify water depths in the pre-2002 (prior to the bathymetric map of Mica Bay) aerial photographs; however, the relatively unchanged delta margin combined with the reoccurrence of a similar low water surface elevation (see Figure 2-3) suggests significant changes in overall delta relief may not have been substantial between 1999 pre-project conditions and 2002 and 2003 post-project conditions. The most apparent morphological change (the northward migration of the primary channel across the delta) occurred prior to 1999.

A discussion of delta morphology can be found in Schumm (2003), so only a few observations and discussion points regarding similarities and differences in the pre-project delta morphology exhibited by the historical photos are presented here. The most significant observation is the similar shape and extent of the delta margin and remnant distributary channels of Mica Creek. For example, the delta margin is clearly visible east of the Kootenai County boat ramp in the 1965 photo (see Photo 1965-1-B in Appendix H). In addition, the shape and alignment of what appear to be remnant distributary channels and perhaps even channels formed by underwater springs have remained relatively constant since the earliest photographs (see Figure 4-1). On the other hand, the most significant difference between the 1965 and 1999 photos appears to be the alignment shift that occurred in the primary channel approximately half-way across the delta. Some time between 1965 and 1999 this channel either gradually or abruptly migrated northward and elongated the delta lobe at the mouth. A fan-shaped lobe is apparent in the 1965 photograph at the mouth (delta margin) of the primary channel; however, the subsequent channel shift resulted in the formation of another fan-shaped lobe to the northeast. This fan, and part of the remnant fan just to the southeast can be seen in Figure 4-2. It appears from the 1984 photo that the channel avulsion to the



Source: Idaho Transportation Department
Date: April 19, 1999
Water Surface Elevation: 647.2 m (2,123.2 ft)

FIGURE 4-2
Mica Bay Aerial Photography
MICA BAY AND MICA CREEK
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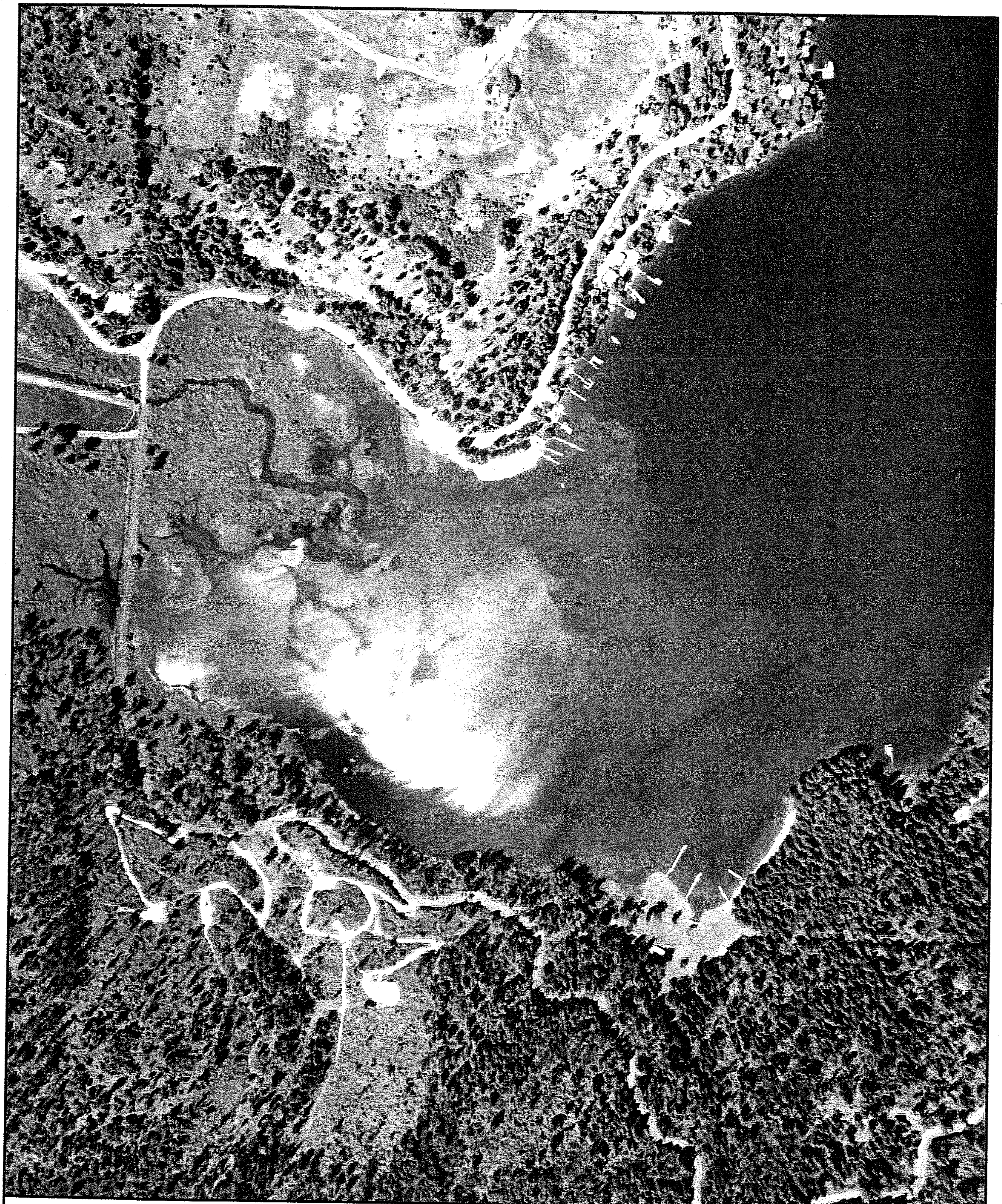

Source: Idaho Transportation Department
Date: June 4, 2003
Water Surface Elevation: 647.7 m (2,124.9 ft) Provisional Data
0 500 1,000
Feet Approximate Scale

N
W E
S

FIGURE 4-4
Mica Bay Aerial Photography
MICA BAY AND MICA CREEK
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north had begun at that time. The 1992 aerial photograph exhibits similar channel features across the delta as the 1984 photograph; however, the small channel migrating north, off the primary channel, is more defined in the 1992 photograph. Between 1992 and 1999, the channel to the north becomes the primary channel across the delta, directing flows and redistributing sediment along the north shore of the bay. It is very likely that the flood of 1996 completed the realignment and development of the channel to the north. Schumm (2003) reports the results of studies indicating the most important upstream controls on delta morphology are water discharge, flow velocity, and sediment load; with water discharge being more significant than sediment load, but sediment load was directly related to discharge. The flood of 1996 was the second highest flood on record in the vicinity of Coeur d'Alene Lake.

Figures 4-5 and 4-6 depict recent photos of deltas in the nearby Rockford and Windy bays of Coeur d'Alene Lake, respectively. These figures are included to provide insight to regional delta formations, although difference in size and shape should be expected as a result of differing watershed characteristics and the local lake basin morphology.

4.3 Conclusions

Although delta relief can not be quantified using the aerial images, a comparison of pre-project photos to 2002 and 2003 photographs indicate the project did not result in enough sediment deposition in Mica Bay to extend the delta farther out into the lake. In fact, the photos exhibit the most apparent morphological change occurred prior to even 1999. This change was the shift in alignment of the primary channel closer to the north shore of the bay, which appears to have been progressing at least as far back as 1984, became more defined by 1992, and by 1999 the channel to the north had become the primary channel across the delta. Based on the difference between the 1992 and 1999 photos, it is likely that the flood of 1996 exacerbated this change and may have increased the size of the fan-shaped lobe at the mouth of the channel at the delta margin. At other locations on the delta, there are channels visible in aerial photographs taken 35 years ago that are still visible today.

Source: Idaho Transportation Department
Date: May 27, 2003
Water Surface Elevation: 647.2 m (2123.3 ft) Provisional Data

N
W E
S

0 1,000 2,000 Feet Approximate Scale

FIGURE 4-5

Rockford Bay Aerial Photography

MICA BAY AND MICA CREEK
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Source: Idaho Transportation Department
Date: May 27, 2003
Water Surface Elevation: 647.2 m (2123.3 ft) Provisional Data

0 1,000 2,000 Feet Approximate Scale

N W E S

FIGURE 4-6
Windy Bay Aerial Photography
MICA BAY AND MICA CREEK
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5.0 Underwater Photography

5.1 Methods

Underwater photography in Mica Bay was taken during two field efforts:

- July 18, 2002—Black-and-white video
- August 12, 2003—Color still photographs and limited black-and-white video

The July 2002 video was made using an Atlantis™ Underwater Camera borrowed from IDEQ. The camera, mounted on a 100-foot cable, was deployed from a boat during the hydrographic surveying effort (see Chapter 2, *Hydrographic Survey and Historical Lake Water Surface Elevations*). A video monitor in the boat was used to view real-time images as the boat was maneuvered to locations and underwater features of interest. The camera has six high-powered infrared light emitting diodes that allows underwater viewing up to 25 feet ahead in total darkness. The location of each video segment was recorded using GPS equipment (described in Chapter 2, *Hydrographic Survey and Historical Lake Water Surface Elevations*) while videotaping.

To assess potential impacts to water intake structures in the bay (see Chapter 9, *Water Supply and Treatment Systems*), underwater color photographs were taken by a diver at multiple locations in August 2003. Some limited black and white video footage was taken as well (using the same Atlantis™ Underwater Camera from the boat), but the focus of the effort was to collect underwater color photographs. The underwater 35-millimeter camera used was a Reefmaster CL manufactured made by Sealife. Fuji 400 ASA color film was used. The locations of the photographs were determined using GPS equipment operated from a boat in the vicinity of the diver.

5.2 Results

Figure 5-1 illustrates where underwater photography was taken in Mica Bay. The July 2002 video footage is included with this report. The August 2003 underwater color photographs are presented in Appendix I. A brief description and relevant findings from the underwater photography efforts are presented below.

Note to Reader: Water depths are presented in dual units for ease of reference to Figure 2-1.

The underwater video is provided in DVD format as Appendix Q.

5.2.1 Underwater Video

For the purposes of the descriptions below, references to water depths are based on the controlled summer-pool elevation of 647.7 meters (2125.0 feet) (Mica Bay elevation datum).

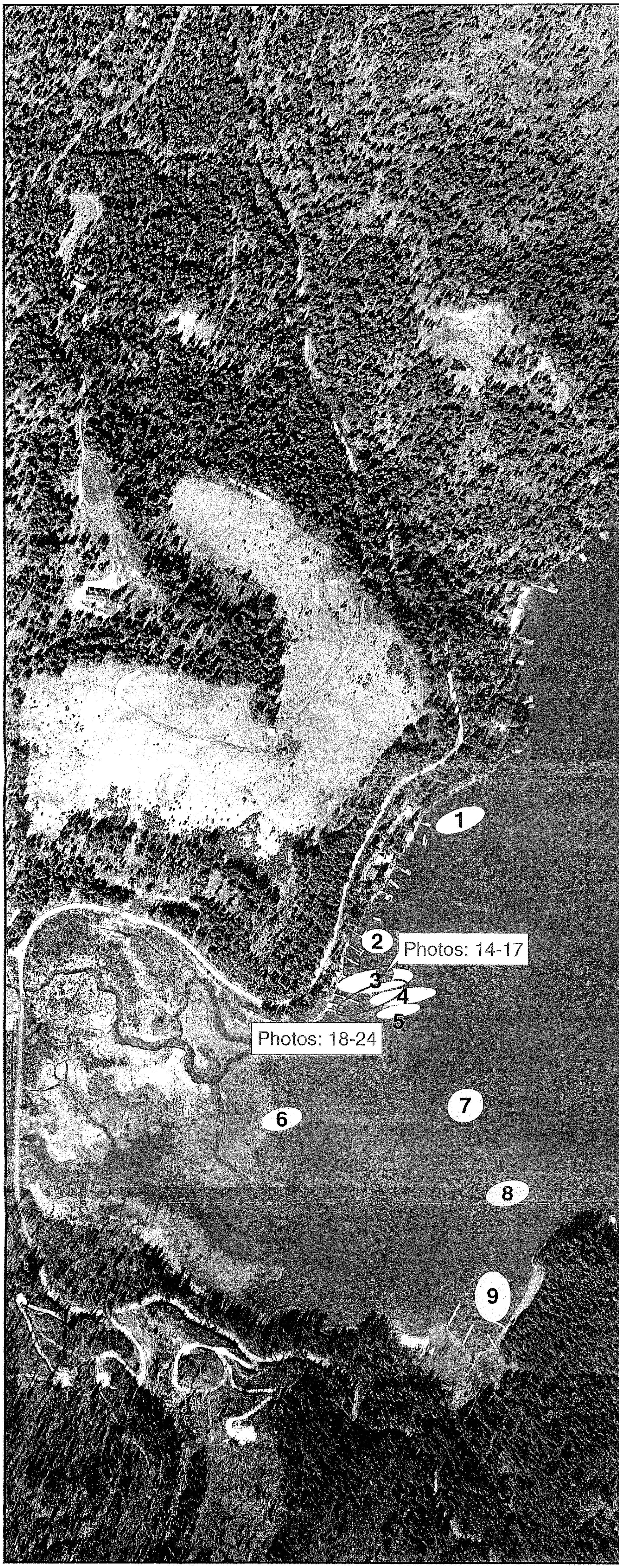

FIGURE 5-1
Mica Bay Underwater Photography
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

Black and White Video Segments (July 2002)

Color Still Photos (August 2003)

Color Still Photos 18-24 (August 2003)

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5.2.1.1 Segment 1

Description

Video footage at this location was collected while moving in from deep to shallow water. The footage starts at 10 meters (33 feet) and ends at 5 meters (15 feet) water depth. This is the deepest location of all the video segments. Because this area is located in relatively deep water and removed from any tributaries, sediment deposits at this location would be expected to be fine- to very-fine-grained.

Findings

The texture of the lake bottom at this location appears to be predominately fine- to very-fine-grained sediment. Rooted aquatic plants are either non-existent or rare in the deeper water at this location (first part of the Segment 1), but are present in the more shallow areas. Based on the range of water depths and the transition from the absence to presence of rooted aquatic plants, it appears Segment 1 spans the fringe of the sublittoral and littoral zones. This is consistent with the reported area-weighted lake-wide mean for secchi-disc transparency of 4.9 meters (16 feet) and 6.9 meters (23 feet) (Woods and Beckwith, 1997). In the deepest water of this segment, some large-diameter logs resting on the lake bottom show only minimal signs of sediment deposition. They are fully exposed above the lake bed and have only a dusting of sediment on top of them. The rooted aquatic plants in the littoral zone do not appear to be impacted by sediment deposition.

5.2.1.2 Segment 2

Description

Water depths at this location range from approximately 2 meters (7 feet) to 5 meters (16 feet). This segment was taken near the private boat docks along the north shore of the bay.

Findings

Rooted aquatic plants dominate the lake bottom at this location. The plants are dense, multiple species are present, and variable growth heights are evident. Multiple submerged pilings that are not covered in sediment exist throughout this location. In addition to the pilings, logs also lie horizontally and fully exposed on the bottom. A submerged boat also lies on the lake bed. It appears to have been underwater for many years based on the condition of the wood and the periphytic algae growth on the structure. The sides of the boat extend approximately 18 to 24 inches above the lake bottom, and the interior of the boat shows no signs of significant sediment accumulation.

5.2.1.3 Segment 3

Description

Water depths at this location range from approximately 1 meter (3 feet) to 8 meters (27 feet). This segment begins almost on shore over a private concrete ramp and extends outward into deeper water off the north shore of the bay.

Findings

The concrete ramp at the beginning of the segment does not appear to be covered with sediment in this area near shore. Water intake lines and tire anchors are also clearly visible in this segment. These structures show no signs of significant, recent sediment deposition at this location. Dense stands of rooted aquatic plants are prevalent and some yellow perch can be seen in the video.

5.2.1.4 Segment 4

Description

Water depths at this location range from approximately 2 meters (7 feet) to 8 meters (27 feet). This segment begins at the base (bottomset bed) of the delta front, moves up the slope (foreset bed), across the pivot point, and over the top (topset bed) of the delta. The segment ends just east of the Kootenai County boat ramp and is located at the downstream extent of the main channel across the delta. This segment is near the Core 7 location.

Findings

Consistent with delta morphology (Schumm, 2003; Summerfield, 1991; Skinner and Porter, 1987), the bottomset bed is predominately fine-grained substrate, and a coarsening of bed material is evident as the video moves up the foreset bed to the topset bed. Wood fragments and branches at the base of the delta are not buried beneath a thick layer of sediment. At one point along the foreset bed, a branch (approximately 2- to 4-inch diameter) protrudes from relatively coarse sand. This is evidence of reworked delta sediment and debris associated with a significant flood event and or high inflowing water velocities during low lake levels. As the lake level drops, the inflowing stream can cut into the delta deposits and redistribute them further into the lake. The topset bed at this location appears to be very well sorted. Even in this active portion of the topset bed, some limited rooted plant growth exists. This would not be expected if a significant amount of sediment had been deposited here within recent months.

5.2.1.5 Segment 5

Description

Water depths at this location were essentially the same as Segment 4. This segment is located along the topset bed of the delta slightly south of Segment 4. A survey rod (described in Chapter 2, *Hydrographic Survey and Historical Lake Water Surface Elevations*) was used while filming this segment to disturb and suspend the bottom sediments in front of the camera to provide insight to the physical nature of the substrate.

Findings

The composition of the bottom at this location appears to be a mixture of sandy silt and rooted aquatic vegetation. The aquatic vegetation is not as dense as it is in other locations; however, because of the proximity of the active channel and the frequency of relatively low lake stages, this is not unexpected. The effect of boat traffic traveling across this location and Segment 4 while going to and from the county boat ramp may also promote a well-sorted topset bed. It may also potentially deter significant plant growth because of turbulence and scour at variable water depths.

5.2.1.6 Segment 6

Description

This segment was filmed in a water depth of approximately 1 meter (3 feet). During the winter season this location is commonly dewatered. This segment is very near the Core 2 location.

Findings

The lake bottom at this location is densely covered with a variety of rooted aquatic plants that do not appear to have significant, if any, sediment deposition over them. A large, submerged log on the lake bottom is not covered with sediment. This same log was photographed 5 months later in December 2002 when it was exposed for the first time after project activities in spring 2002 (see Photo 5-1).

PHOTO 5-1
Location of Underwater Video Segment 6 in December 2002 (The log shown here is visible in the July 2002 underwater video.)

5.2.1.7 Segment 7

Description

Water depths at this location range from approximately 2 meters (7 feet) to 3 meters (9 feet). It is located near the pivot point from the delta topset bed to the foreset bed.

Findings

Coarse-grained sediment mixed with organic debris dominate the lake bottom at this location. This area is similar in appearance to segments 4 and 5, except that there appears to be a higher accumulation of fine organic debris at this location. This is not unexpected because this area is farther from the fluvial processes associated with Mica Creek that become significant during flood conditions and winter drawdown. Being more distant from fluvial processes such as channel incision, the fine organic debris is less likely to be transported away. The presence of sandy substrate underlying the thin veneer of organic debris at this location provides evidence; however, that in the past this location was more directly influenced by fluvial processes. Numerous smallmouth bass and northern pikeminnow appear in this segment.

5.2.1.8 Segments 8 - 9

Description

These two segments are described collectively because the underwater features and water depth (2 meters [7 feet]) are similar.

Findings

These locations are dominated by dense and extensive stands of rooted aquatic vegetation covering nearly 100 percent of the lake bottom. Some of the plants nearly reach the lake surface and it is apparent when the camera approaches the bottom that the stems are not buried by sediment. A northern pike can be seen holding in the cover of the aquatic vegetation and then fleeing from approaching camera during Segment 8.

5.2.2 Underwater Color Photographs

The primary purpose of the underwater still photographs was to provide visual evidence of water intakes and nearby substrate conditions. Only observations relative to the lake substrate conditions are presented here (see Chapter 9, *Water Supply and Treatment Systems*, for assessment of the water supply systems).

Photos 1 through 13 indicate that significant sediment deposition at these locations has not occurred since the water intake devices were installed. This is most evident by the exposed conveyance lines lying on the lake bottom. Also evident in these photographs are rocks and branches lying exposed on the nearby lake bottom, as well as rooted aquatic vegetation.

Photos 14 through 17 are also of a water intake structure that is nearest the delta, but the lake bottom does not appear in the photographs; however, Photos 18, 19, 22, and 23 show the lake bottom (topset bed) in the vicinity of this intake. Photo 24 shows the foreset bed, and Photos 20 and 21 show the bottomset bed. It is interesting to note that objects such as a bottle and large wood fragments are exposed on the lake bottom even in deeper water just beyond the delta where sediment deposition would be expected.

5.3 Conclusions

Underwater video footage was recorded at nine different locations in Mica Bay in July 2002. Color still photographs were taken at five underwater locations by a diver in August 2003. The underwater video effort included areas along the outer edge of the delta near the mouth of the active channel paralleling the north shore of the bay. The video footage recorded many bottom features such as wood pilings, logs, tires, a sunken boat, water intake structures, and accompanying pipes that had been submerged before the project began. Dense stands of well developed rooted aquatic plants were observed that showed no signs of burial. The underwater photography conducted by the diver revealed that every water intake structure (conveyance piping and slotted or screened intake standpipe) was fully exposed on the lake bed. The video and color still photographs show that the project has not resulted in an observable accumulation of a recent sediment layer at the many locations photographed in Mica Bay.

6.0 Turbidity Analysis

6.1 Methods

6.1.1 Purpose of Turbidity Analysis

The purpose of this analysis is to present turbidity data collected during construction activities for the project. The primary focus of this impact assessment relates to potential impacts durin g the first year of construction (fall 2001 through summer 2002). This chapter, however, also provides turbidity, meteorology, and hydrology data collected after this period because these later data help in understanding runoff/melt conditions at the site during the period of primary interest. These data will be used to help address the impacts of sediment on aquatic biological resources in Mica Bay, South Fork Mica Creek, and Mica Creek (see Chapter 8, *Biological Resources in Mica Bay, South and North Fork Mica Creek, and Mica Creek*), recreational uses (see Chapter 10, *Recreation*), and domestic water supplies (see Chapter 9, *Water Supply and Treatment Systems*) in Mica Bay.

Turbidity is a unit of measurement quantifying the degree to which light traveling through a water column is scattered by the suspended organic (including algae) and inorganic particles. The scattering of light increases with a greater suspended load. Turbidity is commonly measured in Nephelometric Turbidity Units (NTU). Turbidity can be a useful indicator of runoff from construction sites, fields, logging activity, industrial sources, and other sources.

6.1.2 Turbidity Sampling Locations

Turbidity data were collected at 33 locations within the Mica Creek and Rockford Bay drainages. The following six locations were evaluated to analyze the effects of sediment on resources within Mica Bay:

- Mica Bay boat launch (station #9)
- Mica Creek at Loff's Bay Road Bridge (station #12)
- South Fork Mica Creek leaving project (station #2)
- South Fork Mica Creek midway through project (station #7)
- South Fork Mica Creek upstream of the project (station #1)
- North Fork Mica Creek upstream of the project (station #8)

These six locations are representative of conditions just upstream and within Mica Bay, conditions within the project-influenced reaches, and conditions upstream of the project. Figure 6-1 identifies these locations.

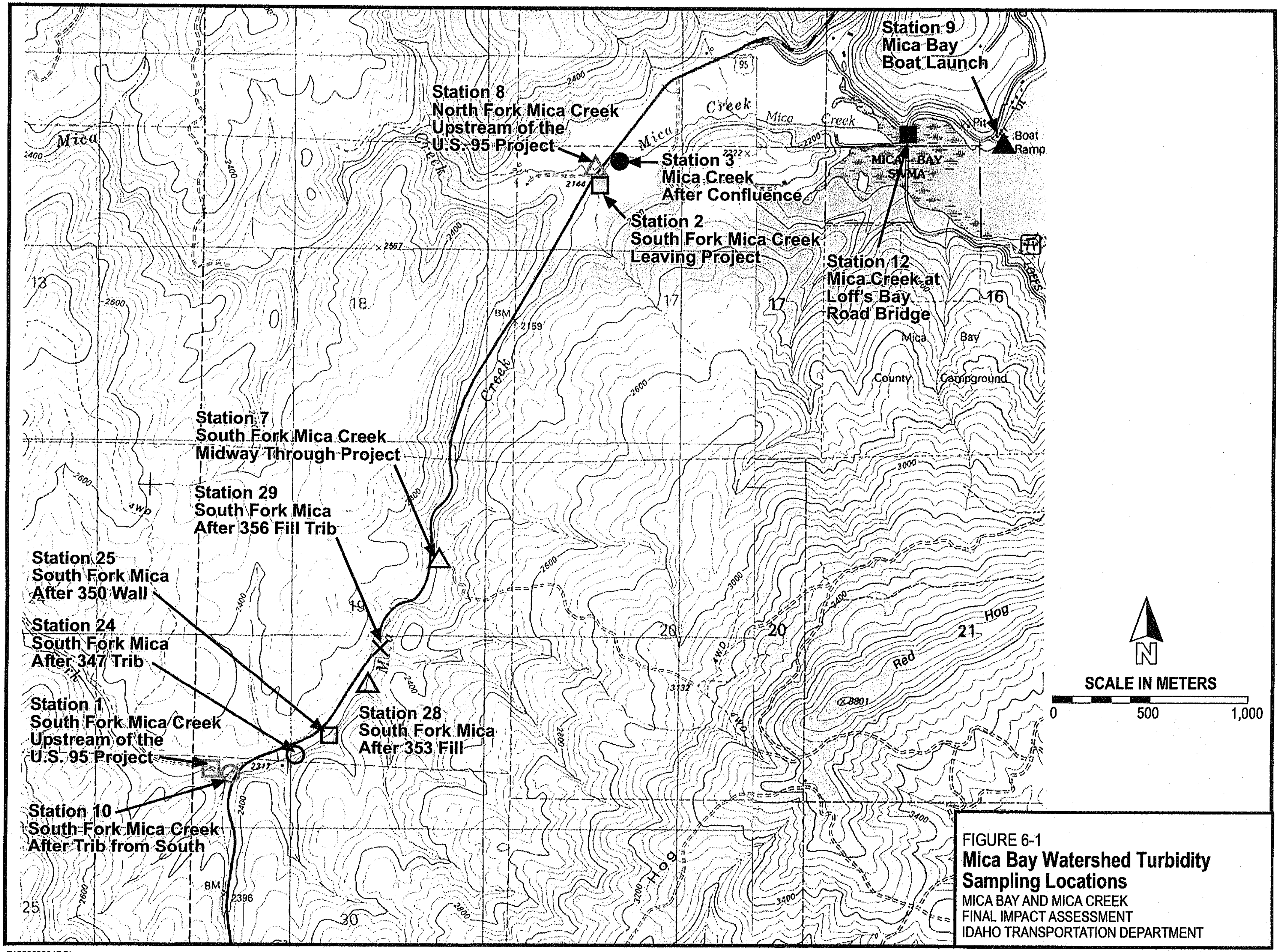

FIGURE 6-1
Mica Bay Watershed Turbidity Sampling Locations
MICA BAY AND MICA CREEK
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Because turbidity data were more limited during fall 2001 through winter 2002, the following two additional locations were used to analyze the effects of sediment on resources within Mica Bay during this time period (see Figure 6-1):

- Mica Creek after confluence (station #3)
- South Fork Mica Creek upstream of the project, but after tributary from south (station #10)

Samples from station #3 are representative of turbidity prior to Mica Bay, while those from station #10 generally are more representative of upstream of project conditions—although project activities may have, at times, influenced turbidity levels at station #10. Station #10 was used to represent upstream conditions only up until station #1 was established.

All twelve sampling locations within South Fork Mica Creek, North Fork Mica Creek, Mica Creek and Mica Bay were evaluated to analyze the effects of sediment on resources within South Fork Mica Creek and Mica Creek:

- South Fork Mica Creek upstream of the project (station #1)
- South Fork Mica Creek After Trib from South (station #10)
- South Fork Mica After 347 Trib (station #24)
- South Fork Mica After 350 Wall (station #25)
- South Fork Mica After 353 Fill (station #28)
- North Fork Mica After 356 Fill Trib (station #29)
- South Fork Mica Creek midway through project (station #7)
- South Fork Mica Creek leaving project (station #2)
- North Fork Mica Creek upstream of the project (station #8)
- Mica Creek After Confluence (station #3)
- Mica Creek at Loff's Bay Road Bridge (station #12)
- Mica Bay boat launch (station #9)

Figure 6-1 identifies these locations. Turbidity data within tributaries of South Fork Mica Creek were reviewed to analyze project impacts versus other factors that contribute to elevated turbidity (for example, logging and/or agriculture); however, tributary turbidity and TSS data is not included in this report. The data were not included because tributary data collection did not begin until late May 2002, after which, within that first construction year, there were no substantial project-related erosion problems affecting the Mica Creek watershed.

6.1.3 Precipitation, Air Temperature, and Turbidity

Evaluating turbidity associated with meteorological data is an important component of understanding the erosion process. The process of soil erosion involves detachment and soil transportation. The primary cause of detachment is the impact of rainfall and/or snowmelt on a soil surface lacking protective vegetative cover, such as ground disturbances resulting from construction. Other sources of turbidity that are initiated by precipitation and melt events include erosion from agricultural fields, erosion from forest roads resulting from logging, and eroding stream banks. The complete turbidity data set for the locations used to analyze effects on Mica Bay is plotted along with precipitation in Figures 6-2 through 6-9 (located at the end of this chapter).

Daily air temperature and precipitation data measured at the Coeur d'Alene, Idaho, weather station (elevation 2132 feet; cooperative ID 101956) were used for comparison to project site data. The Coeur d'Alene weather station is the closest weather station with available data. The Coeur d'Alene weather station is located at the airport, approximately 7 miles due north of the project site. Daily minimum and maximum temperatures are plotted along with daily precipitation data in Figures 6-10 through 6-17 (located at the end of this chapter).

Typically, the project site is colder and has higher precipitation than the Coeur d'Alene weather station. Because the project site is typically colder than the Coeur d'Alene weather station, snowmelt conditions could be overstated and there is likely to be less runoff associated with winter and early spring events than available temperature data would suggest. In addition, because precipitation is generally higher at the project site, periods with elevated turbidity are likely the result of more precipitation than recorded at the weather station. Although the temperature and precipitation data presented are not an ideal representation of conditions at the project site, they provide insight as to what form of precipitation (rain or snow) occurred at the site at any given time. In addition, the temperature data indicate when snowmelt conditions were initiated.

6.1.4 Turbidity Sampling Periods

Turbidity sampling at two locations on South Fork Mica Creek (stations #2 and #10) was initiated in late September 2001 by ITD personnel (see Figure 6-1). Additional sampling sites were added in the following months to provide insight into background conditions for North Fork Mica Creek, South Fork Mica Creek, and locations in and immediately upstream of Mica Bay. Field sampling in and immediately upstream of Mica Bay commenced in February 2002. From late September 2001 until late March 2002, turbidity samples were taken four times per month, on average.

CH2M HILL personnel began turbidity sampling in March 2002. From March 25, 2002, through May 22, 2002, turbidity samples were taken twice daily. Daily turbidity samples were taken the remainder of spring 2002. Following spring 2002, turbidity samples were taken at least twice each week during or immediately after measurable precipitation events. Therefore, although samples were not taken on a regular basis, the turbidity levels monitored provide indicators of the site during periods when turbidity would be at its highest.

Supplemental turbidity data were provided by the Coeur d'Alene Tribe and IDEQ. The Coeur d'Alene Tribe provided limited data at South Fork Mica Creek just downstream of the project and Mica Creek following three large precipitation events in October 2001 and January 2002. IDEQ provided limited turbidity data at various locations on South Fork Mica Creek, North Fork Mica Creek, Mica Creek, and at the Mica Bay boat launch following three large precipitation events in October 2001 and January 2002, and 3 days during mid-February and mid-March when temperatures were elevated and snowmelt was occurring.

6.1.5 Quality Assurance/Quality Control Procedures

At the request of USEPA, a detailed turbidity monitoring plan, including quality assurance/quality control (QA/QC) procedures, was submitted in September 2002. The updated plan and all QC data are included in this impact assessment report as Appendix J. There were 57 field samples collected at South Fork Mica Creek and Mica Creek with corresponding laboratory QC samples. On average, lab results were +/-2.0 NTU different than field results. The median difference between lab and field results was +/-0.9 NTU. A very good correlation exists between lab and field data ($R^2 = 0.98$). Based on these QA procedures and QC results, all field turbidity data collected have been retained for purposes of the analyses in this impact assessment.

6.2 Results

6.2.1 Hydrology

Table 6-1 presents the contributing drainage areas to Mica Creek. All areas are based on a 10-meter digital elevation model (DEM). The North Fork Mica Creek drainage is the largest contributing-drainage area to the Mica Creek watershed (approximately 61 percent). This suggests that the North Fork Mica Creek drainage contributes proportionately higher flows than the South Fork Mica Creek drainage.

TABLE 6-1
Contributing Drainage Area

South Fork Upstream of the Project (Station #1)	South Fork Leaving Project (Station #2)*	North Fork Upstream of the Project (station #8)	Mica Creek Watershed
2,463 acres	5,183 acres	9,188 acres	14,941 acres

*Station #2 includes all of the drainage area associated with station #1. The Mica Creek watershed includes all of the South Fork and North Fork drainage areas, in addition to 570 acres that are local to Mica Creek.

Table 6-2 presents streamflow data measured to date. On average, North Fork Mica Creek (station #8) contributes about 66 percent of the total flow to Mica Creek while South Fork Mica Creek (station #2) contributes the remaining 34 percent. Flow data generally are representative of the contributing-drainage areas presented above, with the exception of the high flow event in spring 2002 when the North Fork provided about 80 percent of the total flow.

TABLE 6-2
Measured Streamflows

Date	South Fork Upstream of the Project (Station #1) (cfs)	South Fork Leaving Project (Station #2) (cfs)	North Fork Upstream of the Project (Station #8) (cfs)
April 16, 2002	37.9	51.0	206
March 12, 2003	4.9	10.8	NA*
March 14, 2003	NA*	NA*	18.2
March 26, 2003	23.4	53.5	80.5
April 14, 2003	5.1	10.0	21.8
May 13, 2003	2	4.5	9.0

TABLE 6-2
Measured Streamflows

Date	South Fork Upstream of the Project (Station #1) (cfs)	South Fork Leaving Project (Station #2) (cfs)	North Fork Upstream of the Project (Station #8) (cfs)
May 27, 2003	1.1	3.0	5.9
June 11, 2003	1.3	2.1	4.1
July 3, 2003	0.5	1.1	1.6
July 15, 2003	0.3	0.7	1.1

*NA indicates that discharge was not measured on that date.

6.2.2 Turbidity Results

The complete turbidity data set for the locations used to analyze effects on South Fork Mica Creek, North Fork Mica Creek, Mica Creek and Mica Bayis in Table 6-3 (located at the end of this chapter). Table 6-4 (located at the end of this chapter) presents supplemental turbidity collected by IDEQ. Table 6-5 (located at the end of this chapter) presents monthly statistics of daily instantaneous turbidity readings taken in the field. Table 6-6 (located at the end of this chapter) shows all precipitation events and corresponding turbidity data.

The complete turbidity data set for the six monitoring sites used to analyze effects on Mica Bay is plotted against the percent exceedance and is shown in Figure 6-18. The percent exceedance curve shows the number of occurrences in which instantaneous turbidity values were exceeded during the sampling period (September 2001 through present). This figure indicates that turbidity values in the bay generally were much closer to values at stations upstream of the project than in South Fork Mica Creek downstream of the project. Individual seasons and events are discussed in more detail below.

6.2.2.1 Chronology of Elevated Turbidity Events

During fall 2001 (see Figure 6-2), three precipitation events occurred on October 11, November 21, and November 30 ranging from 0.21 to 0.27 inch that were accompanied by turbidity samples collected by ITD. Two of the three samples (October 11 and November 21) were taken under similar temperature conditions (ranging from 40 to 55 degrees F) and resulted in turbidity values greater than 100 NTU in Mica Creek. However, a comparison of turbidity values taken on South Fork Mica Creek downstream of the project (station #2) with samples taken after the confluence with North Fork Mica Creek (station #3) shows that elevated turbidity levels are not entirely project related. The data suggest that readings downstream of the confluence were largely determined by conditions in North Fork Mica Creek. This is because North Fork Mica Creek turbidity levels were much higher than South Fork levels and the North Fork contributes approximately 60 percent of the total flow to Mica Creek. Therefore, the North Fork contributed more sediment to Mica Bay for these two measured events than did the South Fork drainage. The third sample (November 30) followed the first significant snowfall when temperatures were near freezing. Turbidity results show that South Fork Mica Creek conditions at station #10 were exceeded by 10 NTU during this time period at creek stations #2 and #3.

On October 23, 2001, the sediment pond embankment was breached by seepage erosion in the area of the outlet pipe of the basin. Although two precipitation events (0.63 inch in 2 days) with air temperatures well above freezing (ranged from 38 to 58 degrees F) occurred coincident with the breach, they likely did not cause it. Neither the spillway nor the embankment were over-topped during these events. ITD construction diaries (see Appendix K) show that turbid conditions decreased noticeably within 2 days. Turbidity levels were less than 20 NTU at all sample locations downstream of the project on October 26, 2001. The Contractor made some repairs to the embankment and the sediment basin was put back into operation. On November 23, 2001, the sediment basin embankment was breached at this same location. Again, three precipitation events (1.01 inches in 3 days) with air temperatures that ranged from 29 to 54 degrees F occurred coincident with the second breach. Again, these events did not lead to over-topping of the spillway or embankment. The second breach was also caused by seepage erosion in the area of the outlet pipe. ITD estimated that approximately 270 cubic yards of soil material from the breached embankment was washed downstream. It is estimated that about half of this material entered the South Fork Mica Creek. The remaining material was deposited in the unnamed tributary downstream of the sediment basin before entering the South Fork Mica Creek. Photo 6-1 shows the sediment pond subsequent to the second breach. In the foreground is an accumulation of sediment near the inlet to the basin. The breach is shown in the upper portion of the photo. It is clear that the size of the breach represented a small portion of the total embankment. ITD's calculations also indicate that approximately 15 cubic yards of material was eroded from the down-cutting of the basin bottom within the basin. ITD subsequently removed the sediment basin from use, and the sediment basin site was restored to natural conditions during the 2002 construction season.

Photo 6-1 Sediment Pond after Second Breach

Erosion problems from stormwater runoff and snowmelt also were experienced during the winter. In response to these issues, ITD and the Contractor increased efforts to monitor and respond to erosion and sedimentation issues. Additional measures were also implemented to control the potential for erosion. Despite these efforts, periods of elevated turbidity occurred, as described below.

During December 2001 (see Figure 6-3) two turbidity samples were taken by ITD following precipitation events (December 7 and December 14). The first turbidity sample (December 7) was taken after a 3-day snowfall event and produced similar results to the sample taken during the fall under near freezing temperatures in which upstream conditions were exceeded by less than 10 NTU. The second sample was taken after a large 2-day precipitation event (more than 1.6 inches over 2 days) at increased temperatures (December 14). Turbidity results for Mica Creek show that conditions at station #10 were exceeded by more than 50 NTU following this large event, with the highest reading being 110 NTU (South Fork Mica Creek midway through the project, station #7).

Field sampling within and immediately upstream of Mica Bay commenced in February 2002. Isolated elevated turbidity events during winter 2002 show that samples taken at the Mica Bay boat launch (station #9) generally were substantially lower than the turbidity values within the project-influenced reach of the South Fork of Mica Creek (stations #2 and #7). For example, for turbidity events on February 21, March 11, March 12, and March 26; the values at the launch were 10, 23, 30, and 24 percent; respectively; of their corresponding values at station #2.

During February and March 2002, Mica Creek substantially exceeded South Fork Mica Creek upstream conditions twice (February 21 and March 11). Both instances had approximately 0.2 inch of precipitation (possibly rain-on-snow events) coupled with increased temperatures. On these two particular dates, turbidity in Mica Creek (station #3) was 11 times and 6 times higher, respectively, than their corresponding highest upstream readings (stations #8 and #10). The precipitation event that occurred on February 8 under similar temperature conditions, though there was 0.63 inch of precipitation, had different results. Turbidity values following this event were less than 13 NTU at all sample locations. The February 8 data show that elevated turbidity cannot be predicted based on precipitation events alone. Other climatological and construction factors influence turbidity conditions.

On April 13 and 14, 2002, the maximum instantaneous turbidity readings were 17 and 213 NTU at the Mica Bay boat launch and Mica Creek at Loff's Bay Road Bridge, respectively. Turbidity levels for this event in the South Fork downstream of the project were comparable to those upstream. Elevated values for this event (176 NTU) at North Fork Mica Creek suggest that instances of elevated turbidity during spring 2002 were not always project related. This suggests that there are other external disturbances that influence Mica Bay and creek turbidity readings. See Section 6.2.2.2 and Chapter 7, *Mica Creek Watershed Characterization*, for further discussion of sources.

Supplemental turbidity data on January 10, 2002 provided by IDEQ show that turbidity in South Fork Mica Creek upstream of and just below the large sediment basin were 40 NTU and greater than 1,000 NTU, respectively. Turbidity at the Mica Bay boat launch was 24 NTU. These samples were taken following heavy precipitation and unusually high temperatures. Bellgrove Creek and Mica Creek were near flood level on January 8, 2002, under conditions similar to spring-runoff. These data show that although there were periods where heavy precipitation and unusually high temperatures created challenging field conditions with respect to erosion, the turbidity level at Mica Bay, although higher than average values, was not as high as might be presumed for this event based on samples from small project-influenced drainages to the South Fork Mica Creek.

The potential importance of frozen conditions and stream dilution is further illustrated by IDEQ and ITD data collected on February 18 and 19. Photos 6-2 and 6-3 show turbid water from the sediment basin stream and the confluence of the sediment basin stream with South Fork Mica Creek on February 18, 2002. Turbidity readings by IDEQ at the location shown in Figure 6-2 ranged from 937 to 974 NTU. IDEQ turbidity readings in South Fork Mica Creek immediately upstream of this input was about 4 NTU and the reading in the North Fork Mica Creek was 6 NTU. The corresponding IDEQ readings in the South Fork Mica Creek at the new US 95 bridge (Station 384) ranged from 161 to 181 NTU. Despite the turbid conditions on the 18th, after a night of freezing temperatures, turbidity levels at all sample sites downstream were less than 23 NTU on February 19, 2002 based on ITD sampling. These data indicate that although the project periodically influenced turbidity levels in small tributaries, turbidity levels downstream of the project were less severe as the flow increased downstream and turbidity levels were reduced. In addition, elevated turbidity conditions were at times further mitigated by freezing temperatures.

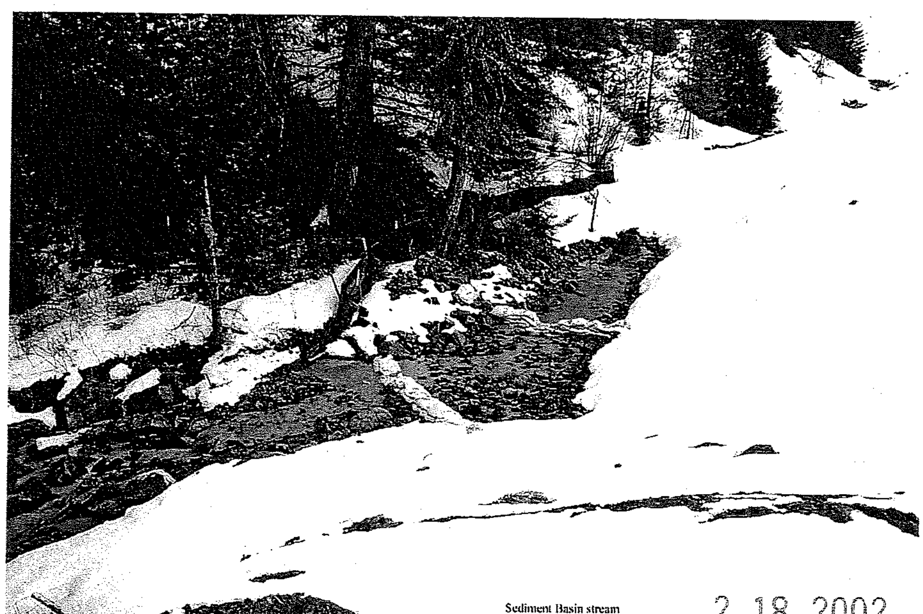

Photo 6-2 Sediment Basin Stream

Photo 6-3 Confluence of Sediment Basin Stream with South Fork Mica Creek

As noted above, the highest runoff occurs during Spring months, with rain on snow events and rapid melting. The highest measured turbidity value in Mica Bay occurred in March 2002 (because sampling in Mica Bay did not commence until February 8, 2002 it is not known if there were higher values prior to early February). The maximum instantaneous turbidity reading at the Mica Bay boat launch recorded during the first construction year was 161 NTU and occurred on March 11, 2002. This particular turbidity spike of 161 NTU diminished to 72 NTU by the next day, and further diminished to 29.6 by the day after that. By March 19, approximately 9 days from the onset of the event, turbidity in Mica Bay was down to 11.9 NTU. The next turbidity spike (66.7 NTU) occurred on March 26, 2002 and was down to 11.2 NTU by the next day. Another turbidity spike seen at Loff's Bay Road (but not at the boat launch) in mid-April 2002 was also only several days in duration.

Specific instances of elevated turbidity events occurring after summer 2002 that were influenced by the project are as follows:

- **January 26, 2003.** On this date, a severe rain-on-snow event occurred that resulted in a slope failure at the south end of the South Fork Mica Creek canyon. Although the slope had been inspected and deemed stable, topsoil on a section of new embankment became saturated and sloughed onto the existing highway. ITD and the Contractor mobilized immediately to isolate and remove the material. Based on load counts, it is estimated that approximately 90 cubic yards of soil material sloughed off the embankment. The Contractor also used a vacuum truck to collect mud that flowed into vegetation adjacent to the existing highway. Despite the actions taken by ITD and the Contractor, some of this material entered an unnamed tributary to the South Fork Mica Creek. This is the tributary just upstream of station #10that enters the South Fork Mica Creek approximately 100 meters downstream of the South Fork Mica Creek background station (station #1). The turbid water was short-lived and the Mica Creek system recovered rapidly. Elevated turbidity values for Mica Bay and Mica Creek at Loff's Bay Road Bridge following more than 0.6 inch of precipitation were back down to pre-event conditions within 2 to 4 days.

- **May 31, 2003.** Despite the best management practices (BMPs) that were implemented, extremely high precipitation in a very short period of time resulted in some challenging field conditions where BMPs were overcome and breached near the haul road and waste area (it should be noted that the rainfall was not predicted and came overnight). However, elevated turbidity values at the Mica Bay boat launch and Mica Creek at Loff's Bay Road Bridge following 1.21 inches of precipitation were short-lived and reduced to background levels within 2 days.

Turbidity monitoring in Mica Bay after the first year of construction has shown that there are periods when the creeks upstream of the bay are relatively clear, but the data in the bay can be relatively turbid. These events have been coincident with winter drawdown of the lake. One example is October 29, 2002 when turbidity at the boat launch was about 50 NTU while all creek samples that day and days immediately preceding it were about 2 NTU or less. Another example was on January 30, 2004, when turbidity at the launch was 100 NTU while upstream creek stations ranged from 11 to 36 NTU.

The chronology of elevated turbidity events in Mica Bay, South Fork and North Fork Mica Creeks, and Mica Creek described in detail in this sub-section shows that the factors that influenced elevated turbidity are complex and variable, with considerable differences in magnitude, duration, cause, and mitigating circumstances for each event. At times, the US 95 construction activities contributed substantial turbidity to the bay and creeks, but it is also apparent that there were other sources of turbidity, and other factors such as precipitation and freezing that influenced or mitigated the duration and magnitude of the events.

6.2.2.2 Comparison to Background

All streams have background turbidity, or a baseline standard for a natural amount of turbidity. The differences between turbidity readings between sites within and immediately upstream of potential project influence were evaluated to determine the periods when background conditions were exceeded.

For the South Fork Mica Creek stream stations, this background to downstream-of-project comparison was straight-forward. For the mainstem Mica Creek, both the South Fork and North Fork Mica Creek background stations were considered.

For Mica Bay, the comparison was more complicated and subjective. Turbidity in the bay can be affected by inputs from both the North Fork and South Fork, bank erosion within and runoff to the mainstem Mica Creek, resuspension of sediment from the delta, and turbidity in the outer bay/main lake that may at times be transported to the inner bay. Because there are no data available for sources of turbidity other than the upstream South Fork and North Fork Mica Creek stations, the comparison of background creek data to Mica Bay data was only valid at times when the lake level was low enough such that the boat launch sampling station in the bay was more "creek-like" than "bay-like." There was one elevated turbidity event at the boat launch station during the first year of construction that was coincident with a low enough lake level for this comparison to be made. This was an event on February 21, 2002. For this event the boat launch station value was 28.7 NTU compared to 9.8 NTU and 21.9 NTU at the South Fork and North Fork background stations, respectively. At other times, there was no applicable background data available, thus the comparison was not made.

Table 6-7 summarizes exceedances of NTU criteria for the South Fork Mica Creek and Mica Creek stations. Overall, this assessment was based on approximately 275 readings taken at each station. For comparison, the Idaho water quality standard for cold water biota states that turbidity shall not exceed background turbidity by more than 50 NTU instantaneously or more than 25 NTU for more than 10 consecutive days.

None of the monitoring sites within South Fork Mica Creek or Mica Creek had extended periods of turbidity measurements that exceeded background conditions by more than 25 NTU for more than 10 days. This does not necessarily mean that there were no such exceedances because during January 2002 there were more than 10 days without any available data. Section 6.2.2.3 further discusses the implication for periods with no turbidity measurements.

On 21 days readings on South Fork Mica Creek exceeded background conditions at a minimum of one sampling station by more than 50 NTU. On ten days instantaneous readings on Mica Creek (station #12 or station #3) exceeded background conditions of South Fork Mica Creek at a minimum of one sampling station by more than 50 NTU, and on 6 days the readings exceeded North Fork Mica Creek at a minimum of one sampling station by more than 50 NTU. In total, there were twenty-five days when readings at either South Fork Mica Creek or Mica Creek exceeded background conditions of either North Fork Mica Creek or South Fork Mica Creek. The greatest occurrence of values that exceed background conditions by more than 50 NTU was during fall 2001 through winter 2002 (i.e., seventeen days). Table 6-7 presents instantaneous turbidity readings when readings in South Fork Mica Creek and Mica Creek exceeded background conditions.

As noted earlier, there were a number of days prior to March 2002 when turbidity data were not available. Thus, it is not apparent from the measured turbidity data alone if there were periods prior to March 2002 when values exceeded criteria for more than 10 consecutive days. A qualitative analysis of these periods is provided in the section 6.2.2.3 below.

6.2.2.3 Periods With No Available Turbidity Data

As shown in Table 6-6 (located at the end of this chapter) numerous precipitation events occurred during fall 2001 through winter 2002 when there was no sampling. Table 6-8 has been provided to qualitatively describe potential turbidity conditions during periods where there are no turbidity data from fall 2001 through winter 2002. Comments are based on temperature, precipitation, available turbidity data under comparable conditions, and ITD construction diaries.

TABLE 6-7
Instantaneous Field Turbidity Readings (NTU) Exceeding Background

Date	South Fork Mica Creek Upstream of the Project (Station #1)	South Fork Mica Creek After Trib from South (Station #10)	South Fork Mica After 347 Trib (Station #24)	South Fork Mica After 350 Wall (Station #25)	South Fork Mica After 353 Fill (Station #28)	South Fork Mica After 356 Fill Trib (Station #29)	South Fork Mica Creek Midway through Project (Station #7)	South Fork Mica Creek Leaving Project (Station #2)	North Fork Mica Creek Upstream of the Project (Station #8)	Mica Creek After Confluence (Station #3)	Mica Creek at Loff's Bay Road Bridge (Station #12)	Mica Bay Boat Launch (Station #9)
10/11/01 am	NS	3.75	NS	NS	NS	NS	5.59	33.3	NS	186	NS	NS
10/12/01 pm	NS	2.08	NS	NS	NS	NS	57.9	16.3	NS	16.1	NS	NS
10/30/01		2.9**						310**				
10/31/01		40.3**				421**		112*				
11/21/01 am	NS	13.6	NS	NS	NS	NS	38.6	64.7	NS	119	NS	NS
12/14/01 am	NS	19.1	NS	NS	NS	NS	110	101	NS	84	NS	NS
1/10/02		12.3**	1265**									24.7**
2/18/02		4.5**						173**	6.0**			
2/21/02 am	NS	9.81	NS	NS	NS	NS	379	294	21.9	251	NS	28.7
3/11/02 am	NS	28.2	NS	NS	NS	NS	645	713	30.4	179	NS	161
3/12/02 am	NS	166	NS	NS	NS	NS	313	242, 242.3**	21.2, 22.4**	19.9	NS, 96.5**	72, 81.7**
3/14/02 pm	NS	74.3	NS	NS	NS	NS	68.5	125	12.9	30.5	NS	29.6
3/20/02 am	NS	21.6	NS	NS	NS	NS	102.6	91	21.1	62.4	NS	46.2
3/25/02 pm	4.62	20.1	NS	NS	NS	NS	94.3	92.2	7.9	35.2	NS	21.3
3/26/02 pm	7.18	40	NS	NS	NS	NS	181	275	18.4	106	NS	66.7
3/27/02 pm	6.81	12.4	NS	NS	NS	NS	84	104	11.6	40.2	NS	42.9
3/29/02 pm	6.42	9.65	NS	NS	NS	NS	57.1	61.3	10.8	22	NS	20.1
4/5/02 pm	6.33	7.55	NS	NS	NS	NS	59.1	48.8	9.77	15.1	20.8	7.73
4/14/02 am	71	62	NS	NS	NS	NS	73.1	83.3	176	186	213	6
11/19/2002	24.8	26.7	22.5		16.5	26.5	28	56.3	36.7	42.9	140	14.6
12/13/2002	12.4	10.5	18.4	26.1	48.5	70.4	75.7	17.4	14.6	13.6	15.2	21.5
12/14/2002	12.6	16.3	89.6	4.07	86.8	179	116	26.8	13.5	17.8	14.3	22.2
01/26/2003	35.9	333	Flooded	307	377	Flooded	291	312	54.4	97.9	106	167
02/16/2003	14.2	26.3	147	92.1	77.2	73.1	62.7	40.2	20	23.7	17.3	16.3
05/31/2003	4.54	5.13	5.76	5.56	6.67	8.97	11.6	34.2	6.4	16.2	59.5	88.2

[a]Outlined values are instances where turbidity readings within Mica Creek exceeded background conditions at North Fork Mica Creek by more than 50 NTU.
[b]Shaded values are instances where turbidity readings within Mica Creek or South Fork Mica Creek exceeded background conditions at South Fork Mica Creek by more than 50 NTU.
*Supplemental turbidity data provided by Coeur d'Alene Tribe
**Supplemental turbidity data provided by Idaho Department of Environmental Quality
NS = Not Sampled

TABLE 6-8
Periods During Fall 2001 through Winter 2002 with No Available Turbidity Data

Dates	Duration (days)	Temperature Range (degrees F)	Total Precipitation (inches)	Comments
September 22, 2001 - September 26, 2001	5	46-86	0.15	Turbidity levels downstream of the project were likely less than 10 NTU based on data for comparable climatic conditions.
September 29, 2001 - October 4, 2001	6	37-80	0	Turbidity levels downstream of the project were likely less than 10 NTU based on data for comparable climatic conditions.
October 6, 2001 – October 10, 2001	5	32-67	.25	Elevated turbidity levels may have occurred following heavy rainfall. Similar precipitation event 2 days later (0.27 inch) resulted in 186 NTU at Mica Creek (station #3). This reading was likely influenced by North Fork Mica Creek because station #2 on South Fork Mica Creek leaving the project was only 33 NTU.
October 13, 2001 – October 18, 2001	6	34-68	.38	Elevated turbidity levels may have occurred following heavy rain and snowfall which caused South Fork Mica Creek to rise 6 inches. The main precipitation event (0.26 inch) during this period occurred on October 14, 2001. As stated above, a similar precipitation volume 3 days earlier (0.27 inch) resulted in 186 NTU at Mica Creek but was likely influenced by North Fork Mica Creek.
October 20, 2001 – October 25, 2001	6	36-53	.86	Two large precipitation events resulted in backfill failures on October 23, 2001 that contributed to excess turbidity in Mica Creek. ITD construction diaries show that turbid conditions decreased noticeably within 2 days. Turbidity levels were less than 20 NTU at all sample locations downstream of the project on October 26, 2001.
October 27, 2001 – October 30, 2001	4	36-56	.39	Elevated turbidity levels may have occurred as stormwater discharge increased following a large precipitation event on October 30, 2001. Turbidity on South Fork Mica Creek leaving the project (station #2) was 112 NTU on October 31, 2001 following 0.56 inch of rain.
November 1, 2001 – November 9, 2001	9	29-61	.24	Turbidity levels at all sample locations downstream of the project were likely less than 10 NTU. Temperatures were cold and precipitation events were small.
November 10, 2001 – November 20, 2001	11	29-58	1.14	Heavy precipitation resulted in increased turbid conditions throughout the watershed. Construction diaries note several erosion control problems; however, observations in the diaries indicate that turbid conditions existed upstream of the project. This indicates that elevated turbidity levels were not entirely project related. Similar precipitation volumes during late October 2001 resulted in turbidity levels that exceeded 100 NTU on the South Fork Mica Creek (station #2).

TABLE 6-8
Periods During Fall 2001 through Winter 2002 with No Available Turbidity Data

Dates	Duration (days)	Temperature Range (degrees F)	Total Precipitation (inches)	Comments
November 22, 2001 – November 29, 2001	8	24-46	1.45	Heavy precipitation combined with the sediment basin breach likely resulted in increased turbid conditions. Turbidity data on November 21, 2001 shows that there was elevated turbidity on South Fork Mica Creek and Mica Creek (40 to 120 NTU) following 0.3 inch of precipitation. Turbidity levels may have been elevated on November 26, 2001 following a rain-on-snow event but were likely short-lived because of cold temperatures.
December 1, 2001 – December 6, 2001	6	30-46	2.35	Several large snow events occurred during this period. Turbidity likely would have peaked on December 3, 2001 because of heavy precipitation and increased temperatures. Cold temperatures for the remainder of this period reduced runoff and elevated turbidity would have been short-lived. Turbidity levels at all sample locations downstream of the project were less than 22 NTU on December 7, 2001.
December 8, 2001 - December 13, 2001	6	28-41	0.6	Construction diaries indicate that warmer weather and heavy rainfall caused all drainages around Coeur d'Alene Lake to have elevated turbidity. Peak turbidity levels on Mica Creek were likely less than 80 NTU based on data for comparable climatic conditions.
December 15, 2001 – January 24, 2002	41	17-51	2.86	Much of the precipitation in December occurred from December 14, 2001 through December 19, 2001 under cold temperatures where significant runoff was unlikely. Construction diaries note that erosion control looked good in all areas on December 18, 2001. Construction efforts were on hold from December 22, 2001 through January 6, 2002. From December 20, 2001 through January 6, 2002 temperatures were often below freezing and there were two main precipitation events (both less than 0.2 inch) that were likely snow. Therefore, although there are no diary entries to verify that erosion was minimal during this period, climatic conditions indicate that there were no rain-on-snow events or significant snowmelt that would have initiated extended periods with accelerated erosion. Turbidity likely peaked following two large rain-on-snow events with unusually warm temperatures (mid to high 40s) that occurred on January 7, 2002 -January 8, 2002. Construction diaries indicate that Bellgrove Creek and Mica Creek were near flood level under conditions similar to spring runoff on January 8, 2002. Supplemental turbidity data on January 10, 2002 provided by IDEQ show that turbidity on South Fork Mica Creek (background conditions) and just below the large sediment basin were 40 NTU and greater than 1,000 NTU, respectively. Turbidity at the Mica Bay boat launch was 24 NTU; therefore, although heavy precipitation and warm temperatures created challenging conditions with respect to project erosion, turbidity levels at Mica Bay were not severely impacted by the project.

TABLE 6-8
Periods During Fall 2001 through Winter 2002 with No Available Turbidity Data

Dates	Duration (days)	Temperature Range (degrees F)	Total Precipitation (inches)	Comments
				During the remainder of January 2002, large precipitation events occurred when temperatures were below freezing which indicate that there were no rain-on-snow events. Turbidity conditions may have been elevated around January 21, 2002 when temperatures increased and snowmelt was initiated.
January 29, 2002 – February 7, 2002	9	19-45	0.68	Temperatures were cold and the two main precipitation events were snow. Turbidity values downstream of the project were likely less than 15 NTU based on data for comparable climatic conditions.
February 9, 2002 – February 18, 2002	10	21-49	0.08	Temperatures were below freezing and there was very little precipitation. Turbidity values were likely low.
February 22, 2002 – February 25, 2002	4	16-51	0.2	Above-average temperatures and high winds may have resulted in elevated turbidity conditions due to project runoff and snowmelt throughout the watershed. Elevated turbidity conditions would have been short-lived and would have been less than 30 NTU at all sample locations analyzed based on data for comparable climatic conditions.
March 1, 2002 – March 4, 2002	4	21-43	0	There was no precipitation during this time period. Turbidity levels in and immediately upstream of Mica Bay were likely less than 10 NTU based on data for comparable climatic conditions.
March 15, 2002 – March 18, 2002	4	20-37	0.22	Below-freezing temperatures likely reduced elevated turbidity levels that were present from March 11, 2002 through March 14, 2002. Turbidity levels in Mica Bay were likely less than background levels based on data for comparable climatic conditions.

Based on the information presented in Table 6-8, there were three periods where there were 10 or more consecutive days without available turbidity data:

- November 10, 2001 through November 20, 2001
- December 15, 2001 through January 24, 2002
- February 9, 2002 through February 18, 2002

Based on ITD construction diaries and climatological conditions during these three periods, it is possible that elevated turbidity could have occurred within Mica Bay for more than 10 consecutive days on one occasion. South Fork Mica Creek and/or Mica Bay turbidity levels could have been elevated for 11 consecutive days from November 10, 2001, through November 20, 2001. During this time period heavy precipitation resulted in increased turbidity conditions that were observed throughout the area.

Based on climatological and construction information alone, it could be inferred that turbidity levels could have been elevated for more than 10 consecutive days on South Fork Mica Creek following two large rain-on-snow events with unusually warm temperatures that occurred on January 7, 2002 through January 8, 2002. However, IDEQ data showed that turbidity at the Mica Bay boat launch on January 10 was 24.7 NTU compared to 12.3 NTU upstream of the project, which indicates that elevated turbidity within Mica Bay could have only existed for less than 3 days.

6.2.2.6 Total Suspended Solids (TSS)

A total of 57 grab samples (6 separate days at approximately 12 locations within South Fork Mica Creek, North Fork Mica Creek, Mica Creek and Mica Bay each day) were collected between April 2002 and January 2004 for analysis of TSS. A reasonably good correlation exists between TSS and lab turbidity samples (R^2=0.78) for the entire data set (Figure 6-19 at the end of this chapter). The regression line appears to be strongly influenced by a single very high data point. Figure 6-20 at the end of this chapter shows the scatter plot with this high value excluded. Note that there is substantial variability for data points with turbidity values greater than 100 NTU (TSS values range from 45 to 410 mg/L). The R^2 value also drops to 0.59. Therefore, it is difficult to reliably estimate TSS values based on turbidity data.

6.2.2.7 Settleability of Project Soils

Physical information on watershed soils, including project soils, is described in detail in Chapter 3, *Sediment Analysis*. The project soils had an average silt/clay content of 44 percent. Similarly the agricultural and forest soils had an average silt/clay content of 41 percent. In contrast, instream sediment samples throughout the watershed had silt/clay fractions ranging from 1 to 2 percent. This information is further described in Chapter 11, *Conclusions*. This kind of information is relevant to the likelihood of eroded soils being deposited in Mica Creek and/or Mica Bay. In addition, a limited amount of other information is available on the settleability of soils in the Mica Creek watershed. The two other additional sources of information on settleability are: 1) several turbid runoff samples collected and analyzed by IDEQ; and 2) information on ITD and contractor attempts to settle, flocculate and filter turbid runoff streams at the project site. Each of these is described below.

The first IDEQ sample was collected on October 30, 2001, at about 3:45 p.m., from South Fork Mica Creek near Station 384. Six field-measured turbidity results at this site and time averaged 310 NTU. The sample was analyzed at the IDEQ laboratory for TSS and settleable solids. Triplicate TSS measurements had an average concentration 1,890 mg/L. The settleable solids result reported by IDEQ's lab for that same sample was 0.7 milliliter (mL). This latter result indicates that the sediment in that sample was essentially non-settleable. The volumetric settleable solids test as defined in Standard Methods (APHA, Standard Methods for Examination of Water and Wastewater, 20th Edition, 1998) consists of allowing solids in a 1-liter sample to settle for 1 hour in an inverted cone-shaped device (that is, an Imhoff cone). Results are reported in mL per L (it is assumed that these are the units reported by the IDEQ lab as mL). Thus, a result of 0.7 mL/L means that the settled volume was negligible (i.e., there are 1,000 mL in a L; thus 0.7 mL/L represents 0.07 percent).

The second IDEQ sample was collected on February 18, 2002, at 4 p.m., from drainage around the sediment pond site. Three field-measured turbidity results at this site and time averaged 958 NTU. The sample was analyzed at the IDEQ laboratory for TSS and settleable solids. The TSS concentration was 371 mg/L. The settleable solids result reported by IDEQ's lab for that same sample was less than 0.2 mL. This latter result indicates that the settleable sediment in that sample was too small to even quantify.

Another IDEQ sample was collected on October 22, 2001, at 6:15 p.m., from a small drainage at Station 356. Turbidity was not measured. Triplicate TSS analyses at the IDEQ laboratory ranged from 93,500 to 194,000 mg/L (average of 148,000). A settleable solids test was not done, but the IDEQ analyst noted: "This sample seemed to contain much heavier sediment than the other two samples submitted today. Every attempt was made to obtain a homogeneous sample but even on a stir plate, the sediment tended to drop to the bottom faster than it could be stirred." Note that the holding time was exceeded for this sample prior to TSS analyses, however, the general observation regarding settleability would not likely have been affected.

ITD collected five samples that were analyzed for TSS, turbidity, and settleable solids on February 18, 2004. Table 6-9 presents the results of this sampling event.

TABLE 6-9
February 18, 2004, TSS, Turbidity, and Settleable Solids Sampling Event

	TSS (mg/L)	Lab Turbidity (NTU)	Field Turbidity (NTU)	Settleable Solids (ml/L)
Station #1 South Fork Mica Creek Background	180	85	95	0.7
Station #2 South Fork Mica Creek Leaving Project	95	66	72	0.2
Station #8 North Fork Mica Creek Background	120	61	64	0.5
Station #9 Mica Bay Boat Launch	250	106	117	0.8
Station #12 Mica Creek at Loff's Bay Road Bridge	120	58	58	0.2

The results above suggest that runoff containing very high TSS concentrations is likely to contain a substantial fraction of settleable sediment. Runoff containing relatively lower concentrations, more in line with the higher values measured in South Fork Mica Creek, are likely to contain a much lower fraction of sediment that is settleable.

In spring 2002, ITD contracted with Natural Site Solutions (NSS) of Redmond, Washington, to install a flocculent (chitosan) treatment system at the project site. This specialized treatment system was brought in to help control unexpected and pervasive problems with poor settleability of finer silt/clay fraction of soils eroded from construction areas. This finer fraction of the soils was not settling adequately in existing BMPs at the site. The treatment system installed included a pre-flocculation and gravity settling process followed by further flocculation and sand filtration. Stormwater runoff samples were collected for system design treatability studies. These samples had been allowed to settle for more than 72 hours yet still had turbidity levels greater than 1,000 NTU (estimated to be 2,350 NTU).

6.3 Conclusions

Turbidity is a term commonly used to describe the appearance of water (cloudy, muddy, or colored). It is also a scientific unit of measurement quantifying the degree to which light traveling through a water sample is scattered by the suspended organic (including algae) and inorganic particles. The scattering of light increases as the concentration of particles increases. Turbidity is commonly measured in Nephelometric Turbidity Units (NTU). There are other ways to measure the concentration of soils and sediments in water. These include total suspended solids and suspended sediment methods. These are usually reported as milligrams of solids or sediment per liter of water (mg/L).

IDEQ criteria for turbidity restrict the increase to no more than 50 NTU above background on an instantaneous basis, and to no more than 25 NTU over background for 10 consecutive days or more.

There were 21 days from September 2001 through September 2003 on which instantaneous turbidity readings on South Fork Mica Creek exceeded upstream background conditions, at a minimum of one sampling station, by more than 50 NTU. On 10 individual days, instantaneous readings on Mica Creek exceeded background conditions of South Fork Mica Creek, at a minimum of one sampling station, by more than 50 NTU, and on 6 days the readings exceeded conditions of North Fork Mica Creek, at a minimum of one sampling station, by more than 50 NTU. In total, there were 25 days when readings at either South Fork Mica Creek or Mica Creek exceeded background conditions of either North Fork Mica Creek or South Fork Mica Creek. The greatest occurrence of values that exceed background conditions by more than 50 NTU was during fall 2001 through winter 2002 (17 days). There were fewer measured turbidity events in Mica Bay, with most data indicating that levels in Mica Bay tended to be about 25 percent of the values measured in the project-influenced reaches of the South Fork Mica Creek.

None of the monitoring sites within South Fork Mica Creek or Mica Creek had extended periods during which turbidity measurements that exceeded background conditions by more than 25 NTU lasted for more than 10 days. Available turbidity data also does not reveal any events of elevated turbidity in Mica Bay lasting 10 days or longer. This does not necessarily mean that there were no such exceedances in the creeks or bay because there were several periods prior to March of 2002 when there were more than 10 days without available turbidity data. ITD construction diaries and climatological information were examined to qualitatively evaluate the potential for prolonged elevated turbidity during periods without measured data. Considering all information, more than 10 days of elevated turbidity could likely only have occurred on one occasion (11 days from November 10 through November 20, 2001).

Based on measured turbidity data, elevated levels that were influenced by the project returned to levels that were comparable to pre-event or background conditions in no more than 9 days, and usually much sooner.

Information on watershed soils shows that soils from the project were similar in physical characteristics to other soils, and contained a much higher fraction of silt/clay (approximately 40 percent) than in-creek sediment samples (1 to 2 percent silt/clay). Most project area runoff samples tested for settleability showed very poor settleability.

In addition, turbidity data collected show that turbidity levels within the watershed naturally fluctuate and are influenced by factors other than construction activity such as agriculture, logging, and eroding stream banks. There were also occasions when turbidity levels at the sampling location in the bay were higher than upstream in the South Fork and North Fork Mica Creek and the mainstem Mica Creek; this generally occurred during the winter drawdown of Coeur d'Alene Lake.

Table 6-3 Instantaneous field turbidity readings (NTU)

Date	South Fork Mica Creek upstream of the U.S. 95 project (Station #1)	South Fork Mica Creek After Trib from South (Station #10)	South Fork Mica After 347 Trib (Station #24)	South Fork Mica After 350 Wall (Station #25)	South Fork Mica After 353 Fill (Station #28)	South Fork Mica After 356 Fill Trib (Station #29)	South Fork Mica Creek Midway through Project (Station #7)	South Fork Mica Creek Leaving Project (Station #2)	North Fork Mica Creek upstream of the U.S. 95 project (Station #8)	Mica Creek After Confluence (Station #3)	Mica Creek at Loff's Bay Road Bridge (Station #12)	Mica Bay Boat Launch (Station #9)
9/21/01 am	NS	3.35	NS	NS	NS	NS	NS	1.74	NS	2.1	NS	NS
9/27/01 am	NS	3.19	NS	NS	NS	NS	NS	2.4	NS	2.46	NS	NS
9/28/01 am	NS	2.26	NS	NS	NS	NS	NS	2.24	NS	2.33	NS	NS
10/5/01 am	NS	26.2	NS	NS	NS	NS	NS	1.78	NS	1.81	NS	NS
10/11/01 am	NS	3.75	NS	NS	NS	NS	5.59	33.3	NS	186	NS	NS
10/12/01 pm	NS	2.08	NS	NS	NS	NS	57.9	16.3	NS	16.1	NS	NS
10/19/01 pm	NS	1.35	NS	NS	NS	NS	8.11	15.6	NS	6.99	NS	NS
10/26/01 pm	NS	1.45	NS	NS	NS	NS	18.6	13.2	NS	16.3	NS	NS
10/30/01		2.9**						310**				
10/31/01		40.3**				421**		112*				
11/9/01 am	NS	1.67	NS	NS	NS	NS	6.15	6.25	NS	6.6	NS	NS
11/21/01 am	NS	13.6	NS	NS	NS	NS	38.6	64.7	NS	119	NS	NS
11/30/01 am	NS	13.1	NS	NS	NS	NS	18.7	23.4	NS	23.7	NS	NS
12/7/01 am	NS	12.4	NS	NS	NS	NS	18.4	20.1	NS	21.1	NS	NS
12/14/01 am	NS	19.1	NS	NS	NS	NS	110	101	NS	84	NS	NS
1/10/02		12.3**	1265**									24.7**
1/25/02								113*		44.6*		
1/28/02								151*				
2/8/02 am	NS	12	NS	NS	NS	NS	5.4	11	6.11	12.2	NS	11.1
2/18/02		4.5**						173**	6.0**			
2/19/02 am	NS	4.4	NS	NS	NS	NS	22.9	12.8	6.62	12.5	NS	18.5
2/21/02 am	NS	9.81	NS	NS	NS	NS	379	294	21.9	251	NS	28.7
2/26/02 am	NS	20.9	NS	NS	NS	NS	18.9	25.2	16.2	7.8	NS	12.4
2/28/02 am	NS	12.9	NS	NS	NS	NS	9.41	8.99	7.1	7.3	NS	15.4
3/5/02 am	NS	14.4	NS	NS	NS	NS	40	11.1	5.17	7.96	NS	8.04
3/7/02 am	NS	13.2	NS	NS	NS	NS	12.4	10.4	7.4	7.2	NS	20.3
3/11/02 am	NS	28.2	NS	NS	NS	NS	645	713	30.4	179	NS	161
3/12/02 am	NS	166	NS	NS	NS	NS	313	242, 242.3**	21.2, 22.4**	19.9	NS, 96.5**	72, 81.7**
3/14/02 pm	NS	74.3	NS	NS	NS	NS	68.5	125	12.9	30.5	NS	29.6
3/19/02 am	NS	7.7	NS	NS	NS	NS	13.1	12.8	5.36	7.22	NS	11.9
3/20/02 am	NS	21.6	NS	NS	NS	NS	102.8	91	21.1	62.4	NS	46.2
3/21/02 am	NS	6.49	NS	NS	NS	NS	15.2	14.3	7.09	9.74	NS	10.3
3/25/02 pm	4.62	20.1	NS	NS	NS	NS	94.3	92.2	7.9	35.2	NS	21.3
3/26/02 am	3.77	6.21	NS	NS	NS	NS	16.9	18.5	5.79	11	NS	8.57
3/26/02 pm	7.18	40	NS	NS	NS	NS	181	275	18.4	106	NS	66.7
3/27/02 am	5.67	8.65	NS	NS	NS	NS	30.2	31.6	9.55	18.1	NS	11.2
3/27/02 pm	6.81	12.4	NS	NS	NS	NS	84	104	11.6	40.2	NS	42.9
3/28/02 am	5.15	7.36	NS	NS	NS	NS	25.4	22.7	8.34	13.1	NS	14.4
3/28/02 pm	10.2	16.3	NS	NS	NS	NS	120	131	20.8	49.7	NS	9.99
3/29/02 am	6.2	8.52	NS	NS	NS	NS	19.2	19.7	9.39	13.6	NS	11.2
3/29/02 pm	6.42	9.65	NS	NS	NS	NS	57.1	61.3	10.8	22	NS	20.1
4/1/02 am	6.87	8.06	NS	NS	NS	NS	17.5	19.3	7.85	10.8	15	10.1
4/1/02 pm	10.4	10.6	NS	NS	NS	NS	45.8	40.8	14.9	18.2	21.4	7.86
4/2/02 am	6.48	7.03	NS	NS	NS	NS	25.6	28.1	7.59	11.1	12.9	11.8
4/2/02 pm	6.26	7.57	NS	NS	NS	NS	26.1	24.3	7.56	14.5	16.5	9.93

Table 6-3 Instantaneous field turbidity readings (NTU)

Date	South Fork Mica Creek upstream of the U.S. 95 project (Station #1)	South Fork Mica Creek After Trib from South (Station #10)	South Fork Mica After 347 Trib (Station #24)	South Fork Mica After 350 Wall (Station #25)	South Fork Mica After 353 Fill (Station #28)	South Fork Mica After 356 Fill Trib (Station #29)	South Fork Mica Creek Midway through Project (Station #7)	South Fork Mica Creek Leaving Project (Station #2)	North Fork Mica Creek upstream of the U.S. 95 project (Station #8)	Mica Creek After Confluence (Station #3)	Mica Creek at Loff's Bay Road Bridge (Station #12)	Mica Bay Boat Launch (Station #9)
4/3/02 am	5.7	6.98	NS	NS	NS	NS	15.7	15.9	6.89	10.6	10.7	8.89
4/3/02 pm	5.98	7.08	NS	NS	NS	NS	30.7	27.6	7.92	13.7	17.2	10.3
4/4/02 am	6.37	5.69	NS	NS	NS	NS	15.2	14.9	6.72	11	12.2	9
4/4/02 pm	6.3	7.01	NS	NS	NS	NS	25.6	25.1	8.78	13.1	16.2	8.48
4/5/02 am	5.48	6.15	NS	NS	NS	NS	14.7	13	7.91	9	9.82	4.05
4/5/02 pm	6.33	7.55	NS	NS	NS	NS	59.1	48.8	9.77	15.1	20.8	7.73
4/7/02 am	11.4	11	NS	NS	NS	NS	20.3	30.4	14.9	14.4	19.2	8.41
4/8/02 am	11.8	9.57	NS	NS	NS	NS	14.5	15.5	11.6	12.3	12.5	10.5
4/8/02 pm	7.82	9.19	NS	NS	NS	NS	15.7	20.7	11	13.2	14.5	4.7
4/9/02 am	7.26	7.24	NS	NS	NS	NS	11.6	12.3	9.42	9.84	12.3	3.05
4/9/02 pm	7.36	8.7	NS	NS	NS	NS	13.6	14.8	8.82	11.2	13.4	6.23
4/10/02 am	10.2	10	NS	NS	NS	NS	13.6	13.7	13.1	12.7	17.3	5.96
4/10/02 pm	34.5	39.1	NS	NS	NS	NS	58.4	69.7	33.7	43.5	65.1	5.43
4/11/02 am	13.2	11.8	NS	NS	NS	NS	16.1	18.9	14.4	14.8	18	7.91
4/11/02 pm	11.5	12.2	NS	NS	NS	NS	17.6	20.1	12.1	13.8	16.3	5.02
4/12/02 am	16.4	14.8	NS	NS	NS	NS	17.1	19.4	15	16.6	17.6	3.58
4/12/02 pm	20.9	17.6	NS	NS	NS	NS	23	22.7	19.7	20.6	21.1	2.92
4/13/02 am	34.8	33	NS	NS	NS	NS	34.8	44.4	33.8	33.2	42.2	16.7
4/14/02 am	71	62	NS	NS	NS	NS	73.1	83.3	176	186	213	6
4/15/02 am	22.1	21.3	NS	NS	NS	NS	27	25.6	37.4	38.2	34.7	9.06
4/15/02 pm	16.3	15.4	NS	NS	NS	NS	25.9	26.7	26.4	28.5	39.1	17.1
4/16/02 am	13.1	12.2	NS	NS	NS	NS	16.3	19.1	18.8	20.1	19.8	5.25
4/16/02 pm	9.9	11	NS	NS	NS	NS	15.4	17.3	14.9	17.1	16.1	5.2
4/17/02 am	8.3	8.1	NS	NS	NS	NS	10	12.3	11.6	12.3	11.6	6.1
4/17/02 pm	8.9	8.3	NS	NS	NS	NS	15.7	19.6	11	9.2	9.8	6.9
4/18/02 am	5.2	7.6	NS	NS	NS	NS	6.9	10.2	9.7	7.1	9.6	3.1
4/18/02 pm	4.9	7.1	NS	NS	NS	NS	9.7	13.3	10.3	13	9.1	3.9
4/19/02 am	4.4	6.1	NS	NS	NS	NS	8.2	7.5	8.4	6.4	7.8	2.9
4/19/02 pm	7.05	6.55	NS	NS	NS	NS	9.43	11.7	10.6	10.7	8.44	5.21
4/22/02 am	6.45	7.14	NS	NS	NS	NS	8.04	8.28	7.41	7.37	6.96	2.22
4/22/02 pm	6.24	6.39	NS	NS	NS	NS	8.15	10.2	8.86	9.28	8.75	4.2
4/23/02 am	6.08	5.85	NS	NS	NS	NS	7.29	7.49	6.55	5.98	6.24	3.73
4/23/02 pm	5.22	5.28	NS	NS	NS	NS	8.01	34	7.42	11.5	9.4	2.83
4/24/02 am	5.29	5.11	NS	NS	NS	NS	7.76	7.64	5.54	6.75	6.28	1.79
4/24/02 pm	7.09	5.22	NS	NS	NS	NS	7.39	10.1	6.37	7.74	9.88	3.6
4/25/02 am	5.5	8.3	NS	NS	NS	NS	8.2	8.1	5.9	6.9	6.3	4.3
4/25/02 pm	5.6	4.5	NS	NS	NS	NS	8.1	7.7	5.3	6.6	6.8	6.2
4/26/02 am	6.4	5.7	NS	NS	NS	NS	6.6	6.7	4.5	5.6	5.4	8.6
4/26/02 pm	4.7	5.2	NS	NS	NS	NS	9.2	9.7	5.1	6.5	5.4	7.7
4/29/02 am	4.73	4.77	NS	NS	NS	NS	6.22	6.43	4.98	5.1	6.37	8.65
4/29/02 pm	5.16	4.47	NS	NS	NS	NS	6.62	6.88	4.4	5.72	5.6	7.99
4/30/02 am	4.99	4.75	NS	NS	NS	NS	6.5	6.43	4.72	6.35	5.68	7.06
4/30/02 pm	5.74	5.62	NS	NS	NS	NS	6.45	6.49	5.68	5.9	6.31	8.28
5/1/02 am	5.7	5.5	NS	NS	NS	NS	6.8	5.9	5.2	5.2	5.9	7.9
5/1/02 pm	5.19	4.56	NS	NS	NS	NS	5.81	5.5	6.3	5.78	6.17	6.3
5/2/02 am	5.73	6.04	NS	NS	NS	NS	5.5	6.34	5.36	5.36	7.23	7.39

Table 6-3 Instantaneous field turbidity readings (NTU)

Date	South Fork Mica Creek upstream of the U.S. 95 project (Station #1)	South Fork Mica Creek After Trib from South (Station #10)	South Fork Mica After 347 Trib (Station #24)	South Fork Mica After 350 Wall (Station #25)	South Fork Mica After 353 Fill (Station #28)	South Fork Mica After 356 Fill Trib (Station #29)	South Fork Mica Creek Midway through Project (Station #7)	South Fork Mica Creek Leaving Project (Station #2)	North Fork Mica Creek upstream of the U.S. 95 project (Station #8)	Mica Creek After Confluence (Station #3)	Mica Creek at Loff's Bay Road Bridge (Station #12)	Mica Bay Boat Launch (Station #9)
5/2/02 pm	7.91	7.34	NS	NS	NS	NS	7.33	8.09	8.37	7.95	7.07	6.9
5/3/02 am	6.54	5.41	NS	NS	NS	NS	7.04	5.91	5.87	5.6	6.77	5.21
5/3/02 pm	5.26	4.68	NS	NS	NS	NS	5.75	6.01	5.86	6.03	6.51	3.95
5/6/02 am	5.16	5.1	NS	NS	NS	NS	6.72	6.75	4.5	5.2	5.61	5.04
5/6/02 pm	4.41	3.78	NS	NS	NS	NS	4.53	4.86	4.57	5.36	4.41	4.32
5/7/02 am	3.41	4.01	NS	NS	NS	NS	4.48	5.22	3.91	4.56	4.1	4.41
5/7/02 pm	3.61	3.42	NS	NS	NS	NS	4.85	4.73	4.51	3.96	4.03	4.37
5/8/02 am	4.28	5.2	NS	NS	NS	NS	5.96	5.52	3.46	5.21	3.63	4.47
5/8/02 pm	3.48	3.84	NS	NS	NS	NS	4.58	4.59	3.57	4.49	3.75	4.27
5/9/02 am	4.27	4.21	NS	NS	NS	NS	5.02	4	3.42	4.01	4.05	4.8
5/9/02 pm	3.86	3.41	NS	NS	NS	NS	5.27	4.62	4.64	4.53	4.64	3.99
5/10/02 am	2.85	3.12	NS	NS	NS	NS	4.71	4.51	3.8	3.73	4.02	4.38
5/10/02 pm	3.93	4.04	NS	NS	NS	NS	4.93	4.6	3.97	5.48	4.29	4.6
5/13/02 am	3.26	3.72	NS	NS	NS	NS	4.91	4.42	3.59	3.62	4.3	4.09
5/13/02 pm	3.84	4.19	NS	NS	NS	NS	4.74	4.63	4.4	4.47	7.16	4.58
5/14/02 am	3.22	3.91	NS	NS	NS	NS	4.74	3.91	4.31	3.87	4.51	3.97
5/14/02 pm	3.35	3.61	NS	NS	NS	NS	4.39	4.84	3.82	4.16	5.2	3.84
5/15/02 am	3.52	3.65	NS	NS	NS	NS	4.12	3.44	3.2	3.05	3.05	3.71
5/15/02 pm	2.72	3.75	NS	NS	NS	NS	3.71	4.09	3.5	3.55	3.51	3.01
5/16/02 am	2.88	2.95	NS	NS	NS	NS	11.6	7.01	2.89	4.25	4.9	3.72
5/16/02 pm	4.15	3.02	NS	NS	NS	NS	5.59	5.15	3.12	3.79	3.83	3.4
5/17/02 am	3.49	3.36	NS	NS	NS	NS	5.91	4.74	3.73	3.53	3.18	3.73
5/17/02 pm	4	4.12	NS	NS	NS	NS	5.69	5.8	4.33	4	4.43	3.85
5/20/02 am	5.38	6.61	NS	NS	NS	NS	13	6.89	4.88	5.21	5.23	6.93
5/20/02 pm	3.21	3.15	NS	NS	NS	NS	9.19	7.61	4.05	5.26	5.58	3.16
5/21/02 am	4.07	3.6	NS	NS	NS	NS	6.07	5.79	4.61	4.58	4.81	2.56
5/21/02 pm	2.82	2.95	NS	NS	NS	NS	4.65	4.37	4.26	3.78	3.89	3.68
5/22/02 am	5.66	6.32	NS	NS	NS	NS	8.66	4.95	9.52	8.74	4.83	2.65
5/22/02 pm	21.7	19.2	57.9	52.8	52.2	49.1	67.6	53.9	33.3	35.1	37.2	3.06
05/23/2002	5.43	4.46	7.67	6.36	5.77	6.33	7.54	6.83	6.61	6.31	5.22	3.35
05/24/2002	3.66	3.85	6.51	7.67	5.52	5.4	8.45	5.14	3.71	4.74	4.35	2.66
05/28/2002	4.58	4.18	5.33	5.63	6.55	6.47	10.5	10.5	5.47	6.38	6.21	3.39
05/29/2002	3.24	3.56	4.74	6.13	5.22	4.92	6.38	5.84	4.16	5.16	3.78	2.65
05/30/2002	3.49	3.06	7.27	5.93	4.84	4.63	5.58	5.86	4.87	5.02	3.17	5.35
05/31/2002	2.86	2.6	4.72	4.18	4.45	4.6	5.09	4.18	4.77	4.93	3.12	6.2
06/03/2002	2.86	2.32	3.04	3.39	4.46	3.57	4.31	4.52	4.26	4.46	3.57	2.38
06/04/2002	2.79	2.54	3.73	3.94	3.93	4.23	4.03	4.68	3.56	3.93	2.79	2.85
06/05/2002	2.57	2.45	3.11	3.53	4.37	3.86	4.87	4.26	4.13	4.21	3.65	3.15
06/06/2002	2	2.03	2.15	2.95	3.36	3.38	4.31	4.07	2.84	4.26	2.63	2.81
06/07/2002	2.3	2.35	3.05	2.36	3.06	2.57	3.26	3.47	2.8	2.49	1.96	2.38
06/08/2002	2.98	1.95	2.49	2.5	3.01	3.12	3.36	3.43	2.64	2.67	2.23	3.28
06/10/2002	2.02	1.76	2.98	2.46	2.99	2.95	3.53	2.88	2.85	2.84	2.35	3.98
06/11/2002	2.17	2.09	2.76	2.45	3.13	2.9	2.83	3.79	2.46	2.59	2.1	2.43
06/13/2002	2.65	2.34	2.18	2.43	2.6	3.14	3.18	2.88	2.61	3.16	2.04	1.76
06/14/2002	1.82	1.81	2.17	2.16	2.5	3.33	2.88	2.69	2.13	2.32	3.13	1.34
06/17/2002	2.17	1.75	2.97	2.61	2.81	2.4	3.8	2.66	1.91	2.13	2.2	2.41

Table 6-3 Instantaneous field turbidity readings (NTU)

Date	South Fork Mica Creek upstream of the U.S. 95 project (Station #1)	South Fork Mica Creek After Trib from South (Station #10)	South Fork Mica After 347 Trib (Station #24)	South Fork Mica After 350 Wall (Station #25)	South Fork Mica After 353 Fill (Station #28)	South Fork Mica After 356 Fill Trib (Station #29)	South Fork Mica Creek Midway through Project (Station #7)	South Fork Mica Creek Leaving Project (Station #2)	North Fork Mica Creek upstream of the U.S. 95 project (Station #8)	Mica Creek After Confluence (Station #3)	Mica Creek at Loff's Bay Road Bridge (Station #12)	Mica Bay Boat Launch (Station #9)
06/18/2002	2.73	2.38	3.45	NS	4.29	4.77	6.69	24.9	4.53	7.77	4.93	3.62
06/19/2002	2.58	2.7	2.92	NS	3.3	3.62	3.07	3.31	3.02	2.62	3.41	2.53
06/20/2002	2.09	2.24	2.33	NS	2.51	3.33	2.9	2.42	2.18	1.92	2.19	1.83
06/21/2002	2.16	1.96	3.53	2.57	2.22	3.45	2.54	2.16	1.94	2.04	2.01	1.76
06/24/2002	2.64	2.38	2.77	2.66	2.7	2.49	2.62	4.29	1.53	1.89	2.14	1.94
06/25/2002	2.01	1.69	2.52	2.96	2.44	3.68	2.66	2.74	2.1	1.91	2.24	1.42
06/26/2002	2.33	2.16	3	2.21	2.65	2.72	3.56	2.6	1.57	1.56	1.85	1.47
06/27/2002	2.12	1.72	2.33	2.15	2.91	3.44	3.28	2.84	1.92	2.14	2.13	1.94
06/28/2002	3.08	2.11	2.4	2.71	2.38	2.86	3.2	3.88	1.74	2.02	1.8	1.66
06/29/2002	5.34	3.63	3.82	NS	4.32	4.42	4.17	5.39	3.1	3.2	10.2	1.86
07/01/2002	2.22	1.89	2.33	NS	2.72	2.95	3.05	2.91	2.64	2.45	2.25	2.99
07/02/2002	2.12	1.97	2.24	NS	2.45	2.58	2.86	2.51	2.08	2.22	2.41	1.68
07/03/2002	2.1	1.65	2.9	2.84	2.24	2.19	2.59	2.44	1.77	1.88	1.55	1.38
07/05/2002	4.63	2.04	2.23	2.02	1.99	2.07	2.02	2.31	1.51	1.91	1.77	1.7
07/08/2002	2.39	1.91	2.54	NS	3.12	2.58	2.06	2.92	1.86	2.46	1.61	1.54
07/11/2002	3.13	2.28	3.35	NS	2.11	2.66	2.18	2.46	1.89	2.66	4.2	2.05
07/15/2002	2.16	1.78	2.05	NS	1.93	3.42	2.74	2.92	1.41	1.97	6.45	1.81
07/18/2002	3.83	2.43	2.58	NS	2.1	3.27	1.95	2.42	1.38	1.86	3.23	1.95
07/22/2002	3	1.89	NS	NS	NS	2.07	2.19	2.53	1.19	2.28	2.7	1.47
07/25/2002	1.76	1.94	NS	NS	NS	NS	2.42	2.45	2.01	2.24	2.44	1.08
07/29/2002	3.49	1.97	NS	NS	NS	NS	3.27	2.77	1.45	1.79	2.27	0.44
08/02/2002	2.5	1.58	NS	NS	NS	NS	3.08	2.39	1.94	1.44	2.02	1.31
08/05/2002	5.29	2.08	NS	NS	NS	NS	2.04	2.6	2.34	1.89	1.93	0.74
08/08/2002	2.47	2.12	NS	NS	NS	NS	2.11	2.29	1.22	1.72	2.02	0.87
08/13/2002	1.84	2.7	NS	NS	NS	NS	2.56	3.98	1.28	2.54	2.61	1.4
08/15/2002	1.79	2.54	NS	NS	NS	NS	5.41	2.8	1.58	2.21	2.42	0.63
08/19/2002	2.16	2.05	NS	NS	NS	NS	4.11	1.62	2.04	1.96	1.64	1.43
08/22/2002	2.65	1.68	NS	NS	NS	NS	2.47	2.31	2.02	1.76	2.12	1.19
08/26/2002	3.19	9.04	NS	NS	NS	NS	3.73	2.69	1.78	2.31	2.95	1.22
08/29/2002	164	178	NS	NS	NS	NS	39.9	66.9	5.1	46.1	2.39	0.84
08/30/2002	12.4	10.8	NS	NS	NS	NS	17.6	19.9	1.77	6.71	7	1.04
09/03/2002	4.36	3.05	NS	NS	NS	NS	3.56	3.1	2.43	3.59	2.58	1.14
09/05/2002	4.01	2.4	NS	NS	NS	NS	3.88	2.76	1.63	2	2.02	0.81
09/09/2002	4.38	11.2	NS	NS	NS	NS	3.36	2.5	1.93	1.89	3.82	0.95
09/12/2002	2.9	2.8	NS	NS	NS	NS	3.41	3.7	1.52	1.82	2.44	0.91
09/16/2002	3.04	2.76	NS	NS	NS	NS	2.3	3.27	5.5	9.02	2.72	1.04
09/17/2002	3.63	3.67	NS	NS	NS	NS	4.3	2.57	2.36	2.77	3.77	1.09
09/20/2002	2.33	2.37	NS	NS	NS	NS	3	1.94	1.26	1.84	2.17	2.72
09/23/2002	2.6	2.92	NS	NS	NS	NS	2.46	2.15	1.71	1.45	2.01	1
09/26/2002	2.73	2.58	NS	NS	NS	NS	2.47	2.34	1.87	1.78	3.18	1.13
10/01/2002	2.2	3.69	NS	NS	NS	NS	2.66	1.75	1.22	1.44	6.02	1.01
10/03/2002	2.61	2.4	NS	NS	NS	NS	2.57	1.84	1.01	1.25	2.09	0.72
10/07/2002	3.15	2.53	NS	NS	NS	NS	2.23	1.89	1.13	1.29	1.91	0.93
10/10/2002	3.05	2.73	NS	NS	NS	NS	2.94	1.96	1.28	1.54	2.08	0.89
10/14/2002	1.68	1.77	NS	NS	NS	NS	1.91	1.83	1.17	1.38	2.05	0.97
10/17/2002	1.84	1.93	NS	NS	NS	NS	2.32	1.68	1.35	1.57	2.64	1.14

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Table 6-3 Instantaneous field turbidity readings (NTU)

Date	South Fork Mica Creek upstream of the U.S. 95 project (Station #1)	South Fork Mica Creek After Trib from South (Station #10)	South Fork Mica After 347 Trib (Station #24)	South Fork Mica After 350 Wall (Station #25)	South Fork Mica After 353 Fill (Station #28)	South Fork Mica After 356 Fill Trib (Station #29)	South Fork Mica Creek Midway through Project (Station #7)	South Fork Mica Creek Leaving Project (Station #2)	North Fork Mica Creek upstream of the U.S. 95 project (Station #8)	Mica Creek After Confluence (Station #3)	Mica Creek at Loff's Bay Road Bridge (Station #12)	Mica Bay Boat Launch (Station #9)
10/21/2002	1.98	1.69	NS	NS	NS	NS	2.58	2.02	1.03	1.21	1.74	1.9
10/24/2002	2.74	1.79	NS	NS	NS	NS	2.32	1.97	2.04	1.82	2.27	2.2
10/28/2002			NS	NS	NS	NS	1.82	1.53	1.58	1.41	5.1	1.99
10/29/2002	1.7	1.35	NS	NS	NS	NS	1.39	1.55	1.11	1.2	2.25	49.6
11/05/2002	F	F	NS	NS	NS	NS	F	F	F	F	F	3.3
11/08/2002	39.9	38.7	NS	NS	NS	NS	16.7	15.9	25	19.6	25.8	19.1
11/11/2002	4.04	3.87	NS	NS	NS	NS	3.91	4.15	2.25	4.2	4.92	4.32
11/12/2002	2.58	2.31	NS	NS	NS	NS	3.04	4.79	5.72	5.24	4.4	4.26
11/14/2002	2.71	3.5	3.84	8.73	6.28	7.19	3.41	3.27	2.11	3.25	3.55	6.35
11/19/2002	24.8	26.7	22.5		16.5	26.5	28	56.3	36.7	42.9	140	14.6
11/21/2002	3.29	3.07	4.65	4.07	5.29	5.44	5.5	7.81	2.81	3.79	6.34	10.6
11/23/2002	2.42	2.28	2.69	2.67	2.73	2.9	2.68	2.85	1.73	1.74	2.35	2.24
11/25/2002	2.05	2.15	3.17	2.62	3.15	2.79	2.8	2.43	2.49	F	F	9
12/03/2002	F	F	F	2.13	2.69	2.88	2.18	2.55	2.2	3.12	8.19	4.87
12/05/2002	2.01	1.83	2.06	2.1	2.35	2.51	2.3	2.41	1.42	1.62	3.91	5.83
12/09/2002	3.25	2.51	NS	2.25	2.81	2.5	2.25	2.22	1.78	1.53	4.43	4.71
12/10/2002	2.09	2.48	2.81	2.21	3.23	3.31	2.73	3.7	2.43	1.84	5.37	4.47
12/12/2002	2.72	2.53	3.64	3.7	3.44	5.49	3.54	2.84	1.92	2.7	10.9	6.09
12/13/2002	12.4	10.5	18.4	26.1	48.5	70.4	75.7	17.4	14.6	13.6	15.2	21.5
12/14/2002	12.6	16.3	89.6	4.07	86.8	179	118	26.8	13.5	17.8	14.3	22.2
12/15/2002	7.11	6.89	8.73	9.24	10.6	14.8	15.4	16.6	9.02	14.3	13.8	15.9
12/16/2002	10.2	10.2	19.7	34	36.1	42.5	46.1	46.8	33.8	37	32.6	18.6
12/18/2002	4.24	4.12	5.96	7.04	8.15	8.28	7.37	6.46	7.53	7.41	8.35	12.1
12/23/2002	F	F	F	3.19	2.73	3.83	3.21	3.57	2.42	3.02	3.72	4.26
12/26/2002	F	F	F	2.52	2.74	2.63	2.41	2.76	3.14	F	F	F
12/27/2002	F	F	F	2.65	4.24	6.96	4.88	7.64	4.06	4.75	4.49	F
12/29/2002	F	F	F	7.92	9.42	11.1	10.8	14.3	8.77	9.88	12.5	F
12/31/2002	F	F	F	10.4	10.7	12.6	10.6	11.9	6.8	7.77	8.16	F
01/02/2003	6.24	7.2	8.79	7.66	10.6	11.5	9.11	9.14	8.53	7.98	8.05	F
01/06/2003	6.16	6.6	8.24	7.78	8.49	9.53	9.32	11.3	9.13	10.2	10.1	10.4
01/09/2003	4.27	4.13	5.44	5	5.56	6.39	5.86	6.61	5.95	5.84	7.08	9.27
01/12/2003	F	F	F	F	4.96	5.56	5.42	5.69	4.67	5.53	6.65	F
01/13/2003	F	F	F	F	5.93	6.27	5.04	5.83	4.98	4.74	6.69	F
01/14/2003	5.81	5.99	9.75	8.47	8.84	10.1	9.6	10.5	7.5	7.82	8.19	9.76
01/16/2003	4.37	4.1	5.65	5.12	6.23	7.62	6.71	6.88	5.84	7.23	8.77	7.4
01/20/2003	3.43	3.76	4.78	4.32	5.14	6.82	5.24	5.81	5.18	4.78	5.1	6.8
01/22/2003	4.24	4.08	6.83	4.89	5.09	5.73	4.83	5.49	4.16	4.48	5.11	5.92
01/26/2003	35.9	333	Flooded	307	377	Flooded	291	312	54.4	97.9	106	167
01/28/2003	10.4	12.4	18.1	14.6	18.7	19.2	17.5	21	12.6	15.7	16.1	17.2
01/29/2003	9.64	50.9	NS	NS	Dark	NS	55.3	31.5	12.2	17.6	18.9	13
01/30/2003	10.4	12.3	13.3	19.1	18.3	18.2	21.2	22.2	13.7	14.4	15.9	16.9
01/31/2003	15.3	24.2	Flooded	46	42.8	40.7	39.6	40	21.6	27.9	28.8	4.44
02/03/2003	7.63	9.53	28.9	22.5	23	23.3	23.8	20.5	10.1	13.3	12.2	5.76
02/08/2003	5.21	5.33	6.4	6.08	6.16	7.04	7.41	8.65	6.16	6.41	6.09	3.87
02/11/2003	5.38	5.76	7.52	5.85	6.24	6.96	6.79	7.92	12.5	11	7.26	3.93

Table 6-3 Instantaneous field turbidity readings (NTU)

Date	South Fork Mica Creek upstream of the U.S. 95 project (Station #1)	South Fork Mica Creek After Trib from South (Station #10)	South Fork Mica After 347 Trib (Station #24)	South Fork Mica After 350 Wall (Station #25)	South Fork Mica After 353 Fill (Station #28)	South Fork Mica After 356 Fill Trib (Station #29)	South Fork Mica Creek Midway through Project (Station #7)	South Fork Mica Creek Leaving Project (Station #2)	North Fork Mica Creek upstream of the U.S. 95 project (Station #8)	Mica Creek After Confluence (Station #3)	Mica Creek at Loff's Bay Road Bridge (Station #12)	Mica Bay Boat Launch (Station #9)
06/17/2003	2.86	3.14	3.23	3.54	3.38	3.72	3.32	2.81	1.95	1.93	3.03	1.83
06/24/2003	2.05	2.19	5.92	3.74	2.39	2.82	2.93	2.45	1.52	1.93	2.58	1.72
06/27/2003	5.09	6.31	8.21	4.23	3.47	3.68	3.96	2.83	1.61	2.26	2.53	1.45
06/30/2003	4.11	4.04	4.18	4.47	3.92	4.26	3.55	3.07	2	2.44	3.67	2.08
07/02/03*	3.05	3.03	3.79	4.42	3.52	3.28	2.59	2.75	1.61	1.78	3.04	1.27
07/08/2003	3.15	3.39	4.32	6	3.24	3.91	2.53	2.7	1.6	2.24	3.01	1.3
07/10/2003	3.36	3.18	4.11	4.21	2.74	3.13	2.34	2.55	1.84	2.13	2.86	1.17
07/15/2003	4.29	NS	7.87	5.38	4.77	3.8	2.97	3.7	1.71	2.21	2.86	1.11
07/18/2003	2.98	3.41	5.84	3.87	3.11	4.16	3.94	2.44	2.07	2.19	2.51	1.72
07/21/2003	3.41	3.25	6.16	3.21	3.46	4.22	2.87	3.11	2.38	2.63	3.74	1.58
07/25/2003	3.89	4.11	5.61	4.14	4.61	5.19	3.86	3.39	2.51	2.92	4.09	0.9
07/29/2003	3.98	4.13	5.8	4.32	3.9	3.61	3.18	3.03	2.36	2.72	3.33	0.75
08/01/2003	3.33	3.45	5.32	4.96	4.3	3.26	3.98	2.2	3.84	2.94	NS	1.97
08/04/2003	4.62	4.38	5.13	4.6	4.18	4.77	4.11	3.61	2.74	2.88	3.64	1.18
08/07/2003	4.28	4.11	4.21	4.37	3.87	4.12	3.04	3.19	2.41	2.67	3.92	1.34
08/11/2003	4.54	3.69	5.11	4.16	4.01	5.54	3.42	3.87	1.96	9.21	4.11	1.24
08/14/2003	3.36	4.18	6.79	5.64	4.35	3.61	3.77	3.15	1.98	2.96	3.11	1.25
08/18/2003	3.87	4.21	7.16	5.12	5.39	4.72	3.99	3.2	2.11	2.64	2.96	0.85
08/21/2003	4.05	5.11	6.18	4.92	5.19	4.82	4.16	3.28	2.1	3.21	3.15	1.15
08/22/2003	4.15	4.86	8.01	3.91	4.48	4.82	3.51	4.31	2.46	2.84	2.59	1.91
08/25/2003	6.73	7.85	6.56	6.25	4.45	4.19	4.16	3.72	2.18	3.63	3.08	1.37
08/28/2003	4.13	5.11	6.24	5.82	5.14	4.69	4.27	3.76	2.28	2.54	2.64	1.17
09/02/2003	6.2	5.21	10.3	6.42	6.11	5.19	5.11	3.22	2.35	2.76	2.79	1.27
09/04/2003	5.73	4.82	NS	NS	4.82	5.64	4.91	4.48	2.71	2.94	5.19	2.06
09/08/2003	6.69	6.86	6.44	6.16	5.91	6.48	5.36	4.62	3.06	2.89	6.07	1.04
09/09/2003	5.43	5.1	4.78	6.02	4.01	5.34	4.28	4.11	3.76	3.14	5.32	0.89
09/12/2003	5.81	5.39	5.24	4.81	4.73	5.25	4.44	3.74	2.94	3.18	6.22	1.62

[a]Outlined values are instances where turbidity readings within Mica Creek exceeded background conditions at North Fork Mica Creek by more than 50 NTU.

[b]Shaded values are instances where turbidity readings within Mica Creek or South Fork Mica Creek exceeded background conditions at Sorth Fork Mica Creek by more than 50 NTU.

*Supplemental turbidity data provided by Coeur d'Alene Tribe

**Supplemental turbidity data provided by Idaho Department of Environmental Quality

NS = Not Sampled

F = Frozen

TABLE 6-4
Idaho Department of Environmental Quality (IDEQ) Turbidity Monitoring Results (NTU)

Sample Location Description	10/30/01	10/31/01	01/10/02	02/18/2002	02/23/2002	03/12/2002
South Fork Mica Creek, Downstream of Project at New Bridge Abutments	310	—	—	—	—	—
South Fork Mica Creek, Background Taken at South Wooden Bridge	2.9	40	—	—	—	—
South Fork Mica Creek, North Wooden Bridge	—	421	—	—	—	—
South Fork Mica Creek, South Bridge Above Sediment Basin Discharge	—	—	12.3	—	—	—
South Fork Mica Creek, Just Below Large Sediment Basin Discharge (in-stream)	—	—	1265	—	—	—
Mica Bay at Public Boat Launch Near Mica Creek	—	—	24.7	—	—	—
Coeur d'Alene Lake, Michaelson's located 1/2 mile West of Gould's Landing	—	—	3.4	—	—	—
Trib Around Sediment Basin	—	—	—	958	—	—
South Fork Mica Creek, Upstream (in photo) of Confluence With Sediment Basin Stream	—	—	—	4.5	—	—
New Bridge	—	—	—	173	—	—
North Fork Mica Creek, Under Highway 95	—	—	—	6	—	—
Run-on Water above 2nd Wooden Bridge	—	—	—	—	22.4	—
Run-off Water near 2nd Wooden Bridge	—	—	—	—	63.2	—
Next Stream North of Site 1 at Elevated Culvert #2, Run-on	—	—	—	—	36.3	—
Next Stream North of Site 1 at Elevated Culvert #2, Run-off	—	—	—	—	74.6	—
Stream That is Between First and Second Wooden Bridge, Run-on	—	—	—	—	9.45	—
Stream That is Between First and Second Wooden Bridge, Run-off	—	—	—	—	71.8	—
Large Sediment Basin Stream, Run-on Taken Below Logging Road Washout	—	—	—	—	64.6	—
Large Sediment Basin Stream, Run-off Taken in New Stream Channel Near Large Sediment Basin	—	—	—	—	>1,000	—
North Fork Mica Creek at Confluence	—	—	—	—	—	22.4
South Fork Mica Creek at Confluence	—	—	—	—	—	242
Hanson Bridge	—	—	—	—	—	18.3
Mica Bridge at Loff's Bay Road	—	—	—	—	—	96.5
Goulds Landing	—	—	—	—	—	3
Culvert x Loff's Bay Road, Conveys Water from W1/2 Sec N	—	—	—	—	—	15
Located About 100 ft East of Mica Bridge	—	—	—	—	—	15
North Mica Public Boat Launch Off End of Dock	—	—	—	—	—	81.7
Small Trib to Mica Bay on Mica Shores Rd, Near Michaelson's	—	—	—	—	—	9
Michaelson's Dock	—	—	—	—	—	7

TABLE 6-5
Monthly Statistics of Daily Instantaneous Turbidity

Month	Min	Max	Mean	Median	Std Dev	Count
South Fork Mica Creek Background (Station #1)						
Sep-01	-	-	-	-	-	-
Oct-01	-	-	-	-	-	-
Nov-01	-	-	-	-	-	-
Dec-01	-	-	-	-	-	-
Jan-02	-	-	-	-	-	-
Feb-02	-	-	-	-	-	-
Mar-02	4	10	6	6	2	9
Apr-02	4	71	11	6	11	47
May-02	3	22	5	4	3	38
Jun-02	2	5	3	2	1	21
Jul-02	2	5	3	2	1	11
Aug-02	2	164	20	3	51	10
Sep-02	2	4	3	3	1	9
Oct-02	2	3	2	2	1	9
Nov-02	2	40	10	3	14	8
Dec-02	2	13	6	4	4	9
Jan-03	3	36	10	6	9	12
Feb-03	5	14	7	6	3	8
Mar-03	4	16	8	7	3	14
Apr-03	3	8	4	4	2	9
May-03	2	6	4	3	1	10
Jun-03	2	6	4	3	2	8
Jul-03	3	4	4	3	0	8
Aug-03	3	7	4	4	1	10
Sep-03	5	7	6	6	0	5
South Fork Mica Creek After Trib from South (Station #10)						
Sep-01	2	3	3	3	1	3
Oct-01	1	40	11	3	16	7
Nov-01	2	14	9	13	7	3
Dec-01	12	19	16	16	5	2
Jan-02	12	12	12	12	-	1
Feb-02	4	21	11	11	6	6
Mar-02	6	166	27	13	40	17
Apr-02	4	62	11	8	10	47
May-02	3	19	5	4	3	38
Jun-02	2	4	2	2	0	21
Jul-02	2	2	2	2	0	11
Aug-02	2	178	21	2	55	10
Sep-02	2	11	4	3	3	9
Oct-02	1	4	2	2	1	9
Nov-02	2	39	10	3	14	8
Dec-02	2	16	6	4	5	9
Jan-03	4	333	39	7	94	12
Feb-03	5	26	9	6	7	8
Mar-03	4	19	8	8	4	14
Apr-03	3	8	5	5	1	9
May-03	3	8	4	4	1	10
Jun-03	2	6	4	4	1	8
Jul-03	3	4	4	3	0	7
Aug-03	3	8	5	4	1	10
Sep-03	5	7	5	5	1	5

TABLE 6-5 Cont.
Monthly Statistics of Daily Instantaneous Turbidity

Month	Min	Max	Mean	Median	Std Dev	Count
South Fork Mica After 353 Fill (Station #28)						
Sep-01	-	-	-	-	-	-
Oct-01	-	-	-	-	-	-
Nov-01	-	-	-	-	-	-
Dec-01	-	-	-	-	-	-
Jan-02	-	-	-	-	-	-
Feb-02	-	-	-	-	-	-
Mar-02	-	-	-	-	-	-
Apr-02	-	-	-	-	-	-
May-02	4	52	12	6	18	7
Jun-02	2	4	3	3	1	21
Jul-02	2	3	2	2	0	8
Aug-02	-	-	-	-	-	-
Sep-02	-	-	-	-	-	-
Oct-02	-	-	-	-	-	-
Nov-02	3	17	7	5	6	5
Dec-02	2	87	16	4	24	15
Jan-03	5	377	40	8	102	13
Feb-03	6	77	16	8	22	10
Mar-03	6	41	12	9	9	14
Apr-03	4	9	6	6	1	9
May-03	3	7	5	4	1	10
Jun-03	2	5	4	4	1	8
Jul-03	3	5	4	3	1	8
Aug-03	4	5	5	4	1	10
Sep-03	4	6	5	5	1	5
South Fork Mica After 356 Fill Trib (Station #29)						
Sep-01	-	-	-	-	-	-
Oct-01	421	421	421	421	-	1
Nov-01	-	-	-	-	-	-
Dec-01	-	-	-	-	-	-
Jan-02	-	-	-	-	-	-
Feb-02	-	-	-	-	-	-
Mar-02	-	-	-	-	-	-
Apr-02	-	-	-	-	-	-
May-02	5	49	12	5	17	7
Jun-02	2	5	3	3	1	21
Jul-02	2	3	3	3	0	9
Aug-02	-	-	-	-	-	-
Sep-02	-	-	-	-	-	-
Oct-02	-	-	-	-	-	-
Nov-02	3	27	9	5	10	5
Dec-02	3	179	25	7	47	15
Jan-03	6	41	12	9	10	12
Feb-03	6	73	16	8	21	10
Mar-03	7	48	15	11	12	14
Apr-03	5	9	7	6	1	9
May-03	4	9	6	5	2	10
Jun-03	3	5	4	4	1	8
Jul-03	3	5	4	4	1	8
Aug-03	3	6	4	5	1	10
Sep-03	5	6	6	5	1	5

TABLE 6-5 Cont.
Monthly Statistics of Daily Instantaneous Turbidity

Month	Min	Max	Mean	Median	Std Dev	Count
South Fork Mica Creek Midway through Project (Station #7)						
Sep-01	-	-	-	-	-	-
Oct-01	6	58	23	13	24	4
Nov-01	6	39	21	19	16	3
Dec-01	18	110	64	64	65	2
Jan-02	-	-	-	-	-	-
Feb-02	5	379	87	19	163	5
Mar-02	12	645	108	57	158	17
Apr-02	6	73	18	15	15	47
May-02	4	68	8	6	10	38
Jun-02	3	7	4	3	1	21
Jul-02	2	3	2	2	0	11
Aug-02	2	40	8	3	12	10
Sep-02	2	4	3	3	1	9
Oct-02	1	3	2	2	0	10
Nov-02	3	28	8	4	9	8
Dec-02	2	116	20	5	33	15
Jan-03	5	291	35	9	75	14
Feb-03	6	63	15	8	18	10
Mar-03	6	44	13	10	10	14
Apr-03	5	7	6	6	1	9
May-03	3	12	5	4	2	10
Jun-03	3	5	4	3	1	8
Jul-03	2	4	3	3	1	8
Aug-03	3	4	4	4	0	10
Sep-03	4	5	5	5	0	5
South Fork Mica Creek Leaving Project (Station #2)						
Sep-01	2	2	2	2	0	3
Oct-01	2	310	72	16	111	7
Nov-01	6	65	31	23	30	3
Dec-01	20	101	61	61	57	2
Jan-02	113	151	132	132	27	2
Feb-02	9	294	87	19	120	6
Mar-02	10	713	116	61	173	17
Apr-02	6	83	20	16	16	47
May-02	3	54	7	5	8	38
Jun-02	2	25	4	3	5	21
Jul-02	2	3	3	3	0	11
Aug-02	2	67	11	3	20	10
Sep-02	2	4	3	3	1	9
Oct-02	2	2	2	2	0	10
Nov-02	2	56	12	4	18	8
Dec-02	2	47	11	6	12	15
Jan-03	5	312	35	10	80	14
Feb-03	7	40	14	9	10	10
Mar-03	7	63	16	11	15	14
Apr-03	5	8	7	7	1	9
May-03	3	34	7	4	10	10
Jun-03	2	7	4	3	1	8
Jul-03	2	4	3	3	0	8
Aug-03	2	4	3	3	1	10
Sep-03	3	5	4	4	1	5

TABLE 6-5 Cont.
Monthly Statistics of Daily Instantaneous Turbidity

Month	Min	Max	Mean	Median	Std Dev	Count
North Fork Mica Creek Background (Station #8)						
Sep-01	-	-	-	-	-	-
Oct-01	-	-	-	-	-	-
Nov-01	-	-	-	-	-	-
Dec-01	-	-	-	-	-	-
Jan-02	-	-	-	-	-	-
Feb-02	6	22	11	7	7	6
Mar-02	5	30	13	10	7	17
Apr-02	4	176	15	9	25	47
May-02	3	33	5	4	5	38
Jun-02	2	5	3	3	1	21
Jul-02	1	3	2	2	0	11
Aug-02	1	5	2	2	1	10
Sep-02	1	6	2	2	1	9
Oct-02	1	2	1	1	0	10
Nov-02	2	37	10	3	13	8
Dec-02	1	34	8	4	8	15
Jan-03	4	54	12	8	13	14
Feb-03	6	20	10	8	5	9
Mar-03	5	29	11	9	6	14
Apr-03	3	40	9	5	12	9
May-03	3	6	4	3	1	10
Jun-03	2	2	2	2	0	8
Jul-03	2	3	2	2	0	8
Aug-03	2	4	2	2	1	10
Sep-03	2	4	3	3	1	5
Mica Creek After Confluence (Station #3)						
Sep-01	2	2	2	2	0	3
Oct-01	2	186	45	16	79	5
Nov-01	7	119	50	24	61	3
Dec-01	21	84	53	53	44	2
Jan-02	45	45	45	45	-	1
Feb-02	7	251	58	12	108	5
Mar-02	7	179	37	20	45	17
Apr-02	5	186	17	11	27	47
May-02	3	35	6	5	5	38
Jun-02	2	8	3	3	1	21
Jul-02	2	3	2	2	0	11
Aug-02	1	46	7	2	14	10
Sep-02	1	9	3	2	2	9
Oct-02	1	2	1	1	0	10
Nov-02	2	43	12	4	15	7
Dec-02	2	37	9	6	10	14
Jan-03	4	98	17	8	24	14
Feb-03	6	24	10	8	5	10
Mar-03	5	32	13	10	8	14
Apr-03	3	9	5	5	2	9
May-03	3	16	5	3	4	10
Jun-03	2	3	3	2	1	8
Jul-03	2	3	2	2	0	8
Aug-03	3	9	4	3	2	10
Sep-03	3	3	3	3	0	5

TABLE 6-5 Cont.
Monthly Statistics of Daily Instantaneous Turbidity

Month	Min	Max	Mean	Median	Std Dev	Count
Mica Creek at Loff's Bay Road Bridge (Station #12)						
Sep-01	-	-	-	-	-	-
Oct-01	-	-	-	-	-	-
Nov-01	-	-	-	-	-	-
Dec-01	-	-	-	-	-	-
Jan-02	-	-	-	-	-	-
Feb-02	-	-	-	-	-	-
Mar-02	97	97	97	97	-	1
Apr-02	5	213	19	12	31	47
May-02	3	37	6	4	5	38
Jun-02	2	10	3	2	2	21
Jul-02	2	6	3	2	1	11
Aug-02	2	7	3	2	2	10
Sep-02	2	4	3	3	1	9
Oct-02	2	6	3	2	1	10
Nov-02	2	140	27	5	51	7
Dec-02	4	33	10	8	8	14
Jan-03	5	106	18	8	26	14
Feb-03	6	17	9	8	4	10
Mar-03	6	32	13	9	8	14
Apr-03	4	9	6	6	1	9
May-03	3	60	10	4	18	10
Jun-03	2	5	3	3	1	8
Jul-03	3	4	3	3	1	8
Aug-03	3	4	3	3	1	9
Sep-03	3	6	5	5	1	5
Mica Bay Boat Launch (Station #9)						
Sep-01	-	-	-	-	-	-
Oct-01	-	-	-	-	-	-
Nov-01	-	-	-	-	-	-
Dec-01	-	-	-	-	-	-
Jan-02	25	25	25	25	-	1
Feb-02	11	29	17	15	7	5
Mar-02	8	161	33	20	39	17
Apr-02	2	17	7	6	3	47
May-02	3	8	4	4	1	38
Jun-02	1	4	2	2	1	21
Jul-02	0	3	2	2	1	11
Aug-02	1	1	1	1	0	10
Sep-02	1	3	1	1	1	9
Oct-02	1	50	6	1	15	10
Nov-02	2	19	8	6	6	9
Dec-02	4	22	11	6	7	11
Jan-03	4	167	24	10	47	11
Feb-03	4	16	9	9	5	8
Mar-03	5	29	11	10	6	13
Apr-03	3	6	5	5	1	9
May-03	2	88	13	5	27	10
Jun-03	1	4	2	2	1	8
Jul-03	1	2	1	1	0	8
Aug-03	1	2	1	1	0	10
Sep-03	1	2	1	1	0	5

Table 6-6 Precipitation Events and Corresponding Turbidity Data

Precipitation Date	Tmax (F)	Tmin (F)	Precipitation (in)	Sample Date	Turbidity (NTU) Station #1 South Fork Mica Creek upstream of the U.S. 95 project	Station #10 South Fork Mica Creek After Trib from South	Station #24 South Fork Mica After 347 Trib	Station #25 South Fork Mica After 350 Wall	Station #28 South Fork Mica After 353 Fill	Station #29 South Fork Mica After 356 Fill Trib	Station #7 South Fork Mica Creek Midway through Project	Station #2 South Fork Mica Creek Leaving Project	Station #8 North Fork Mica Creek upstream of the U.S. 95 project	Station #3 Mica Creek After Confluence	Station #12 Mica Creek at Loff's Bay Road Bridge	Station #9 Mica Bay Boat Launch
09/26/2001	78	50	0.15													
09/27/2001	66	52	0.08	9/27/01 am	NS	3.19	NS	NS	NS	NS	NS	2.4	NS	2.46	NS	NS
09/28/2001	66	51	0.16	9/28/01 am	NS	2.26	NS	NS	NS	NS	NS	2.24	NS	2.33	NS	NS
				10/5/01 am	NS	26.2	NS	NS	NS	NS	NS	1.78	NS	1.81	NS	NS
10/08/2001	58	39	0.02													
10/09/2001	52	38	0.23													
10/11/2001	55	40	0.27	10/11/01 am	NS	3.75	NS	NS	NS	NS	5.59	33.3	NS	186	NS	NS
10/12/2001	55	39	0.05	10/12/01 pm	NS	2.08	NS	NS	NS	NS	67.9	16.3	NS	16.1	NS	NS
10/13/2001	55	36	0.12													
10/14/2001	56	39	0.26													
10/19/2001	58	36	0.02	10/19/01 pm	NS	1.35	NS	NS	NS	NS	8.11	15.6	NS	6.99	NS	NS
10/20/2001	58	40	0.08													
10/22/2001	53	38	0.27													
10/23/2001	51	41	0.36													
10/25/2001	46	36	0.15													
10/26/2001	47	37	0.03	10/26/01 pm	NS	1.45	NS	NS	NS	NS	18.6	13.2	NS	16.3	NS	NS
10/28/2001	55	38	0.08													
10/29/2001	51	36	0.01													
10/30/2001	47	38	0.3	10/30/2001		2.9**						310**				
10/31/2001	51	42	0.56	10/31/2001	NS	40.3**				421**		112*				
11/01/2001	53	43	0.17													
11/03/2001	53	41	0.01													
11/05/2001	60	37	0.03													
11/07/2001	40	33	0.03													
				11/9/01 am	NS	1.67	NS	NS	NS	NS	6.15	6.25	NS	6.6	NS	NS
11/14/2001	50	43	0.31													
11/15/2001	53	39	0.02													
11/16/2001	58	40	0.15													
11/17/2001	51	42	0.63													
11/18/2001	46	36	0.01													
11/20/2001	46	31	0.02													
11/21/2001	54	42	0.21	11/21/01 am	NS	13.6	NS	NS	NS	NS	38.6	64.7	NS	119	NS	NS
11/22/2001	46	29	0.29													
11/23/2001	45	35	0.51													
11/24/2001	41	24	0.04													
11/25/2001	44		0.02													
11/26/2001	36	33	0.18													
11/27/2001	37		0.01													
11/29/2001	36		0.4													
11/30/2001	38	32	0.24	11/30/01 am	NS	13.1	NS	NS	NS	NS	18.7	23.4	NS	23.7	NS	NS
12/01/2001	36	32	0.88													
12/02/2001	44	34	0.41													
12/03/2001	46	35	0.24													
12/04/2001	37	30	0.35													
12/05/2001	36	30	0.21													
12/06/2001	34	30	0.26													
				12/7/01 am	NS	12.4	NS	NS	NS	NS	18.4	20.1	NS	21.1	NS	NS
12/11/2001	33	28	0.04													
12/13/2001	41	29	0.56													
12/14/2001	43	37	1.08	12/14/01 am	NS	19.1	NS	NS	NS	NS	110	101	NS	84	NS	NS
12/15/2001	38	25	0.02													
12/16/2001	39	27	0.23													
12/17/2001	46	36	0.51													
12/19/2001	36	22	0.31													
12/28/2001	27	19	0.13													
01/03/2002	33	28	0.16													
01/06/2002	38	32	0.03													
01/07/2002	44	32	0.44													

Table 6-6 Precipitation Events and Corresponding Turbidity Data

Precipitation Date	Tmax (F)	Tmin (F)	Precipitation (in)	Sample Date	Turbidity (NTU) Station #1 South Fork Mica Creek upstream of the U.S. 95 project	Station #10 South Fork Mica Creek After Trib from South	Station #24 South Fork Mica After 347 Trib	Station #25 South Fork Mica After 350 Wall	Station #28 South Fork Mica After 353 Fill	Station #29 South Fork Mica After 356 Fill Trib	Station #7 South Fork Mica Creek Midway through Project	Station #2 South Fork Mica Creek Leaving Project	Station #8 North Fork Mica Creek upstream of the U.S. 95 project	Station #3 Mica Creek After Confluence	Station #12 Mica Creek at Loff's Bay Road Bridge	Station #9 Mica Bay Boat Launch
01/08/2002	51	42	0.26													
				1/10/02		12.3**	1265**									24.7**
01/12/2002	41	33	0.05													
01/17/2002	31	25	0.06													
01/18/2002	29	22	0.05													
01/19/2002	32	23	0.27													
01/20/2002	34	28	0.2													
01/23/2002	31	26	0.1													
01/24/2002	39	27	0.04													
01/25/2002	42	30	0.53	1/25/02								113*	44.6*			
01/26/2002	45	33	0.18													
01/27/2002	35	25	0.05													
				1/28/02								151*				
01/30/2002	27	23	0.08													
01/31/2002	34	24	0.07													
02/01/2002	35	32	0.22													
02/04/2002	35	25	0.25													
02/07/2002	43	35	0.06													
02/08/2002	41	32	0.63	2/8/02 am	NS	12	NS	NS	NS	NS	5.4	11	6.11	12.2	NS	11.1
02/18/2002	49	27	0.08	2/18/02		4.5**						173**	6.0**			
02/19/2002	44	32	0.01	2/19/02 am	NS	4.4	NS	NS	NS	NS	22.9	12.8	6.62	12.5	NS	18.5
02/20/2002	41	33	0.2													
				2/21/02 am	NS	9.81	NS	NS	NS	NS	379	294	21.9	251	NS	28.7
02/23/2002	51	37	0.01													
02/24/2002	39	20	0.19													
				2/26/02 am	NS	20.9	NS	NS	NS	NS	18.9	25.2	18.2	7.8	NS	12.4
02/28/2002	31	22	0.02	2/28/02 am	NS	12.9	NS	NS	NS	NS	9.41	8.99	7.1	7.3	NS	15.4
				3/5/02 am	NS	14.4	NS	NS	NS	NS	40	11.1	5.17	7.96	NS	8.04
03/06/2002	45	17	0.11													
03/07/2002	18	13	0.12	3/7/02 am	NS	13.2	NS	NS	NS	NS	12.4	10.4	7.4	7.2	NS	20.3
03/08/2002	27	14	0.05													
03/10/2002	40	25	0.18													
03/11/2002	45	34	0.23	3/11/02 am	NS	28.2	NS	NS	NS	NS	645	713	30.4	179	NS	161
03/12/2002	48	35	0.24	3/12/02 am	NS	166	NS	NS	NS	NS	313**	242, 242.3**	21.2, 22.4**	19.9	NS, 96.5**	72, 81.7**
03/14/2002	40	30	0.18	3/14/02 pm	NS	74.3	NS	NS	NS	NS	68.5	125	12.9	30.5	NS	29.6
03/17/2002	37	20	0.07													
03/18/2002	37	20	0.15													
03/19/2002	34	28	0.16	3/19/02 am	NS	7.7	NS	NS	NS	NS	13.1	12.8	5.36	7.22	NS	11.9
03/20/2002	43	27	0.58	3/20/02 am	NS	21.6	NS	NS	NS	NS	102.6	91	21.1	62.4	NS	46.2
03/21/2002	30	16	0.02	3/21/02 am	NS	6.49	NS	NS	NS	NS	15.2	14.3	7.09	9.74	NS	10.3
03/25/2002	43	36	0.05	3/25/02 pm	4.62	20.1	NS	NS	NS	NS	54.3	92.2	7.9	35.2	NS	21.3
				3/26/02 am	3.77	6.21	NS	NS	NS	NS	16.9	18.5	5.79	11	NS	8.57
				3/26/02 pm	7.18	40	NS	NS	NS	NS	181	275	18.4	108	NS	66.7
				3/27/02 am	5.67	8.65	NS	NS	NS	NS	30.2	31.6	9.55	18.1	NS	11.2
				3/27/02 pm	6.81	12.4	NS	NS	NS	NS	84	104	11.6	40.2	NS	42.9
				3/28/02 am	5.15	7.36	NS	NS	NS	NS	25.4	22.7	8.34	13.1	NS	14.4
				3/28/02 pm	10.2	16.3	NS	NS	NS	NS	120	131	20.8	49.7	NS	9.99
				3/29/02 am	6.2	8.52	NS	NS	NS	NS	19.2	19.7	9.39	13.6	NS	11.2
				3/29/02 pm	6.42	9.65	NS	NS	NS	NS	57.1	61.3	10.8	22	NS	20.1
				4/1/02 am	6.87	8.06	NS	NS	NS	NS	17.5	19.3	7.85	10.8	15	10.1
				4/1/02 pm	10.4	10.6	NS	NS	NS	NS	45.8	40.8	14.9	18.2	21.4	7.86
				4/2/02 am	6.48	7.03	NS	NS	NS	NS	25.6	28.1	7.59	11.1	12.9	11.8
				4/2/02 pm	6.26	7.57	NS	NS	NS	NS	26.1	24.3	7.56	14.5	16.5	9.93
				4/3/02 am	5.7	6.98	NS	NS	NS	NS	15.7	15.9	6.89	10.6	10.7	8.89
				4/3/02 pm	5.98	7.08	NS	NS	NS	NS	30.7	27.6	7.92	13.7	17.2	10.3
				4/4/02 am	6.37	5.69	NS	NS	NS	NS	15.2	14.9	6.72	11	12.2	9
				4/4/02 pm	6.3	7.01	NS	NS	NS	NS	25.6	25.1	8.78	13.1	16.2	8.48
				4/5/02 am	5.48	6.15	NS	NS	NS	NS	14.7	13	7.91	9	9.82	4.05

Table 6-6 Precipitation Events and Corresponding Turbidity Data

Precipitation Date	Tmax (F)	Tmin (F)	Precipitation (in)	Sample Date	Turbidity (NTU) Station #1 South Fork Mica Creek upstream of the U.S. 95 project	Station #10 South Fork Mica Creek After Trib from South	Station #24 South Fork Mica After 347 Trib	Station #25 South Fork Mica After 350 Wall	Station #28 South Fork Mica After 353 Fill	Station #29 South Fork Mica After 356 Fill Trib	Station #7 South Fork Mica Creek Midway through Project	Station #2 South Fork Mica Creek Leaving Project	Station #8 North Fork Mica Creek upstream of the U.S. 95 project	Station #3 Mica Creek After Confluence	Station #12 Mica Creek at Loff's Bay Road Bridge	Station #9 Mica Bay Boat Launch
				4/5/02 pm	6.33	7.55	NS	NS	NS	NS	59.1	48.8	9.77	15.1	20.8	7.73
04/07/2002	56	40	0.08	4/7/02 am	11.4	11	NS	NS	NS	NS	20.3	30.4	14.9	14.4	19.2	8.41
				4/8/02 am	11.8	9.57	NS	NS	NS	NS	14.5	15.5	11.6	12.3	12.5	10.5
				4/8/02 pm	7.82	9.19	NS	NS	NS	NS	15.7	20.7	11	13.2	14.5	4.7
				4/9/02 am	7.26	7.24	NS	NS	NS	NS	11.6	12.3	9.42	9.84	12.3	3.05
				4/9/02 pm	7.36	8.7	NS	NS	NS	NS	13.6	14.8	8.82	11.2	13.4	6.23
04/10/2002	47	37	0.27	4/10/02 am	10.2	10	NS	NS	NS	NS	13.6	13.7	13.1	12.7	17.3	5.96
				4/10/02 pm	34.5	39.1	NS	NS	NS	NS	58.4	69.7	33.7	43.5	65.1	5.43
04/11/2002	50	39	0.43	4/11/02 am	13.2	11.8	NS	NS	NS	NS	16.1	18.9	14.4	14.8	18	7.91
				4/11/02 pm	11.5	12.2	NS	NS	NS	NS	17.6	20.1	12.1	13.8	16.3	5.02
04/12/2002	54	40	0.15	4/12/02 am	16.4	14.8	NS	NS	NS	NS	17.1	19.4	15	16.6	17.6	3.58
				4/12/02 pm	20.9	17.6	NS	NS	NS	NS	23	22.7	19.7	20.6	21.1	2.92
04/13/2002	57	43	0.18	4/13/02 am	34.8	33	NS	NS	NS	NS	34.8	44.4	33.8	33.2	42.2	16.7
04/14/2002	66	46	0.71	4/14/02 am	71	62	NS	NS	NS	NS	73.1	83.3	176	186	213	6
				4/15/02 am	22.1	21.3	NS	NS	NS	NS	27	25.6	37.4	38.2	34.7	9.06
				4/15/02 pm	16.3	15.4	NS	NS	NS	NS	25.9	26.7	26.4	28.5	39.1	17.1
04/16/2002	49	35	0.04	4/16/02 am	13.1	12.2	NS	NS	NS	NS	16.3	19.1	18.8	20.1	19.8	5.25
				4/16/02 pm	9.9	11	NS	NS	NS	NS	15.4	17.3	14.9	17.1	16.1	5.2
04/17/2002	45	36	0.04	4/17/02 am	8.3	8.1	NS	NS	NS	NS	10	12.3	11.6	12.3	11.6	6.1
				4/17/02 pm	8.9	8.3	NS	NS	NS	NS	15.7	19.6	11	9.2	9.8	6.9
04/18/2002	51	36	0.08	4/18/02 am	5.2	7.6	NS	NS	NS	NS	6.9	10.2	9.7	7.1	9.6	3.1
				4/18/02 pm	4.9	7.1	NS	NS	NS	NS	9.7	13.3	10.3	13	9.1	3.9
				4/19/02 am	4.4	6.1	NS	NS	NS	NS	8.2	7.5	8.4	6.4	7.8	2.9
				4/19/02 pm	7.05	6.55	NS	NS	NS	NS	9.43	11.7	10.6	10.7	8.44	5.21
				4/22/02 am	6.45	7.14	NS	NS	NS	NS	8.04	8.28	7.41	7.37	6.96	2.22
				4/22/02 pm	6.24	6.39	NS	NS	NS	NS	8.15	10.2	8.86	9.28	8.75	4.2
				4/23/02 am	6.08	5.85	NS	NS	NS	NS	7.29	7.49	6.55	5.98	6.24	3.73
				4/23/02 pm	5.22	5.28	NS	NS	NS	NS	8.01	34	7.42	11.5	9.4	2.83
				4/24/02 am	5.29	5.11	NS	NS	NS	NS	7.76	7.64	5.54	6.75	6.28	1.79
				4/24/02 pm	7.09	5.22	NS	NS	NS	NS	7.39	10.1	6.37	7.74	9.88	3.6
				4/25/02 am	5.5	8.3	NS	NS	NS	NS	8.2	8.1	5.9	6.9	6.3	4.3
				4/25/02 pm	5.6	4.5	NS	NS	NS	NS	8.1	7.7	5.3	6.6	6.8	6.2
				4/26/02 am	6.4	5.7	NS	NS	NS	NS	6.6	6.7	4.5	5.6	5.4	8.6
				4/26/02 pm	4.7	5.2	NS	NS	NS	NS	9.2	9.7	5.1	6.5	5.4	7.7
				4/29/02 am	4.73	4.77	NS	NS	NS	NS	6.22	6.43	4.98	5.1	6.37	8.65
				4/29/02 pm	5.16	4.47	NS	NS	NS	NS	6.62	6.88	4.4	6.72	5.6	7.99
				4/30/02 am	4.99	4.75	NS	NS	NS	NS	6.5	6.43	4.72	6.35	5.68	7.06
				4/30/02 pm	5.74	5.62	NS	NS	NS	NS	6.45	6.49	5.68	5.9	6.31	8.28
				5/1/02 am	5.7	5.5	NS	NS	NS	NS	6.8	5.9	5.2	5.2	5.9	7.9
				5/1/02 pm	5.19	4.56	NS	NS	NS	NS	5.81	5.5	6.3	5.78	6.17	6.3
				5/2/02 am	5.73	6.04	NS	NS	NS	NS	5.5	6.34	5.36	5.36	7.23	7.39
				5/2/02 pm	7.91	7.34	NS	NS	NS	NS	7.33	8.09	8.37	7.95	7.07	6.9
				5/3/02 am	6.54	5.41	NS	NS	NS	NS	7.04	5.91	5.87	5.6	6.77	5.21
				5/3/02 pm	5.26	4.68	NS	NS	NS	NS	5.75	6.01	5.86	6.03	6.51	3.95
05/06/2002	49	33	0.48	5/6/02 am	5.16	5.1	NS	NS	NS	NS	6.72	6.75	4.5	5.2	5.61	5.04
				5/6/02 pm	4.41	3.78	NS	NS	NS	NS	4.53	4.86	4.57	5.36	4.41	4.32
05/07/2002	44	32	0.12	5/7/02 am	3.41	4.01	NS	NS	NS	NS	4.48	5.22	3.91	4.56	4.1	4.41
				5/7/02 pm	3.61	3.42	NS	NS	NS	NS	4.85	4.73	4.51	3.96	4.03	4.37
05/08/2002	43	30	0.05	5/8/02 am	4.28	5.2	NS	NS	NS	NS	5.96	5.52	3.46	5.21	3.63	4.47
				5/8/02 pm	3.48	3.84	NS	NS	NS	NS	4.58	4.59	3.57	4.49	3.75	4.27
				5/9/02 am	4.27	4.21	NS	NS	NS	NS	5.02	4	3.42	4.01	4.05	4.8
				5/9/02 pm	3.86	3.41	NS	NS	NS	NS	5.27	4.62	4.64	4.53	4.64	3.99
				5/10/02 am	2.85	3.12	NS	NS	NS	NS	4.71	4.51	3.8	3.73	4.02	4.38
				5/10/02 pm	3.93	4.04	NS	NS	NS	NS	4.93	4.6	3.97	5.48	4.29	4.6
				5/13/02 am	3.26	3.72	NS	NS	NS	NS	4.91	4.42	3.59	3.62	4.3	4.09
				5/13/02 pm	3.84	4.19	NS	NS	NS	NS	4.74	4.63	4.4	4.47	7.16	4.58
				5/14/02 am	3.22	3.91	NS	NS	NS	NS	4.74	3.91	4.31	3.87	4.51	3.97
				5/14/02 pm	3.35	3.61	NS	NS	NS	NS	4.39	4.84	3.82	4.16	5.2	3.84

Table 6-6 Precipitation Events and Corresponding Turbidity Data

Precipitation Date	Tmax (F)	Tmin (F)	Precipitation (in)	Sample Date	Turbidity (NTU) Station #1 South Fork Mica Creek upstream of the U.S. 95 project	Station #10 South Fork Mica Creek After Trib from South	Station #24 South Fork Mica After 347 Trib	Station #25 South Fork Mica After 350 Wall	Station #28 South Fork Mica After 353 Fill	Station #29 South Fork Mica After 356 Fill Trib	Station #7 South Fork Mica Creek Midway through Project	Station #2 South Fork Mica Creek Leaving Project	Station #8 North Fork Mica Creek upstream of the U.S. 95 project	Station #3 Mica Creek After Confluence	Station #12 Mica Creek at Loff's Bay Road Bridge	Station #9 Mica Bay Boat Launch
				5/15/02 am	3.52	3.65	NS	NS	NS	NS	4.12	3.44	3.2	3.05	3.05	3.71
				5/15/02 pm	2.72	3.75	NS	NS	NS	NS	3.71	4.09	3.5	3.55	3.51	3.01
				5/16/02 am	2.88	2.95	NS	NS	NS	NS	11.6	7.01	2.89	4.25	4.9	3.72
				5/16/02 pm	4.15	3.02	NS	NS	NS	NS	5.59	5.15	3.12	3.79	3.83	3.4
				5/17/02 am	3.49	3.36	NS	NS	NS	NS	5.91	4.74	3.73	3.53	3.18	3.73
				5/17/02 pm	4	4.12	NS	NS	NS	NS	5.69	5.8	4.33	4	4.43	3.85
05/18/2002	60	43	0.16													
05/19/2002	64	45	0.01													
05/20/2002	77	51	0.26	5/20/02 am	5.38	6.61	NS	NS	NS	NS	13	6.89	4.88	5.21	5.23	6.93
				5/20/02 pm	3.21	3.15	NS	NS	NS	NS	9.19	7.61	4.05	5.26	5.58	3.16
05/21/2002	58	41	0.14	5/21/02 am	4.07	3.6	NS	NS	NS	NS	6.07	5.79	4.61	4.58	4.81	2.56
				5/21/02 pm	2.82	2.95	NS	NS	NS	NS	4.65	4.37	4.26	3.78	3.89	3.68
05/22/2002	55	44	0.12	5/22/02 am	5.66	6.32	NS	NS	NS	NS	8.66	4.95	9.52	8.74	4.83	2.65
				5/22/02 pm	21.7	19.2	57.9	52.8	52.2	49.1	67.6	53.9	33.3	35.1	37.2	3.06
05/23/2002	48	38	0.27	05/23/2002	5.43	4.46	7.67	6.36	5.77	6.33	7.54	6.83	6.61	6.31	5.22	3.35
				05/24/2002	3.66	3.85	6.51	7.67	5.52	5.4	8.45	5.14	3.71	4.74	4.35	2.66
05/26/2002	64	48	0.05													
05/27/2002	69	52	0.13													
05/28/2002	73	54	0.33	05/28/2002	4.58	4.18	5.33	5.63	6.55	6.47	10.5	10.5	5.47	6.38	6.21	3.39
05/29/2002	69	55	0.02	05/29/2002	3.24	3.56	4.74	6.13	5.22	4.92	6.38	5.84	4.16	5.16	3.78	2.65
				05/30/2002	3.49	3.06	7.27	5.93	4.84	4.63	5.58	5.86	4.87	5.02	3.17	5.35
				05/31/2002	2.86	2.6	4.72	4.18	4.45	4.6	5.09	4.18	4.77	4.93	3.12	6.2
				06/03/2002	2.86	2.32	3.04	3.39	4.46	3.57	4.31	4.52	4.26	4.46	3.57	2.38
				06/04/2002	2.79	2.54	3.73	3.94	3.93	4.23	4.03	4.68	3.56	3.93	2.79	2.85
				06/05/2002	2.57	2.45	3.11	3.53	4.37	3.86	4.87	4.26	4.13	4.21	3.65	3.15
				06/06/2002	2	2.03	2.15	2.95	3.36	3.38	4.31	4.07	2.84	4.26	2.63	2.81
				06/07/2002	2.3	2.35	3.05	2.36	3.06	2.57	3.26	3.47	2.8	2.49	1.96	2.38
				06/08/2002	2.98	1.95	2.49	2.5	3.01	3.12	3.36	3.43	2.64	2.67	2.23	3.28
06/09/2002	46	41	0.28													
06/10/2002	57	46	0.07	06/10/2002	2.02	1.76	2.98	2.46	2.99	2.95	3.53	2.88	2.85	2.84	2.35	3.98
				06/11/2002	2.17	2.09	2.76	2.45	3.13	2.9	2.83	3.79	2.46	2.59	2.1	2.43
06/12/2002	71	50	0.01													
				06/13/2002	2.65	2.34	2.18	2.43	2.6	3.14	3.18	2.88	2.61	3.16	2.04	1.76
				06/14/2002	1.82	1.81	2.17	2.16	2.5	3.33	2.88	2.69	2.13	2.32	3.13	1.34
				06/17/2002	2.17	1.75	2.97	2.61	2.81	2.4	3.8	2.66	1.91	2.13	2.2	2.41
06/18/2002	68	53	0.32	06/18/2002	2.73	2.38	3.45	NS	4.29	4.77	6.69	24.9	4.53	7.77	4.93	3.62
06/19/2002	58	48	0.22	06/19/2002	2.58	2.7	2.92	NS	3.3	3.62	3.07	3.31	3.02	2.62	3.41	2.53
				06/20/2002	2.09	2.24	2.33	NS	2.51	3.33	2.9	2.42	2.18	1.92	2.19	1.83
				06/21/2002	2.16	1.96	3.53	2.57	2.22	3.45	2.54	2.16	1.94	2.04	2.01	1.76
				06/24/2002	2.64	2.38	2.77	2.66	2.7	2.49	2.62	4.29	1.53	1.89	2.14	1.94
				06/25/2002	2.01	1.69	2.52	2.96	2.44	3.68	2.66	2.74	2.1	1.91	2.24	1.42
				06/26/2002	2.33	2.16	3	2.21	2.65	2.72	3.56	2.6	1.57	1.56	1.85	1.47
				06/27/2002	2.12	1.72	2.33	2.15	2.91	3.44	3.28	2.84	1.92	2.14	2.13	1.94
				06/28/2002	3.08	2.11	2.4	2.71	2.38	2.86	3.2	3.88	1.74	2.02	1.8	1.66
06/29/2002	74	58	0.58	06/29/2002	5.34	3.63	3.82	NS	4.32	4.42	4.17	5.39	3.1	3.2	10.2	1.86
06/30/2002	71	54	0.19													
				07/01/2002	2.22	1.89	2.33	NS	2.72	2.95	3.05	2.91	2.64	2.45	2.25	2.99
				07/02/2002	2.12	1.97	2.24	NS	2.45	2.58	2.86	2.51	2.08	2.22	2.41	1.68
				07/03/2002	2.1	1.65	2.9	2.84	2.24	2.19	2.59	2.44	1.77	1.88	1.55	1.38
				07/05/2002	4.63	2.04	2.23	2.02	1.99	2.07	2.02	2.31	1.51	1.91	1.77	1.7
07/08/2002	83	60	0.15	07/08/2002	2.39	1.91	2.54	NS	3.12	2.58	2.06	2.92	1.86	2.46	1.61	1.54
07/09/2002	73	52	0.11													
				07/11/2002	3.13	2.28	3.35	NS	2.11	2.66	2.18	2.46	1.89	2.66	4.2	2.05
				07/15/2002	2.16	1.78	2.05	NS	1.93	3.42	2.74	2.92	1.41	1.97	6.45	1.81
				07/18/2002	3.83	2.43	2.58	NS	2.1	3.27	1.95	2.42	1.38	1.86	3.23	1.95
				07/22/2002	3	1.89	NS	NS	NS	2.07	2.19	2.53	1.19	2.28	2.7	1.47
				07/25/2002	1.76	1.94	NS	NS	NS	NS	2.42	2.45	2.01	2.24	2.44	1.08
				07/29/2002	3.49	1.97	NS	NS	NS	NS	3.27	2.77	1.45	1.79	2.27	0.44

Table 6-6 Precipitation Events and Corresponding Turbidity Data

Precipitation Date	Tmax (F)	Tmin (F)	Precipitation (in)	Sample Date	Turbidity (NTU) Station #1 South Fork Mica Creek upstream of the U.S. 95 project	Station #10 South Fork Mica Creek After Trib from South	Station #24 South Fork Mica After 347 Trib	Station #25 South Fork Mica After 350 Wall	Station #28 South Fork Mica After 353 Fill	Station #29 South Fork Mica After 356 Fill Trib	Station #7 South Fork Mica Creek Midway through Project	Station #2 South Fork Mica Creek Leaving Project	Station #8 North Fork Mica Creek upstream of the U.S. 95 project	Station #3 Mica Creek After Confluence	Station #12 Mica Creek at Loff's Bay Road Bridge	Station #9 Mica Bay Boat Launch
				08/02/2002	2.5	1.58	NS	NS	NS	NS	3.08	2.39	1.94	1.44	2.02	1.31
				08/05/2002	5.29	2.08	NS	NS	NS	NS	2.04	2.6	2.34	1.89	1.93	0.74
				08/08/2002	2.47	2.12	NS	NS	NS	NS	2.11	2.29	1.22	1.72	2.02	0.87
				08/13/2002	1.84	2.7	NS	NS	NS	NS	2.56	3.98	1.28	2.54	2.61	1.4
				08/15/2002	1.79	2.54	NS	NS	NS	NS	5.41	2.8	1.58	2.21	2.42	0.63
				08/19/2002	2.16	2.05	NS	NS	NS	NS	4.11	1.62	2.04	1.96	1.64	1.43
08/22/2002	74	54	0.15	08/22/2002	2.65	1.68	NS	NS	NS	NS	2.47	2.31	2.02	1.76	2.12	1.19
				08/26/2002	3.19	9.04	NS	NS	NS	NS	3.73	2.69	1.78	2.31	2.95	1.22
				08/29/2002	164	178	NS	NS	NS	NS	39.9	66.9	5.1	46.1	2.39	0.84
08/30/2002	77	58	0.23	08/30/2002	12.4	10.8	NS	NS	NS	NS	17.6	19.9	1.77	6.71	7	1.04
				09/03/2002	4.36	3.05	NS	NS	NS	NS	3.56	3.1	2.43	3.59	2.58	1.14
09/04/2002	69	47	0.01													
09/05/2002	71	50	0.02	09/05/2002	4.01	2.4	NS	NS	NS	NS	3.88	2.76	1.63	2	2.02	0.81
				09/09/2002	4.38	11.2	NS	NS	NS	NS	3.36	2.5	1.93	1.89	3.82	0.95
				09/12/2002	2.9	2.8	NS	NS	NS	NS	3.41	3.7	1.52	1.82	2.44	0.91
				09/16/2002	3.04	2.76	NS	NS	NS	NS	2.3	3.27	5.5	9.02	2.72	1.04
09/17/2002	66	52	0.14	09/17/2002	3.63	3.67	NS	NS	NS	NS	4.3	2.57	2.36	2.77	3.77	1.09
09/18/2002	57	48	0.08													
				09/20/2002	2.33	2.37	NS	NS	NS	NS	3	1.94	1.26	1.84	2.17	2.72
				09/23/2002	2.6	2.92	NS	NS	NS	NS	2.46	2.15	1.71	1.45	2.01	1
				09/26/2002	2.73	2.58	NS	NS	NS	NS	2.47	2.34	1.87	1.78	3.18	1.13
09/29/2002	69	43	0.03													
09/30/2002	58	42	0.08													
10/01/2002	58	36	0.07	10/01/2002	2.2	3.69	NS	NS	NS	NS	2.66	1.75	1.22	1.44	6.02	1.01
10/03/2002	61	37	0.02	10/03/2002	2.61	2.4	NS	NS	NS	NS	2.57	1.84	1.01	1.25	2.09	0.72
10/04/2002	51	46	0.08													
10/05/2002	59	46	0.13													
				10/07/2002	3.15	2.53	NS	NS	NS	NS	2.23	1.89	1.13	1.29	1.91	0.93
				10/10/2002	3.05	2.73	NS	NS	NS	NS	2.94	1.96	1.28	1.54	2.08	0.89
				10/14/2002	1.68	1.77	NS	NS	NS	NS	1.91	1.83	1.17	1.38	2.05	0.97
				10/17/2002	1.84	1.93	NS	NS	NS	NS	2.32	1.68	1.35	1.57	2.64	1.14
				10/21/2002	1.98	1.69	NS	NS	NS	NS	2.58	2.02	1.03	1.21	1.74	1.9
				10/24/2002	2.74	1.79	NS	NS	NS	NS	2.32	1.97	2.04	1.82	2.27	2.2
				10/28/2002			NS	NS	NS	NS	1.82	1.53	1.58	1.41	5.1	1.99
10/29/2002	46	29	0.07	10/29/2002	1.7	1.35	NS	NS	NS	NS	1.39	1.55	1.11	1.2	2.25	49.6
				11/05/2002	F	F	NS	NS	NS	NS	F	F	F	F	F	3.3
11/08/2002	56	34	0.52	11/08/2002	39.9	38.7	NS	NS	NS	NS	16.7	15.9	25	19.6	25.8	19.1
11/09/2002	48	41	0.19													
11/10/2002	45	35	0.19													
11/11/2002	45	35	0.05	11/11/2002	4.04	3.87	NS	NS	NS	NS	3.91	4.15	2.25	4.2	4.92	4.32
11/12/2002	49	37	0.06	11/12/2002	2.58	2.31	NS	NS	NS	NS	3.04	4.79	5.72	5.24	4.4	4.26
11/13/2002	50	42	0.17													
11/14/2002	51	38	0.22	11/14/2002	2.71	3.5	3.84	8.73	6.28	7.19	3.41	3.27	2.11	3.25	3.55	6.35
11/15/2002	49	34	0.03													
11/16/2002	46	31	0.01													
11/19/2002	48	40	0.49	11/19/2002	24.8	26.7	22.5		16.5	26.5	28	56.3	36.7	42.9	140	14.6
11/20/2002	51	45	0.03													
				11/21/2002	3.29	3.07	4.65	4.07	5.29	5.44	5.5	7.81	2.81	3.79	6.34	10.6
11/22/2002	51	42	0.07													
11/23/2002	50	43	0.1	11/23/2002	2.42	2.28	2.69	2.67	2.73	2.9	2.68	2.85	1.73	1.74	2.35	2.24
11/24/2002	44	27	0.12													
				11/25/2002	2.05	2.15	3.17	2.62	3.15	2.79	2.8	2.43	2.49	F	F	9
				12/03/2002	F	F	F	2.13	2.69	2.88	2.18	2.55	2.2	3.12	8.19	4.87
				12/05/2002	2.01	1.83	2.06	2.1	2.35	2.51	2.3	2.41	1.42	1.62	3.91	5.83
12/09/2002	40	30	0.02	12/09/2002	3.25	2.51	NS	2.25	2.81	2.5	2.25	2.22	1.78	1.53	4.43	4.71
12/10/2002	38	30	0.02	12/10/2002	2.09	2.48	2.81	2.21	3.23	3.31	2.73	3.7	2.43	1.84	5.37	4.47
12/11/2002	40	33	0.26													
12/12/2002	41	33	0.15	12/12/2002	2.72	2.53	3.64	3.7	3.44	5.49	3.54	2.84	1.92	2.7	10.9	6.09

Table 6-6 Precipitation Events and Corresponding Turbidity Data

Precipitation Date	Tmax (F)	Tmin (F)	Precipitation (in)	Sample Date	Turbidity (NTU) Station #1 South Fork Mica Creek upstream of the U.S. 95 project	Station #10 South Fork Mica Creek After Trib from South	Station #24 South Fork Mica After 347 Trib	Station #25 South Fork Mica After 350 Wall	Station #28 South Fork Mica After 353 Fill	Station #29 South Fork Mica After 356 Fill Trib	Station #7 South Fork Mica Creek Midway through Project	Station #2 South Fork Mica Creek Leaving Project	Station #8 North Fork Mica Creek upstream of the U.S. 95 project	Station #3 Mica Creek After Confluence	Station #12 Mica Creek at Loft's Bay Road Bridge	Station #9 Mica Bay Boat Launch
12/13/2002	48	40	0.6	12/13/2002	12.4	10.5	18.4	26.1	48.5	70.4	75.7	17.4	14.6	13.6	15.2	21.5
12/14/2002	46	40	0.34	12/14/2002	12.6	16.3	89.6	4.07	88.8	179	116	26.8	13.5	17.8	14.3	22.2
12/15/2002	55	44	0.84	12/15/2002	7.11	6.89	8.73	9.24	10.6	14.8	15.4	16.6	9.02	14.3	13.8	15.9
12/16/2002	49	40	0.41	12/16/2002	10.2	10.2	19.7	34	36.1	42.5	46.1	46.8	33.8	37	32.6	18.6
12/17/2002	47	33	0.26													
12/18/2002	41	32	0.03	12/18/2002	4.24	4.12	5.96	7.04	8.15	8.28	7.37	6.46	7.53	7.41	8.35	12.1
				12/23/2002	F	F	F	3.19	2.73	3.83	3.21	3.57	2.42	3.02	3.72	4.26
12/26/2002	38	32	0.17	12/26/2002	F	F	F	2.52	2.74	2.63	2.41	2.76	3.14	F	F	F
12/27/2002	36	32	0.62	12/27/2002	F	F	F	2.65	4.24	6.96	4.88	7.64	4.06	4.75	4.49	F
12/28/2002	45	33	0.3													
12/29/2002	38	32	0.57	12/29/2002	F	F	F	7.92	9.42	11.1	10.8	14.3	8.77	9.88	12.5	F
12/30/2002	35	30	0.04													
12/31/2002	36	31	0.68	12/31/2002	F	F	F	10.4	10.7	12.6	10.6	11.9	6.8	7.77	8.16	F
01/01/2003	39	33	0.07													
01/02/2003	40	34	0.24	01/02/2003	6.24	7.2	8.79	7.66	10.6	11.5	9.11	9.14	8.53	7.98	8.05	F
01/03/2003	46	37	0.48													
01/05/2003	43	35	0.16													
				01/06/2003	6.16	6.6	8.24	7.78	8.49	9.53	9.32	11.3	9.13	10.2	10.1	10.4
				01/09/2003	4.27	4.13	5.44	5	5.56	6.39	5.86	6.61	5.95	5.84	7.08	9.27
				01/12/2003	F	F	F	F	4.96	5.56	5.42	5.69	4.67	5.53	6.65	F
01/13/2003	43	33	0.16	01/13/2003	F	F	F	F	5.93	6.27	5.04	5.83	4.98	4.74	6.69	F
01/14/2003	39	35	0.07	01/14/2003	5.81	5.99	9.75	8.47	8.84	10.1	9.6	10.5	7.5	7.82	8.19	9.76
01/15/2003	38	32	0.13													
				01/16/2003	4.37	4.1	5.65	5.12	6.23	7.62	6.71	6.88	5.84	7.23	8.77	7.4
01/19/2003	33	29	0.01													
				01/20/2003	3.43	3.76	4.78	4.32	5.14	6.82	5.24	5.81	5.18	4.78	5.1	6.8
01/22/2003	34	29	0.16	01/22/2003	4.24	4.08	6.83	4.89	5.09	5.73	4.83	5.49	4.16	4.48	5.11	5.92
01/23/2003	41	27	0.63													
01/25/2003	40	33	0.04													
01/26/2003	47	38	0.62	01/26/2003	35.9	333	Flooded	307	377	Flooded	291	312	54.4	97.9	106	167
01/28/2003	46	35	0.09	01/28/2003	10.4	12.4	18.1	14.6	18.7	19.2	17.5	21	12.6	15.7	16.1	17.2
				01/29/2003	9.64	50.9	NS	NS	Dark	NS	55.3	31.5	12.2	17.6	18.9	13
01/30/2003	41	32	0.44	01/30/2003	10.4	12.3	13.3	19.1	18.3	18.2	21.2	22.2	13.7	14.4	15.9	16.9
01/31/2003	52	40	0.27	01/31/2003	15.3	24.2	Flooded	46	42.8	40.7	39.6	40	21.6	27.9	28.8	4.44
02/01/2003	51	38	0.35													
02/03/2003	41	30	0.05	02/03/2003	7.63	9.53	28.9	22.5	23	23.3	23.8	20.5	10.1	13.3	12.2	5.76
				02/08/2003	5.21	5.33	6.4	6.08	6.16	7.04	7.41	8.65	6.16	6.41	6.09	3.87
				02/11/2003	5.38	5.76	7.52	5.85	6.24	6.96	6.79	7.92	12.5	11	7.26	3.93
				02/13/2003	4.92	5.23	5.7	5.23	5.9	5.94	5.58	6.61	7.24	6.34	6.21	12
02/14/2003	46	33	0.01													
02/16/2003	51	37	0.26	02/16/2003	14.2	26.3	147	92.1	77.2	73.1	62.7	40.2	20	23.7	17.3	16.3
02/17/2003	45	34	0.14	02/17/2003	7.14	7.96	10.1	9.97	10.3	12.2	11.7	14.2	15.8	11.1	11.3	15.5
				02/18/2003	5.91	6.47	8.04	7.54	8.18	8.59	8.71	9.98	7.69	7.76	8.28	9.58
				02/20/2003	4.82	6.42	7.84	7.8	8.9	9.24	9.23	10.8	7.09	7.78	7.51	7.46
02/21/2003	44	36	0.06													
02/22/2003	50	31	0.01													
				02/24/2003	F	F	F	F	7.44	7.58	8.27	7.83	6.24	6.56	7.28	F
				02/27/2003	F	F	F	F	5.58	8.32	6.82	8.74	NS	7.65	7.83	F
03/03/2003	41	33	0.02	03/03/2003	3.84	4.03	5.33	7	5.92	6.67	5.75	6.55	5.6	5.92	6.73	F
				03/06/2003	10.3	4.77	5.01	5.42	6.44	7.7	6.73	7.39	5.63	6.52	7.33	9.66
03/09/2003	42	27	0.16	03/09/2003	4.02	4.76	5.52	5.17	6.03	6.64	5.62	6.51	5.01	5.22	6.16	6.06
03/10/2003	42	27	0.19	03/10/2003	6.48	6.88	10.4	10.8	10.1	11	11.3	11.6	7.6	9.11	9.3	13.1
03/13/2003	53	44	0.06	03/13/2003	5.49	6.47	8	8.63	7.97	8.96	8.52	11.6	10.3	10.3	11.3	11
				03/14/2003	6.84	9.42	19.5	15.7	12.4	36.9	12.4	10.2	8.41	10	9.01	13
03/15/2003	48	36	0.34	03/15/2003	9.79	10.7	28.3	23.3	22.3	22.1	23.6	36.5	28.8	31.5	31.8	29.4
03/16/2003	49	39	0.44													
				03/18/2003	5.73	6.35	6.97	8.09	8.67	10.3	8.36	10.3	10.1	9.51	9.2	4.72
				03/20/2003	5.63	7.03	6.92	6.68	7.93	7.57	7.12	9.16	7.63	7.98	8.09	5.46

Table 6-6 Precipitation Events and Corresponding Turbidity Data

					Turbidity (NTU)											
Precipitation Date	Tmax (F)	Tmin (F)	Precipitation (in)	Sample Date	Station #1 South Fork Mica Creek upstream of the U.S. 95 project	Station #10 South Fork Mica Creek After Trib from South	Station #24 South Fork Mica After 347 Trib	Station #25 South Fork Mica After 350 Wall	Station #28 South Fork Mica After 353 Fill	Station #29 South Fork Mica After 358 Fill Trib	Station #7 South Fork Mica Creek Midway through Project	Station #2 South Fork Mica Creek Leaving Project	Station #8 North Fork Mica Creek upstream of the U.S. 95 project	Station #3 Mica Creek After Confluence	Station #12 Mica Creek at Loff's Bay Road Bridge	Station #9 Mica Bay Boat Launch
03/21/2003	53	40	0.03													
03/22/2003	46	40	0.77													
03/23/2003	51	35	0.3													
				03/24/2003	10	10.8	13.8	12.9	13.3	14.7	14.4	16.1	16.9	15.9	16.6	12
				03/25/2003	9.14	8.94	10.7	10.9	10.8	11.7	12.6	14.1	12.8	14.3	13.5	13.2
03/26/2003	45	34	0.34	03/26/2003	15.7	19.2	32.1	35.9	41.2	48.4	43.7	63	16.4	30.8	28.7	9.75
03/27/2003	48	32	0.43	03/27/2003	8.05	8.37	8.61	10.1	10.4	11	11.9	13.4	11.6	12.2	11.5	7.22
03/31/2003	67	44	0.04	03/31/2003	8.5	7.98	6.98	7.2	8.15	8.96	8.32	10.8	7.67	8.54	8.25	5.97
04/01/2003	59	40	0.02													
04/02/2003	48	35	0.08													
04/03/2003	43	35	0.15	04/03/2003	8.1	7.96	7.08	7.8	7.77	7.54	6.55	8.17	6.84	6.4	6.03	3.1
04/04/2003	42	32	0.15													
04/05/2003	46	35	0.03													
04/06/2003	43	34	0.02													
				04/07/2003	3.95	4.92	5.34	4.81	5.66	5.48	5.3	7.32	5.13	5.96	5.98	5.93
04/09/2003	68	44	0.14													
				04/10/2003	4.78	5.57	4.92	4.76	4.32	8.01	5.8	6.43	4.91	5.04	6.74	5.15
04/11/2003	69	41	0.05	04/11/2003	3.76	3.81	4.91	4.85	5.1	9.21	5.18	7.39	40	6.02	6.01	4.01
04/13/2003	55	40	0.16													
04/14/2003	60	43	0.05	04/14/2003	3.57	3.9	4.89	6	5.66	5.48	5.86	6.55	4.79	5.13	4.98	5.95
04/17/2003	53	37	0.07	04/17/2003	3.69	5.07	6.68	6.51	6.68	7.25	6.87	8.27	8.92	8.75	8.92	5.93
04/18/2003	47	37	0.36													
04/19/2003	52	33	0.02													
				04/22/2003	3.97	4.41	7.52	5.2	4.75	5.95	5.66	6.24	4.22	4.82	4.95	6.15
				04/24/2003	5.06	4.69	4.81	5.2	5.14	6.13	5.88	5.26	3.47	3.65	4.12	3.43
04/25/2003	61	38	0.18													
				04/28/2003	2.84	3.11	8.18	6.11	8.57	8.46	4.6	4.74	3.39	3.43	4.27	3.62
04/30/2003	54	43	0.02													
05/01/2003	59	45	0.13													
05/02/2003	58	42	0.02	05/02/2003	6.14	7.58	8.26	11.3	6.58	6.93	4.79	4.38	3.5	3.43	4.12	5.3
05/04/2003	54	42	0.16													
05/05/2003	51	39	0.23													
				05/06/2003	3.13	3.5	4.25	5.66	5.54	5.67	4.4	4.21	3.07	3.08	4.29	3.22
05/07/2003	48	35	0.13													
				05/08/2003	4.12	4.63	5.12	5.64	7.41	8.37	5.63	5.86	4.21	4.73	5.23	3.61
05/12/2003	67	44	0.02	05/12/2003	3.55	4.75	7.84	9.21	4.9	4.58	3.84	4.06	3.2	3.22	3.78	4.66
05/13/2003	57	44	0.13													
				05/15/2003	3.06	3.98	6.13	4.17	3.69	3.86	3.89	3.8	3.31	3.65	3.83	5.36
05/17/2003	53	36	0.05													
05/18/2003	48	36	0.21													
05/19/2003	51	35	0.08	05/19/2003	3.07	3.54	3.68	3.99	3.79	4.06	3.39	3.49	2.67	3.13	3.48	3.11
				05/22/2003	3.21	3.45	4.21	4.46	4.07	5.04	4.61	4.22	3.74	4.13	5.35	2.35
05/25/2003	91	54	0.64													
05/26/2003	63	54	0.07	05/26/2003	2.44	2.67	2.93	3.82	3.34	3.85	3.88	3.23	3.02	3.39	3.41	9
				05/30/2003	3.5	3.14	3.46	3.04	3.71	3.84	3.22	2.98	3.15	2.87	3.2	4.72
05/31/2003	67	55	1.21	05/31/2003	4.54	5.13	5.76	5.56	6.67	8.97	11.6	34.2	6.4	16.2	59.5	88.2
06/01/2003	66	52	0.02													
				06/02/2003	2.89	2.74	3.02	4.62	5.06	4.45	4.7	6.53	2.27	3.36	4.65	2.77
				06/06/2003	6.32	4.52	3.55	3.89	3.67	4.78	3.21	5.49	2.36	3.36	1.81	3.25
				06/09/2003	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
				06/10/2003	2.3	4.32	2.54	3.21	3.91	4.21	3.32	3.18	1.8	2.97	3.66	2.91
06/11/2003	73	48	0.5													
06/13/2003	78	55	0.12	06/13/2003	2.43	2.36	2.73	2.66	2.85	2.97	3.4	3.45	2.01	2.15	3.22	3.79
06/14/2003	78	54	0.07													
				06/17/2003	2.86	3.14	3.23	3.54	3.38	3.72	3.32	2.81	1.95	1.93	3.03	1.83
06/22/2003	61	46	0.02													
				06/24/2003	2.05	2.19	5.92	3.74	2.39	2.82	2.93	2.45	1.52	1.93	2.58	1.72
06/25/2003	72	51	0.01													

Table 6-6 Precipitation Events and Corresponding Turbidity Data

					Turbidity (NTU)											
					Station #1	Station #10	Station #24	Station #25	Station #28	Station #29	Station #7	Station #2	Station #8	Station #3	Station #12	Station #9
Precipitation Date	Tmax (F)	Tmin (F)	Precipitation (in)	Sample Date	South Fork Mica Creek upstream of the U.S. 95 project	South Fork Mica Creek After Trib from South	South Fork Mica After 347 Trib	South Fork Mica After 350 Wall	South Fork Mica After 353 Fill	South Fork Mica After 356 Fill Trib	South Fork Mica Creek Midway through Project	South Fork Mica Creek Leaving Project	North Fork Mica Creek upstream of the U.S. 95 project	Mica Creek After Confluence	Mica Creek at Loff's Bay Road Bridge	Mica Bay Boat Launch
				06/27/2003	5.09	6.31	8.21	4.23	3.47	3.68	3.96	2.83	1.61	2.26	2.53	1.45
				06/30/2003	4.11	4.04	4.18	4.47	3.92	4.26	3.55	3.07	2	2.44	3.67	2.08
				07/02/03*	3.05	3.03	3.79	4.42	3.52	3.28	2.59	2.75	1.61	1.78	3.04	1.27
				07/08/2003	3.15	3.39	4.32	6	3.24	3.91	2.53	2.7	1.6	2.24	3.01	1.3
				07/10/2003	3.36	3.18	4.11	4.21	2.74	3.13	2.34	2.55	1.84	2.13	2.86	1.17
				07/15/2003	4.29	NS	7.87	5.38	4.77	3.8	2.97	3.7	1.71	2.21	2.86	1.11
07/16/2003	91	64	0.22													
				07/18/2003	2.98	3.41	5.84	3.87	3.11	4.16	3.94	2.44	2.07	2.19	2.51	1.72
				07/21/2003	3.41	3.25	6.16	3.21	3.46	4.22	2.87	3.11	2.38	2.63	3.74	1.58
				07/25/2003	3.89	4.11	5.61	4.14	4.61	5.19	3.86	3.39	2.51	2.92	4.09	0.9
				07/29/2003	3.98	4.13	5.8	4.32	3.9	3.61	3.18	3.03	2.36	2.72	3.33	0.75
				08/01/2003	3.33	3.45	5.32	4.98	4.3	3.26	3.98	2.2	3.84	2.94	NS	1.97
08/03/2003	85	62	0.27													
08/04/2003	66	59	0.23	08/04/2003	4.62	4.38	5.13	4.6	4.18	4.77	4.11	3.61	2.74	2.88	3.64	1.18
				08/07/2003	4.28	4.11	4.21	4.37	3.87	4.12	3.04	3.19	2.41	2.67	3.92	1.34
				08/11/2003	4.54	3.69	5.11	4.16	4.01	5.54	3.42	3.87	1.96	9.21	4.11	1.24
				08/14/2003	3.36	4.18	6.79	5.64	4.35	3.61	3.77	3.15	1.98	2.96	3.11	1.25
				08/18/2003	3.87	4.21	7.16	5.12	5.39	4.72	3.99	3.2	2.11	2.64	2.98	0.85
				08/21/2003	4.05	5.11	6.18	4.92	5.19	4.82	4.16	3.28	2.1	3.21	3.15	1.15
				08/22/2003	4.15	4.86	8.01	3.91	4.48	4.82	3.51	4.31	2.46	2.84	2.59	1.91
08/23/2003	71	57	0.08													
				08/25/2003	6.73	7.85	6.56	6.25	4.45	4.19	4.16	3.72	2.18	3.63	3.08	1.37
				08/28/2003	4.13	5.11	6.24	5.82	5.14	4.69	4.27	3.76	2.28	2.54	2.64	1.17
				09/02/2003	6.2	5.21	10.3	6.42	6.11	6.19	5.11	3.22	2.35	2.76	2.79	1.27
				09/04/2003	5.73	4.82	NS	NS	4.82	5.64	4.91	4.48	2.71	2.94	5.19	2.06
09/08/2003	75	52	0.69	09/08/2003	6.69	6.86	6.44	6.16	5.91	6.48	5.36	4.62	3.06	2.89	6.07	1.04
09/09/2003	53	50	0.61	09/09/2003	5.43	5.1	4.78	6.02	4.01	5.34	4.28	4.11	3.76	3.14	5.32	0.89
				09/12/2003	5.81	5.39	5.24	4.81	4.73	5.25	4.44	3.74	2.94	3.18	6.22	1.62

[a]Outlined values are instances where turbidity readings within Mica Creek exceeded background conditions at North Fork Mica Creek by more than 50 NTU.

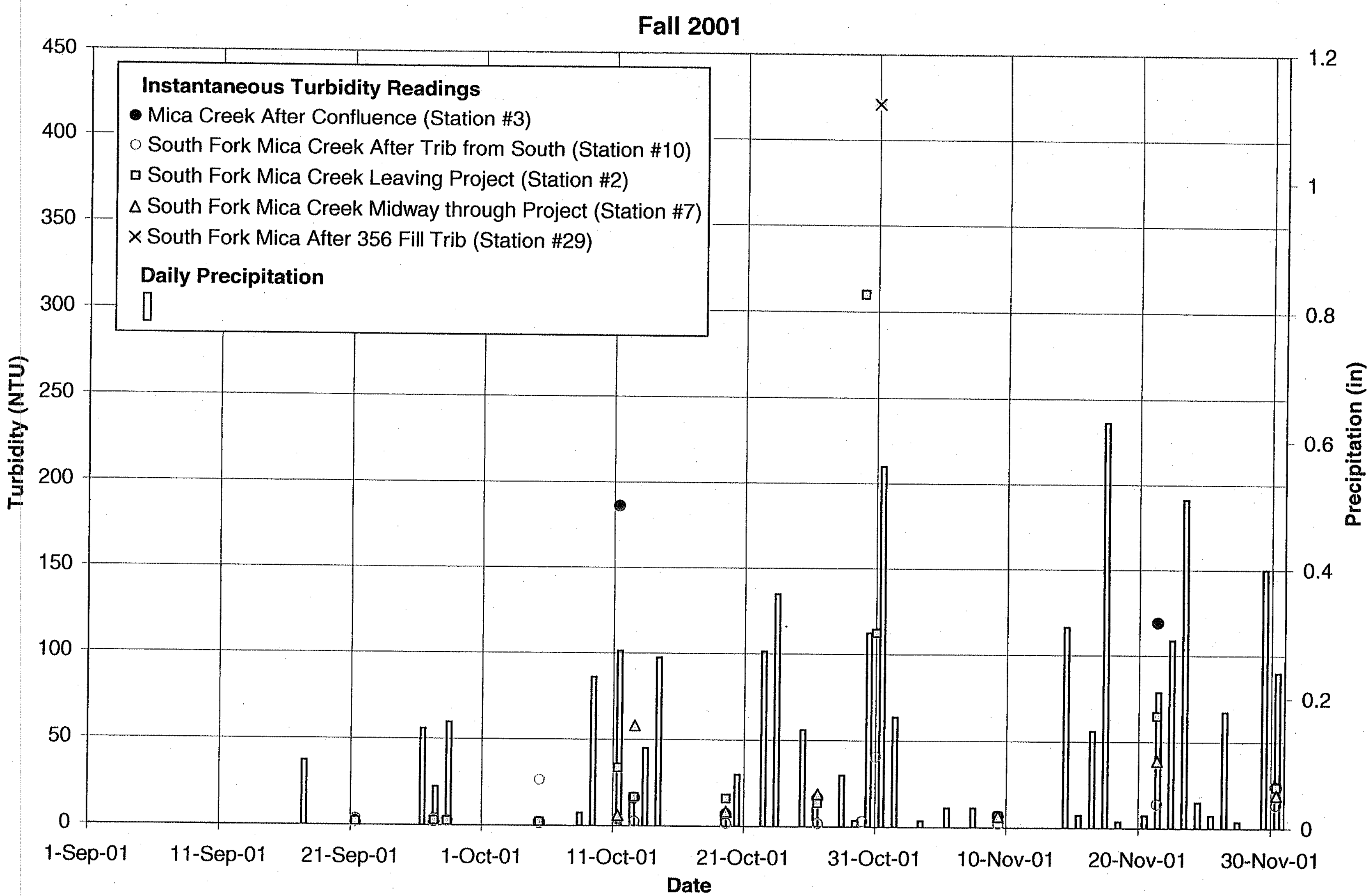
[b]Shaded values are instances where turbidity readings within Mica Creek or South Fork Mica Creek exceeded background conditions at Sorth Fork Mica Creek by more than 50 NTU.

*Supplemental turbidity data provided by Coeur d'Alene Tribe

**Supplemental turbidity data provided by Idaho Department of Environmental Quality

NS = Not Sampled

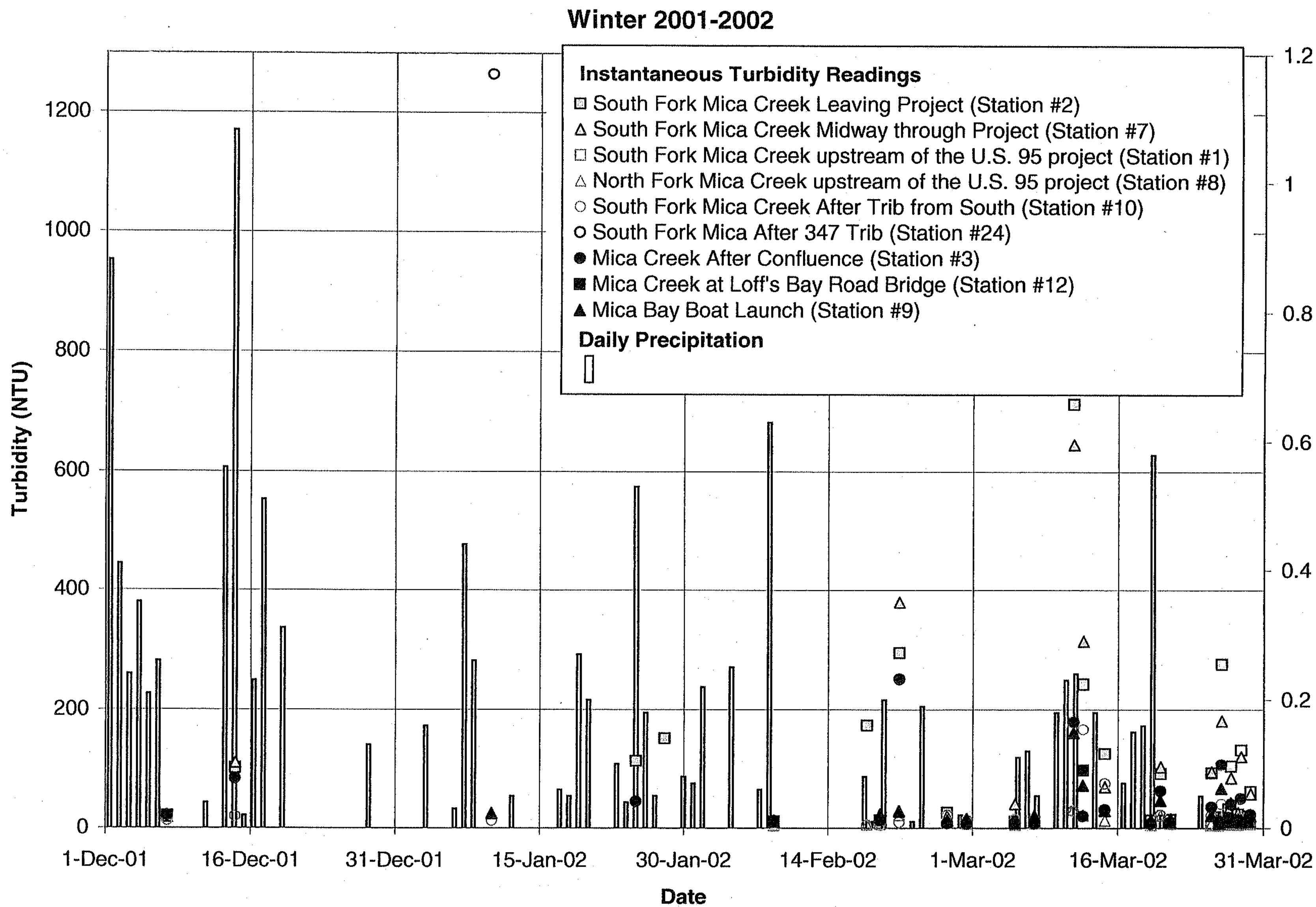
F = Frozen



NOTES: Supplemental turbidity data on 10/30/01 was provided by IDEQ
Supplemental turbidity data on 10/31/01 was provided by IDEQ and Coeur d'Alene Tribe

Figure 6-2

BOI040630001.XLS/KG



NOTES: Supplemental turbidity data on 1/10/02, 2/18/02 and 3/12/02 were provided by IDEQ
Supplemental turbidity data on 1/25/02 and 1/28/02 were provided by Coeur d'Alene Tribe

Figure 6-3

BOI040630001.XLS/KG

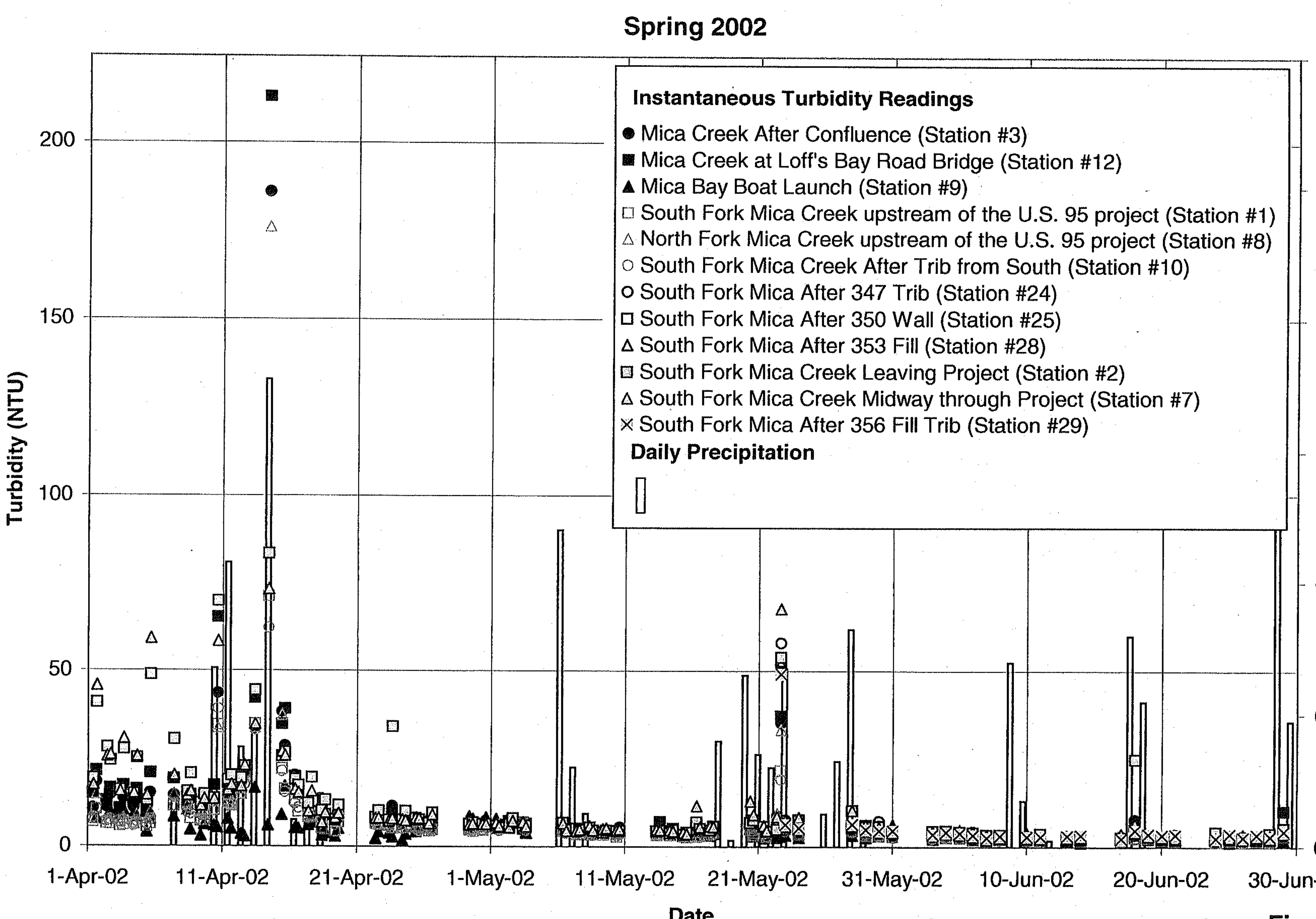


Figure 6-4

BOI040630001.XLS/KG

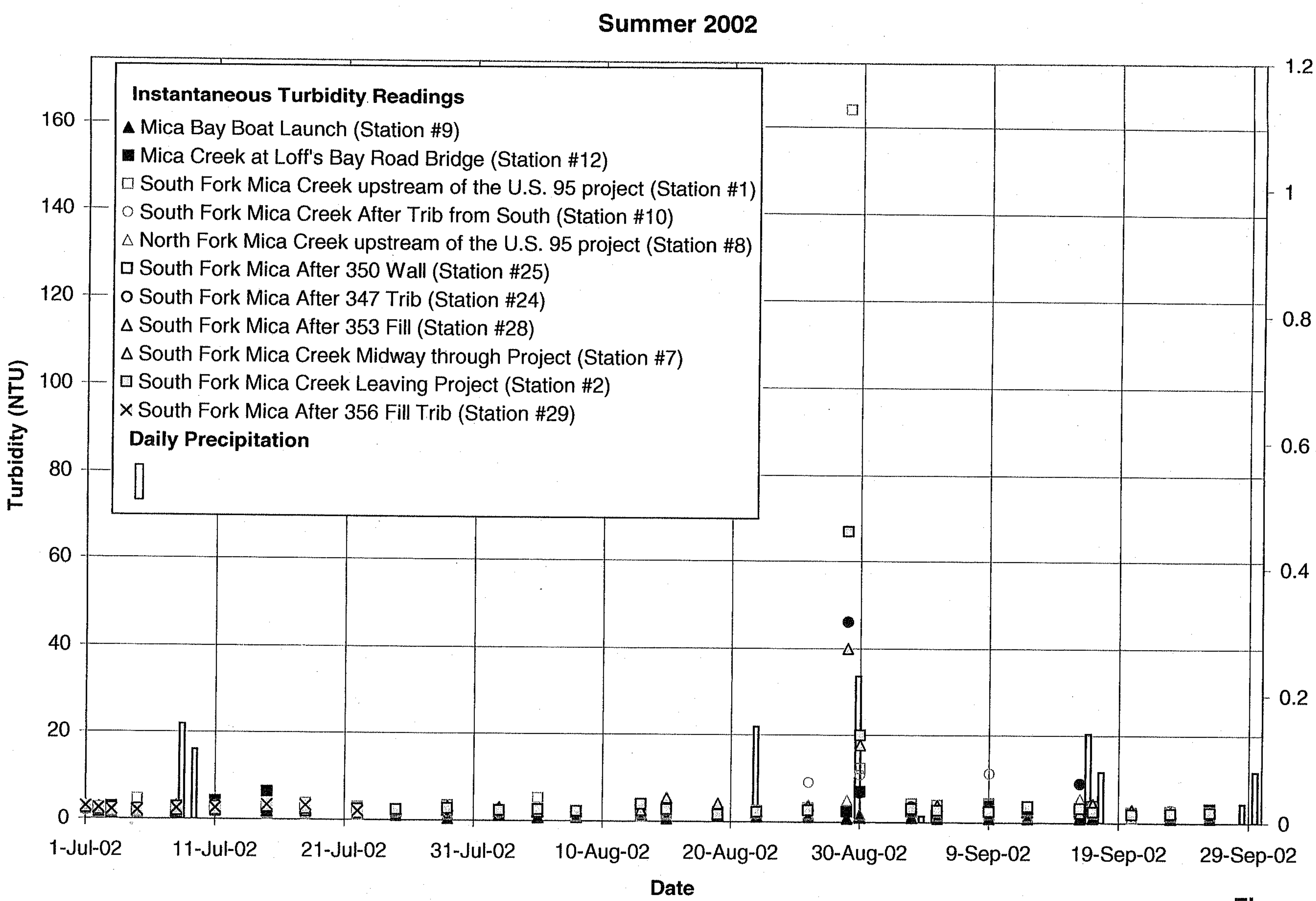


Figure 6-5

BOI040630001.XLS/KG

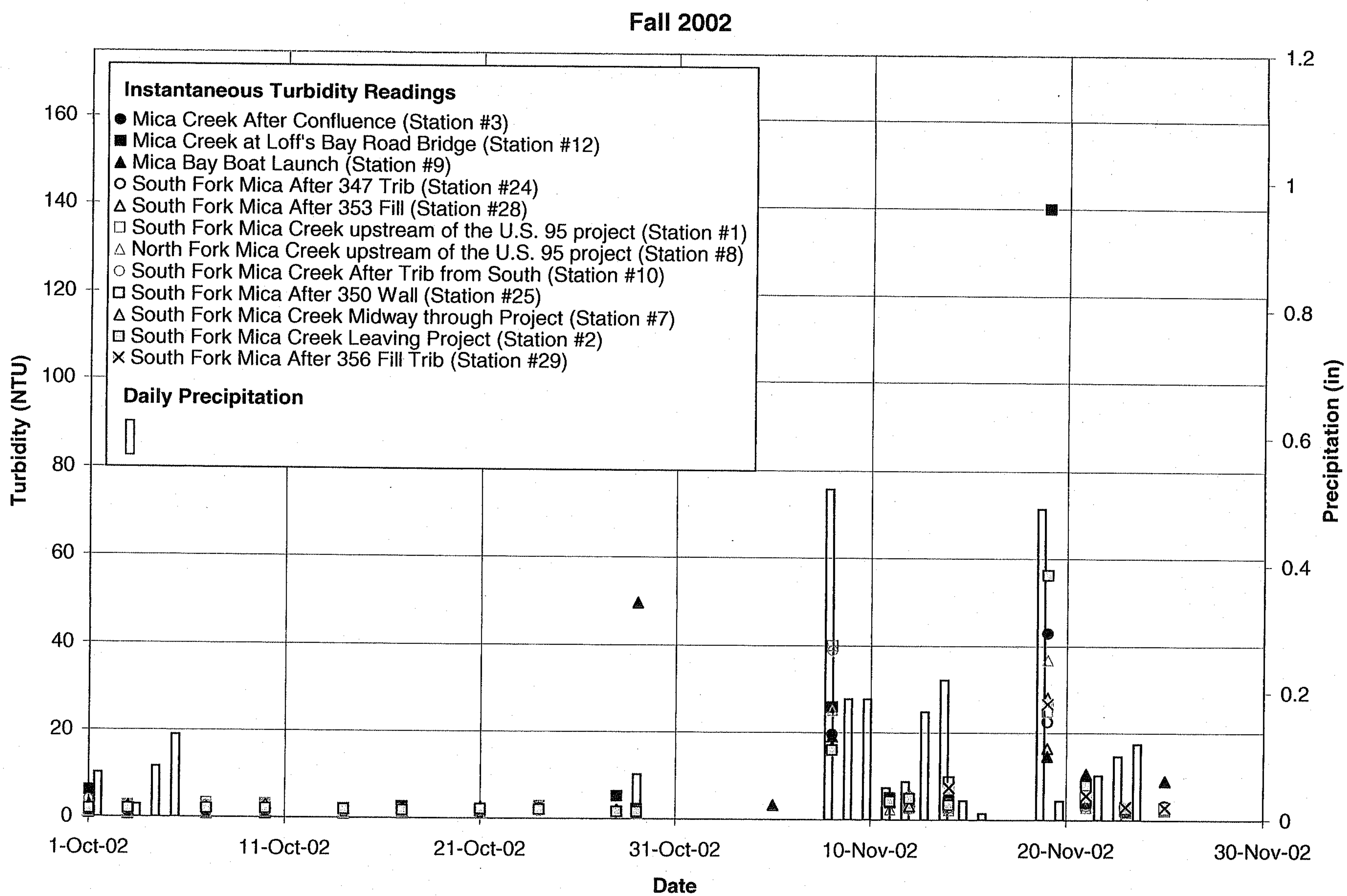


Figure 6-6

BOI040630001.XLS/KG

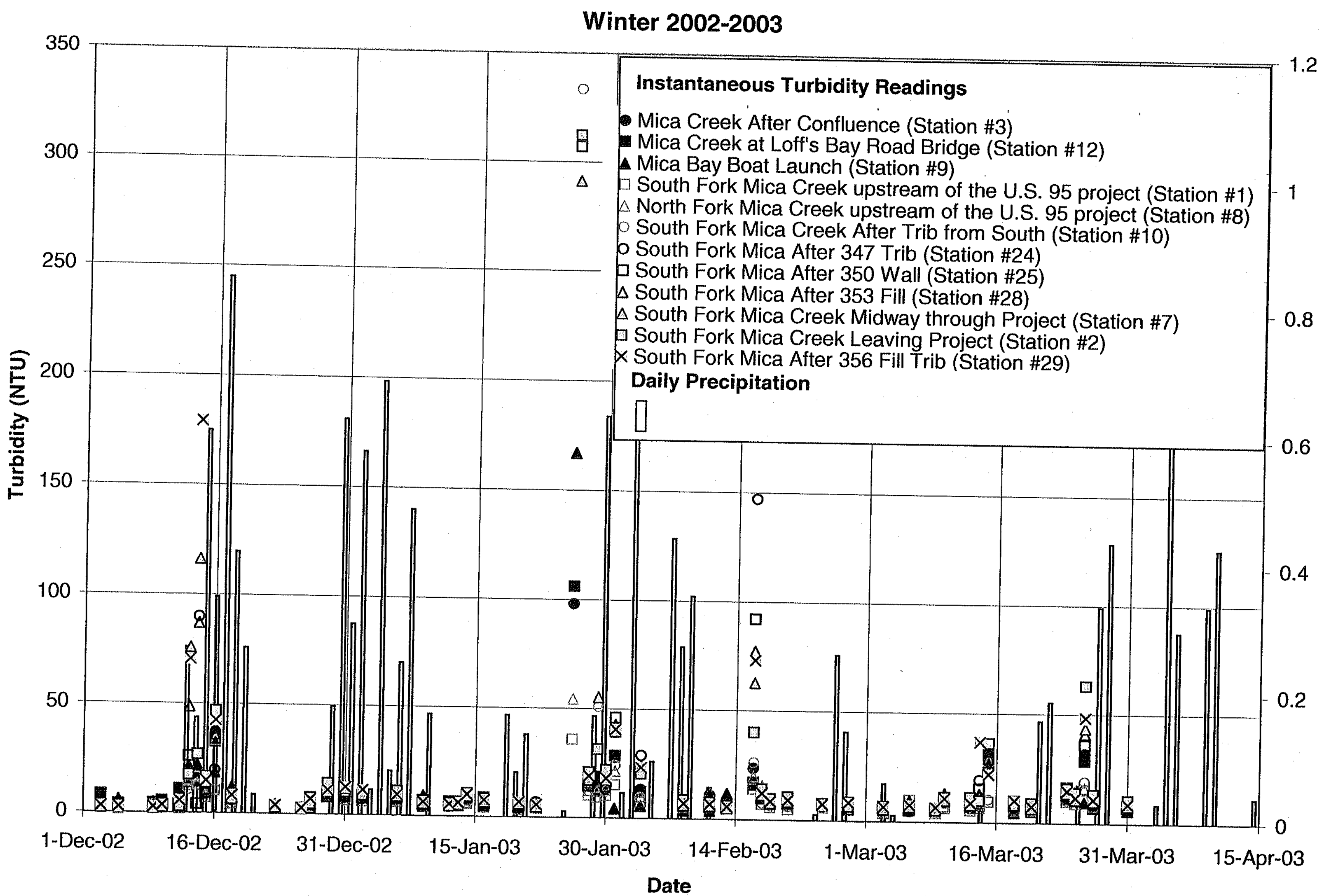


Figure 6-7

BOI040630001.XLS/KG

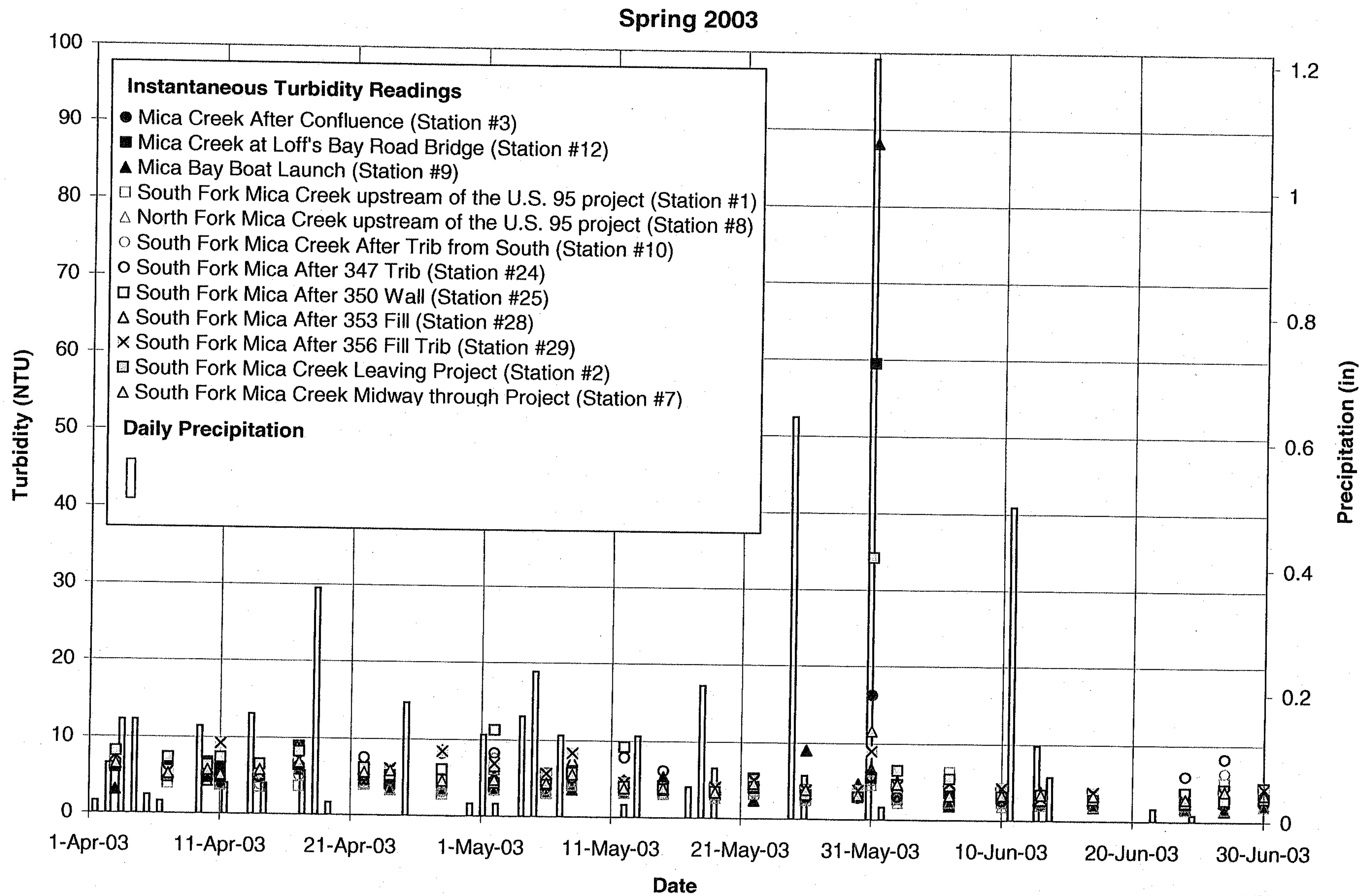


Figure 6-8

BOI040630001.XLS/KG

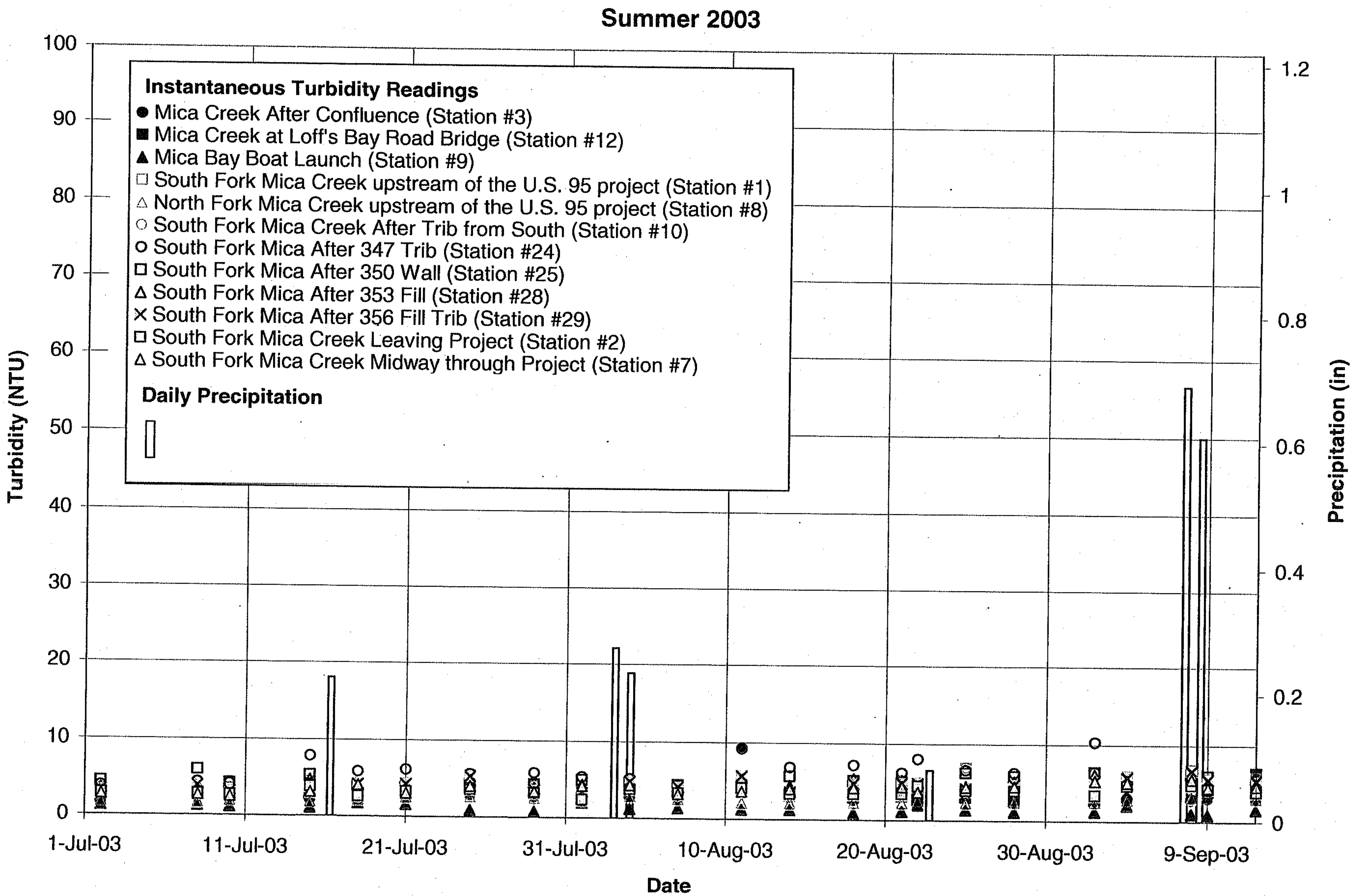


Figure 6-9

BOI040630001.XLS/KG

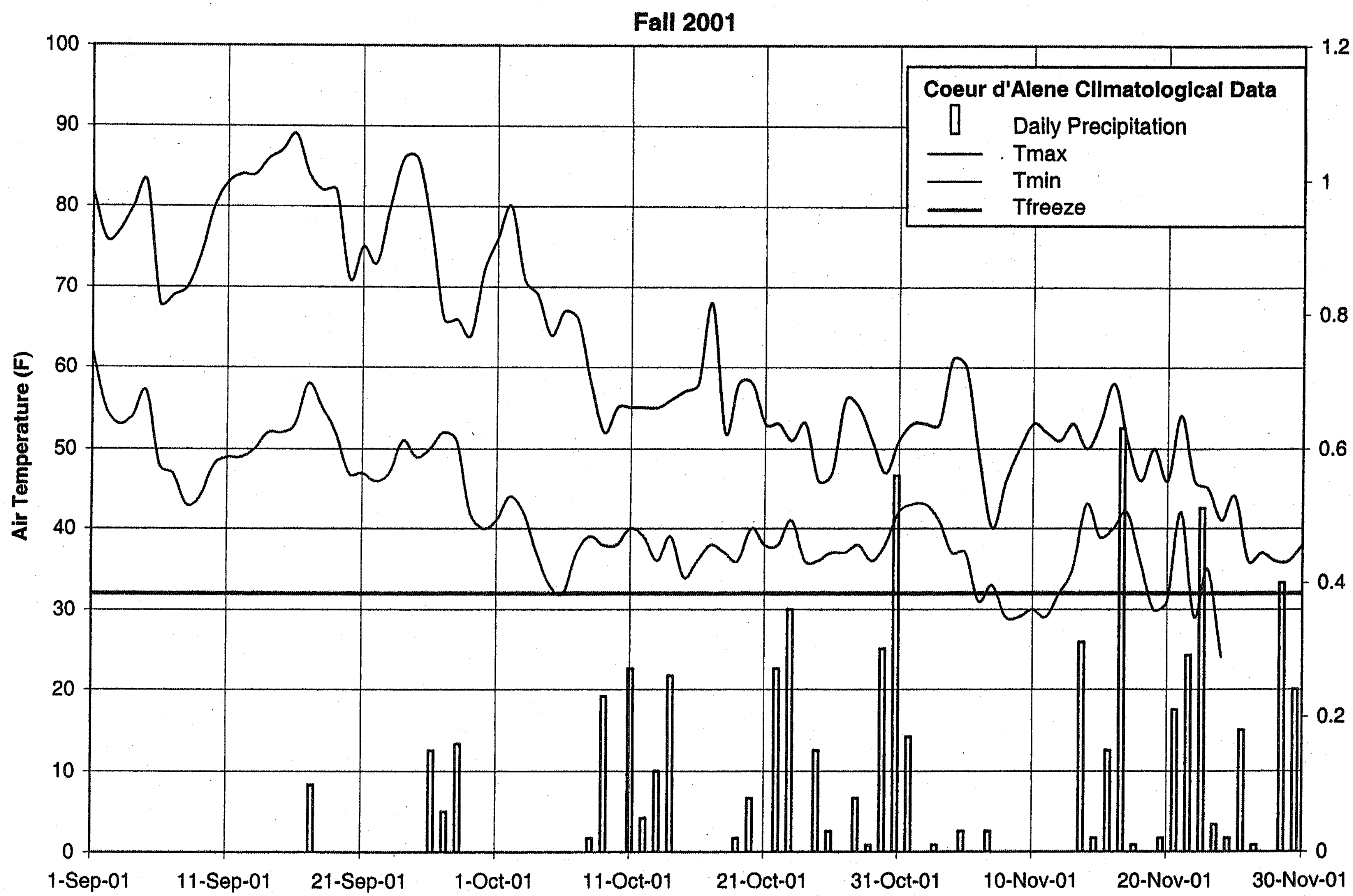


Figure 6-10

BOI040630002.XLS/KG

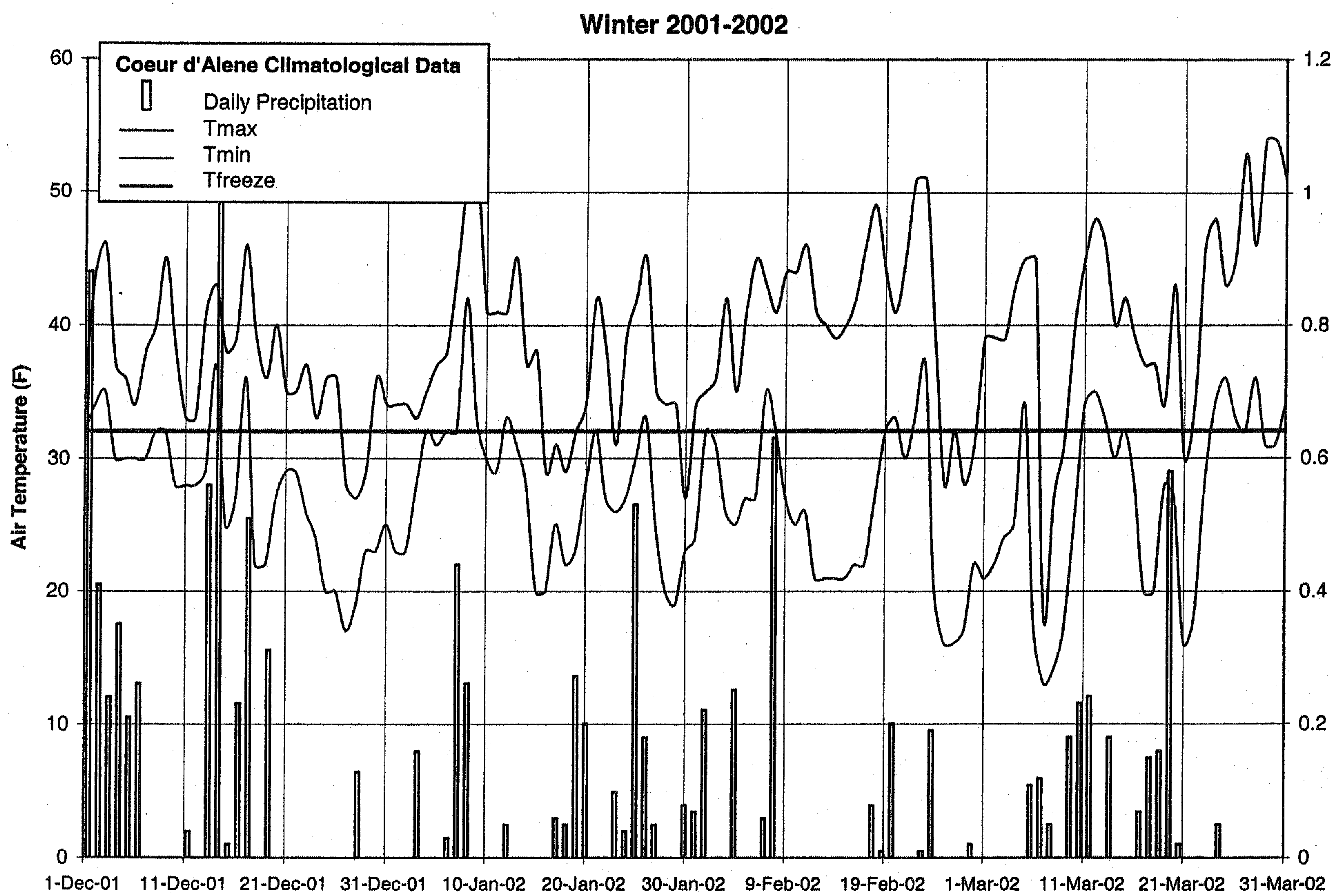

Winter 2001-2002
Coeur d'Alene Climatological Data
Daily Precipitation
Tmax
Tmin
Tfreeze
Air Temperature (F)
Precipitation (in)
60
50
40
30
20
10
0
1.2
1
0.8
0.6
0.4
0.2
0
1-Dec-01
11-Dec-01
21-Dec-01
31-Dec-01
10-Jan-02
20-Jan-02
30-Jan-02
9-Feb-02
19-Feb-02
1-Mar-02
11-Mar-02
21-Mar-02
31-Mar-02

Figure 6-11

Spring 2002

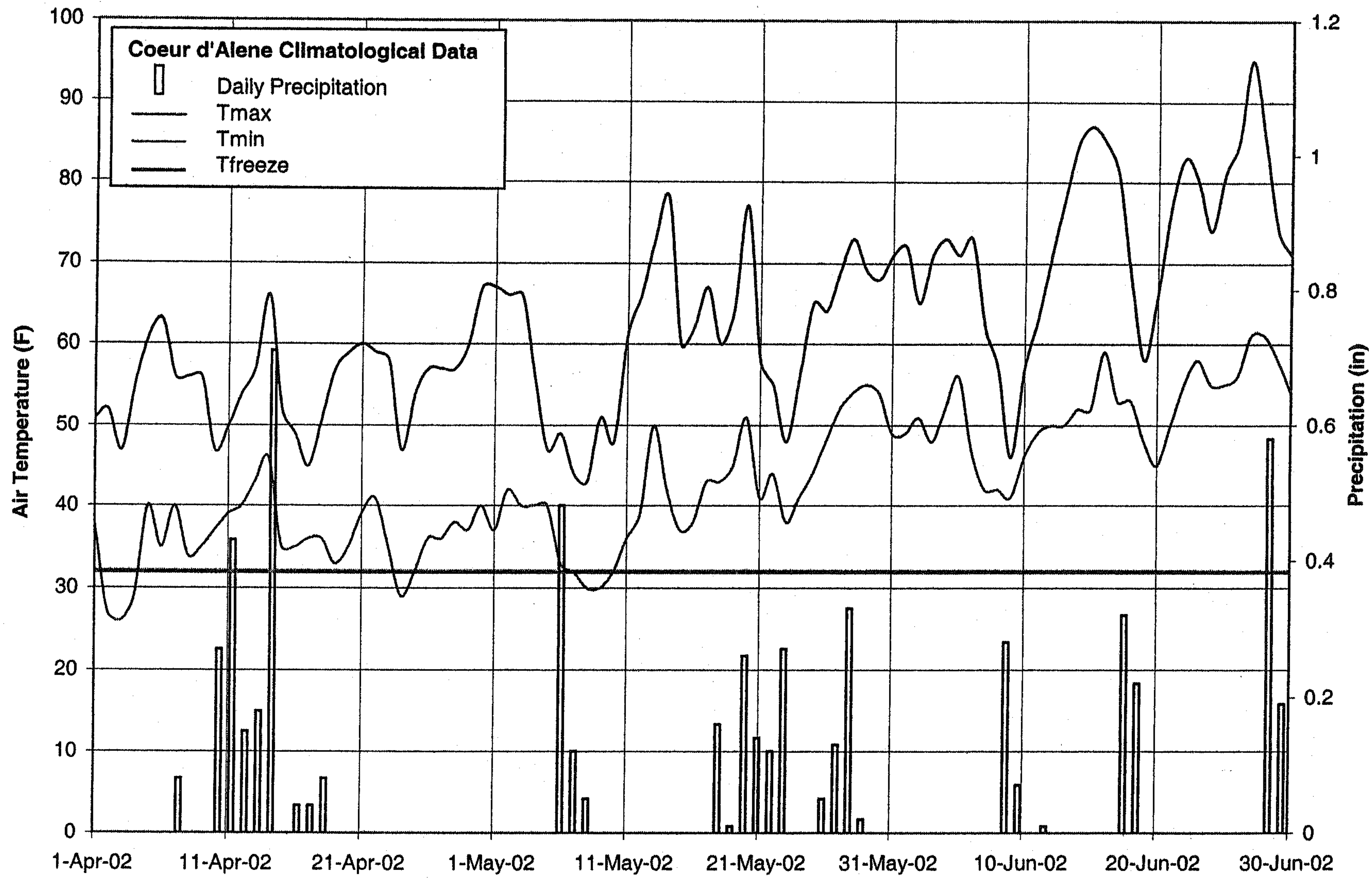


Figure 6-12

BOI040630002.XLS/KG

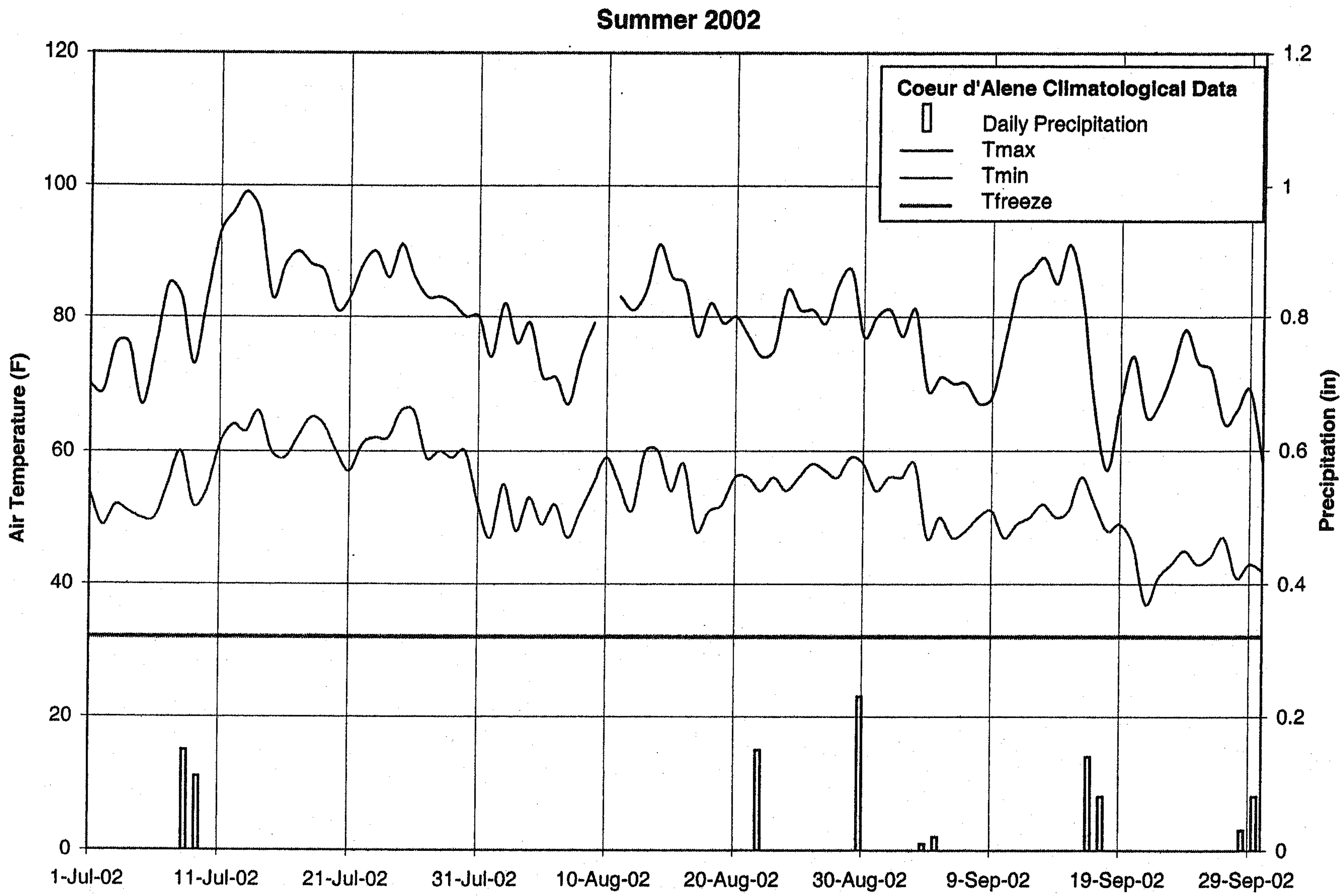


Figure 6-13

BOI040630002.XLS/KG

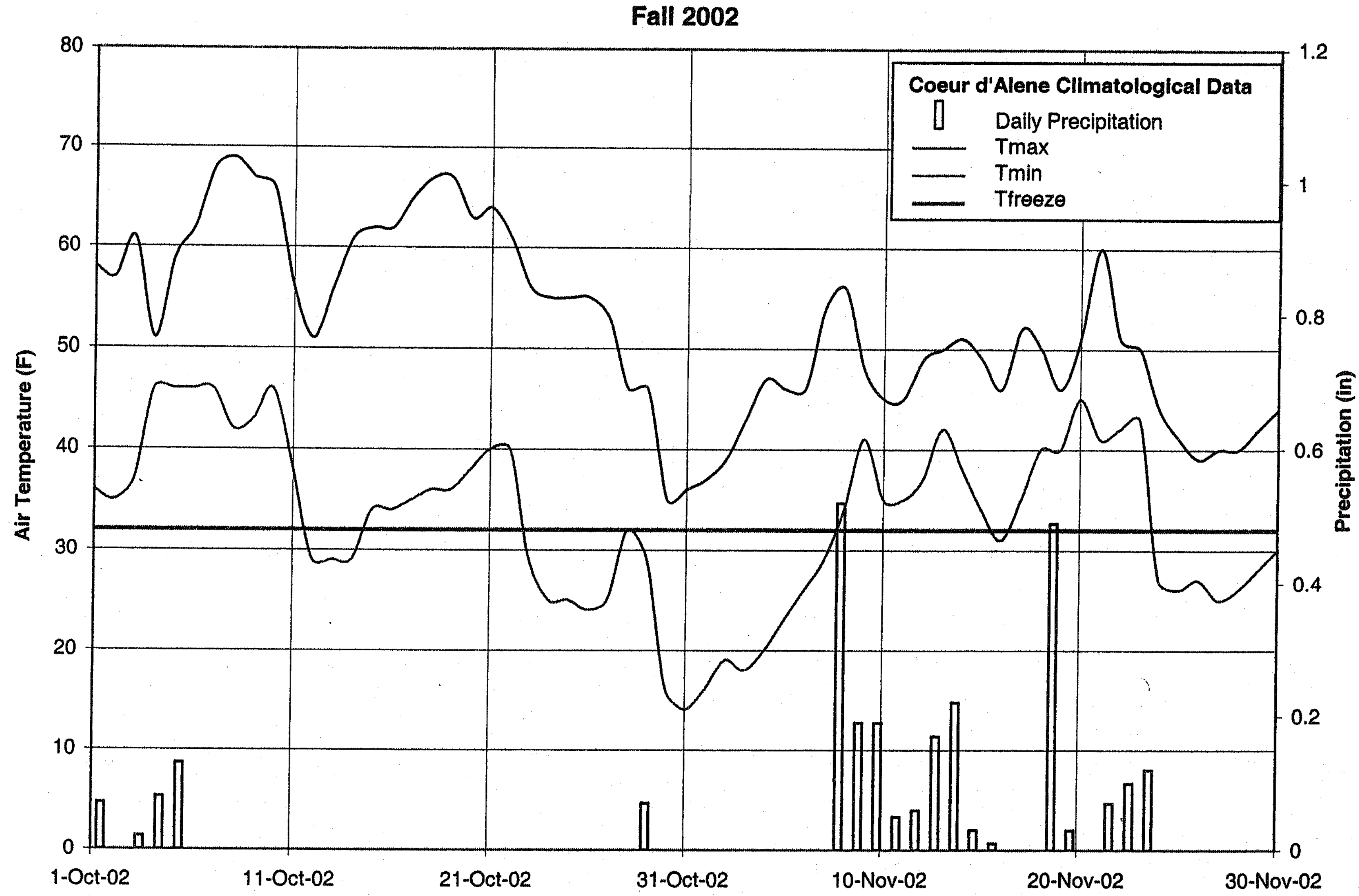


Figure 6-14

BOI040630002.XLS/KG

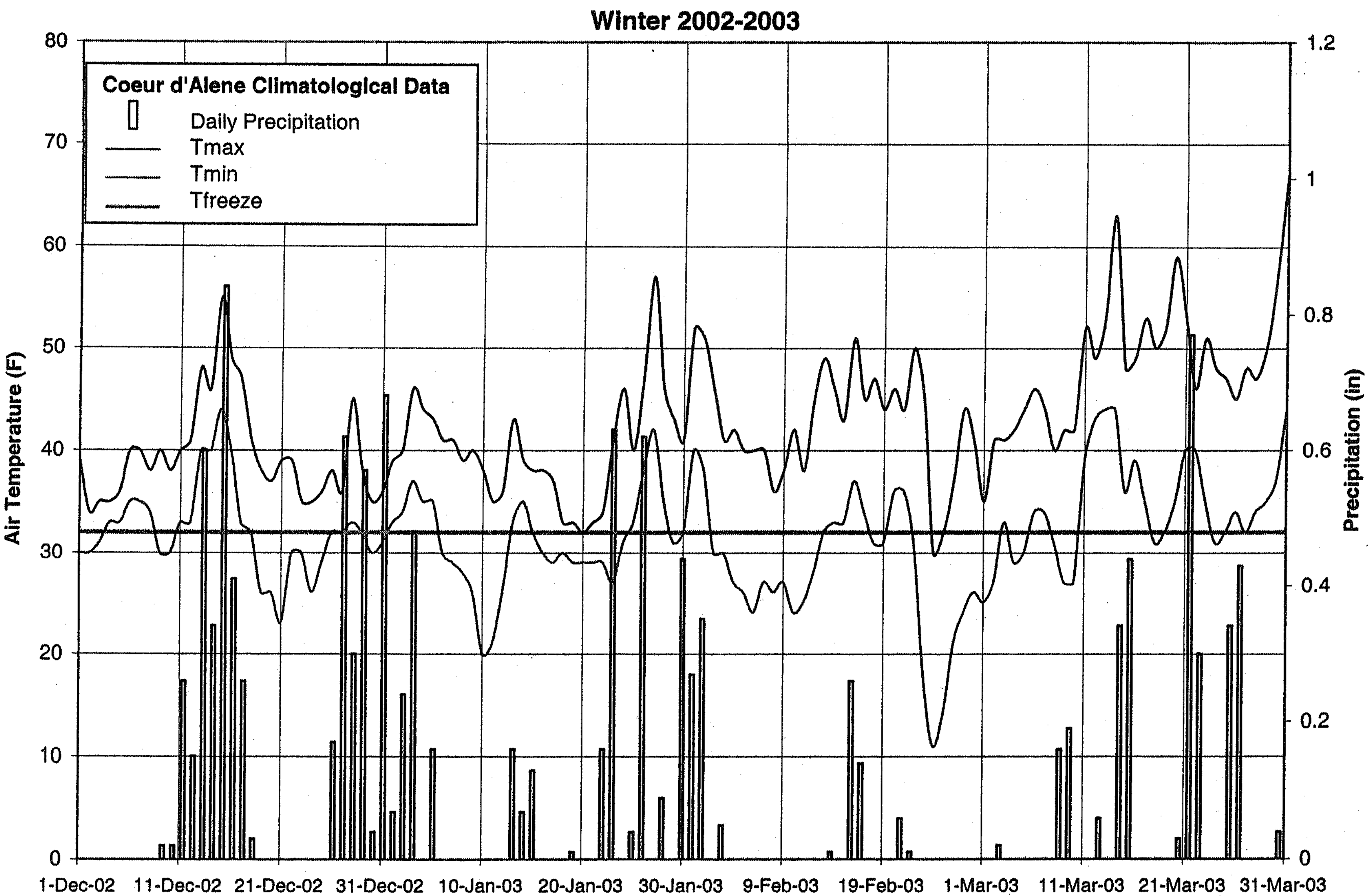


Figure 6-15

BOI040630002.XLS/KG

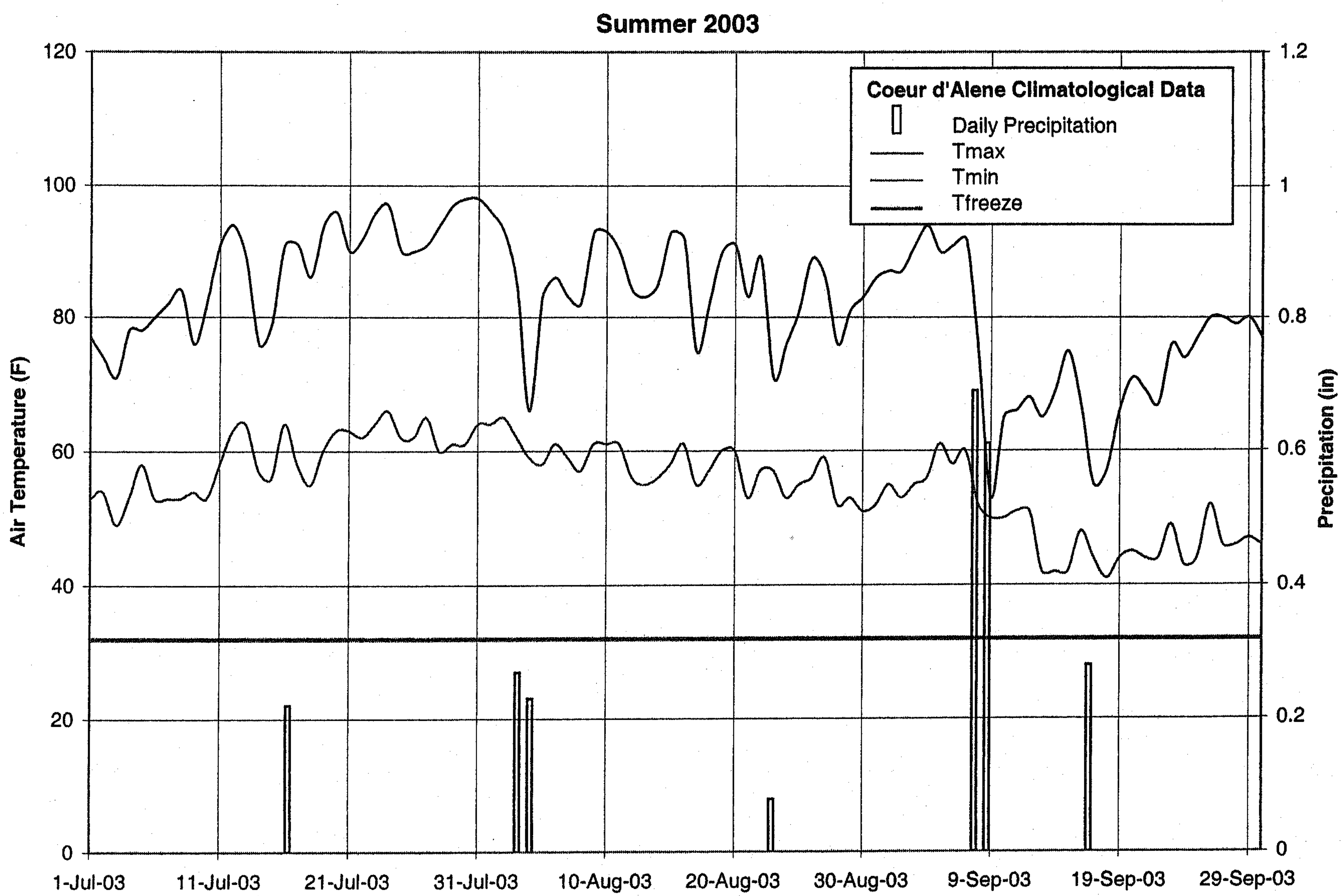
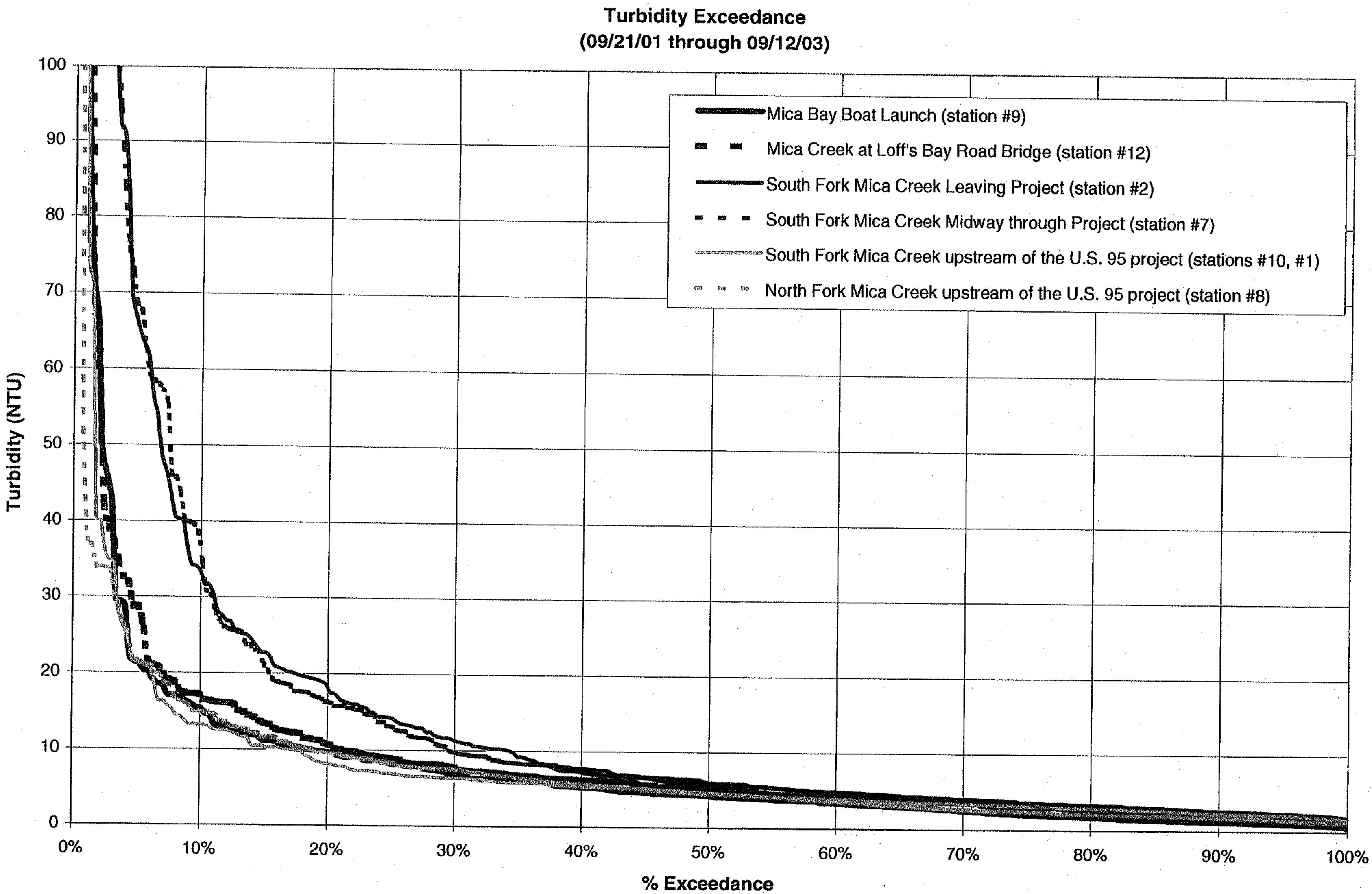


Figure 6-17

BOI040630002.XLS/KG

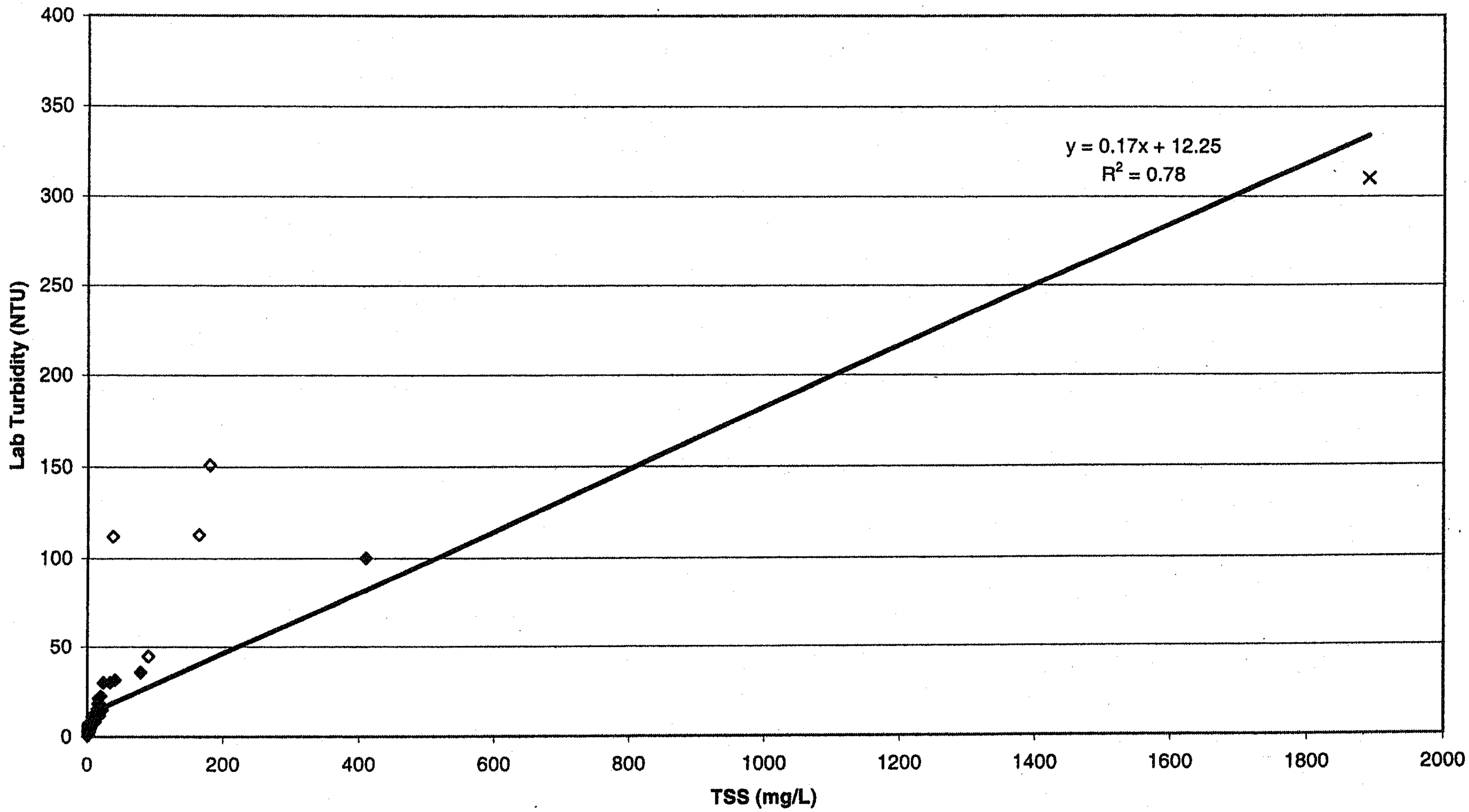


NOTE: Background curve uses station #10 data, which is a project-influenced station, until background station #1 was established (March 25, 2002)

Figure 6-18

BOI040630003.XLS/KG

South Fork Mica Creek and Mica Creek
Lab Turbidity vs. TSS

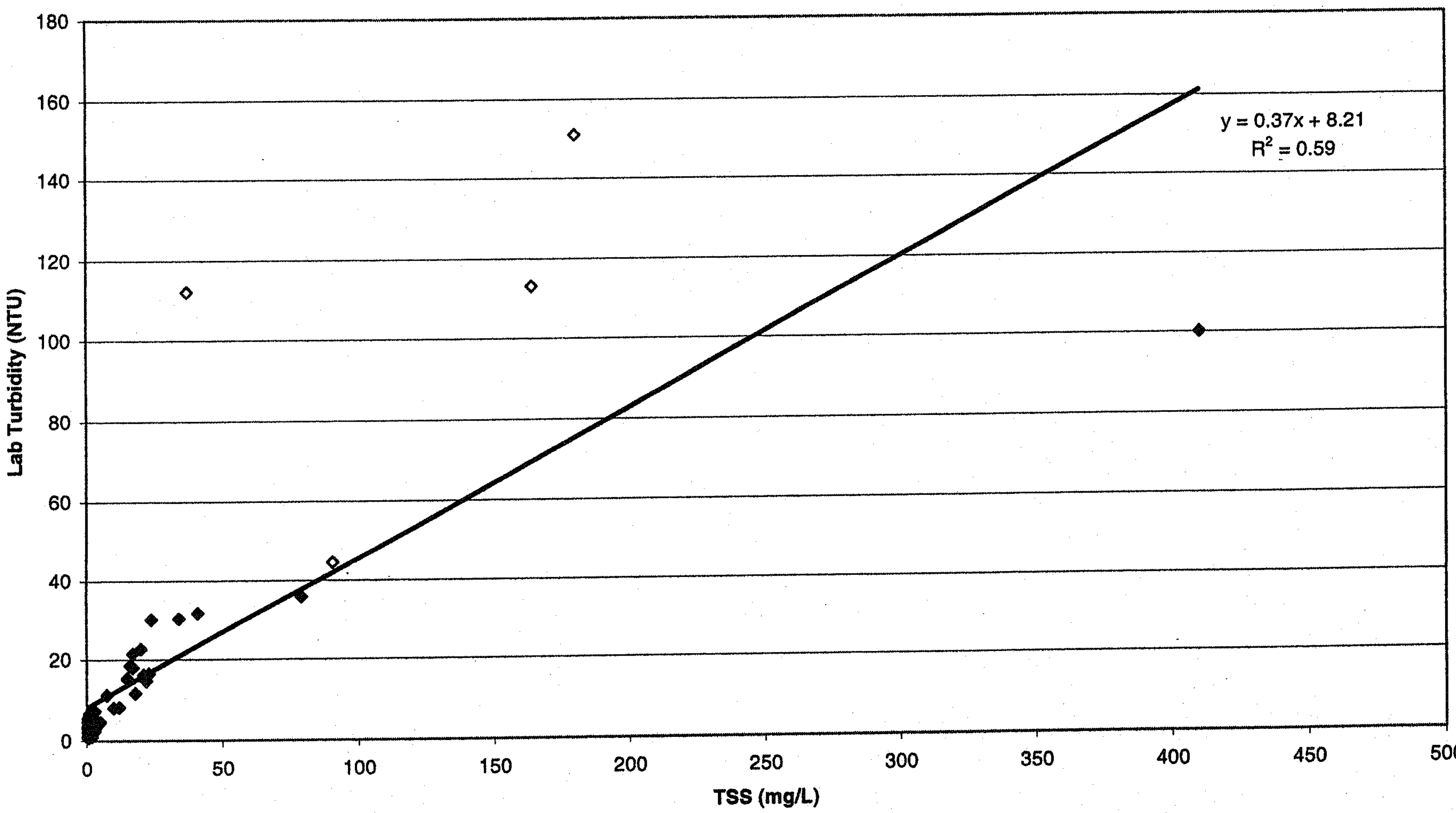


NOTES: TSS values <1.0 mg/L were plotted at 0.5 mg/L
Supplemental field data points provided by the Coeur d'Alene Tribe are shown hollow
Supplemental field data points provided by Idaho Department of Environmnetal Quality shown as an "x"

Figure 6-19

BOI040630004.XLS/KG

South Fork Mica Creek and Mica Creek
Lab Turbidity vs. TSS



NOTES: TSS values <1.0 mg/L were plotted at 0.5 mg/L
Supplemental field data points provided by the Coeur d'Alene Tribe are shown hollow

Figure 6-20

7.0 Mica Creek Watershed Characterization

7.1 Overview

Mica Creek is a 23.3-square-mile forested watershed managed for timber and agriculture production (Pettit and Zahoor, 2001; IDEQ, 1999). The North Fork Mica Creek watershed is 14.4 square miles, and the South Fork Mica Creek watershed is 8.1 square miles. Elevation in the watershed ranges from 2,125 feet at the mouth of Mica Creek to 5241 feet on Mica Peak. Forested land encompasses 82.6 percent of the watershed with the remaining land used for agriculture and residential subdivisions (IDEQ, 1999; Colla, et al., 2002). Land ownership is primarily private (93.5 percent) with small areas owned by the U.S. Bureau of Land Management (2.2 percent) and the State of Idaho (4.3 percent) (IDEQ, 1999).

As discussed in Chapter 6, *Turbidity*, a substantial portion of the turbidity/sediment in Mica Creek originates upstream of the project in both the north and south forks. This is not new information. Sediment was considered problematic in the watershed before the project commenced. The sediment levels in Mica Creek were determined to be higher than desirable at least as far back as 1998 when IDEQ included it on its list of impaired waters (that is, on the so-called 303(d) list) (IDEQ 1998). As a result, IDEQ conducted a Total Maximum Daily Load (TMDL) process to establish a plan to reduce sediment loads to Mica Creek to natural background conditions (IDEQ, 1999).

Several sources of information have been reviewed that provide insights into sediment issues in the Mica Creek watershed. Sources of sediment include agricultural and forestry activities, stream encroachment activities, and stream bank erosion. Information regarding these sources is described in IDEQ's TMDL (IDEQ, 1999), the Cumulative Watershed Effects Assessment (Pettit and Zahoor, 2001), Idaho Department of Lands (IDL) files regarding logging activities, Idaho Department of Water Resources (IDWR) files regarding stream encroachments, and a Mica Creek habitat assessment survey done in summer 2003. Each of these is further described below.

7.2 Mica Creek Sediment TMDL and Implementation Plan

The following information is taken from the final TMDL for Mica Creek (IDEQ, 1999):

- Climate patterns in the watershed are such that areas between 3,000 and 5,000 feet in elevation hold a transient snowpack in winter which is subject to rapid melt when wet Pacific air masses predominate, with high discharge rain-on-snow events being common.
- The annual sediment load from the Mica Creek watershed is about 650 tons per year, with the majority of that load occurring in the winter and spring months. This load is about 12 percent higher than natural background (that is, without anthropogenic sources such as logging and agriculture). Thus, the TMDL targeted a reduction of 80 tons per year. The majority of that reduction (66 tons per year) is anticipated to be

derived from improved management practices on forested lands, which would still deliver about 468 tons per year at natural background conditions.

- "...the sediment loading of streams in the Northern Rocky Mountains is not continuous nor does it occur on a yearly basis. The majority of the sediment in the bed and affecting the beneficial uses is loaded in large discharge events, which have a return period of 10-15 years."
- The 1996 flood event alone led to 800 tons of sediment resident in the Mica Creek bed, and noted that this would be additive to those from the 1974 and earlier flood events.

The developers of the TMDL derived the estimates of sediment loading described above using separate models for agricultural land (Revised Universal Soil Loss Equation), forested land (U.S. Forest Service WATSED model), and forest roads (relationship between CWE road score and sediment yield per mile of road).

7.3 Idaho Forest Practices Act Records

Forest land comprises 83 percent (Colla, et al., 2002; IDEQ, 2002) of the Mica Creek watershed, making it the single largest land use. To gain insight to past conditions and practices associated with this significant land use, available information from the IDL was obtained and is summarized below.

The IDL administers and enforces the Idaho Forest Practices Act (FPA) (Idaho Code Title 38, Chapter 13) which is designed to ensure that forest practices on state, private, and federal lands in Idaho are conducted so that site productivity and water quality are protected (State of Idaho, 2003). Before commencing a forest practice, the operator, timber owner, or landowner must notify IDL, and then follow the rules set forth by the Act.

An important element of the FPA is the Idaho Cumulative Watershed Effects (CWE) program that is integral to TMDL development on water quality limited stream segments. A draft report of the non-federal forested portions of Mica Creek (HUC Nos. 17060303-0902) Cumulative Watershed Effects Assessment, dated December 18, 2001, was available for review for this assessment (Pettit and Zahoor, 2001).

In addition to the draft CWE Assessment report described above, the IDL compiled available FPA notifications from properties within the Mica Bay watershed. Copies of notifications from 1988 to the present were requested in September 2002 for inclusion in this report (see Appendix L). Because the IDL hard-copy file only goes back 7 years, most of the data submitted were electronic copies of notifications back through 1993—although these were incomplete (see October 8, 2002, letter in Appendix L).

The FPA notifications available from IDL are tabulated in Appendix L. These notifications indicate timber harvest volumes since 1993, so the relative magnitude of logging activity in the watershed is reflected over that time period. Based on the FPA notifications, 46 million board feet have been reported in the watershed from 1993 through September 2002. Twenty-six percent of the timber harvested during this period occurred in year 2000, or 1 year prior to the project construction (see Figure 7-1). It is likely that this elevated level of forest activity was a source of sediment to the creeks just prior to the project commencing.

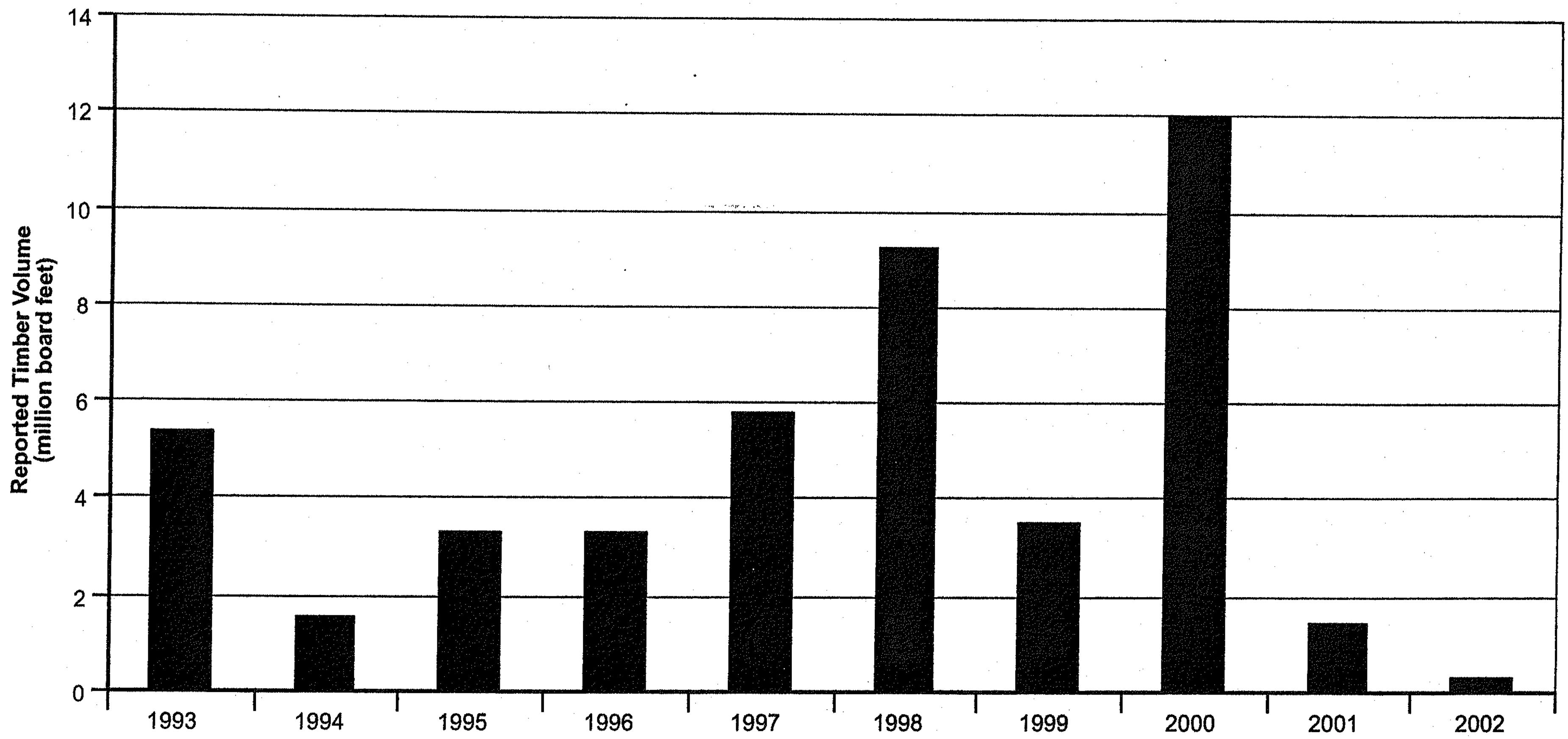


FIGURE 7-1
Timber Volume Harvested in the Mica Creek and Mica Bay Watersheds During 1993-2003
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

T102003001BOI

CH2MHILL

Using the township, range and section data reported with the FPA Notifications, the volume of timber harvested since 1993 was determined for each of the following watersheds: South Fork Mica Creek, North Fork Mica Creek, Mica Creek, and Mica Bay. The analysis reveals that 52 percent of the timber was harvested in the North Fork Mica Creek basin. The South Fork Mica basin yielded 31 percent, followed by Mica Bay at 14 percent and Mica Creek at 3 percent. If only the timber harvested from the North Fork and South Fork Mica creek basins are considered, the North Fork accounts for 63 percent of the total. During 2000, when the majority of timber was harvested, the North Fork Mica Creek accounted for 46 percent of the total, while the South Fork Mica Creek accounted for 53 percent. Because some of the sections span one or more drainage divides amongst these basins, the percentages reported above are approximate.

Included with the reported timber volumes in Appendix L are some FPA inspection narratives and reports, cease and repair orders, and violation notices from the IDL to a timber operator in the Mica Bay watershed in 1986. These records describe unsatisfactory conditions on both the North Fork and South Fork of Mica Creek drainages.

The FPA violation that occurred in the South Fork Mica Creek drainage involved a washed-out culvert at one location and a failure to remove a temporary stream crossing at another (FPA Notification No. 36996C). These violations were described in the IDL inspection report dated July 16, 1986; however, the unremoved temporary stream crossing was first described in an October 1, 1985 inspection report. Neither violation was corrected until sometime between November 6 and November 13, 1986.

The violation that occurred in the North Fork Mica Creek drainage was described as two culvert failures "resulting in deterioration of the roadway surface and subsequent damage to water quality" (FPA Notification No. 36997C). The violation was first reported by IDL on their July 16, 1986, inspection report; however, the operator did not complete the corrective measures until sometime between November 7 and November 13, 1986.

The history of logging in the Coeur d'Alene area dates back to the 1800s (Woods and Beckwith, 1997). Modern logging practices, utilizing extensive road systems and clear cutting, began in the late 1930s and reached peak application in the 1970s (Woods and Beckwith, 1997). Because the IDL records were either discontinued or incomplete, it is unknown how many FPA violations have occurred in the Mica Bay watershed since the Act was passed in 1974. Considering the fact that the vast majority of the watershed has been and continues to be managed for timber production, logging represents a source of sediment to Mica Bay and its tributaries. A history of watershed disturbance resulting in elevated sediment yields is consistent with the findings of the TMDL for Mica Creek as described above (IDEQ, 1999). The TMDL process also found that natural background sediment loads from forested lands would be 469 tons per year in this watershed.

7.4 Mica Creek Channel Encroachment History

The following information is a summary of some past stream channel encroachment applications for Idaho Department of Water Resources (IDWR) permits in the lower Mica Creek stream reach:

- **Permit # 95-S-213, issued January 31, 1974 to John Toedter.** Dragline dredging of sand deposits from 800 feet of stream bed and disposal on banks.
- **Permit # 95-S-249, issued June 27, 1975 to John Toedter.** Channel straightening and dragline dredging of sand deposits from 800 feet of stream bed and disposal on banks.
- **Permit # 95-S-260, issued February 2, 1976 to John Toedter.** Channel straightening and dragline dredging from 800feet of stream bed and disposal on banks.
- **Permit # 95-S-287, issued May 24, 1977 to John Toedter.** Channel straightening and dragline dredging from 800 feet of stream bed and disposal on banks.
- **Permit # 95-S-308, issued August 27, 1980 to John Toedter for similar work.** Permit extended January 1981, January 1982, January 1983, January 1984, January 1985, and December 1985.
- **Permit # 95-S-316, issued 1981 to Kent Hood.** Channel cleaning of 1,200 feet of stream bed downstream of Toedter property.
- **Permit # 95-S-446, Toedter application date August 15, 1995, permit not issued.** Permit requested approval to excavate the channel and abate bank erosion.

It could not be determined when or if the work identified in these applications was ever completed with regard to any particular permit. Note that several permits were issued to Mr. Toedter in multiple years for identical work. Thus, it appears that this permitted work was not always completed as proposed. It does appear that his channel maintenance effort was relatively intense in the late 1970s (perhaps early 1980s) and then was essentially discontinued after the mid-1980s. Another permit application was submitted by Toedter in 1995 but a permit was not issued and there has not been any apparent subsequent channel maintenance to date. This chronology suggests that stream bank instability and sediment input has likely increased since the cessation of channel maintenance after the mid-1980s.

Also of note, IDWR files contained complaints issued by the downstream neighbor (S.J. Hood) alleging that Mr. Toedter's work has increased downstream sedimentation along the stream reach adjacent to the Hood property thus increasing flooding. There was no evidence in the IDWR files reviewed of any violation issued to Toedter, but much debate and review of his work occurred at the time (for example, a letter from Idaho Governor Evans assuring Mr. Hood that IDWR would require Mr. Toedter to stabilize stream bank areas).

7.5 Mica Creek Watershed Habitat Assessment Photographs

Photographs of unstable, actively eroding stream banks in the Mica Creek watershed were taken during the habitat assessment field inventory effort conducted in September 2002. Illustrative examples are provided here as Photos 7-1 and 7-2.

These photographs exhibit sources of sediment to the Mica Creek watershed primarily associated with bank erosion.

7.6 Conclusions

Based on sediment loads reported in the 1999 Total Maximum Daily Load for Mica Creek, the primary source of sediment in the watershed historically has been logging, with agricultural activities being a secondary source. A substantial increase in logging activities in the watershed occurred in 2000. Streambank encroachment and erosion, as well as stream channelization also appear to have contributed sediment based on records of activities and observations of deeply cut banks. Alterations or disturbances to the streambanks are most apparent in the downstream reaches of the North Fork and South Fork Mica Creeks and essentially the entire length of Mica Creek.

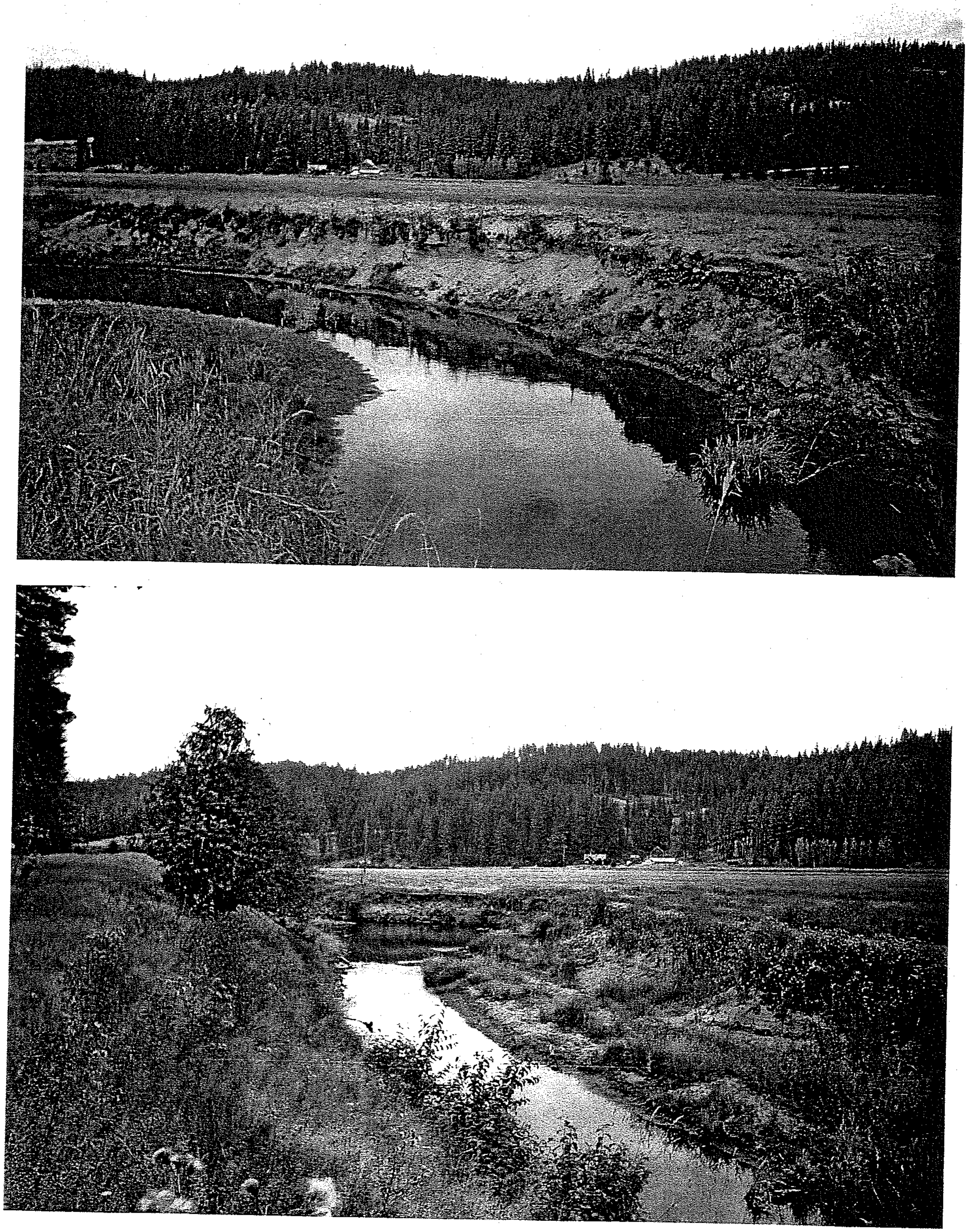


PHOTO 7-1 Two Examples of Erosion on the Main Stem Mica Creek

PHOTO 7-2 Two Examples of Erosion on the North Fork Mica Creek

8.0 Biological Resources in Mica Bay, South Fork and North Fork Mica Creek, and Mica Creek

8.1 Overview of Habitat and Species Present in Mica Bay

The drainage of the Spokane River basin in northern Idaho is approximately 3,840 square miles (Moore, 1986). The St. Joe, Coeur d'Alene, and St. Maries Rivers are major subbasins and are tributaries to Coeur d'Alene Lake. Coeur d'Alene Lake is the third largest natural lake in Idaho with a surface area of 32,000 acres and mean and maximum depths of 70 feet and 200 feet, respectively (Davis and Horner, 1995). This large lake area with varying depths provides a wide and diverse aquatic habitat. The lake also provides highly valued recreation opportunities.

Coeur d'Alene Lake supports several native game fish species including bull trout, cutthroat trout, and mountain whitefish. Non-native, or introduced, game fish species inhabiting the lake include rainbow trout, kokanee salmon, chinook salmon, large and smallmouth bass, northern pike, and tiger muskie. Nongame fish species include suckers, tench, and sculpins. Native and introduced fish species utilizing Coeur d'Alene Lake are shown in Table 8-1.

TABLE 8-1
Native and Introduced Fish Species in Coeur d'Alene Lake

Native		Introduced	
Common Name	**Scientific Name**	**Common Name**	**Scientific Name**
Westslope cutthroat trout	*Oncorhynchus clarki lewisi*	Fall chinook salmon	*Oncorhynchus tshawytscha*
Bull trout	*Salvelinus confluentus*	Kokanee	*Oncorhynchus nerka*
Mountain whitefish	*Prosopium Williamsoni*	Rainbow trout	*Oncorhynchus mykiss*
Northern pikeminnow	*Ptychocheilus oregonensis*	Brook trout	*Salvelinus fontinalis*
Peamouth	*Mylocheilus caurinus*	Largemouth bass	*Micropterus salmoides*
Longnose sucker	*Catostomus catostomus*	Smallmouth bass	*Micropterus dolomieu*
Largescale sucker	*Catostomus macrocheilus*	Black crappie	*Pomoxis nigromaculatus*
Sculpin	*Cottus* sp.	Pumpkinseed sunfish	*Lipomis gibbosus*
		Yellow perch	*Perca flavescens*
		Brown bullhead	*Ameiurus nebulosus*
		Black bullhead	*Ameiurus melas*
		Channel catfish	*Ictalurus punctatus*
		Northern pike	*Esox lucius*
		Tiger muskie	*Esox lucius* x *E. masquinongy*
		Tench	*Tinca tinca*

Sources: Rich, 1992; Davis and Horner, 1995; Coeur d'Alene Tribe, 1996; Moore, 1986

Kokanee were introduced into the system in 1937 and began to support a very large and sought-after fishery (Davis and Horner, 1995; Moore, 1986). In 1973, northern pike were introduced into the lake (Moore, 1986) but were not significant predators of kokanee. In the late 1970s anglers were harvesting nearly 600,000 kokanee and expending more than 250,000 angler hours per year (Moore, 1986). Because of abundant spawning areas and limited fish predators, overpopulation began to occur and the size of the kokanee began to diminish. In 1982, chinook salmon were introduced (Rich, 1992) to increase predation on kokanee and promote better growth (Davis and Horner, 1995). Natural reproduction of chinook salmon occurs in the system and has increased the kokanee predator population to the point that intense management of the chinook salmon population combined with monitoring of the kokanee population is required to maintain the proper predator-prey balance in the lake (Davis and Horner, 1995). In addition, the chinook salmon and the bass fisheries provide the basis for significant trophy fisheries and tournaments are held for each of these species in Coeur d'Alene Lake.

Several large and many small bays on the lake supply considerable and important shallow water habitat, which is used by several fish species for spawning and rearing purposes. The lake also has a large amount of pelagic (open and deep) habitat that also supplies several species (such as kokanee and chinook salmon) with their preferred habitat.

Habitat in many of the bays, specifically Mica Bay, is relatively shallow with extensive sediment and macrophytic vegetation (Woods and Beckwith, 1997). Relatively shallow vegetated areas like this provide important and valuable habitat for fish species including northern pike, bass, sunfish, and crappie, and provide nurseries for pelagic species including trout and salmon. The open water pelagic habitat is primarily located in the central portion of the lake out from the bays. Aquatic vegetation is absent from pelagic areas.

8.2 Fisheries Impact Assessment Methods

8.2.1 Mica Bay Impact Assessment

A literature review was conducted to assess the potential impacts, if any, of total suspended solids (TSS) levels on fishes within Mica Bay that may have come from the project. In general, elevated TSS conditions can influence fish in the following ways (Rowe et al., 2003):

- Behavioral effects—avoidance (holding or migration changes), attraction (TSS as cover; reduced predation risk), reduced feeding success, increased "coughing" or "gill flaring"
- Physical effects—stress, tissue damage, reduced growth, mortality
- Habitat effects—increased sedimentation, fill gravel interstitial spaces, decreased intergravel dissolved oxygen concentrations, decreased residual pool volumes, decreased spawning and emergence success

A literature review of turbidity and TSS impacts to fisheries is provided in Chapter 6 and Appendix K.

Turbidity and TSS values taken from Mica Creek and Mica Bay from September 2001 to the present are compared to literature-derived values where the levels are suspected of causing fisheries impacts. Chapter 6 provides a detailed analysis of turbidity and TSS sampling and analysis in Mica Creek and Mica Bay.

Sediment accumulation evidence is also qualitatively assessed using sediment core analysis (Chapter 3), aerial photos interpretations (Chapter 4), and underwater photography (Chapter 5) comparisons.

Vegetation surveys and northern pike research in Mica Bay were also reviewed for historical perspective.

8.2.2 Mica Creek Stream Habitat Assessment Methods

8.2.2.1 Introduction

Stream habitat sampling was conducted within Mica Creek during September 2002, as required pursuant to the Consent Order between IDEQ and ITD effective May 8, 2002. The Consent Order requires ITD to conduct studies in Mica Creek to assess impacts, if any, from the project resulting from sedimentation in South Fork Mica Creek, mainstem Mica Creek, and Mica Bay. The project area of concern occurs along the South Fork Mica Creek from the U.S. 95 bridge, downstream to the confluence with the North Fork Mica Creek, and within the mainstem of Mica Creek to Coeur d'Alene Lake. This study is designed to assess the sediment deposition impacts on the biological communities in the South Fork and mainstem Mica Creeks from the highway construction project. The purpose of this analysis is to describe the physical stream habitat within the South Fork, North Fork, and mainstem portions of Mica Creek and assess the effects, if any, of the project on Mica Creek.

8.2.2.2 Survey Locations

Survey reaches were located within the Mica Creek drainage (HUC 17010303). The Mica Creek watershed is approximately 21.6 square miles with two main forks, the North Fork (approximately 13.9 square miles) and the South Fork (approximately 7.7 square miles). The lower Mica Creek system is a third-order stream tributary to Coeur d'Alene Lake. South Fork Mica Creek is paralleled by U.S. 95 approximately 2.5 miles upstream of the confluence of North Fork Mica Creek. The area is dominated by privately owned agricultural and grazed lands in the lower portions of the drainage and forested State lands in the upper reaches. Elevations range from approximately 5200 feet in the upper-most portions of the drainage to 2000 feet near Coeur d'Alene Lake.

Seven stream reaches were surveyed with 485 sampled habitat units within the analysis area (Table 8-2, 8-1). The stream reaches represent segments of habitat morphology that contain similar channel type, gradient, and vegetative characteristics and account for 4.9 miles of the approximate 19.9 miles of the Mica Creek streams.

TABLE 8-2
Mica Creek Reach Segments with Habitat Delineations

Reach Code	Location and habitat summary	Unit Length (mile)[1]
MS-1	Mica Creek near the mouth of Coeur d'Alene Lake upstream to the confluence of North Fork and South Fork Mica Creek. MS-1 averages 5 meters wide and is generally a low gradient and deeply entrenched channel (approximately 1 percent), much of which resembles a formed ditch. The channel is surrounded by relatively flat agriculture lands with little definable riparian area.	0.75
SF1/SF2	South Fork Mica Creek along the east side of U.S. 95 and upstream. This reach averages 3 meters wide and is a slightly higher gradient reach (approximately 1.9 percent) than MS-1 and is dominated by glides and runs with densely vegetated and narrow riparian areas. The channel is intermittently confined by the road prism and has been channelized in the lower few hundred meters of the reach.	0.96
SF3	South Fork Mica Creek parallels the east side of U.S. 95, crosses under the highway twice and returns to the east side of the highway. This reach averages 3 meters wide with a slightly higher gradient (approximately 3.3 percent) and larger substrate than SF1/SF2. Much of the reach is confined between the road and hill slope and contains bedrock and boulder substrates. The stream and riparian area vegetation is well developed and dense. The upper portion of the reach ends at a group of beaver complexes.	0.95
SF-4	South Fork Mica Creek from river mile (RM) 2.9 to the U.S. 95 bridge (RM 3.6). This reach averages 3 meters wide and is a lower gradient (approximately 2 percent) than SF3 and dominated by sandy substrates with sand bars and beaver complexes. Stream banks are stable with dense bank and overhead channel vegetation. Riparian areas are dense and well developed.	0.62
USF1	The upper South Fork Mica Creek reach begins at the U.S. 95 bridge and extends upstream to a massive beaver complex. The average width is 7 meters, slightly lower gradient (approximately 1.8 percent) than SF-4, and is dominated by pools associated with the beaver complexes. Riparian vegetation is well developed and streambanks are generally stable and densely vegetated.	0.43
USF2	This upper South Fork Mica Creek reach begins approximately 1.3 kilometers upstream of the U.S. 95 bridge and is above the beaver dam complex whose pools span the width of the valley floor. The width of this reach averages 3 meters, has a moderate gradient (approximately 2.4 percent), is dominated by riffles and pools formed by large wood debris, and contains several beaver ponds. Riparian vegetation is well developed and streambanks are generally stable and densely vegetated.	0.33
NF-1	The North Fork Mica Creek reach begins upstream of the U.S. 95 bridge. The average width is 4 meters and the reach is dominated by pools formed by debris jams and confined by riparian vegetation. The stream reach is intermittently impacted by grazing cattle and has numerous high, exposed cut-banks. The stream is generally confined but has a well developed, dense, and narrow riparian vegetation component.	0.84

[1]Calculated from electronic data in GIS.
[2] Habitat values are evaluated in metric form to fit sampling protocol measures.

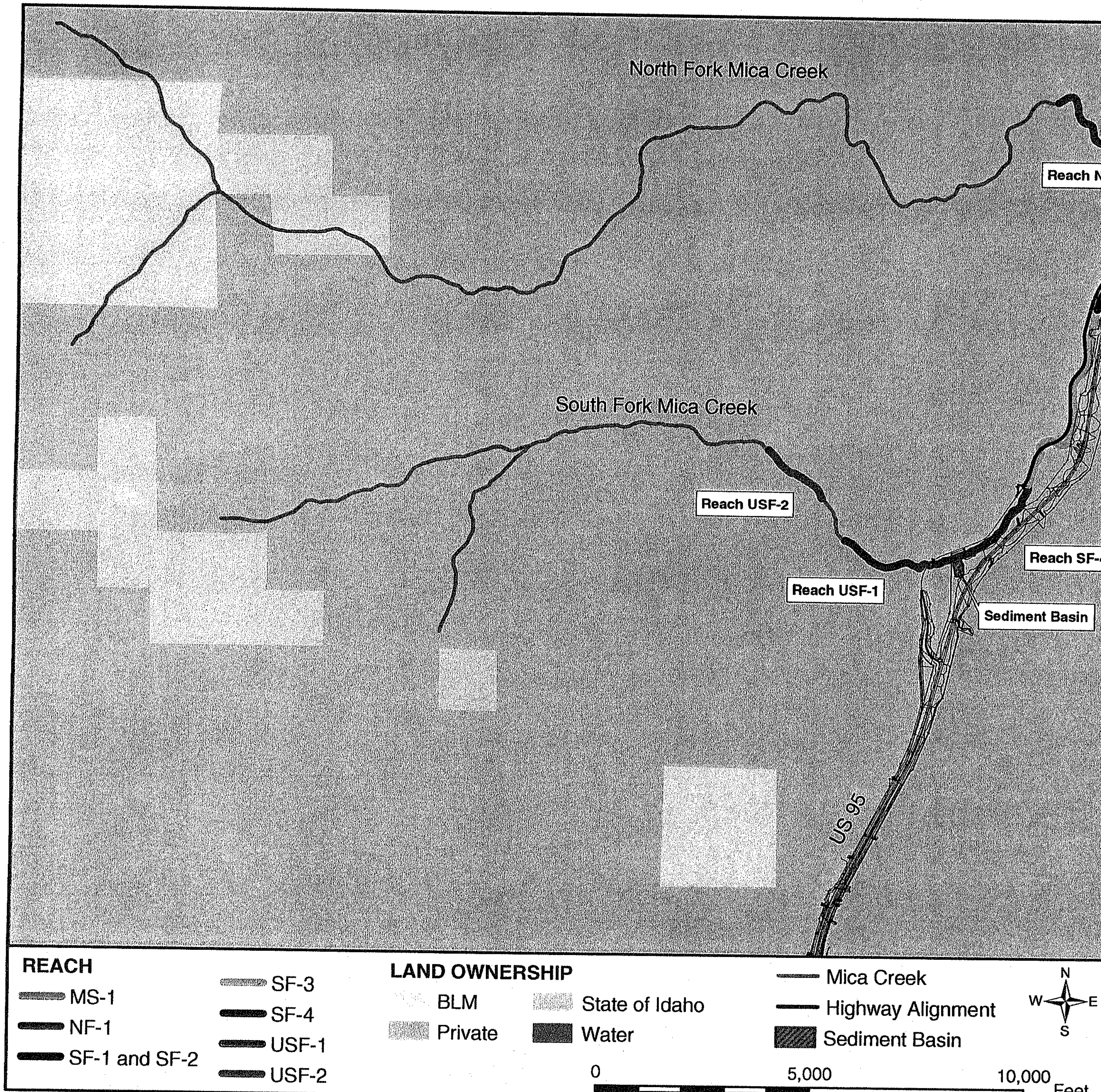


FIGURE 8-1
Mica Creek Habitat Survey
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
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CH2MHILL

8.2.2.3 Methods. Stream habitats were surveyed generally following the protocol described in the *Beneficial Use Reconnaissance Program (BURP) Field Manual for Wadeable (Small) Streams* (IDEQ, 2003). This document describes how to conduct data collection for BURP field sampling and describes the assumptions, methods, and equipment required. This document does not describe the analysis and interpretation of the data collected but refers to the *Idaho Small Stream Ecological Assessment Framework* (Framework; Grafe ed., 2002) for the analysis protocol. The project-specific methods used in the assessment and analysis of the project can be found in the *Methodology for Impact Assessment of South Fork Mica Creek, Mica Creek and Mica Bay in Relation to the U.S. 95 Bellgrove to Mica Project* (CH2M HILL June 2002a). The primary difference between the CH2M HILL survey procedure and the BURP (IDEQ, 2003) protocol is that the CH2M HILL survey was a continuous survey (over 7.85 kilometers) rather than the sample size of 30 times the bankfull width or 100 meters, whichever is greater as described in IDEQ (2003). Further, the information collected for a habitat characteristic was averaged to provide a comparison to BURP (IDEQ, 2003) protocol. The survey data collected at each reach include the description or measure of the following characteristics:

- Unit length
- Channel type (Rosgen)
- Estimated discharge (at beginning of reach)
- Temperature
- Substrate composition and percent embeddedness
- Wolman pebble count (one per reach)
- Presence and dimension of depositional features
- Bankfull width and depth
- Wetted width and depth
- Pool type and quality rating
- Residual depth (pools)
- Streambank condition and percent bank cover
- Percent undercut banks
- Instream cover
- Riparian vegetation composition and buffer width
- Percent canopy cover
- Large woody debris count

In addition, photos and general observations on stream impacts, sand bars, beaver dams and other pertinent items were recorded to aid in the analysis and condition assessment on the reaches within the project area (Figures 8-2 and 8-3).

8.2.2.4 Stream Habitat Analysis (SHI)

The analysis of the stream habitat will follow the Framework (Grafe ed., 2002). This protocol assigns a stream habitat index (SHI) at the reach level. The SHI is derived from correlations with human disturbances and biological measures that are found in Idaho streams. Site-specific habitat measures were analyzed at the stream reach level using the Framework protocol for calculating the SHI. Ten habitat measures, or metrics, are scored to derive the SHI (Table 8-3). Five metrics (instream cover, large organic debris, embeddedness, canopy cover, and disruptive pressures) are significantly associated with land uses in the three ecoregions in Idaho, and the project area resides within the Northern and Middle Rockies (NMR) ecoregion. Additionally, five other habitat measures (Wolman size class, percent fine sediment ≤ 2.5 millimeters, channel shape, percent bank vegetation, and zone of influence) had strong associations with land uses within the NMR ecoregion and are used to calculate the SHI score (Table 8-4; Grafe ed., 2002). The larger values, on the right side of Table 8-4, represent the more desirable conditions for the specific metrics. The habitat metrics will be compared with the NMR ecoregion mean values (Table 8-5) for a general metric condition comparison. Finally, the total SHI score is used in conjunction with the stream fish index (SFI) and stream macroinvertebrate index (SMI) scores to determine the overall reach condition as compared to the NMR reference values.

TABLE 8-3
Stream Habitat Index Metrics

Metric Categories	Metric	Field Rated or Measured	Predicted Response to Increasing Perturbation
Epifaunal substrate/available cover*	Instream cover	Rated	Decrease
	Large organic debris	Measured	Decrease
Embeddedness/ heterogeneity of substrate composition*	Percent fines <2.5 millimeters	Measured	Increase
	Embeddedness	Measured	Increase
	Wolman size classes	Measured	Decrease
Channel flow status*	Channel shape	Rated	Decrease
Bank vegetation protection	Percent bank cover	Measured	Decrease
	Percent canopy cover	Measured	Decrease
	Disruptive pressures	Rated	Increase
Riparian vegetation zone width	Zone of influence	Rated	Decrease

*Metrics of concern

TABLE 8-4
Scoring Criteria for the Northern and Middle Rockies (NMR) Ecoregion SHI *

Habitat Measure	Score										
	0	1	2	3	4	5	6	7	8	9	10
Instream Cover Value	0	1-2	3-4	5-6	7-8	9-10	<u>11-12</u>	13-14	15-16	17-18	19-20
Large Organic Debris (#s)	0	1-3	4-7	8-12	13-17	18-26	<u>27-36</u>	37-48	49-60	61-73	>73
Percent fines <2.5 millimeter	≥40	35-39.9	30-34.9	25-29.9	20-24.9	15-19.9	<u>10-14.9</u>	7-9.9	5-6.9	3-4.9	<3
Embeddedness	0	1-2	3-4	5-6	7-8	9-10	<u>11-12</u>	13-14	15-16	17-18	19-20

TABLE 8-4
Scoring Criteria for the Northern and Middle Rockies (NMR) Ecoregion SHI *

Habitat Measure	Score										
	0	1	2	3	4	5	6	7	8	9	10
Wolman size classes	1-3	4				5	6	7	8	9	10
Channel shape	0-1	2-3	4	5	6	7	8	9	10-11	12-13	14-15
Percent Bank vegetation cover	<30	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-84.9		85-89.9	90-94.9	95-100
Percent Canopy cover	<10	10-19.9	20-24.9	25-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	≥90
Disruptive pressures	0	1	2	3	4	5	6	7	8	9	10
Zone of influence	0	1	2	3	4	5	6	7	8	9	10

* Underlined values represent the mean value or range for the habitat measure for sites within the NMR ecoregion

TABLE 8-5
SHI Total Score Criteria for the Northern Rockies Ecoregion

SHI Condition Category	Northern Rockies Ecoregion*
Above the 25th percentile of the reference condition	≥ 66
10th to 25th percentile of reference condition	58 – 65
Below 10th percentile of reference condition	< 58

*This value is a sum of the scores from Table 8-4, as determined at the reach level. Values come from Grafe ed. (2002, p 6-2).

8.2.2.5 Sand Bars and Beaver Dams

Sand bars were examined as a part of the physical habitat survey (Figure 8-2). Sand bars were examined in 2002 and again in 2003 to compare dimensions and character. The surface area of sand bars was measured at the water line and a staff was used to measure the depth of loose materials. Surface volumes were calculated, but the values are an underestimation resulting from the fact that some of the sand bars in the deeper pools had significant amounts of material below the water surface. In addition, the sand and silt deposits in the bottom of beaver dammed pools were not measured. In 2003, beaver dams in the project area were mapped using GPS (Figure 8-3). This was done in response to the growing realization that the dams are actively managed by beavers and their presence, potential failure, and reconstruction, may have a significant influence on sedimentation and sediment transport in the lower reaches of Mica Creek. Rebar stakes were driven into the tops of the beaver dams to gain insight as to the stability of beaver dams and potential for pulsing of sediment storage and delivery. The rationale was that if the stakes were missing in the following year, then the beaver dam must have been damaged or lost, then rebuilt, with the sediment deposits flushed downstream.

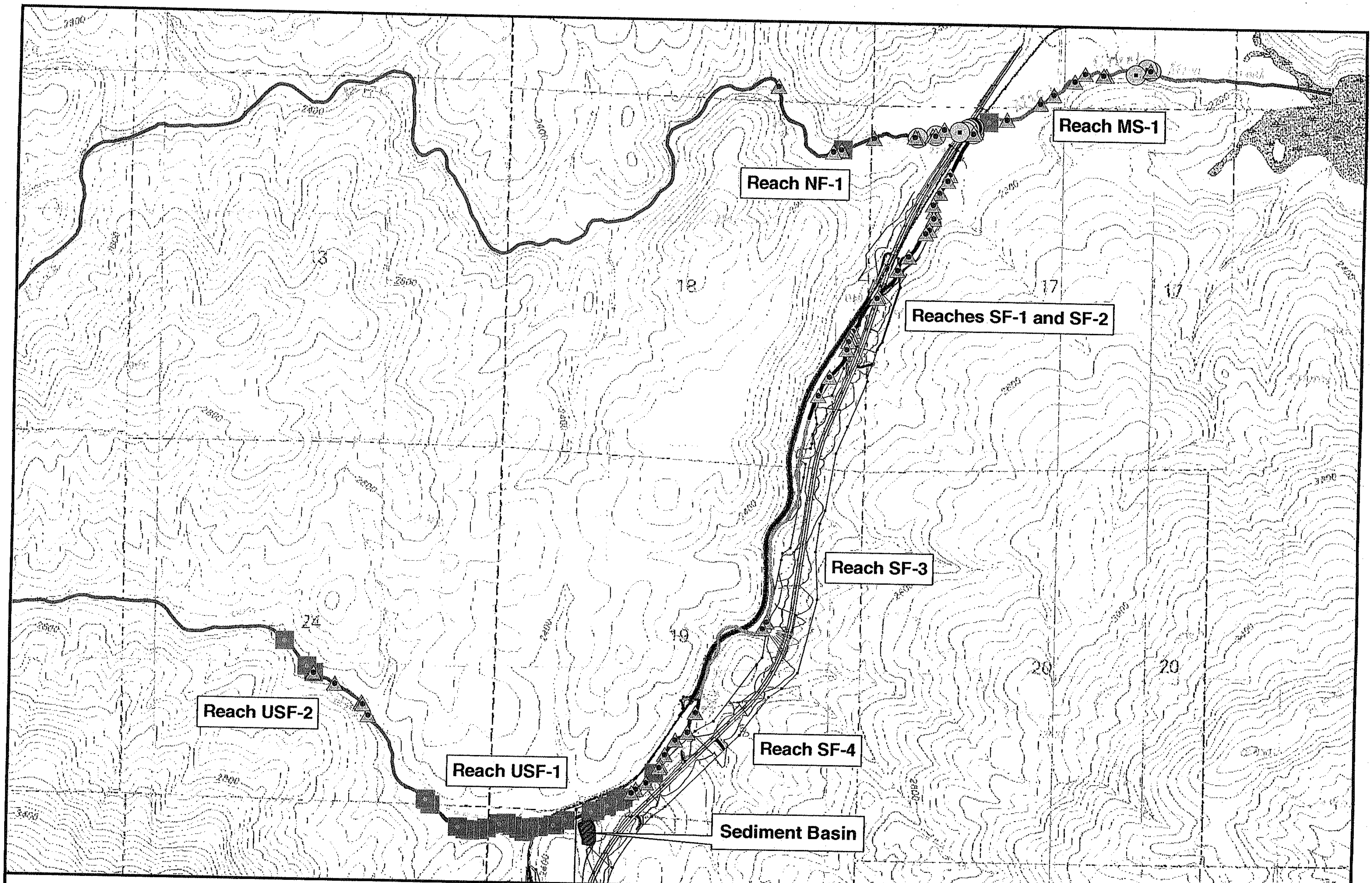

FIGURE 8-2
Mica Creek Habitat Survey 2002
MICA BAY AND MICA CREEK
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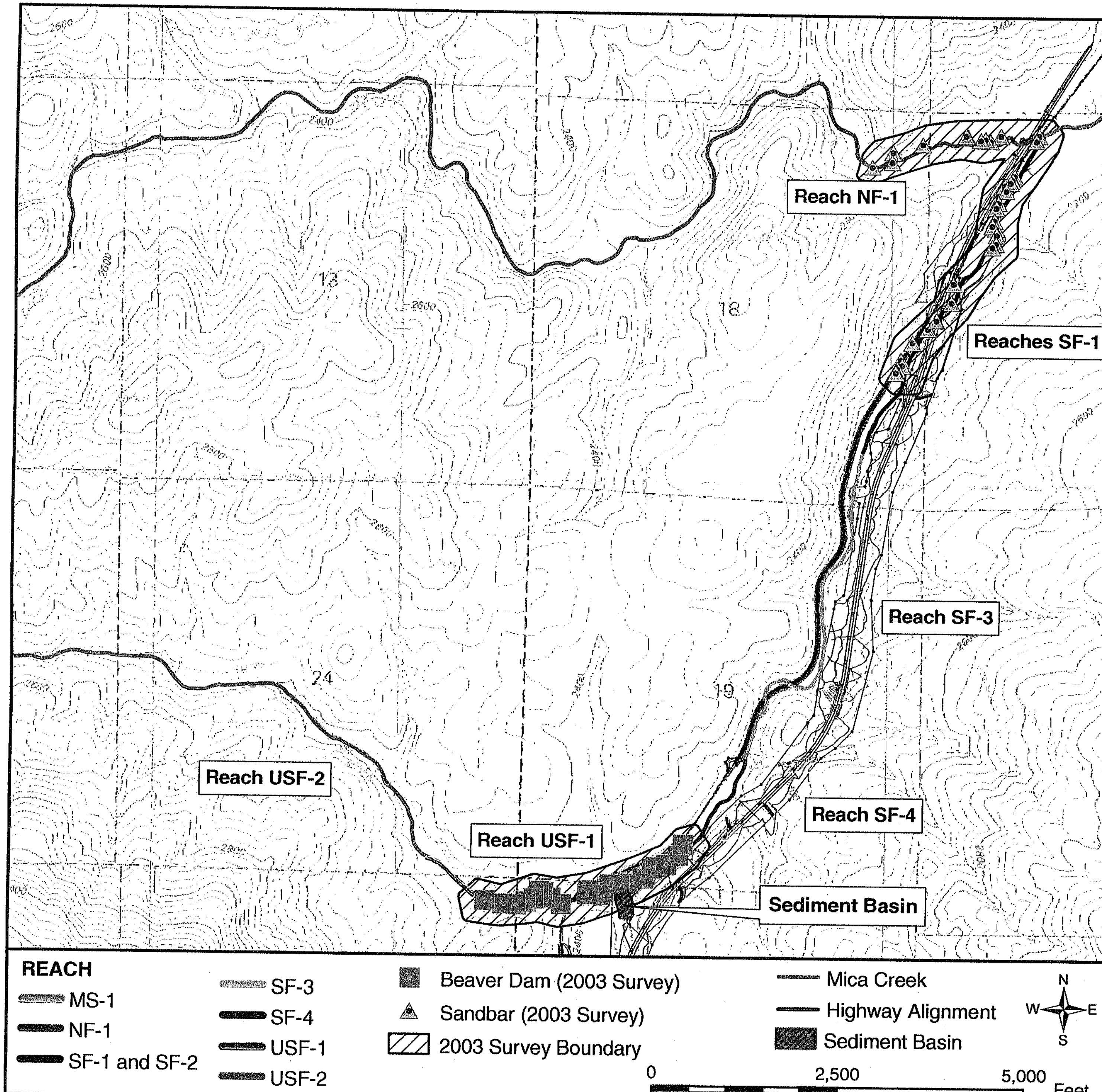

FIGURE 8-3
Mica Creek Habitat Survey 2003
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT
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8.2.2.6 Pool Transects and Scour Chains

Transects were established in pools at five locations in the South Fork Mica Creek and one in the North Fork Mica Creek as shown in Figure 8-4. The distance from a fixed (transect) elevation to the stream bed is measured along the channel at 0.5-to 1.0-foot intervals. Graphical plots of the channel cross-sectional geometry are developed from these measurements so that changes in bed elevation can be monitored through time. The transect data provide a "snap-shot" of the channel geometry at any given time and are useful for assessing net changes in the channel geometry between any two dates; however, they do not provide a record of the dynamic changes that may have occurred between any two monitoring dates.

To determine the maximum amount of scour that may occur between monitoring events, a scour chain was installed at each pool. A known length of scour chain is installed vertically into the stream bed with a known length of chain lying horizontal on the bed. During the next monitoring event, the chain is located and the extra length of chain lying on the stream bed is equal to the amount of scour that occurred during the monitoring interval. If no extra length of chain is exposed, no scour occurred. If the stream bed scoured then aggraded during a sampling interval, this would result in a lengthening of chain lying horizontal, due to scour, and subsequent burial of the chain during deposition. Because the chain location is carefully benchmarked, the depth of sediment deposits over the chain are recorded during field measurements.

8.2.3 Fish Assessment

8.2.3.1 Sample Site Locations

The geographic area of the impact analysis is on Mica Creek from its confluence with Mica Bay upstream 1.1 miles to the North Fork/South Fork Mica Creeks confluence and extending upstream on South Fork Mica Creek to approximately river mile (RM) 2.8 near the uppermost U.S. 95 bridge crossing.

Specific locations for fish and macroinvertebrate sampling were determined during the physical habitat survey based on the physical characteristics of the stream, habitat types in the area, representativeness, and access. Six sites were selected for biological monitoring, three sites on South Fork Mica Creek downstream of the project, one site on the mainstem Mica Creek, and two reference sites—one site upstream of the project on the South Fork Mica Creek, and one site on the North Fork Mica Creek. Sampling site locations and designations are shown in Figure 8-5 and are as follows:

1. Mica Creek, Mainstem (MS)—Mica Creek downstream of the confluence of the North and South Forks of Mica Creek, approximately RM 0.6.
2. Mica Creek, South Fork Site 1 (SF1)—South Fork Mica Creek, approximately RM 0.4 (0.4 mile upstream of the North and South forks confluence).
3. Mica Creek, South Fork Site 2 (SF2)—South Fork Mica Creek, approximately RM 1.3.

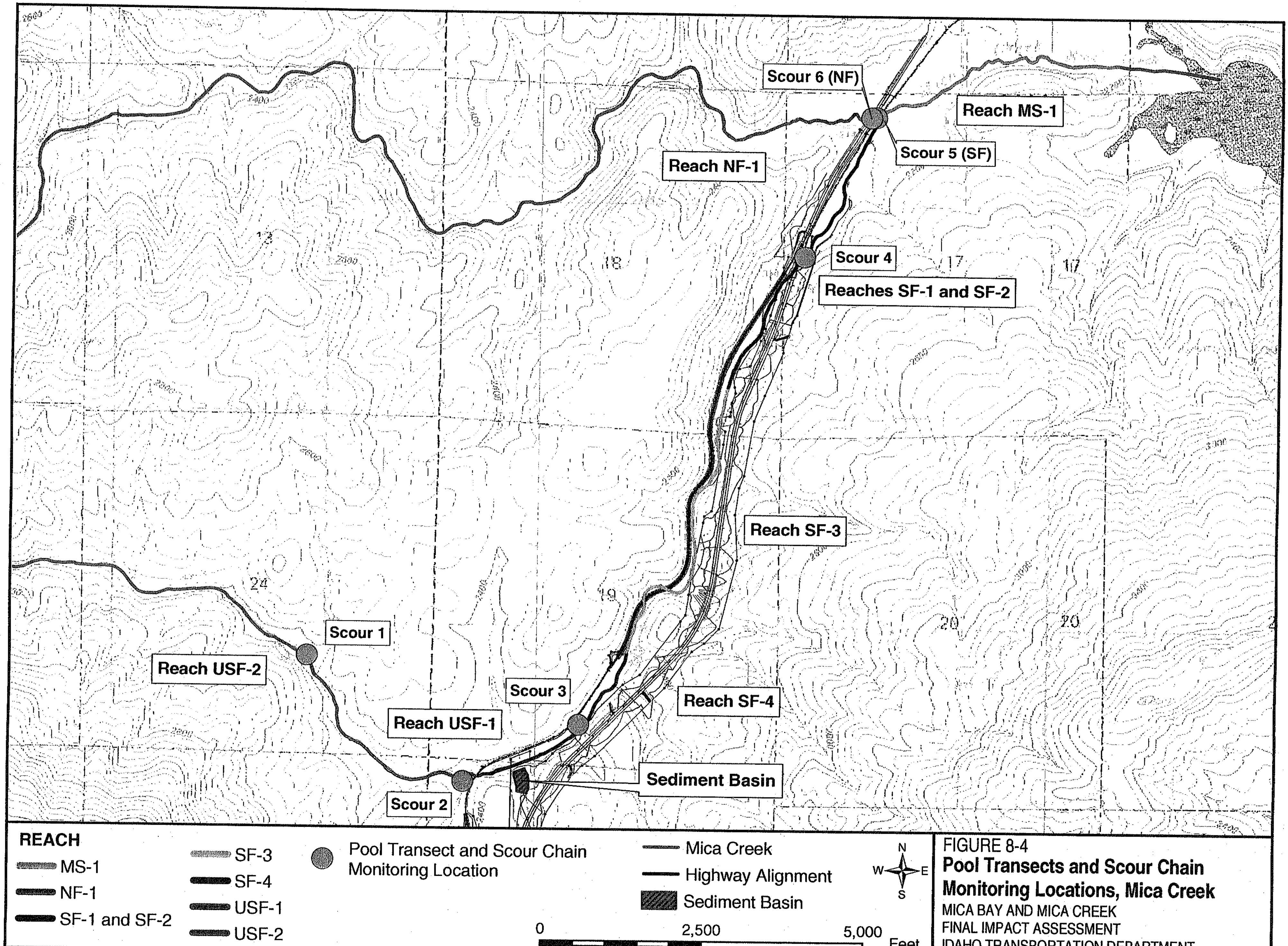

FIGURE 8-4
Pool Transects and Scour Chain Monitoring Locations, Mica Creek
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT
CH2MHILL

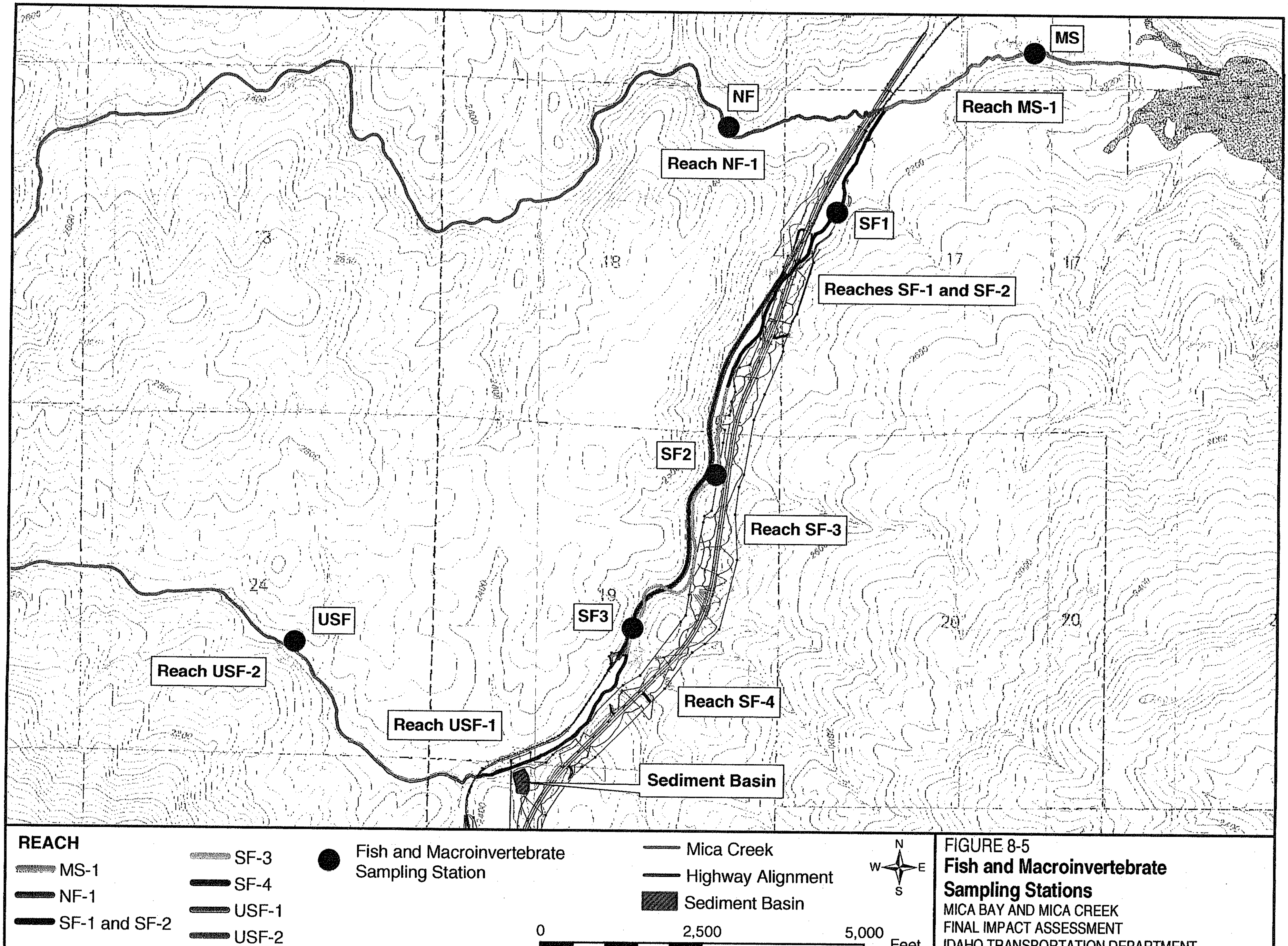

FIGURE 8-5
Fish and Macroinvertebrate Sampling Stations
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT
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4. Mica Creek, South Fork Site 3 (SF3)—South Fork Mica Creek, approximately RM 1.9.
5. Mica Creek, Upper South Fork (USF)—South Fork Mica Creek, approximately RM 3.3 (approximately 0.8 mile upstream of the upper most U.S. 95 bridge crossing). Reference Site.
6. Mica Creek, North Fork (NF)—North Fork Mica Creek, approximately RM 0.5 (0.5 mile upstream of the North and South forks confluence).

Reference Sites. The two reference sites were chosen based on proximity to the project, gradient, land use, and geomorphologic attributes. The South Fork Mica Creek reference site (USF) is upstream of the project in a forested area. Flows may be slightly lower than at the mainstem (MS), SF1, and SF2 sites because the site is upstream yet still comparable biologically. The gradient in this area and other geomorphologic attributes are similar to other South Fork Mica Creek sites. The USF site is in an area, with the exception of a dirt road located approximately 100 yards upslope, removed from significant human disturbance for at least 50 years based on tree height. The USF reference site is typical of a non-impacted portion of South Fork Mica Creek and representative of a small forest stream.

The North Fork Mica Creek reference site (NF) is located in the lower portion of the North Fork drainage in an area utilized for grazing. The channel is slightly larger in size and during high flows carries more flow than the South Fork. Because the site is located in the lower reach of the North Fork, the gradient and other channel attributes are similar to that of the South Fork. Because of these similarities, the biological communities would still be characteristic of a small stream and similar to the South Fork. The NF reference site is representative of a small stream flowing through an area used for grazing similar to areas of the South Fork downstream of the project.

CH2M HILL conducted three fish and macroinvertebrate surveys during a 12-month period: September 2002 (CH2M HILL 2002), June 2003 (CH2M HILL, 2003a), and September 2003 (CH2M HILL, 2003b). Photos 8-1 through 8-12 show pools and riffles that were sampled at each site during each event.

8.2.3.2 Fish Survey Methods

Fish sampling was conducted in tandem with macroinvertebrate sampling at each site. Fish sampling involved collecting, identifying, measuring, and releasing fish. Fish sampling utilized a backpack electrofishing unit and one pass electrofishing in a channel area that was 40 times the width of the stream at each site. Fish sampling methodology followed the *National Marine Fisheries Service Backpack Electrofishing Guidelines* (NMFS, 2000).

Sampling effort related to electrofishing was documented as the number of seconds the probes were in the water and activated. Sampled fish were held in fresh, well-oxygenated water only for the minimum time necessary for measurement and data recording. Collected fish were identified to species, measured (standard fork length), and released onsite. Data was recorded on Fish Sampling Data Sheets (refer to individual sampling event reports; CH2M HILLd, 2002; CH2M HILL, 2003a; CH2M HILL, 2003b).

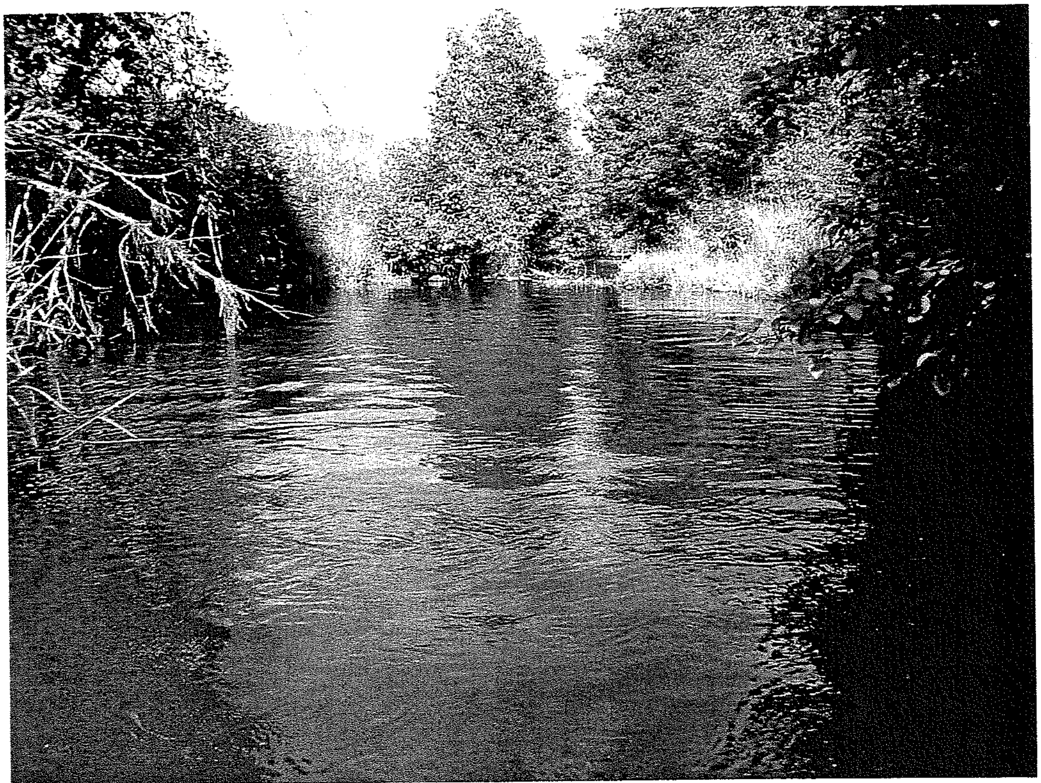


Photo 8-1. MS pool site photograph June 2003


Photo 8-2. MS riffle site photograph June 2003

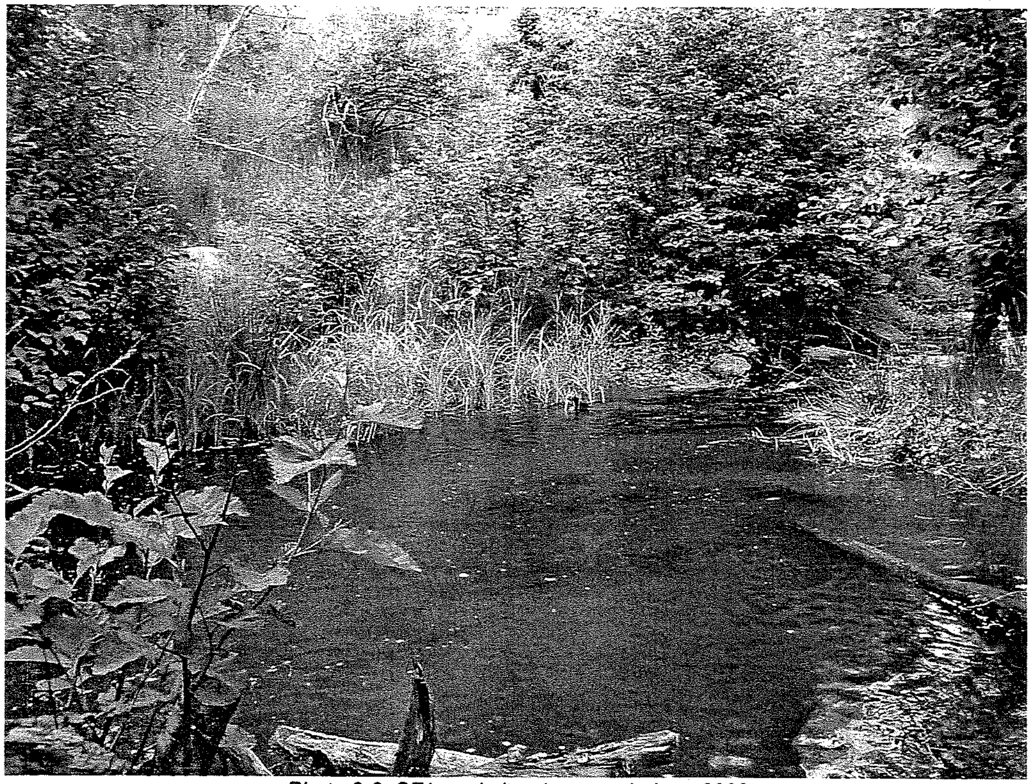


Photo 8-3. SF1 pool site photograph June 2003


Photo 8-4. SF1 riffle site photograph June 2003

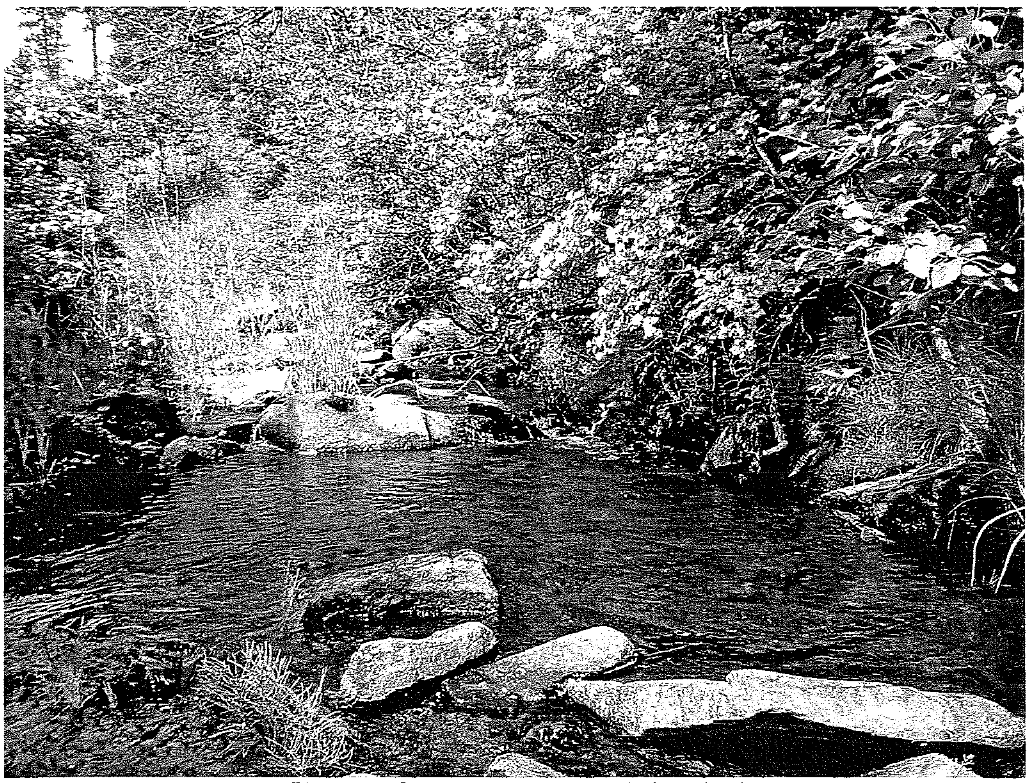


Photo 8-5. SF2 pool site photograph June 2003

Photo 8-6. SF2 riffle site photograph June 2003

Photo 8-7. SF3 pool site photograph June 2003

Photo 8-8. SF3 riffle site photograph June 2003

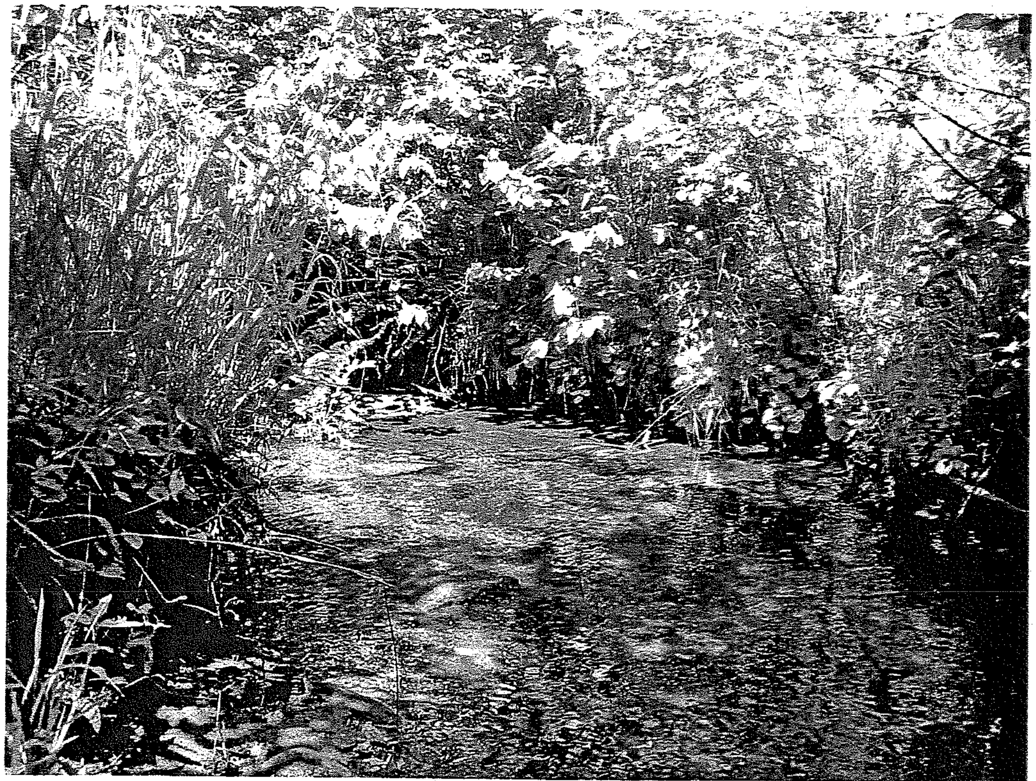


Photo 8-9. USF pool site photograph June 2003

Photo 8-10. USF riffle site photograph June 2003

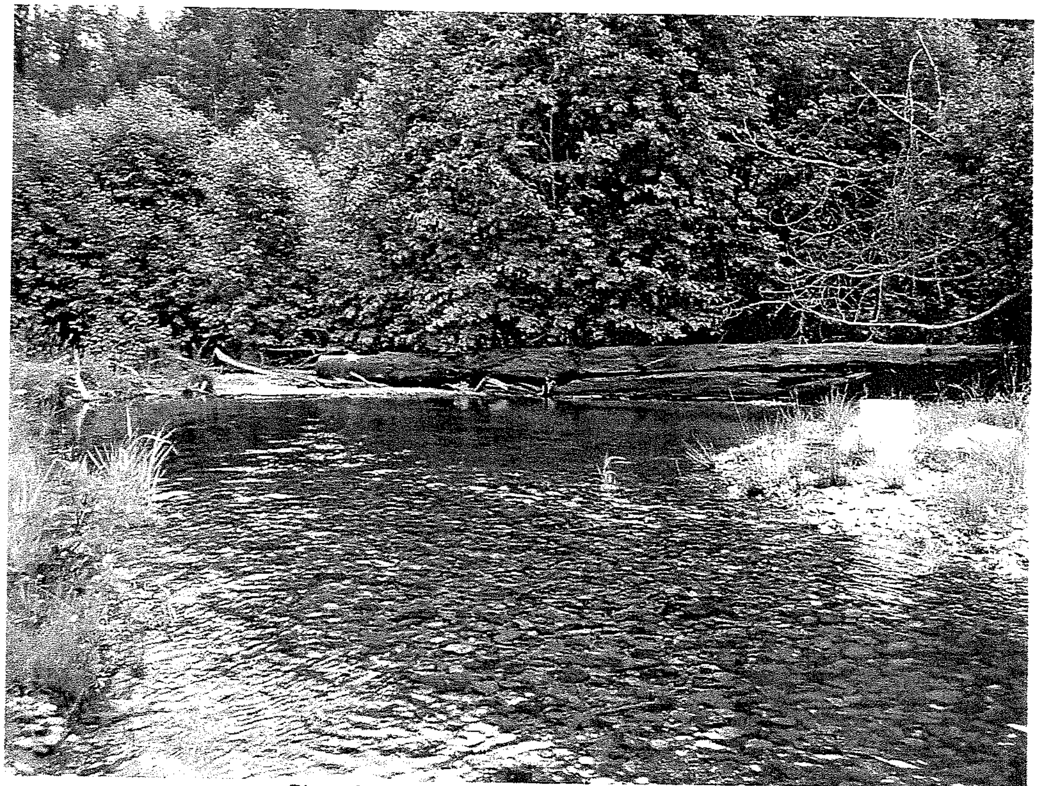


Photo 8-11. NF pool site photograph June 2003

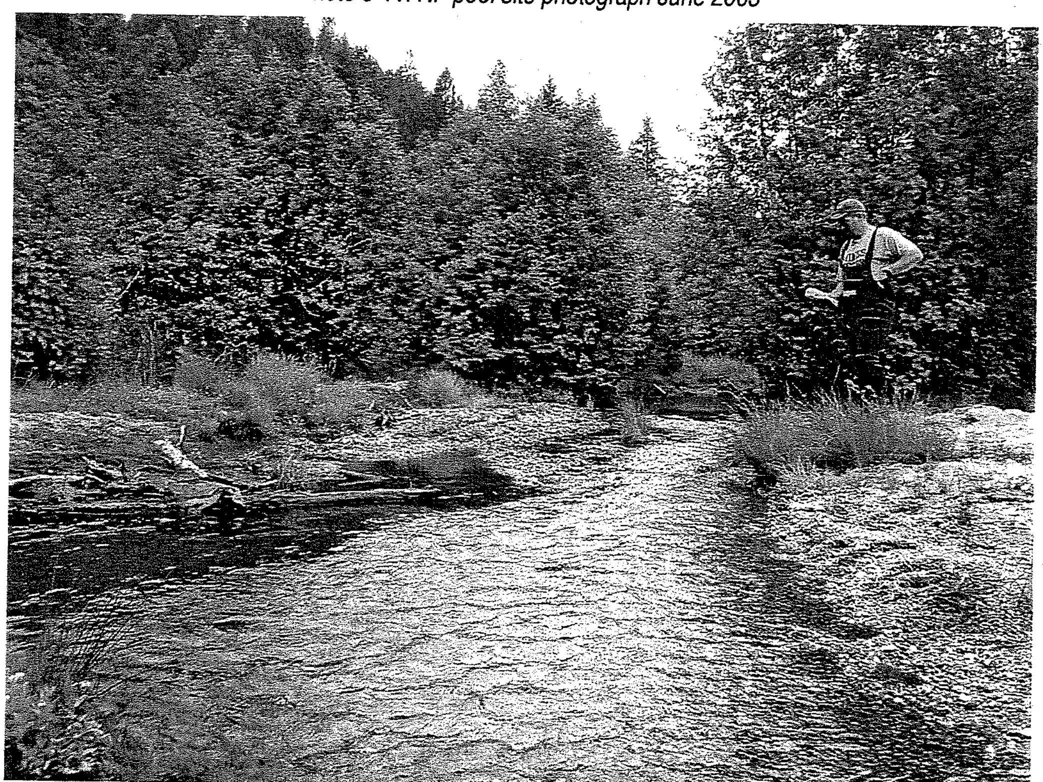


Photo 8-12. NF riffle site photograph June 2003

Electrofishing equipment settings did not exceed the maximum settings listed in the NMFS guidelines, 400 volts, 5 milliseconds pulse width, and 70 hertz pulse rate. A fisheries biologist experienced in electrofishing equipment and techniques conducted the electrofishing activity with assistance from another staff member. Prior to fish sampling, a Scientific Sampling Permit was obtained from the Idaho Department of Fish and Game (IDFG) (permit # F-52-87). The IDFG sampling permit is provided in Appendix C in CH2M HILL 2003a.

8.2.3.3 Fish Data Analysis

Data analysis for fish sampling includes calculating a SFI. The Framework protocol uses analysis of species abundance and presence/absence as a way to test for differences between Idaho ecoregions and elevation by characterizing the streams as either Rangeland or Forest streams (IDEQ, 2002a). The Mica Creek watershed lies in the Northern Rockies (Forest). Therefore, the Forest Index metric scoring method was used to calculate SFIs. The output from the Forest SFI calculation is a simple index value from 0 to 100 with higher values relating to better fish assemblages.

Metrics, representing significant aspects of fish assemblage integrity, described in the Framework (2002a) were used to calculate a SFI for each site. Metrics used for calculating the Forest SFIs are shown in Table 8-6. More detailed information regarding the use and scoring of Forest Index metrics can be found in The Framework (2002a) Table 4-1.

TABLE 8-6
SFI Metric Evaluation and Scoring for Forest Streams

Metric	Metric Scoring Criteria
Number of cold water native species	Small streams (<2.5 m) – 1 cold water native species Larger streams – 2 cold water native species
Percent cold water individuals	Scored as a curve with 90% or more cold water individuals receiving highest score
Percent sensitive native individuals	Scaled to increase steeply and taper off at higher percentages
Number of sculpin age classes	Scored on an "S" curve assuming several age classes would be present at a reference site
Number of selected salmonid age classes	Small streams (<2.5 m) – 2+ age classes receive highest scores Larger streams – 3+ age classes highest scores
Relative abundance (number of cold water individuals/minute of electroshocking)	Scaled because larger streams often have a greater abundance.

Source: IDEQ, 2002a

8.2.4 Macroinvertebrate Assessment of South Fork and North Fork Mica Creek and Mica Creek

Macroinvertebrate sampling followed BURP protocols with three exceptions. These exceptions were limited to the macroinvertebrate sampling method used and are: 1) the kick-net (D-frame) method was used during this study whereas the BURP method utilizes a

Hess sampler; 2) the area sampled using the kick net is larger than a Hess sampler, 2-square-foot versus 0.926 square feet respectively; and 3) the BURP method involves three Hess samples in a riffle at a site and composites them into one sample for the site. During this study, two kicks each were done in two pools and two riffles at each site with the riffle samples being composited into one riffle sample and the pool samples being composited into one pool sample per site.

Macroinvertebrate communities differ between pool and riffle habitat types because each habitat is different hydraulically and morphologically. Pools tend to accumulate more and finer sediment than riffle areas because flow velocities decrease in pools allowing sediment to settle out of the water column. Therefore, pools and riffles were sampled separately to evaluate any potential changes in the community structure of each habitat type due to the project.

8.2.4.1 Stream Macroinvertebrate Protocol (Kick Net)

The macroinvertebrate surveys included field collections of instream benthic macroinvertebrates as well as field measurements of water quality parameters (temperature, pH, conductivity, dissolved oxygen and turbidity). Macroinvertebrate sampling sites were in the same locations as fish survey sites (see Figure 8-5). The kick-net method (500-micron mesh) is recommended for sampling a range of instream habitat types at a stream site. The kick-net method was applied to instream riffle and pool areas during all sampling events. One riffle composite sample and one pool composite sample for a total of two composite samples were collected from each site. For example, one riffle composite sample would be composed of two kick samples from one riffle and two kick samples from another riffle. The same would be done at two pools. Each composite therefore consisted of equal effort, multiple (four) kick samples per habitat type per sampling station. One field duplicate composite sample from either pool or riffle habitat type was also collected. During the September sampling the mainstem site had only one riffle. This riffle was approximately 80 feet in length however, the middle portion of the riffle contained a slower velocity and less turbulence than the lower or upper portions of the riffle. Therefore, the riffle was divided into two portions, lower and upper for the purposes of the macroinvertebrate sampling. Two kick samples were collected in the lower portion of the riffle and two were collected in the upper portion of the riffle so the composite sample contained four kick samples as the other riffle samples at other stations.

No side channel samples were collected. Similar habitats (riffles and pools) were sampled at each site. Equal effort was spent sampling at each site, so the same number of samples were taken at each sampling station. The general sample location and specific microhabitat sample sites were photographed during each sample event.

Analysis of data utilized the Multimetric Analysis approach specified in the Idaho Small Stream Ecological Assessment Framework (2002a). Additional metrics included the Fine Sediment Bioassessment Index (FSBI) developed by Relyea et al. (2000). The FSBI calculation was included based on a verbal request by IDEQ after their review of the results of the September 2002 survey as reported in CH2M HILL's December 20, 2002, Technical Memorandum (CH2M HILL 2002d).

A Wolman pebble count, an assessment of Large Woody Debris (LWD), and canopy closure was conducted at each riffle sample site during the June 2003 and September 2003 sampling events (CH2M HILL 2003a; CH2M HILL 2003b). A Wolman Pebble count was taken during the habitat survey conducted in September 2002 in the close vicinity of macroinvertebrate sampling sites.

Sample collection procedures are described below.

Benthic Macroinvertebrates Riffle (Gravel/Cobble) and Pool Areas. Four, 2-square-foot areas were sampled and combined for each habitat at each site. Each sample was placed in a 500-micron mesh sieve, washed to remove excess debris, and the remaining sample was placed in a container. All four samples were combined into one composite for each habitat type at each site. The organisms were then preserved with 90 percent ethanol, and sent to Rhithron Biological Associates laboratory in Missoula, Montana, for identification.

Wolman Pebble Count. Wolman pebble counts are used to characterize substrate particle sizes. Pebble counts of stream channel transects can be used as an efficient and repeatable means for evaluating the suitability of stream substrates for aquatic life. A Wolman pebble count was conducted at each of the two riffle areas where macroinvertebrate collections occurred. Pebble counts were made within the entire width of the streambed, within the wetted width only, and outside the wetted width only, where possible. In some instances stream flow encompassed the entire channel width. Therefore, only a wetted width count was conducted. In other instances riparian vegetation was dense and prohibited a pebble count outside the wetted channel. The Wolman particle size classes collected within the wetted width can be used as an approximation of the heterogeneity of substrate in the sampled transect and provide an idea of suitability for macroinvertebrate production. Wolman size classes were based on the IDEQ 1999 Beneficial Use Reconnaissance Project (BURP) (IDEQ, 1999a) size classes and are shown in Table 8-7.

Habitat conditions were also noted at each site at the time of sampling. Items noted included the type of bottom substrate in the riffles and pools sampled, the channel width, the amount of stream-bank erosion, the presence and condition of riparian vegetation, and canopy closure in riffle areas.

Canopy Closure. Canopy closure was determined by using a concave spherical densiometer and taking four measurements; 1 foot in from the wetted edge of the left bank, 1 foot in from the wetted edge of the right bank, from the middle of the stream facing upstream, and from the middle of the stream facing downstream. These measurements were taken at both riffle sampling locations at each site.

8.2.4.2 Macroinvertebrate Data Analysis

For each of the three sampling events a sampling event report was written presenting the results of the sampling event. This document presents summaries of the data from all three events and evaluates potential project impacts to the aquatic resources in South Fork and Mica creeks. Between when the September 2003 sampling event report and the compilation of this final Mica Creek and bay report minor errors were found in the macroinvertebrate data from all three events. As a result of these errors a 100 percent Quality Assurance/Quality Control (QA/QC) check was completed against laboratory data on all of the macroinvertebrate data from all three sampling events. Total errors accounted for

1.7 percent of all of the macroinvertebrate data. Although these errors are very minor and did not change the overall results of any of the events individually or cumulatively, some of the individual calculated metrics changed slightly as a result. All macroinvertebrate data and metric results contained in this report and its appendices has been 100 percent QA/QC checked for accuracy.

Benthic macroinvertebrate samples were sorted and identified to the lowest practicable taxonomic levels. At least 400 specimens were identified for each habitat type composite sample with the exception of June 2003 SF2 and SF3 pool samples where 251 and 386 individuals were identified in the sample respectively. With the above noted exceptions the lowest number of specimens identified in a pool habitat composite sample was 422 at Site MS (September 2002) and the lowest number of specimens identified in a riffle habitat type composite sample was 477 at Site USF (September 2002).

TABLE 8-7
Wolman Pebble Count Size Classes

Particle	Size (mm)
Silt/Clay	0 – 1
Sand	1.1 – 2.5
Very Fine Pebble	2.51 - 6
Pebble	6.1 – 15
Coarse Pebble	15.1 – 31
Very Coarse Pebble	31.1 – 64
Small Cobble	64.1 – 128
Large Cobble	128.1 – 256
Small Boulder	256.1 – 512
Medium Boulder	512.1 – 1,024
Large Boulder	1,024.1 and Larger

Source: IDEQ, 1999b

The taxonomic classifications of the identified organisms is used to develop site-specific bioassessment scores using the Idaho Small Stream Ecological Assessment Framework (Framework) protocol metrics. A separate score is developed for each microhabitat (pool or riffle) at each site. Based on a verbal request by IDEQ after their review of the results of the September 2002 survey (as reported in CH2M HILL's December 20, 2002 Technical Memorandum [CH2M HILL 2002d]), the SMI stream conditions ratings (Poor, Fair, Good, Very Good) are not being applied to study site SMI index numbers. This is because during the development and implementation of the SMI protocol, the sample area per macroinvertebrate sample is different than the sample area per site in this study. However, calculation and analysis of the metrics used in calculating the SMI are still useful in evaluating and comparing the macroinvertebrate community health of the Mica Creek system.

Macroinvertebrate data for each habitat at each site are summarized as abundance of individual organisms by taxa, number of taxa (taxa richness), and relative abundance according to major habit preference and feeding type. The Hilsenhoff Biotic Index (HBI) was calculated as described in Plafkin, et al., (1989). The tolerance values used for the HBI range from 0 to 10, with higher values assigned to pollution-tolerant taxa and lower values assigned to pollution-sensitive taxa (Hilsenhoff, 1987). The HBI values can also provide an evaluation of water quality and generalizations regarding organic pollution loads (Mandaville, 2002). The HBI values relating to water quality and organic pollution loads are provided in Table 8-8.

FSBI scores were calculated for each site. In general, the FSBI score can potentially be used to assess fine sediment impacts to the aquatic communities. Streams with high FSBI scores usually have a low percentage of fine sediment whereas streams with low FSBI scores usually have a high percentage of fine sediment. Samples were also evaluated using other metrics specified in the Framework. These metrics, with the exception of the FSBI score, are used to calculate the overall SMI of each microhabitat at each site.

Stream Macroinvertebrate Metrics. Across Idaho the underlying geology, riparian vegetation, gradient, and other natural characteristics vary by region. Biological conditions are expected to vary within ecoregions as well. Currently, Idaho is divided into nine ecoregions. The Mica Creek watershed lies in the Northern Northern Rockies (Northern Mountains) subecoregion. The Northern Mountains is subdivided into the Southern Northern Rockies and the Northern Northern Rockies. Therefore, the Northern Mountains metric scoring formulas were used. Nine metrics are utilized in calculating the SMI. Scoring criteria for these metrics are shown in Table 8-9. Individual metric scores would be averaged to obtain a total score for each microhabitat at each site. Total scores are conventionally interpreted according to a specific scale, however, as previously noted this scale is not being used. More detailed information regarding the scoring of macroinvertebrate metrics can be found in IDEQ (2002a), page 3-1.

TABLE 8-8
Evaluation of Water Quality Using HBI Values

HBI Value	Water Quality	Degree of Organic Pollution
0.00 – 3.50	Excellent	No apparent organic pollution
3.51 – 4.50	Very good	Possible slight organic pollution
4.51 – 5.50	Good	Some organic pollution
5.51 – 6.50	Fair	Fairly significant organic pollution
6.51 – 7.50	Fairly poor	Significant organic pollution
7.51 – 8.50	Poor	Very significant organic pollution
8.51 – 10.00	Very poor	Severe organic pollution

Source: Mandaville, 2002

TABLE 8-9
Stream Macroinvertebrate Index Metrics

Metric	Metric Scoring Formula	5^{th} or 95^{th} Percentiles (as per formula) Northern Mountains
Taxa richness	100 * "Taxa richness" / 95^{th}	39
Ephemeroptera richness (mayfly)	100 * "Ephemeroptera richness" / 95^{th}	13
Plecoptera richness (stonefly)	100 * "Plecoptera richness" / 95^{th}	10
Trichoptera richness (caddisfly)	100 * "Trichoptera richness" / 95^{th}	10
% Plecoptera (stonefly)	100 * "% Plecoptera" / 95^{th}	40
Hilsenhoff Biotic Index (HBI)	100 * (10 – "HBI") / (10 – 5^{th})	1.6
% 5 Dominant taxa	100 * (100 – "% 5 Dominant" / (100 – 5^{th})	52
Scraper taxa	100 * "Scraper taxa" / 95^{th}	8
Clinger taxa	100 * "Clinger taxa" / 95^{th}	23

Source: IDEQ, 2002a

8.3 Results

8.3.1 Mica Bay Impact Assessment

Previous chapters (Chapter 2, page 2-12; Chapter 4, page 4-8; Chapter 5, page 5-7) assert that it is difficult to detect any changes to the Mica Bay delta morphology (shape, size, and depth) that can be directly/indirectly tied to the project.

Qualitative assessments of the aquatic vegetation from 1992 and 1993 are compared to underwater video from 2002. In addition, TSS and turbidity are examined to evaluate the potential contributions from the project on Mica Bay and fish habitat.

8.3.1.1 Aquatic Vegetation

Aquatic vegetation studies conducted by the USGS in 1992 and 1993, were compared to video shot in 2002 to qualitatively assess changes in aquatic vegetation. Comparisons between the early 1990s studies and the 2002 video suggest little difference in the extent and type of vegetations present. The extent and type of vegetation in the bay today is consistent with that found in the earlier studies. In 1992, the USGS conducted two vegetation transects in Mica Bay. One transect was conducted in water approximately 5 feet deep while the other was conducted in areas 10 or more feet deep. Field notes documented that vegetation occurred in relatively shallow areas (less than 5 feet) as well as in areas more than 10 feet deep (USGS, 1993). Excerpts from field notes indicate profuse plant growth along the shallower transect from the shore outward for more than 100 yards and that waterfowl had been grazing on *Scirpus*. Plants found along shallower transects included *Cellitride, Typha, Hitella*, and *Isoetes*. The deeper transect was less diverse and dominated by *Potamogeton* but contained *Elodea canadensis, Potamogeton richardsonii*, and *Potamogeton pusillus*. The USGS field notes indicate that vegetation ends at a depth of approximately 12 feet (USGS, 1993). The shallowness and abundantly vegetated state of Mica Bay is also stated in a USGS report based on sampling conducted in 1992, which found that Mica Bay had an extensive sedimentary delta with abundant vegetation (Woods and Beckwith, 1997). Further, Rich (1992) conducting research on northern pike used Mica Bay as one of his sampling stations in Coeur d'Alene Lake because it was shallow and heavily vegetated. Rich (1992) suggested that Mica Bay provides preferred habitat for northern pike.

Underwater video taken along nine transects in Mica Bay during the summer of 2002 (Furnished with this assessment) shows abundant vegetation in the bay, with the same types of species, and depth of occurrence (ending at a depth of about 12 feet). This video supports the findings of the USGS (1993) and Rich (1994) that habitat in Mica Bay has not noticeably changed since that time. Further, accounts of the abundance of vegetation by the USGS during 1992 and 1993 sampling events, Rich's (1992) account of the bay, and comparison to the underwater video taken in 2002 do not indicate an increased production of aquatic vegetation.

8.3.1.2 Turbidity

Turbidity data are described in detail in Chapter 6. IDEQ criteria for turbidity restrict the increase to no more than 50 NTU above background on an instantaneous basis, and to no more than 25 NTU over background for 10 consecutive days or more.

There were 21 days from September 2001 through September 2003 on which instantaneous turbidity readings on South Fork Mica Creek exceeded upstream background conditions, at a minimum of one sampling station, by more than 50 NTU. On 10 individual days, instantaneous readings on Mica Creek exceeded background conditions of South Fork Mica Creek, at a minimum of one sampling station, by more than 50 NTU, and on 6 days the readings exceeded conditions of North Fork Mica Creek, at a minimum of one sampling station, by more than 50 NTU. In total, there were 25 days when readings at either South Fork Mica Creek or Mica Creek exceeded background conditions of either North Fork Mica Creek or South Fork Mica Creek. The greatest occurrence of values that exceed background conditions by more than 50 NTU was during fall 2001 through winter 2002 (17 days). There were fewer measured turbidity events in Mica Bay, with most data indicating that levels in Mica Bay tended to be about 25 percent of the values measured in the project-influenced reaches of the South Fork Mica Creek.

None of the monitoring sites within South Fork Mica Creek or Mica Creek had extended periods during which turbidity measurements that exceeded background conditions by more than 25 NTU lasted for more than 10 days. Available turbidity data also does not reveal any events of elevated turbidity in Mica Bay lasting 10 days or longer. This does not necessarily mean that there were no such exceedances in the creeks or bay because there were several periods prior to March of 2002 when there were more than 10 days without available turbidity data. ITD construction diaries and climatological information were examined to qualitatively evaluate the potential for prolonged elevated turbidity during periods without measured data. Considering all information, more than 10 days of elevated turbidity could likely only have occurred on one occasion (11 days from November 10 through November 20, 2001).

Based on measured turbidity data, elevated levels that were influenced by the project returned to levels that were comparable to pre-event or background conditions in no more than 9 days, and usually much sooner.

An important factor to consider for this fisheries assessment is which species are likely to be in the vicinity of elevated turbidity conditions in the bay, and for how long. During the month with highest measured turbidity, March 2002, the lake was drawn down. In March 2002, the typical elevation was between 2121.0 and 2122.7 feet. At this elevation, the upper portion of the delta is dewatered, and thus not providing habitat or refuge for fish. However, fishes did continue to have access to Mica Creek during this period. In addition, during the month of March, the salmonid species (trout, chinook and kokanee) would be utilizing deeper pelagic areas, with only relatively short-term forays (hours rather than days) into shallower areas to feed (and may readily avoid high turbidity areas in any case). Other fishes would likely exhibit an avoidance response to elevated turbidity levels and move to other portions of the bay.

Fish have a tolerance to brief periods of high sediment, which is a trait that is essential to survival in environments with spring runoff and flood events (Rowe et al., 2003). As noted by IDEQ: "...there is evidence that short exposures to very high turbidities (100,000 parts per million [ppm]), have no lasting effect..." and "...while brief spikes in turbidity may be benign, frequent episodes are not..." (Rowe et al., 2003).

8.3.2 Mica Creek Stream Habitat Assessment

The analysis of the stream habitat data includes the 485 sampled units that comprise the seven entirely surveyed reaches within the project area (Figure 8-1). General reach descriptions are summarized in Table 8-2. All streams within the project area fit the small stream category described in the Framework (Table 8-10) (Grafe ed., 2002).

The biological survey data and photographs have been incorporated into a GIS database (included on a CD as Appendix P).

TABLE 8-10
Water Body Size Categories Used to Rate Each Criterion

Water Body Size Category	Stream Order	Ave. Width at Base Flow (meters)	Ave. Depth at Base Flow (meters)
Large	≥ 5	≥ 15	≥ 0.4
Small	≤ 5	≤ 15	≤ 0.4

Given the large quantity of data collected for the project, the stream data are presented at the reach level and generally follow the Framework (Grafe ed., 2002) document for the analysis of the metrics (Tables 8-3 and 8-4) and habitats.

8.3.2.1 Stream Habitat Analysis (SHI)

The scoring criteria for the SHI values require an examination of the reach level data by habitat measure. The examination of the data will track the 10 habitat measures identified in Table 8-4. A summary of the 2002 reach level findings with the SHI scores can be found in Appendix N.

Instream Cover. The availability of instream cover is important in sustaining a variety of fish throughout their life cycle. It provides refuge from predators such as birds, terrestrial mammals, and other aquatic species. It also provides protection from sunlight and high current velocities (Bain and Stevenson, 1999).

Instream cover information was collected at pools within the reaches and averaged at the reach level (Figure 8-6). The instream cover values ranged from 15.7 percent (NF-1) to 51.3 percent (SF3) across the reaches with an average of 26 percent within the project area. All of the reach values for stream cover exceeded the mean cover value (14 percent) for the NMR ecoregion as described in Appendix N. Reach SF3 had the highest instream cover value because of abundant cover formed by plunging waters and boulder substrates.

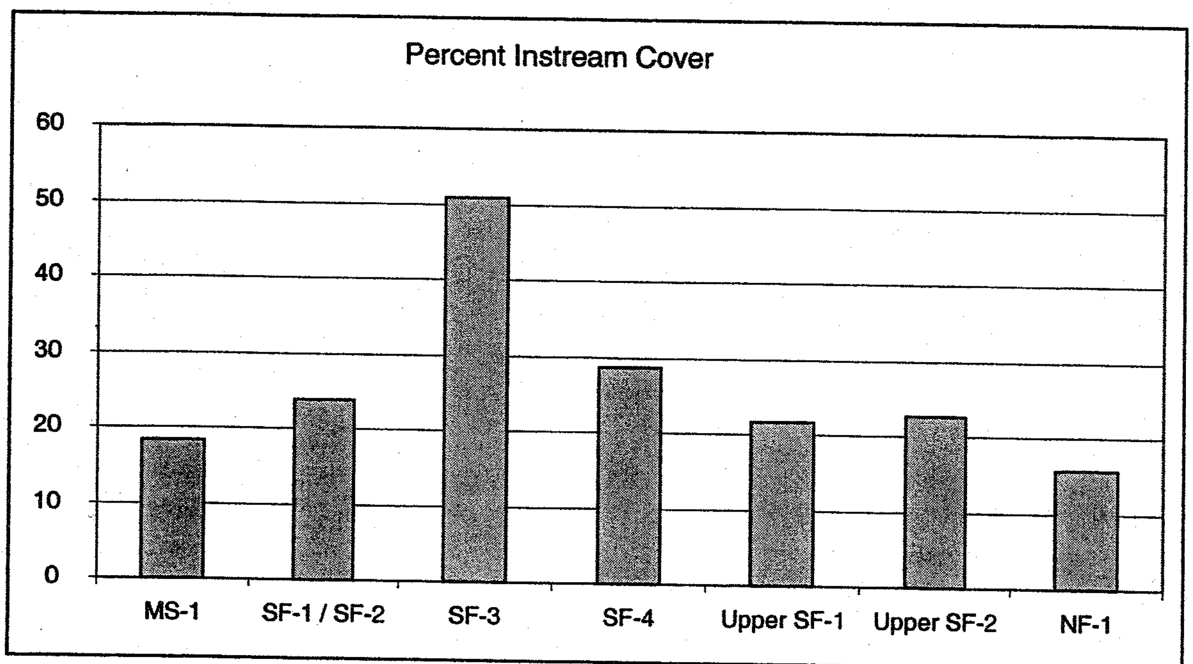


Figure 8-6. Instream Cover for Pools at the Reach Level

Large Organic Debris. Large organic debris (LOD), also called LWD, influences channel morphology by affecting the longitudinal profile, pool formation, channel pattern and position, and channel geometry (Bisson et al., 1987, cited in FEMAT, 1995). Downstream transport rates of sediment and organic matter are controlled in part by storage of this material behind large wood (Betscha, 1979, cited in FEMAT, 1995). Large wood affects the formation and distribution of habitat units, provides cover and complexity, and acts as a substrate for biological activity (Naiman et al., 1992, cited in FEMAT, 1995). Further, some species of salmonids show a high affinity for LOD (Rieman and McIntyre, 1993, cited in IDEQ, [2003]).

LOD data were collected within the reaches and calculated to assess the number of pieces per 100 meters (Figure 8-7). Number of pieces per reach ranged from 9 (SF3) to 50 (USF1) and averaged 29 pieces per 100-meter reach. Four reaches (SF1/SF2, USF1, USF2, and NF-1) exceeded the mean number of LOD (29.6) for the NMR ecoregion as described in Appendix N. The three remaining reaches were less than the average number of LOD expected for the ecoregion.

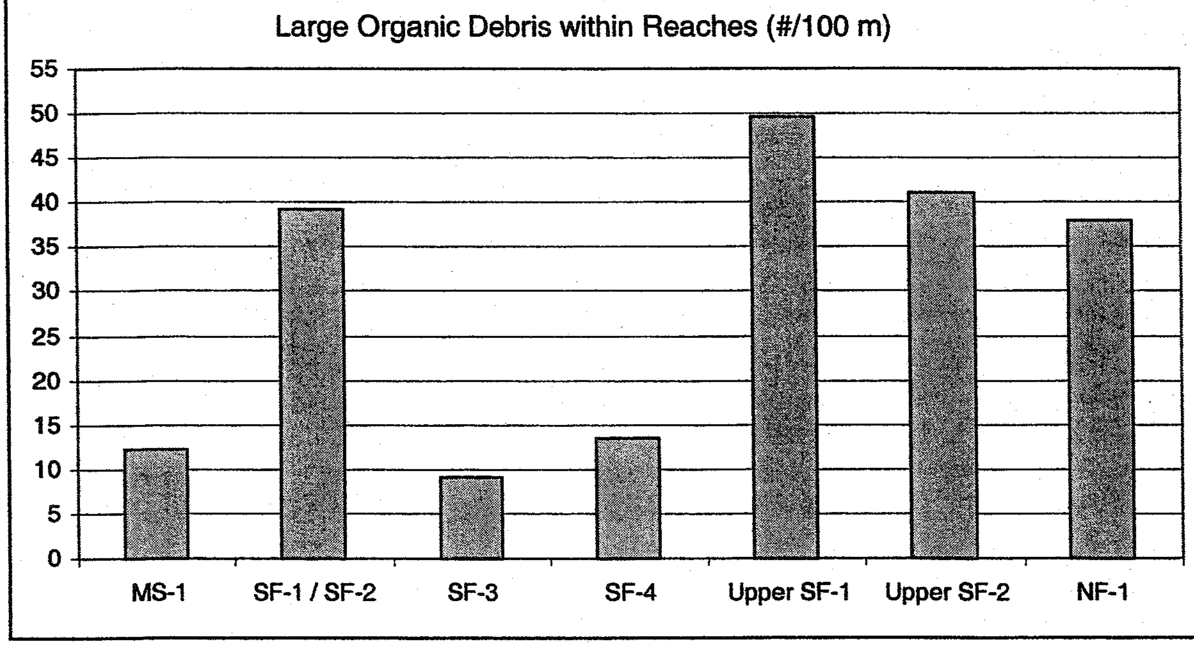


Figure 8-7. LOD per 100 meters for each Reach Within the Project Area

Percent Fine Sediment (in riffles). The proportion of fine sediments on the substrate surface of a stream can provide a good estimate of substrate habitat quality for salmonids. Excess fines can reduce salmonid embryo survival and impede emergence of fry (Bauer and Burton, 1993, cited in IDEQ, 2003). Measures of percent fines are also strongly associated with numerous macroinvertebrate metrics in the Idaho ecoregions (Grafe ed., 2002).

Percent fines is a measurement of stream bed surface particles of 2.50 millimeter diameter or less (that is, silts/organics and sand particles). The BURP process calculates percent fines from Wolman pebble counts (Wolman, 1954, cited in IDEQ, 2003). Percent fines within the reaches were measured using Wolman pebble counts within riffle habitats at the macroinvertebrate sampling sites. Percent fines were also visually estimated within most habitat types during the physical habitat surveys.

Percent fine sediments were measured using Wolman pebble counts in five of the seven reaches and visual observations of surface fines were made in six of the seven reaches (Figures 8-8 and 8-9). Measured Wolman percent fines ranged from 5 percent (MS-1) to 10 percent (SF3), averaging 6 percent, while visually estimated percentages ranged from 8 percent (SF3) to 44 percent (SF-4), averaging 25 percent, within surveyed riffle habitats. Visual estimates of percent fine sediments were also estimated for other habitat types (Figure 8-21). Glide/run habitats ranged from 19 percent (SF3) to 84 percent (SF1/SF2), averaging 53 percent fine sediments. Pool habitats ranged from 19 percent (SF3) to

100 percent (USF1), averaging 74 percent fine sediments. One reach with rapid-dominated habitat (SF3) contained 9 percent surface fine sediments. Wolman pebble count values at all sites measured below the mean value for percent fines (16.8 percent) within the NMR ecoregion (Figure 3, Appendix N). Further, the visual estimations for percent fines within riffles exceeded the mean value of 16.8 percent at four of the six reaches as described in Appendix N.

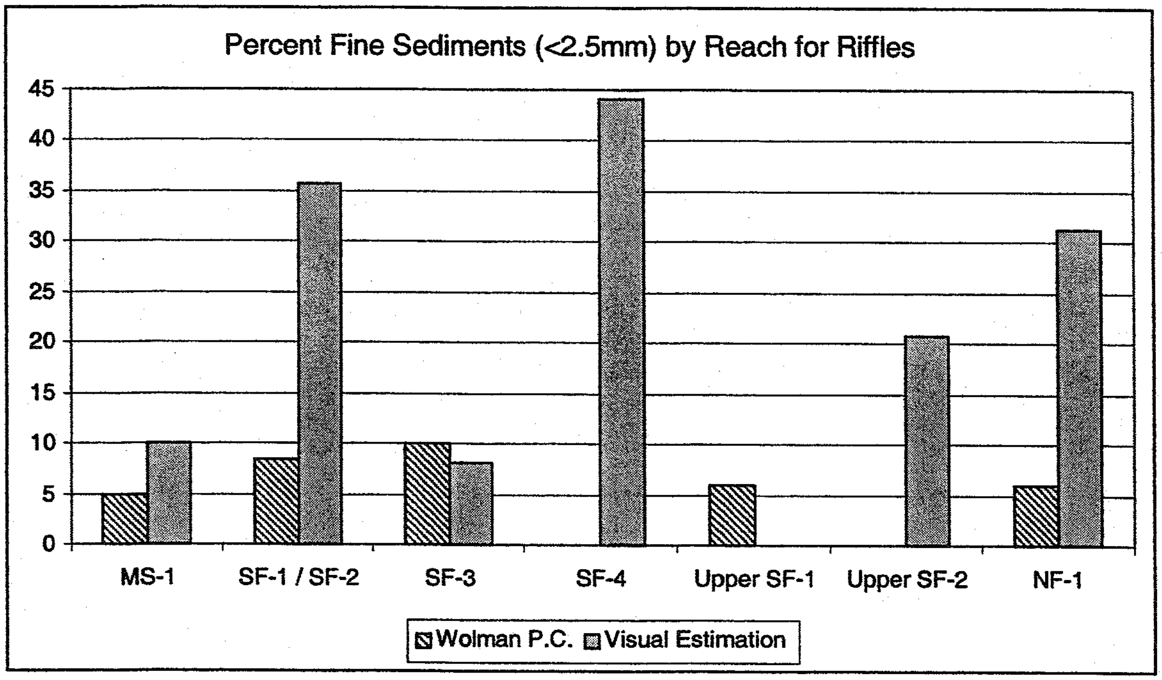


Figure 8-8. Percent Fine Sediments for Riffle Habitats

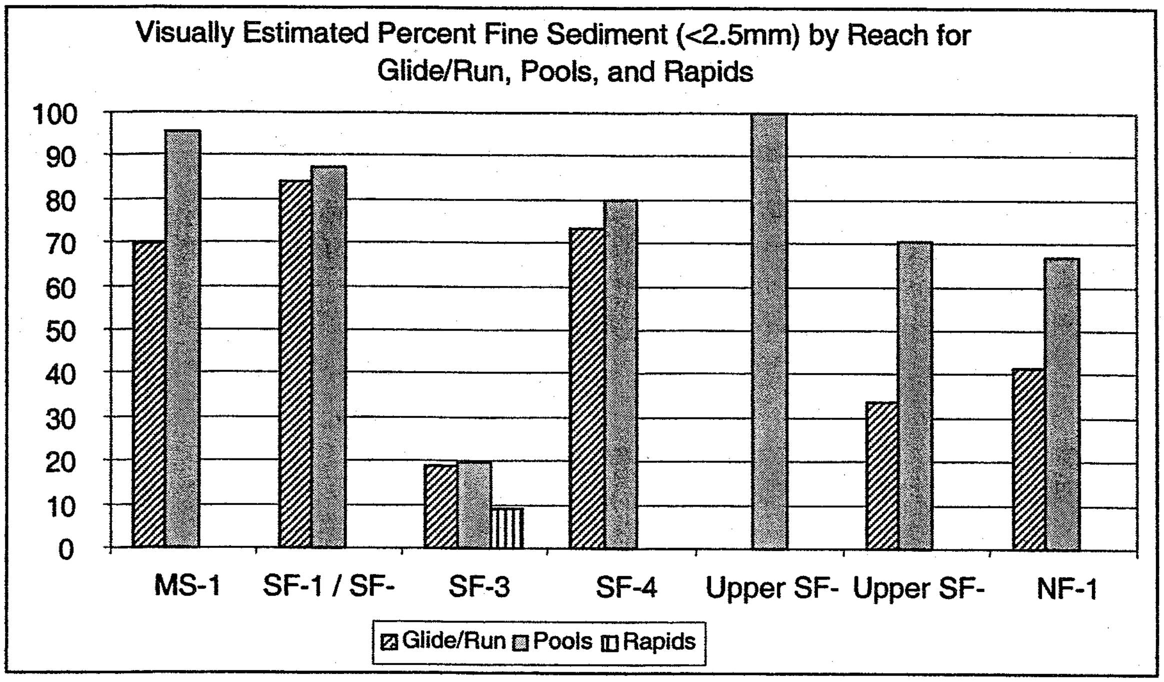


Figure 8-9. Percent Fine Sediments for Glide/Run, Pools, and Rapids

Embeddedness (in riffles). Embeddedness describes the degree that gravel and cobble are surrounded or covered by sand and smaller-sized particles (Figure 8-10). Fine sediment particles fill the interstitial spaces among larger particles causing reduced water circulation through gravels. Higher embeddedness levels typically remove potential refugia habitat between and under coarser substrates that are important for the over-wintering of small fish, salmonid spawning habitat, and sediment-intolerant macroinvertebrate taxa (Bain and Stevenson, 1999).

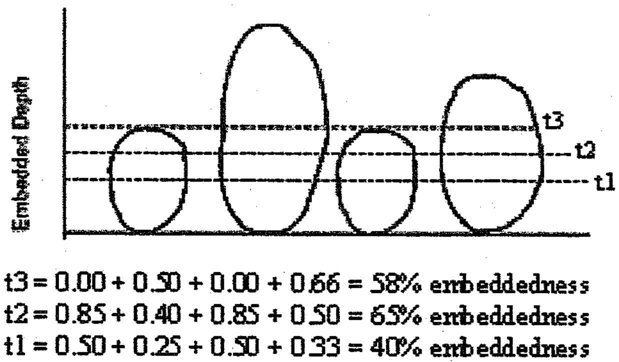
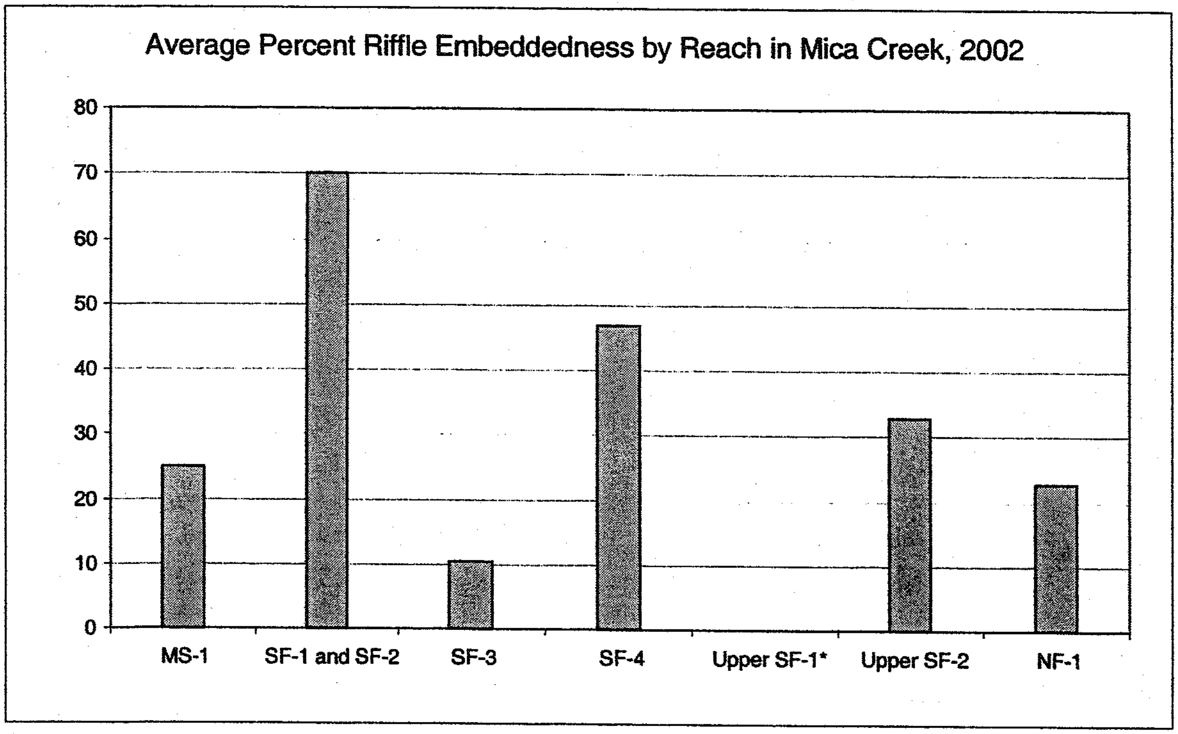


Figure 8-10. An Example of Simulated Increases in Embeddedness that might Result from Adding Fines from Level t1 to t3 (adopted from Stylte and Fischenich, 2004)

Embeddedness data were collected in riffles and averaged at the reach level as a percentage (Figure 8-11). Embeddedness values ranged from 10 percent (SF3) to 70 percent (SF1/SF2) with an average of 34 percent within the project area. USF1 was not included in the ranking because the habitats consisted of only beaver-formed pools and contained no riffle habitats. Embeddedness percentage values are then ranked between 0 and 20 (Bain and Stevenson 1999) and then scored between 0 and 10 for the SHI metric (Appendix N). A score of 0 describes gravel, cobble, and boulders that are more than 75 percent surrounded by fine sediment. A score of 10 describes gravel, cobble, and boulder substrates that are not surrounded by fine sediments. Most sites exceeded the mean value of 12 percent for embeddedness at the reach level (Appendix N) for the NMR ecoregion. Two sites (SF1/SF2 and SF-4) fell below the mean of 12 while USF1 was not included because it lacked riffle habitats.

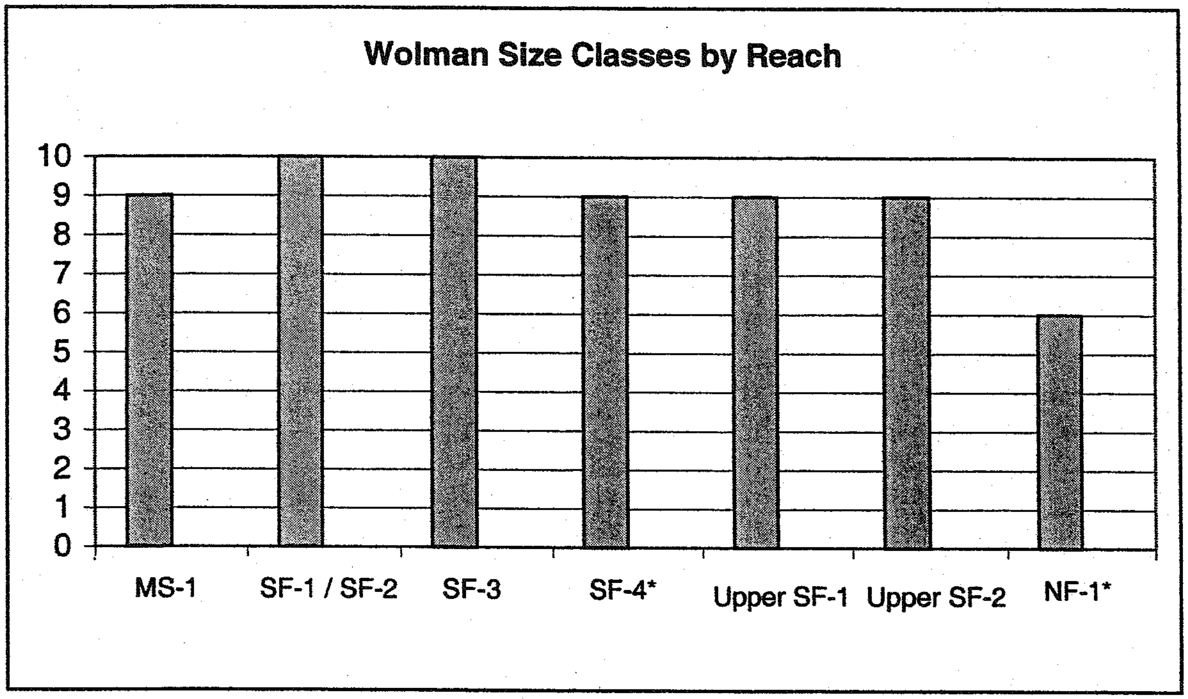


*Site not estimated because of beaver created pools.

Figure 8-11. Embeddedness Within the Reaches

Wolman Size Classes. Particle size classes represent an approximation of the heterogeneity of substrate at sampled sites (Bain and Stevenson 1999). Minshall (1984, cited in Waters, 1995) suggests a functional relationship between macroinvertebrate abundance and substrate heterogeneity where benthos abundance is greatest in a mixture of heterogeneous gravel, pebbles, and cobbles.

Wolman size class data were collected with Wolman pebble counts and summarized for each sampled reach (Wolman, 1954, cited in IDEQ, 2003). Wolman counts were conducted within five of the seven reaches (Figure 8-12). Size class data for SF-4 and USF2 were modified from the visual observation data to fit the Wolman categories. SF1/SF2 and SF3 reported all 10 size categories within the reach whereas the NF-1 reach contained only six of the size classes. All other sites exceeded the mean (7) number of Wolman classes for the NMR ecoregion (Appendix N).



*The sites containing only visual estimates of sediments.

Figure 8-12. Wolman Pebble Count Size Classes

Channel Shape. Shoreline condition is related to the bank erosion rate. Channel shape is the angle formed by the downward sloping streambank as it meets the horizontal water's edge. Fish often congregate near the streambank for the cover it provides. If the bank has been cut away and moved back from the water's edge, valuable rearing habitat may be lost. Measuring the channel shape is effective for monitoring land uses that can change the morphology and relative location of the streambank (Platts et al., 1987, cited in Bain and Stevenson, 1999).

Channel shape was characterized at the reach level for the project area (Table 8-11). Channels ranged from entrenched channels with steep vertical cutbanks (MS-1) to channel-wide, beaver-formed pool complexes (USF2). Within-reach channel conditions varied by Rosgen stream types (Rosgen, 1996) from steeper A-type channels to low gradient G-type channels. Categorized reaches are described in Table 8-2. The mean channel shape for the NMR ecoregion resembles a rectangle-shaped wetted channel and scored an 8 (Appendix N). Reach shape values for the project area ranged from 4 to 7 (Appendix N), describing channels that are inverse trapezoidal to rectangle in shape (IDEQ, 2003).

TABLE 8-11
Stream Channel Types for Project Area Reaches*

Reach	Channel Type (average type across the entire reach)
MS-1	G-type
SF1/SF2	G-type
SF3	B-type downstream to A-type upstream
SF-4	C-type
USF1	No channel type assigned as the reach is composed of a complex of beaver dams
USF2	B-type
NF-1	G-type

* Described in Rosgen (1996)

Percent Bank Vegetation. Streambanks are important transition zones between aquatic and terrestrial systems (Stevenson and Mills, 1999, cited in IDEQ, 2003). When in good condition, these habitats are well vegetated, resistant to erosion, provide cover and refuge for fish species, and maintain LWD recruitment. Banks stabilized by deeply rooted vegetation, rocks, logs, or other resistant materials are less susceptible to flow-related erosion, reduce water velocity along the stream perimeter, and aid in beneficial sedimentation (Bauer and Burton, 1993, cited in IDEQ, 2003). Human impacts and natural disturbances reduce bank vegetation, erosion resistance, structural stability, and fish cover value. Eroding streambanks support little or no riparian vegetation, resulting in a loss of stream shading, undercut banks, nutrient loading, and terrestrial insect drop (important fish food source) into the stream (Overton, et al., 1995, cited in IDEQ, 2003). Bank cover refers to the percent surface protection (IDEQ, 2003).

Reach level, bank cover data are summarized in Figure 8-13. All sites exhibited bank cover percentages of greater than 80 percent. Three sites had bank cover estimates of 100 percent while the NF-1 site had the lowest bank cover average of 81 percent. The mean value for the percent bank cover within the NMR ecoregion is 91.5 percent (Appendix N). Two reaches fell below the NMR mean, MS-1 and NF-1.

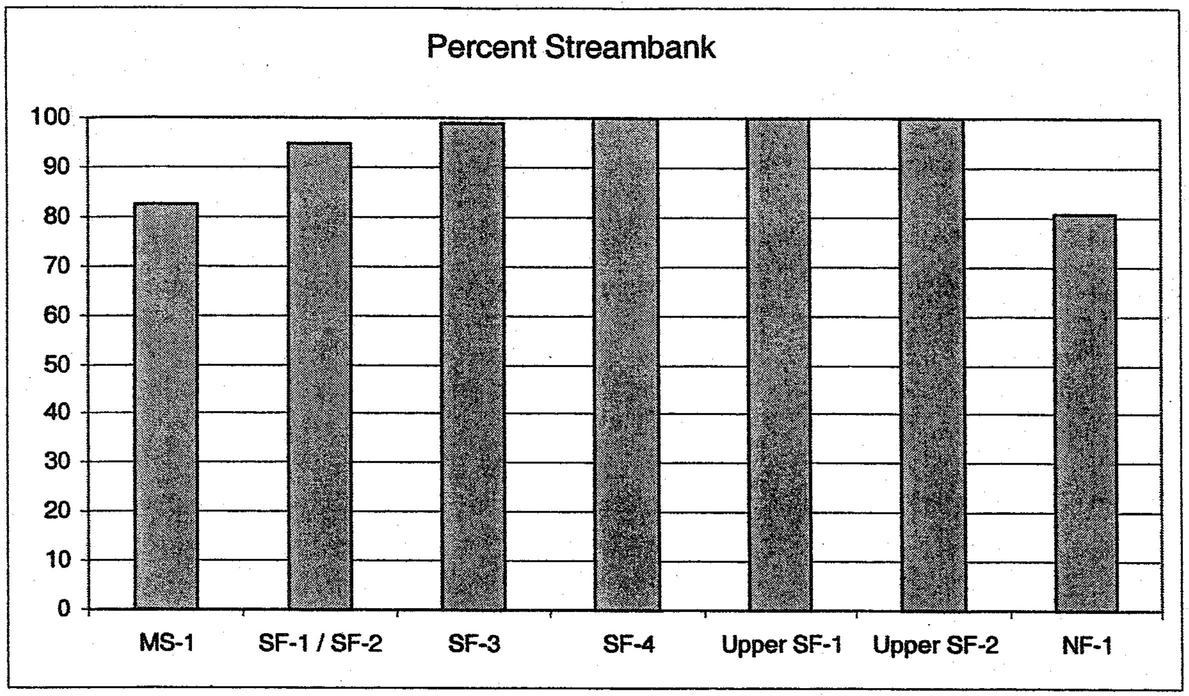


Figure 8-13. Percent Streambank Cover Across the Surveyed Reaches

Percent Canopy Cover. Canopy closure is the percentage of water covered by shade from the outermost perimeter or natural spread of foliage from plants (Armantrout, 1998, cited in IDEQ, 2003). Overstory canopy vegetation layers tend to represent long-lived and persistent riparian plant communities (Bain and Stevenson, 1999). The overstory cover also contributes to cool water temperatures, serves as a source of terrestrial insect input and LWD recruitment, and can provide protection for fishes from avian predators (McMahon et al., 1996).

Reach level and canopy cover data are summarized in Figure 8-14. Canopy cover data varied among the reaches from a high of 22.9 percent (SF1/SF2) to a low of 3.8 percent (NF-1) (Appendix N). Canopy cover averaged 18 percent across the surveyed reaches. The mean for percent canopy cover within the NMR ecoregion is 48 percent (Appendix N). All sites within the project area fell below the mean.

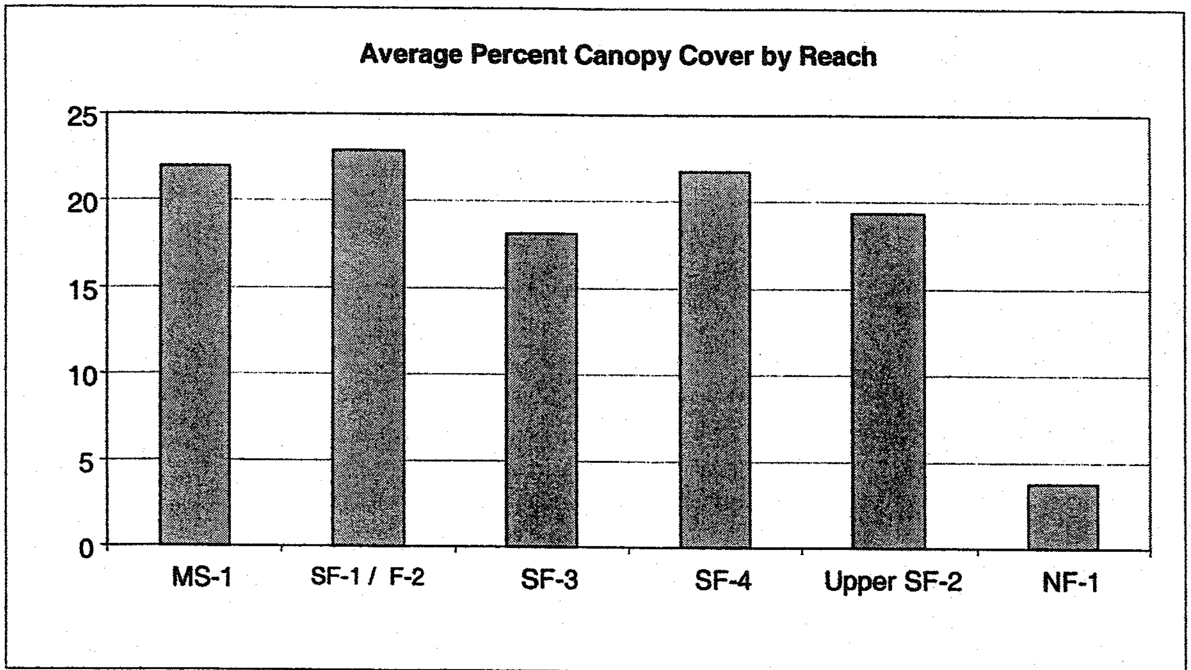


Figure 8-14. Canopy Cover Percentages for the Reaches Surveyed Within the Project Area

Disruptive Pressures. Disruptive pressure refers to the anthropogenic impacts to the riparian zone. The measurement of disruptive pressures at each BURP site is a qualitative assessment (IDEQ, 2003) of the streambank habitat immediately adjacent to the stream. This variable is used to determine seasonal human impacts on riparian zones. Seasonal impacts can include, among others, recreational activities (camping, hiking, fishing, and hunting) and livestock grazing. Persistent pressures include road prism encroachment, agricultural developments adjacent to channels, channelization of streams, and other impacts from land management activities like logging. A number between zero and 10 is assigned at the reach level. A score of zero represents the greatest disruption of the streambank where bank vegetation has been removed to less than 30 percent of the potential biomass. A score of 10 represents no disruption of the bank vegetation and the maximum amount of plant biomass has been achieved (IDEQ, 2003).

The disruptive pressures were qualitatively assessed at the reach level and follow the direction provided in IDEQ (2003). Scores for disruptive pressures ranged from a high score of 8 at two sites (USF1 and USF2), indicating the lowest disruptive pressure, to a low score of 3 at MS-1 (Figure 8-15) (Appendix N). The mean value for disruptive pressure within the NMR ecoregion is 6 (Appendix N). Two of the sites met the mean of 8 while the remainder fell below the mean value, suggesting a higher degree of disruptive pressure on all remaining sites.

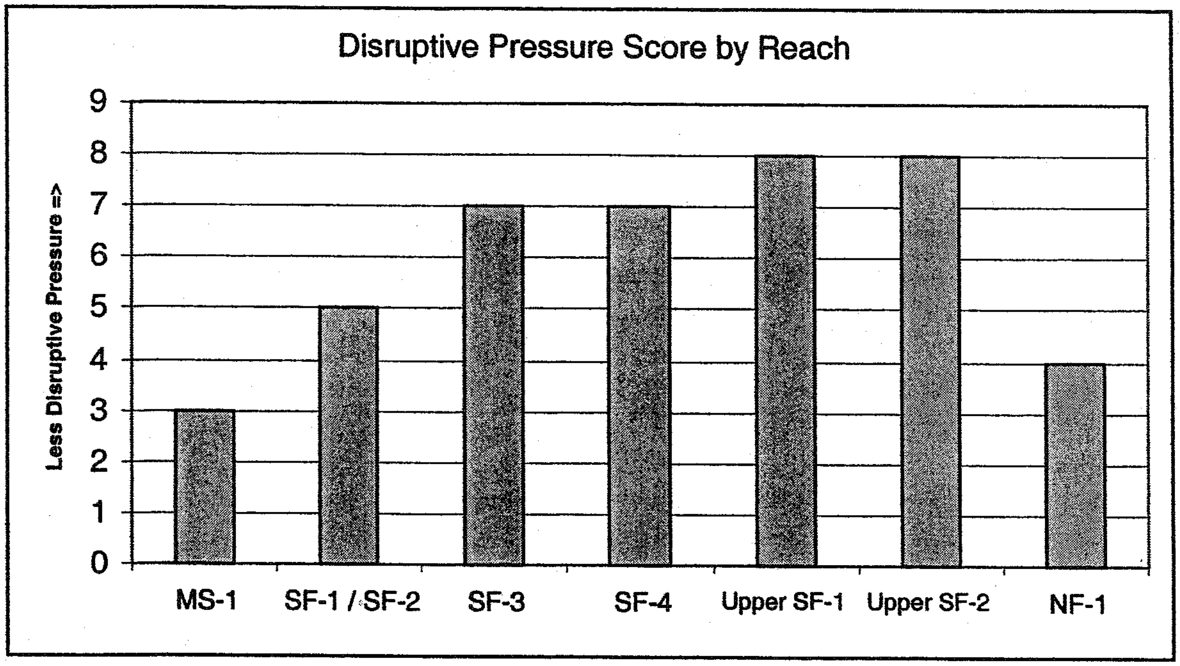


Figure 8-15. Disruptive Pressure Assessments for the Project Area Reaches

Zone of Influence. The zone of influence pertains to the width of the riparian vegetation zone. This area is directly affected by nearby ditches, channels, or other drainage features. Healthy stands of riparian vegetation provide habitat for aquatic and terrestrial animals, and perform important physical functions (for example, erosion control, sediment catchment, and LWD recruitment). The zone of influence is used to determine the overall human impacts on a riparian zone such as roads, logging, lawns, campgrounds, and urban areas. A score is applied at the reach level from zero to 10. A score of zero represents little to no riparian vegetation resulting from human-induced activities. A score of 10 represents a wide, well-developed riparian area that has had no impacts by human activities (IDEQ, 2003).

The zone of influence was qualitatively assessed at the reach level and follows the direction provided in IDEQ (2003) (Figure 8-28). Scores for the zone of influence ranged from a score of 8 at three sites (SF-4, USF1, and USF2), describing riparian zones less influenced by human impacts, to a low of 2 at MS-1, the reach with the greatest riparian disturbance within the project area (Figure 8-16). The mean value for the NMR ecoregion is 7 (appendix N). Four of the 7 reaches met or exceeded the mean, 2 sites fell just below the mean with a reach average of 5, and reach MS-1 rated as a 2.

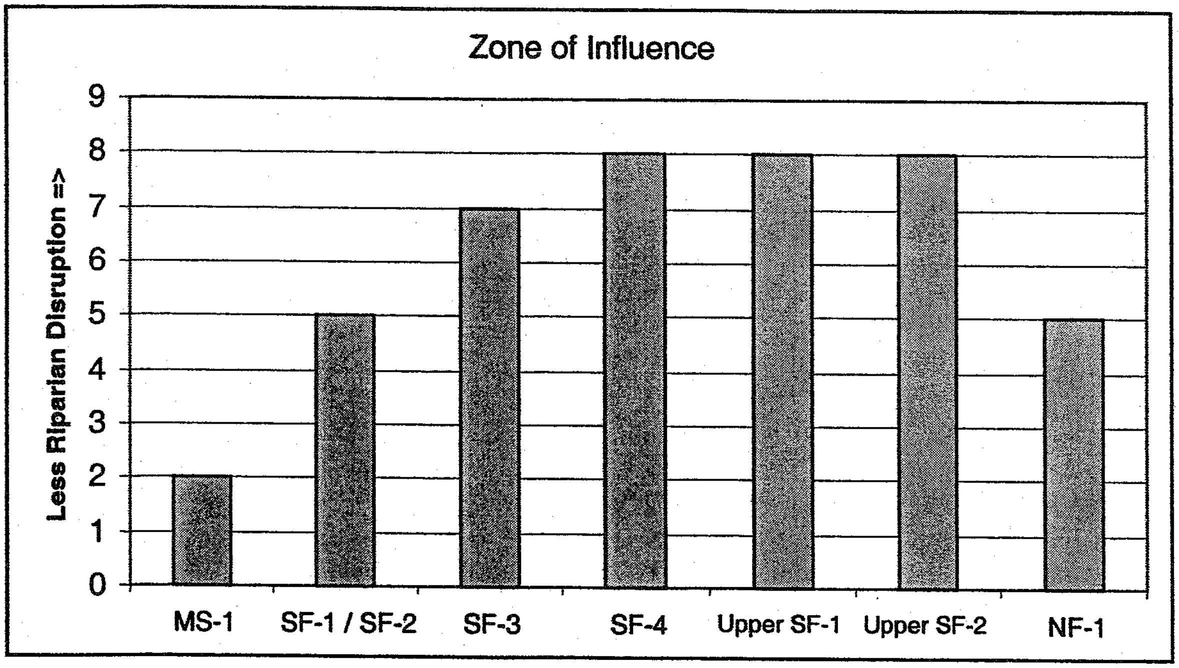


Figure 8-16. Zone of Influence Ratings for the Reaches Within the Project Area

SHI Scores. SHI scores are calculated from the metric scores at the reach level (Grafe ed. 2002). The scores for the reaches are established by the sum of the metric scores as described in Table 8-5. In general, a higher score describes a stream habitat with reduced human impacts. Table 8-12 and Figure 8-17 summarize the reach metric totals and describe the relative position of the measured reach with respect to the NMR ecoregion. Higher condition scores indicate that reaches are closer to mimicking the condition of stream habitats within the NMR ecoregion that have little human disturbance.

TABLE 8-12
SHI Scores and Relative Ranking for the Surveyed Reaches[1]

Reach	Metric Total[2]	NMR Relative Reference Ranking
MS-1	50	Below 10th Percentile
SF1/SF2	54	Below 10th Percentile
SF3	60	10th to 25th Percentile
SF-4	53	Below 10th Percentile
USF1	61	10th to 25th Percentile
USF2	59	10th to 25th Percentile
NF-1	51	Below 10th Percentile

[1] Grafe ed. 2002
[2] See Table 8-5 for reference scores

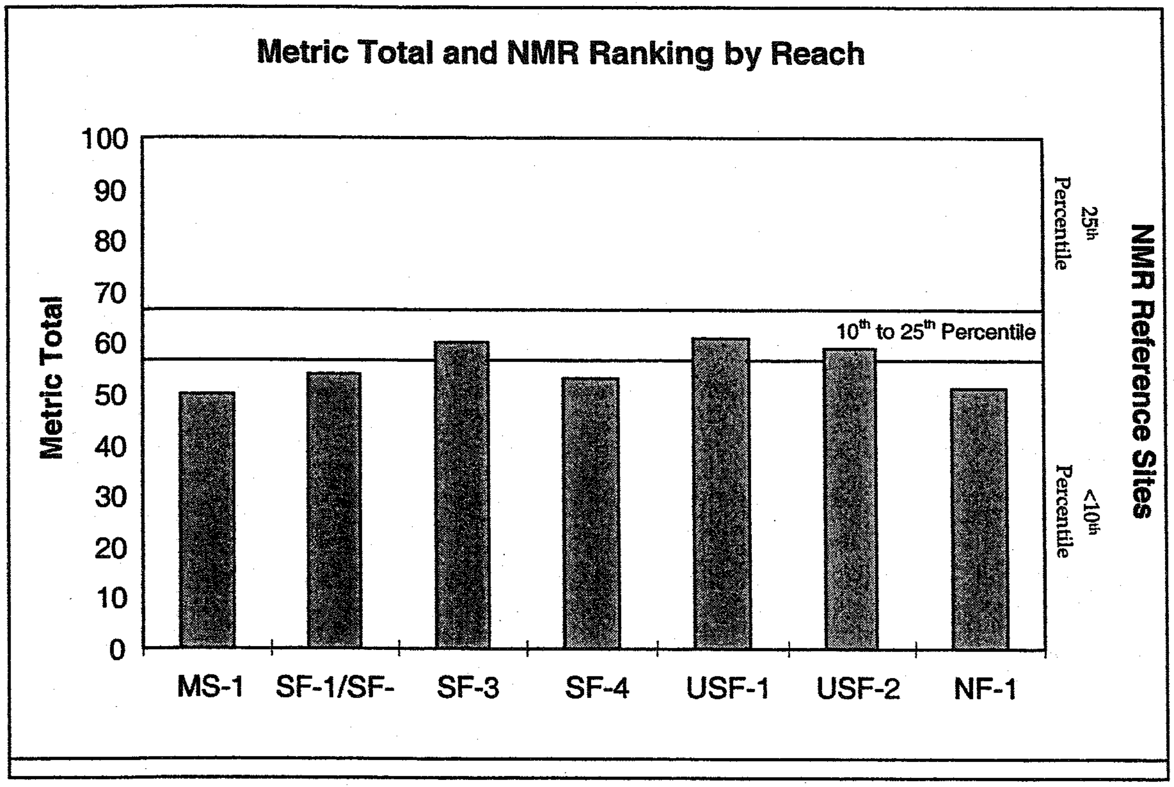


Figure 8-17. NMR Ecoregion Relative Rankings in Relation to Overall Reach Scores for the Project Area

The SHI scores and relative NMR rankings found in Table 8-12 and Figure 8-17 suggest that none of the project area reaches meet the highest reference reach values (above 25th percentile) within the NMR ecoregion. Three reaches within the project area rated within the middle category (SF3, USF1, and USF2). Four of the reaches scored in the lowest category (MS-1, SF1/SF2, SF-4, and NF-1). In other words, when compared to the reference sites within the NMR ecoregion (Grafe ed. 2002), none of the project area sites, including reference reaches, scored in the highest habitat quality range.

8.3.2.2 Sand Bars and Beaver Dams

The locations of sand bars are illustrated in Figures 8-2 and 8-3. Surface areas were highest in the lower mainstem and in the North Fork (Figure 8-18). Much of the sand bar surface area in the North Fork was caused by a single very large sand bar adjacent to a long, high cut-bank. The immediate vicinity was heavily used by cattle. Some of the sand bars in the lower South Fork and lower North Fork were also associated with cattle damage and high cut-banks. The lower mainstem reach of Mica Creek had extensive stream bank instability caused by channelization, deposited sand bars, but no recent influence from cattle grazing. Reaches SF3 had only two small sand bars. The Upper SF1 had no sand bars identified because the reach was entirely impounded by beaver dams.

In 2003, many of the sand bars documented in 2002 were revisited (Figure 8-19). Their locations, shown in Figure 8-3, are almost identical to their positions in 2002. Only a few sand bars were missing from the 2002 survey and there were a few new bars identified in 2003. Some of the sand bars in the South Fork that were loose and barren of plants in 2002, had young vegetation growing on them in 2003. Others remained loose and bare, suggesting either new deposition, or scour followed by deposition in 2003.

Beaver dams were noted in 2002, but were positioned in 2003 with GPS (Figure 8-3). Further, stakes were driven into the tops of the dams for future examination should the study continue into 2004. The presence or absence of the stakes in the dams might suggest how often beaver dams breach and rebuild on an annual basis.

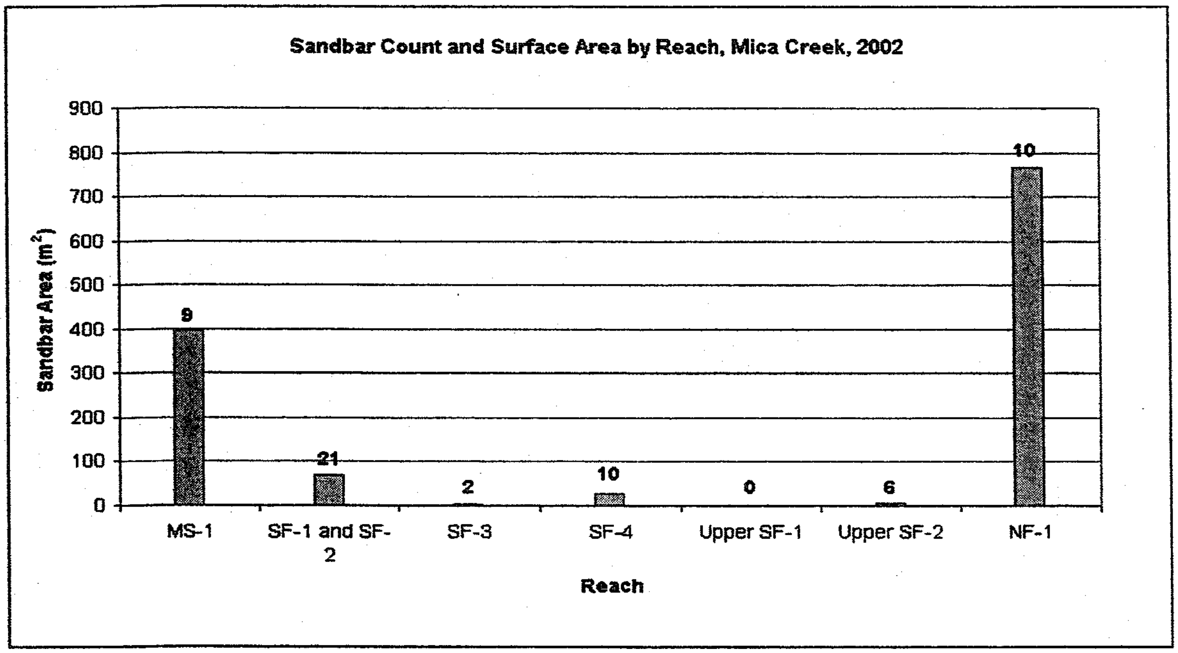


Figure 8-18. Sandbar Count and Surface Area by Reach, Mica Creek, 2002

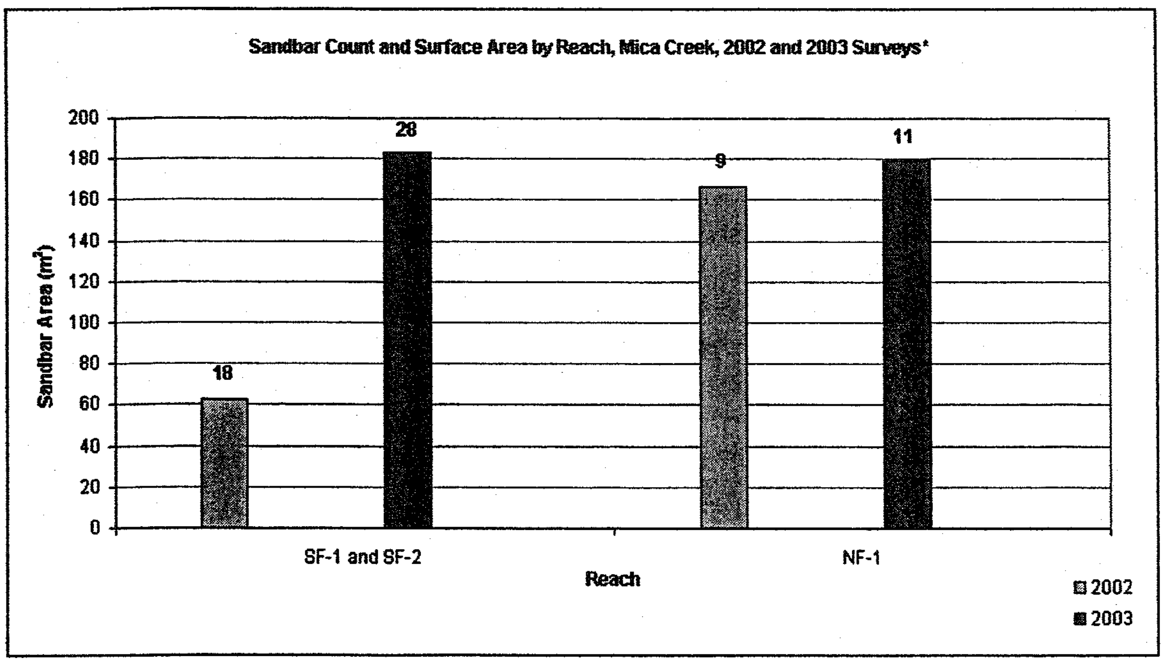


Figure 8-19. Sandbar Count and Surface Area by Reach, Mica Creek, 2002 and 2003 Surveys

8.3.2.3 Scour Chain

As shown in Table 8-13 the pool transects were established in June and July 2003 and measured again in December 2003. During this time interval, the project site received above average precipitation. The historical monthly average precipitation volume measured at the Coeur d'Alene airport for August through November is 7.26 inches. In 2003, a total volume of 10.70 inches of precipitation was measured during these months. August was 64 percent of the historical average; however, September, October, and November were each above their respective historical monthly averages (123 percent, 146 percent, and 182 percent, respectively).

Table 8-13 summarizes the results obtained from the December 2003 transect monitoring event. A summary of channel change and channel geometry plots of the individual transects are included in Appendix N. Result obtained from the scour chains are presented in Table 8-14.

TABLE 8-13
Summary of Pool Transect Monitoring Data

Location Name	Site Description	Transect Location within the Pool	Date Transect was Established	Results from December 15, 16, 2003 Monitoring Event: Dominant Process per Transect (net change in channel X-sect. area)	Results from December 15, 16, 2003 Monitoring Event: Dominant Process per Pool Location (total net change in all transects)
Scour 1	S.F. Mica Creek upstream of project	Upstream	June 24, 2003 (re-measured on July 15, 2003)	Deposition (0.15 ft^2)	Deposition (1.95 ft^2)
		Middle	June 24, 2003 (re-measured on July 15, 2003)	Deposition (0.45 ft^2)	
		Downstream	June 24, 2003 (re-measured on July 15, 2003)	Deposition (1.35 ft^2)	
Scour 2	S.F. Mica Creek upstream of project	Upstream	July 15, 2003	Scour (-1.20 ft^2)	Scour (-0.99 ft^2)
		Middle	July 15, 2003	Scour (-0.17 ft^2)	
		Downstream	July 15, 2003	Deposition (0.38 ft^2)	
Scour 3	S.F. Mica Creek downstream of project	Upstream	July 15, 2003	Deposition (1.20 ft^2)	Scour (-0.67 ft^2)
		Middle	July 15, 2003	Scour (-0.60 ft^2)	
		Downstream	July 15, 2003	Scour (-1.27 ft^2)	

TABLE 8-13
Summary of Pool Transect Monitoring Data

Location Name	Site Description	Transect Location within the Pool	Date Transect was Established	Results from December 15, 16, 2003 Monitoring Event	
				Dominant Process per Transect (net change in channel X-sect. area)	Dominant Process per Pool Location (total net change in all transects)
Scour 4	S.F. Mica Creek downstream of project	Upstream	July 14, 2003	Deposition (1.18 ft^2)	Scour (-0.09 ft^2)
		Downstream	July 14, 2003	Scour (-1.27 ft^2)	
Scour 5	S.F. Mica Creek downstream of project	Upstream	July 14, 2003	Deposition (0.68 ft^2)	Scour (-4.36 ft^2)
		Middle	July 14, 2003	Scour (-0.04 ft^2)	
		Downstream	July 14, 2003	Scour (-5.00 ft^2)	
Scour 6	N.F. Mica Creek	Upstream	July 14, 2003	Deposition (2.25 ft^2)	Deposition (9.60 ft^2)
		Middle	June 24, 2003	Deposition (6.10 ft^2)	
		Downstream	June 24, 2003	Deposition (1.25 ft^2)	

TABLE 8-14
Scour Chain Monitoring Data

Location Name	Installation Data	Monitoring Data	Result
Scour 1 (S.F. Mica Creek upstream of project)	July 15, 2003 Total chain length = 42 links (42 inches) Exposed chain length = 15 links (15 inches)	December 16, 2003 Deposit depth = 0.10 foot Horizontal chain length = 15 links (15 inches)	No scour then Deposit 1 inch Time lapse = 5 months
Scour 2 (S.F. Mica Creek upstream of project)	June 24, 2003 Total chain length = 40 links (40 inches) Exposed chain length = 16 links (16 inches)	December 16, 2003 Under ice – no measurement	Data not available
Scour 3 (S.F. Mica Creek downstream of project)	June 24, 2003 Total chain length = 40 links (40 inches) Exposed chain length = 12 links (12 inches)	December 16, 2003 Deposit depth = 0.10 foot Horizontal chain length = 12 links (12 inches)	No scour then Deposit 1 inch Time lapse = 6 months

TABLE 8-14
Scour Chain Monitoring Data

Location Name	Installation Data	Monitoring Data	Result
Scour 4 (S.F. Mica Creek downstream of project)	July 15, 2003 Total chain length = 40 links (40 inches) Exposed chain length = 15 links (15 inches)	December 15, 2003 Deposit depth = 0.15 foot Horizontal chain length = 20 links (20 inches)	Scour 5 inches then Deposit 2 inches Time lapse = 5 months
Scour 5 (S.F. Mica Creek downstream of project)	June 24, 2003 Total chain length = 40 links (40 inches) Exposed chain length = 7 links (7 inches)	December 16, 2003 Deposit depth = 0.40 foot Horizontal chain length = 8 links (8 inches)	Scour 1 inch then Deposit 5 inches Time lapse = 6 months
Scour 6 (N.F. Mica Creek)	June 24, 2003 Total chain length = 56 links (40 inches) Exposed chain length = 22 links (22 inches)	December 16, 2003 Deposit depth = 0.70 foot Horizontal chain length = 26 links (26 inches)	Scour 4 inches then Deposit 8 inches Time lapse = 6 months

To date, the results of the transect monitoring effort reveal that both scour and deposition occurred during the later half of 2003 at all but one transect, with deposition being the dominant process at 10 of the 17 transects. When the net change in channel cross-sectional area per transect are summed by pool location, deposition is revealed as the dominant process in the most upstream background pool in the South Fork Mica Creek (*Scour 1*) and near the mouth of the North Fork Mica Creek (*Scour 6*). The net change in the channel geometry at *Scour 2* (background), *Scour 3*, and *Scour 4* along the South Fork Mica Creek indicates scour was the dominant process during this time, but only by a slight margin. At the mouth of the South Fork (*Scour 5*), the transect data reveals scour was the dominant process. It is interesting to note from the cross-sectional plots in Appendix N that there was no "blanket" deposition across any single transect downstream of the project in the South Fork Mica Creek. In fact, the only significant deposition occurred at the middle transect in the North Fork Mica Creek pool (*Scour 6*) (see Appendix N).

The scour chain data support the fact that deposition was the dominant process at *Scour 1* and *Scour 6*. The net thickness of deposition at *Scour 1* was 1 inch. The maximum deposition measured at the five chain locations (one chain was unretrievable) (Table 8-14) was obtained in the North Fork Mica Creek (*Scour 6*) with a net deposition of 8 inches over the chain. In the three pools monitored downstream of the project in the South Fork Mica Creek, the maximum depth of scour was 5 inches (*Scour 4*) and the maximum depth of deposition was 5 inches (*Scour 5*). At both these locations, the scour chains revealed both scour and depositional processes.

8.3.2.4 Discussion

Stream Habitat. The purpose of this analysis is to examine the stream habitat component of the biological community within the South Fork, North Fork, and mainstem portions of

Mica Creek to determine if the habitats were impacted by the reconstructed segment of U.S. 95 that parallels South Fork Mica Creek to the mainstem of Mica Creek. The primary concerns from the construction project are related to the sediments released into the South Fork and mainstem Mica Creek, at and below the construction area (Figure 8-1). The following discussion will examine the reaches sampled and analyzed using the *Idaho Small Stream Ecological Assessment Framework* (Grafe ed., 2002) to compare the stream habitat indexes (SHI). In addition, past survey information for the project area as well as general observations from the recent surveys are used to describe and compare existing reach conditions.

A habitat index summarizes the physical condition of stream sites and compares the sum of the habitat values to reference conditions. Human activities can alter or damage stream habitat by removing or destroying vegetation around, above, or within the stream channel; causing channel side and or down-cutting; increasing sediment in the channel; and destroying overhanging banks. The SHI scoring system incorporates human impacts as well as general habitat measures and is based on similar concepts used in the development of the other indexes (SMI and SFI). IDEQ believes the evaluation of physical habitat is a useful interpretive tool. However, the agency is cautious about using the SHI solely to determine aquatic life use support and recommends the use of the combined indices in the overall evaluation of aquatic system health (Grafe ed., 2002). This evaluation covers the SHI only.

Given that the focus of the impact assessment is on sediment-related effects, the discussion will revolve around the habitat metric categories of epiphaunal substrate/ available cover, embeddedness/ heterogeneity of substrate compositions, and channel flow status (metrics of concern, Table 8-3). The importance of the additional metric categories (bank vegetation protection and riparian zone width) are not neglected in the analysis, rather their results can be found in the Results section above and all metrics are used in the overall condition category evaluation.

None of the reaches scored within the highest condition category (greater than 25th percentile of reference conditions) for the NMR ecoregion (Table 8-5). The highest condition category suggests that the combination of all of the habitat metrics meet or exceed the expected habitat condition within the NMR ecoregion, as described in Table 8-4. One habitat measure within the project area that consistently failed to meet the ecoregion mean was percent canopy cover. All reaches rated well below the level expected for canopy cover (48 percent) within the ecoregion and two sites had values of less than 10 percent canopy cover (NF-1 and USF1). All reaches have evidence of land use modifications that have the potential to affect canopy cover. The modifications of portions of the NF-1 channel (riprapping) and intermittently heavy cattle use within and around the reach have likely suppressed the ability of the riparian plant communities to form a well-developed canopy cover across the reach. The USF1 Mica Creek reach is dominated by wide channels created by beaver dam backwaters that result in lower canopy cover values.

Most reaches surveyed revealed some degree of past or recent land-use impacts to the stream channels that may be preventing the attainment of the highest condition category. Reaches MS-1, SF1/SF2, and NF-1 have all been affected to some degree by stream channelization. The channelization within MS-1 has resulted in down-cutting of the stream and the transport of bed and bank materials. SF1/SF2 and NF-1 surveys found recent cattle damage where stream access was available. Cattle use was heavy in the lowest portion of

SF1/SF2, the upper portion of MS-1, and the middle portion of NF-1. Bank destruction within these areas is contributing to sediment inputs to area streams. SF3 has a confined portion that is adjacent to the U.S. 95 road prism. This confined portion appears to have downcut the stream and appears to serve as a transport reach for in-channel materials. SF-4 is dominated by recently constructed beaver dams that serve as sediment storage areas. USF1 is also dominated by sediment-laden beaver ponds that are adjacent to ranch lands. USF2 is a fairly high gradient reach that still rated poorly for fine sediments, suggesting an upstream source above the project.

Three reaches (SF3, USF1, and USF2) scored within the median condition category (10^{th} to 25^{th} percentile of reference condition). SF3 is a higher gradient reach dominated by Rosgen A- and B-type channels. SF3 scored well (at or above the ecoregion mean) for all metrics of concern except LOD and channel shape. However, the prevalence of dense vegetation and conifers in the riparian area suggest that the site will meet future LOD needs. USF1 and USF2 are above the project. USF1 scored well for all metrics of concern except instream cover and channel shape. This reach contains wide, shallow beaver ponds along its entire length that do not offer much in the way of instream cover protection. Given the size and extent of the beaver ponds, it is unlikely that this reach will provide better instream cover in the foreseeable future. USF2 scored well for all metrics of concern except instream cover, percent fines, and channel shape. Instream cover and percent fine sediment may be affected by upstream activities within this reach. Although some riffles appeared to have low enough embeddedness for salmonid spawning, the reach substrate appeared to be dominated by fine sediments with no apparent source adjacent to the reach itself.

The four remaining reaches (MS-1, SF1/SF2, SF-4, and NF-1) all scored in the lowest condition category for the NMR ecoregion (Table 8-5). MS-1 scored well on percent fines, embeddedness, and Wolman class sizes and poorly on the other metrics of concern. However, the reach has been heavily impacted by stream channel modifications. The MS-1 reach has been channelized, continues to scour banks and remains unstable. The channel is described as a Rosgen G-type channel, i.e., deeply incised, unstable, high bank erosion, and high bedload transport (Rosgen, 1996). Little riparian vegetation exists and the only riffle that exists is steep and artificially constructed (i.e., composed of crushed angular rock). Given the current conditions, it is unlikely that this reach will ever reach a higher condition category and may continue to be a chronic source of bank-contributed sediment.

SF1/SF2 also rated within the lowest condition category (less than 10th percentile of the reference condition). The reach scored well on all metrics of concern except instream cover and channel shape. The entire reach contains a narrow channel, and the lower portion of the reach has been channelized and contains areas of heavy cattle use. The entire reach is dominated by a confined Rosgen G-type channel with scattered depositional areas of stable (densely vegetated) and newly formed sand bars (that is, loosely packed and lacking vegetation). The upper portions of the confined channel are fairly straight, low gradient, and heavily vegetated, and pools are formed more by channel constrictions than by LOD or other causal forces. Of particular interest in this reach is evidence of vegetative debris as high as 8 feet above the stream, suggesting variably large flows within this confined channel. The lower portion of the reach finds cattle damage and sloughing banks that resemble, to some degree, that of MS-1.

SF-4 rated within the lowest condition category (less than 10th percentile of the reference condition) as well. This reach scored poorly for most metrics of concern except Wolman size classes. The reach scored especially poorly on percent fine sediment with more than 40 percent fine sediments within sampled riffles. The reach is generally of low gradient and unconfined with a wide riparian area. The upper portion of the reach contains a series of beaver ponds that contain large quantities of fine, medium, and coarse sands. The beaver dams are active and modified on a monthly basis. Additionally, the ponds appear to have been breached during the same storm event that caused the sedimentation pond breach (project). This portion of the project area contains the breached sedimentation pond, and it is likely that some of the materials released from the sedimentation pond are contained within these beaver ponds.

Finally, NF-1 also rated in the lowest condition category (less than 10th percentile of the reference condition). NF-1 was not affected by the project and scored poorly (i.e., below the regional mean) on instream cover, Wolman size classes, and channel shape. The North Fork reach appears to have greater stream flows than that of South Fork Mica Creek and is supported by the almost doubled subwatershed area. The channel is confined, similar to that of MS-1, and the lowest portion of the reach contains riprap-lined banks. The lower portion of the reach is also sand-dominated with large sand bars throughout. Pools within this portion of the reach are created by channel constrictions and LOD. Bank sloughing is prevalent above the riprap and appears to result from both cattle impacts and an attempt to control channel meanders by the landowner. Riparian vegetation is intermittently dense in the lower portion of the reach and becomes less abundant upstream where cattle grazing impacts appear to affect the vegetation as well as the banks. Scattered and large sand bars appear in the upper portion of the reach suggesting periodic excessive flood flows, erosion, and sand transport.

In summary, the general conditions of all the reaches within the project area are less than optimal given the failure of any to meet the highest condition category (greater than 25th percentile of the reference condition) for the NMR ecoregion. The metrics of concern (that is, epiphaunal substrate/ available cover, embeddedness/ heterogeneity of substrate composition, and channel flow status) indicate variability in the current condition of the project area. Instream cover levels were generally poor across all reaches. LOD numbers varied across the reaches. Fine sediments appeared to be functioning appropriately in the macroinvertebrate sample sites but appeared to be generally high elsewhere throughout the project area. The quantities and locations of fine sediments and bars in the North Fork Mica and upper South Fork Mica Creeks suggest a source input of sediments coming from upstream within the drainage area. Embeddedness is a function of fine sediment input and varied in levels across the project area. Wolman class size describes the heterogeneity of the substrate and also varied by habitat and channel type, as expected. Channel shape has resulted from land-use practices and road prism constriction and is generally functioning unnaturally along the lower South Fork, North Fork, and mainstem of Mica Creek (CH2M HILL, 2002d).

Sand Bars and Beaver Dams. Sand bar locations in the North Fork, South Fork, and mainstem Mica Creek are strongly associated with channel gradient. Sand bars were associated with pools or glides in all low gradient reaches. The bars were never found in riffles and rarely in the steeper reaches. Sand bars in all reaches examined had visually similar characteristics. They were composed of coarse to medium-grained amber colored sand with a thin (perhaps 0.25 inch) veneer of dark brown silt. The silt veneer was thicker, however, in the beaver ponds. Since the character was the same in the mainstem, North Fork, and South Fork, it is reasonable to assume that at least some (if not most) of the fine sediment deposition in the mainstem comes from the North Fork. Evidence of the North Fork as a source for fine sediment was found during the habitat surveys. There was stream bank damage from cattle as well as vertical cut-banks from past extreme flow events. Examination of aerial photographs suggest at least a moderate degree of land disturbance in the past from logging, riparian road building, and grazing (Section 7).

The identification of sediment source that caused the observed deposition features in the lower South Fork is confounded by several factors. Some of the sand bar materials in the lower South Fork undoubtedly came from the blow-out of the sedimentation pond and other construction-related erosion that occurred during the rain-on-snow event in January 2002. The color, grain size, and texture of sands/silt deposited in sand bars and behind beaver dams above the project (South Fork Mica Creek) appear to be identical to those downstream. There is a tremendous quantity of similar material impounded behind beaver dams in a beaver complex upstream of the project. During the 2002 event, many of these dams may have blown out, sending significant quantities of sediment downstream.

Beaver activity has changed in the project area since the 2002 event because of the recent cessation of trapping (Hicks, 2003). Since then, many new beaver dams have been built above and below the former sedimentation pond location. Thick sediment deposits are present in the pond both above and below the highway, indicating significant sediment delivery from the watershed above the project. Examination of aerial photographs (Chapter 4) suggests that the upper portion of the watershed has received impacts from past logging, riparian area roads, and cattle activities in streams.

8.3.3 Fish Assessment of South Fork and North Fork Mica Creek and Mica Creek

8.3.3.1 Stream Fish Index Comparison

This section provides the results and discusses the fish community biological integrity for Mica Creek. Fish communities in Mica Creek are discussed relative to upstream and downstream of the project. In addition, the upper South Fork and North Fork Mica Creeks fish communities are provided as an additional comparison, or reference sites, relative to sites downstream of the project on the South Fork Mica Creek and Mica Creek. An SFI was calculated for each site by averaging the three previous SFI scores for each site.

Age classes for cutthroat trout and torrent sculpin used in calculating the SFIs were derived based on length and age relationships stated in Wydoski and Whitney (1979) and from unpublished data from IDEQ (IDEQ, unpublished data, 2002b).

Table 8-15 presents sampling results from each of the six sites for each of the three sampling events and includes the identified fish species, standard fork lengths, habitat types, and substrate types in the areas sampled. Table 8-16 presents a summary of the species abundance, sample reach length, electroshocking time, the catch per unit effort (the number of fish captured per minute of activated probe electroshocking), and SFI scores. Table 8-6 summarizes metrics used to compute the SFI score for each site using the Forest Index. The

CPUE shown in Table 8-16 was calculated by dividing the total number of fish collected by the number of minutes the probes were in the water and activated.

8.3.3.2 Forest SFI

Mica Creek, Mainstem Site (MS). Fish habitat included few pools, primarily glide habitat, one to two riffle areas, few undercut banks, and no LWD. Some overhanging vegetation was present, which provided shade from direct sunlight. However, there is very little instream habitat complexity and significant bank erosion. Streambed substratum at Site MS consisted primarily of sand and silt except in the riffle area. In the riffle area the substrate consisted of coarse angular pebbles, cobbles, and boulders with an average of 8 percent and up to 18 percent fines (substrate of 6.0 millimeter size or less). The shape of many of the boulders indicated that they were columnar basalt. Columnar basalt is characterized by straight angular lines with concave faces and their presence suggests that they were placed for habitat improvement or channel stabilization.

Combining the September 2002 (CH2M HILL 2002), June 2003 (CH2M HILL 2003a), and September 2003 (CH2M HILL 2003b) sampling events indicated the fish species of greatest proportion was torrent sculpin, of which 52 were identified. These sculpins represented three, three, and four age classes respectively, ages 1+, 2+, 3+, and 4+. They ranged between 36 and 96 millimeters in length. Other fish species at Site MS included five cutthroat trout from 47 millimeter to 192 millimeter, from 1, 3, and 1 age classes, respectively. Three smallmouth bass, age 1+ ranging in size from 84 millimeter to 91 millimeter were collected during the September 2003 sampling event. The calculated average SFI was 68, which would conventionally indicate impairment.

South Fork Mica Creek Site 1 (SF1). Site SF1 riffle 1 contained a greater proportion of smaller streambed substrate (averaged across the two riffles and all three events was 28 percent of 6 millimeter size and less within the wetted width) compared to Site MS (average 14 percent of 6 millimeter or less within the wetted width). However, Site MS had only one riffle present during the June and September 2003 sampling events. The primary substratum at Site SF1 riffle 1 included sand and pebbles. Site SF1 riffle 2 contained much less fine substrate (6 millimeter size or less) and consisted primarily of pebbles and cobbles. Stream features consisted of glides, pool, and riffle areas. Woody debris and undercut banks also characterized the site.

In comparison to Site MS, Site SF1 demonstrated a greater number of total fish although species presence were lower as no smallmouth bass were collected, only torrent sculpin and cutthroat trout. The dominant fish species was cutthroat trout (average of 19 across the three events, length range of 27 to 138 millimeter) from two to three age classes. An average of 13 torrent sculpin were captured, ranging in length from 31 to 99 millimeter and comprising two to three age classes. The average calculated SFI for Site SF1 was 87, which conventionally would be considered to indicate no impairment.

TABLE 8-15
Fish Sampling Data Summary
U.S. 95 Bellgrove to Mica, Idaho

Sample Site[1]	Fish Species	Fork Lengths (mm)	Habitat Types	Substrate Type
Mica Creek, Mainstem (MS)				
Sep-02	Torrent sculpin (23)	94, 81, 92, 40, 96, 86, 72, 64, 43, 78, 38, 43, 38, 36, 47, 80, 40, 40, 40, 36, 37, 42, 40	Rearing and migration. Pool, riffle, glides. Pasture, low gradient.	Fine (7%); Pebble (35%); Cobble (52%); Boulder (6%)
	Cutthroat trout (1)	192		
Jun-03	Torrent sculpin (12)	114, 86, 80, 73, 62, 61, 60, 65, 66, 56, 58, 57		Fine (15%); Pebble (23%); Cobble (59%); Boulder (4%)
	Cutthroat trout (3)	172, 87, 47		
Sep-03	Torrent sculpin (17)	96,78,61,79,86,59,77,62,92,71,60,67,45,43,40,39,67		Fine (20%); Pebble (20%); Cobble (51%); Boulder (9%)
	Cutthroat trout (1)	172		
	Small mouth bass (3)	91,90,84		
South Fork Mica Creek Site 1 (SF1)				
Sep-02	Torrent sculpin (12)	82, 61, 53, 46, 58, 66, 34, 31, 33, 83, 56, 61	Rearing, spawning, migration. Pools, riffles, glides. Pasture, low gradient.	Fine (21%); Pebble (55%); Cobble (20%); Boulder (4%)
	Cutthroat trout (23)	56, 102, 59, 105, 120, 96, 121, 119, 137, 96, 138, 123, 129, 88, 59, 51, 58, 54, 63, 71, 58, 107, 64		
Jun-03	Torrent sculpin (17)	95, 70, 73, 66, 45, 49, 44, 45, 44, 48, 47, 46, 49, 45, 99, 82, 77		Fine (36%); Pebble (36%); Cobble (24%); Boulder (4%)
	Cutthroat trout (9)	122, 98, 98, 37, 27, 34, 127, 110, 118		
Sep-03	Torrent sculpin (9)	59,78,82,54,51,58,59,77,60		Fine (38%); Pebble (52%); Cobble (11%); Boulder (0%)
	Cutthroat trout (26)	46,121,130,59,51,111,63,75,110,102,62,50,121,118,51, 130,113,132,59,52,90,100,58,60,59,45		
South Fork Mica Creek Site 2 (SF2)				
Sep-02	Torrent sculpin (9)	31, 73, 60, 38, 40, 94, 83, 37, 34	Rearing, spawning, migration. Pools, riffles, glides. Forest, low gradient.	Fine (18%); Pebble (24%); Cobble (43%); Boulder (15%)
	Cutthroat trout (62)	60, 114, 59, 71, 140, 63, 129, 112, 110, 89, 135, 51, 109, 66, 127, 95, 111, 110, 130, 120, 136, 90, 119, 66, 74, 67, 108, 70, 50, 78, 64, 70, 50, 61, 60, 53, 126, 143, 108, 52, 93, 92, 106, 97, 91, 61, 71, 54, 55, 64, 58, 49, 57, 66, 52, 52, 44, 59, 57, 55, 55, 54		
Jun-03	Torrent sculpin (9)	111, 92, 66, 93, 60, 85, 83,83, 77		Fine (13%); Pebble (28%); Cobble (34%); Boulder (17%)
	Cutthroat trout (27)	160, 127, 108, 105, 91, 110, 108, 88, 91, 93, 22, 28, 208, 111, 150, 110, 96, 132, 83, 99, 86, 102, 108, 89, 91, 89, 35		
Sep-03	Torrent sculpin (9)	51,52,87,82,45,46,49,99,102		Fine (25%); Pebble (31%); Cobble (29%); Boulder (17%)
	Cutthroat trout (72)	91,55,51,126,113,151,146,114,91,112,92,106,54,48,60, 61,111,96,56,74,67,60,53,60,173,192,59,102,143,42,116, 117,106,102,51,54,53,60,104,114,56,98,60,93,82,63,63, 103,84,62,102,54,57,53,52,47,51,57,56,58,61,62,59,56, 56,62,99,104,96,92,107,138		

TABLE 8-15
Fish Sampling Data Summary
U.S. 95 Bellgrove to Mica, Idaho

Sample Site[1]	Fish Species	Fork Lengths (mm)	Habitat Types	Substrate Type
South Fork Mica Creek Site 3 (SF3)				
Sep-02	Torrent sculpin (4)	69, 37, 37, 36	Rearing, spawning, migration. Pools, cascades. Moderate gradient. Forest.	Fine (14%); Pebble (15%); Cobble (23%); Boulder (48%)
	Cutthroat trout (82)	57, 49, 111, 124, 47, 107, 104, 57, 116, 197, 69, 60, 124, 108, 93, 72, 91, 68, 63, 64, 61, 63, 57, 63, 92, 65, 33, 53, 58, 68, 65, 62, 66, 64, 51, 44, 141, 99, 158, 62, 101, 106, 93, 130, 113, 94, 83, 92, 68, 55, 89, 83, 95, 66, 49, 52, 50, 56, 51, 57, 54, 55, 39, 65, 62, 130, 94, 68, 109, 91, 59, 108, 56, 49, 95, 72, 61, 61, 65, 56, 55, 55		
Jun-03	Brown Trout (1)	228		Fine (25%); Pebble (18%); Cobble (39%); Boulder (19%)
	Cutthroat trout (18)	127, 177, 114, 136, 98, 76, 81, 88, 133, 165, 138, 140, 114, 173, 127, 74, 82, 93		
Sep-03	Torrent sculpin (2)	84,39		Fine (25%); Pebble (25%); Cobble (35%); Boulder (15%)
	Cutthroat trout (49)	55,93,102,88,54,136,67,63,82,84,54,110,92,97,98,92,55, 53,66,54,45,55,67,60,50,50,35,48,48,165,52,141,104,128, 104,108,132,92,94,88,97,80,48,72,73,51,55,48,47		
Upper South Fork Mica Creek (USF)				
Sep-02	Torrent sculpin (10)	87, 96, 62, 57, 65, 112, 95, 54, 66, 82	Rearing, spawning, migration. Pools, riffles, glides. Forest, low gradient.	Fine (13%); Pebble (74%); Cobble (11%); Boulder (2%)
	Cutthroat trout (33)	47, 60, 63, 49, 67, 122, 59, 94, 135, 67, 111, 52, 48, 52, 62, 57, 54, 57, 44, 44, 54, 57, 56, 126, 94, 181, 158, 112, 60, 60, 44, 51, 124		
Jun-03	Torrent sculpin (5)	84, 99, 72, 38, 55		
	Cutthroat trout (13)	207, 140, 158, 111, 32, 92, 80, 89, 82, 66, 87, 90, 75		
Sep-03	Torrent sculpin (2)	64,61		
	Cutthroat trout (32)	51,169,52,60,54,50,64,50,58,107,118,110,129,50,69,55, 53,111,136,90,119,116,102,131,104,101,53,112,107,101, 91,83		
North Fork Mica Creek				
Sep-02	Torrent sculpin (22)	70, 71, 82, 83, 42, 62, 79, 76, 102, 75, 67, 36, 43, 43, 38, 69, 65, 38, 40, 66, 75, 92	Rearing, spawning, migration. Pools, riffles, glides. Pasture, low gradient.	Fine (10%); Pebble (89%); Cobble (1%); Boulder (0%)
	Cutthroat trout (55)	152, 126, 65, 132, 66, 74, 58, 66, 139, 79, 122, 73, 71, 62, 65, 57, 71, 69, 64, 72, 58, 59, 63, 56, 59, 61, 62, 48, 59, 74, 63, 50, 54, 58, 64, 60, 59, 63, 77, 62, 62, 64, 60, 60, 62, 61, 61, 61, 59, 128, 156, 177, 152, 59, 195		
Jun-03	Torrent sculpin (16)	81, 50, 56, 57, 48, 57, 61, 52, 53, 60, 57, 91, 50, 67, 58, 86		Fine (22%); Pebble (75%); Cobble (2%); Boulder (0%)
	Cutthroat trout (13)	23, 38, 106, 35, 31, 170, 101, 108, 124, 108, 105, 106, 34		
Sep-03	Torrent sculpin (26)	66,72,68,45,69,82,66,84,79,73,105,66,66,65,32,66,75,63, 70,66,71,67,65,71,70,67		Fine (23%); Pebble (77%); Cobble (0%); Boulder (0%)
	Cutthroat trout (42)	220,77,75,119,115,73,68,83,75,151,124,116,125,112,145, 128,131,94,74,120,133,49,91,80,114,112,99,98,96,60, 107,55,66,66,61,75,67,59,61,63,71		

Substrate proportions represent an average of data from Wolman Pebble Counts at both wetted width riffles (Fine = <6mm; Pebble = 6.1-64mm; Cobble = 64.1-256mm; Boulder = >256)

[1] - All sample collections made with a backpack electroshocker.
September 2002: MS = 610 seconds; SF1 = 538 seconds; SF2 = 581 seconds; SF3 = 567 seconds; USF = 352 seconds; NF = 742 seconds
June 2003: MS = 398 seconds; SF1 = 408 seconds; SF2 = 530 seconds; SF3 = 466 seconds; USF = 298 seconds; NF = 650 seconds
September 2003: MS = 339 seconds; SF1 = 395 seconds, SF2 = 458 seconds; SF3 = 441 seconds; USF = 224 seconds; NF = 550 seconds

TABLE 8-16
Fish Sampling Summary for Mica Creek (Summary September 2002, June 2003, September 2002)
US Highway 95 Bellgrove to Mica

Mica Creek - Stream Location	Sample Date	Species Abundance				# Sculpin Age Classes	# Salmonid Age Classes	Stream Reach Length (ft)	Number of Seconds Electroshocking	Catch per Unit Effort (fish/min)	SFI-Forest
		Torrent Sculpin	Cutthroat Trout	Small Mouth Bass	Brown Trout						
Mainstem	Sept 02	23	1	0	0	3	1	394	610	2.4	69
	Jun 03	12	3	0	0	3	3	480	398	2.3	76
	Sept 03	17	1	3	0	4	1	480	339	3.7	60
	Average	**17**	**2**	**1**	**0**	**3**	**2**	-	**449**	**2.8**	**68**
South Fork Site 1	Sept 02	12	23	0	0	2	3	262	538	3.9	87
	Jun 03	17	9	0	0	2	2	320	408	3.8	80
	Sept 03	9	26	0	0	3	3	320	395	5.3	95
	Average	**13**	**19**	**0**	**0**	**2**	**3**	-	**447**	**4.3**	**87**
South Fork Site 2	Sept 02	9	62	0	0	3	3	394	581	7.3	95
	Jun 03	9	27	0	0	3	5	280	530	4.1	91
	Sept 03	9	72	0	0	3	4	280	458	10.6	95
	Average	**9**	**54**	**0**	**0**	**3**	**4**	-	**523**	**7.3**	**94**
South Fork Site 3	Sept 02	4	82	0	0	2	3	394	567	9.1	87
	Jun 03	5	18	0	1	0	4	320	466	3.0	72
	Sept 03	2	49	0	0	2	3	320	441	6.9	87
	Average	**4**	**50**	**0**	**0**	**1**	**3**	-	**491**	**6.3**	**82**
Upper South Fork	Sept 02	10	33	0	0	3	5	262	352	7.3	96
	Jun 03	5	13	0	0	3	5	240	298	3.6	93
	Sept 03	2	32	0	0	1	3	240	224	9.1	84
	Average	**6**	**26**	**0**	**0**	**2**	**4**	-	**291**	**6.7**	**91**
North Fork	Sept 02	22	55	0	0	3	5	394	742	6.2	96
	Jun 03	16	13	0	0	2	3	400	650	2.7	76
	Sept 03	26	42	0	0	5	4	400	550	7.4	98
	Average	**21**	**37**	**0**	**0**	**3**	**4**	-	**647**	**5.4**	**90**

South Fork Mica Creek Site 2 (SF2). Stream conditions observed at SF2 riffles were similar to those observed at SF1 riffles with respect to riffle 1 containing on average more smaller substrate (6 millimeter size or less) than riffle 2, 22 percent and 13 percent, respectively. However, both riffles contained a similar mixture of coarser substrate, pebbles, cobbles, and boulders. Fish habitat included pool and riffle areas however, there was an absence of woody debris and undercut banks.

Stream conditions at Site SF2 appear to provide favorable habitat for cutthroat trout with an average of 54 individuals ranging in size from 22 to 192 millimeter comprising up to five age classes. This was the highest average number of cutthroat trout collected at any of the sites. Torrent sculpin lengths ranged between 34 and 111 millimeter from an average of nine that were captured. These nine sculpins encompassed three age classes. The average SFI score for Site SF2 is 94. This score is conventionally considered to indicate no impairment.

South Fork Mica Creek Site 3 (SF3). Stream substrate at SF3 riffles was similar to that observed at Site SF2 with smaller substrate (6 millimeter size or smaller) making up an average of 23 percent and 18 percent, respectively. With a better diversity of larger substrate consisting of pebbles, cobbles, and boulders, much of the larger substrate was angular in nature and appeared to be anthropogenic in nature. The gradient of this site was higher than the others with the habitat consisting primarily of cascades; however, two pools and two short riffle areas were present.

Fish community structure at SF3 was not as diverse as SF1 or SF2 with only an average of four torrent sculpins being collected ranging in size from 36 millimeter to 84 millimeter and being comprised of two age classes. It should be noted that no sculpins were collected during the June 2003 sampling event. An average of 50 cutthroat trout were captured and varied in length between 33 and 177 millimeter from three to four age classes. The average SFI score was 82 and is conventionally considered to indicate no impairment. An ASFI score lower than Sites SF1 and SF2 is likely attributable to the low abundance of sculpins being captured although sculpins of two age classes were collected during two sampling events. Sculpin are sometimes difficult to capture during electrofishing due to their benthic nature and cryptic coloration. When electroshocked, sculpins remain on the bottom of the stream unlike many trout and because their coloration is sometimes not observed.

Upper South Fork Mica Creek (USF). Stream substrate and fish habitat conditions are similar to those typically seen in a forested environment with little recent human influence, in that habitat complexity is moderate to high with overhead cover, undercut banks, and some LWD presence. Small substrate (6 millimeter size or less) made up smaller proportions of the substrate. Larger substrate was composed of primarily pebble and cobble size material.

An average of 26 cutthroat trout were captured when combining the three events. The cutthroat trout ranged in length from 32 to 207 millimeter in length and comprised three to five age classes. Six torrent sculpin on average were collected at this site from one to three age classes depending on the event. Sizes ranged from 54 millimeter and 112 millimeter in length. The calculated average SFI score was 91. Again, this score is conventionally considered to indicate good conditions or no impairment. As with Site SF3, a lower average SFI score than Site SF2 is likely attributable to the low abundance of sculpins captured. This reach of the stream is smaller than at downstream sites but the habitat diversity and complexity are higher. However, because it is a smaller stream the pools are not as deep or large.

North Fork Mica Creek (NF). Stream substrate and fish habitat conditions are similar to those described for SF1, in that habitat complexity is lower than at other sites with the exception of site MS, and there is minimal overhead cover. This portion of the creek and adjacent floodplain receives active grazing. The riffle substrate is composed of primarily pebbles with glide and pools areas dominated by sand and fine pebbles. Small substrate (6 millimeter size or less) made up 21 percent and 17 percent of riffle substrate on average across the three sampling events at riffles 1 and 2 respectively. The 2-year floodplain in this area is relatively wide with sections of anastomosed channel (multiple thread channel with various channel widths).

There was a more even distribution between the average number of cutthroat trout and torrent sculpin that were captured, 37 and 21, respectively. The cutthroat trout that were captured ranged from 23 millimeter to 220 millimeter in length and composed of up to five age classes depending on the event. The torrent sculpins ranged in size from 32 millimeter to 105 millimeter in length and represented up to five age classes depending on the event. The calculated SFI score was 90.

8.3.3.3 Mica Creek SFI Upstream Versus Downstream Comparison

Based on the average of three sample events, the SFI ratings for the South Fork Mica Creek were similar between upstream and downstream sample sites. However, the Mica Creek site (MS) had a significantly lower average SFI than all of the other sites. SFI scores for all South Fork and North Fork Mica Creek sites are at least good and do not show signs of impairment. The Mica Creek mainstem site showed impairment of the fish community (average SFI rating of 68). The SFI is determined by evaluating specific metrics including the number of cold water native species present, the number of age classes present, the number of non-native species at the site, and percent tolerant individuals. The depressed SFI score is primarily due to three factors: 1) the limited number of cutthroat trout abundance and age classes throughout the three events, 2) the presence of smallmouth bass being captured at the site, and 3) the degraded habitat at the site. All sites had multiple age classes of cutthroat trout present indicating a good stable age structure with the exception of the Mica Creek site where multiple age classes were present during one sampling event only. All sites contained multiple age classes of torrent sculpins with the exception of the upper South Fork Mica Creek site during one event (only two torrent sculpin were captured and were determined to be of the same age class). Cutthroat trout are lithophylic (gravel) spawners. While torrent sculpins are cavity nesters but both require unembedded gravel for spawning. Therefore, multiple age class presence is an indicator of successful spawning and incubation and that adequate spawning gravel is present.

Mica Creek is a cold water mountain stream and is expected to have much lower species richness than would cool or warm water systems. The least disturbed Western streams have a nearly universal cold water-adapted fish assemblage that includes salmonids (*Oncorhynchus/Salvelinus* sp.), sculpin (*Cottus* sp.), sucker (*Catostomus* sp.), and dace (*Rhinichthys* sp.). As these cold water systems are degraded, species richness often increases. AS cold water habitat declines, their habitats become vulnerable to invasion by facultative cool water native species or nonindigenous species.(IDEQ, 2002). Although there were only two species of fish found at any of the South Fork Mica Creek sites, the numbers of fish sampled and multiple age classes being present at downstream versus upstream sites indicates the project had little long-term effect on the fish communities if it had any effect on them at all. Sampling for fish on Mica Creek yielded the lowest abundance (19 on average) of fish as compared to the other sites. This low abundance of fish is likely attributed to degraded habitat conditions (sloughing banks, channelization, limited undercut bank areas, and lack of large woody debris) and lack of habitat diversity. However, the USF site (reference site) only yielded 32 fish on average. The highest number of fish collected at any of the stations during any of the events occurred at Site SF2 during the September 2003 event where 81 fish were collected, 72 of which were cutthroat trout. The SF2 site contains good habitat diversity, overhead cover, undercut banks, and instream structure which contributes to the high abundance of fish encountered at this site. While other South Fork sites contain these habitat characteristics they are not contained in the same proportions as at SF2. The SF2 site received the highest average SFI rating (94) followed closely by USF, NF, and SF1 with average SFI scores of 91, 90, and 87, respectively. Sites SF3 and MS followed with average SFI scores of 82 and 68, respectively.

The low fish numbers at the MS would be expected to some extent as there is little instream structure at this site. In addition, channelization along with the low gradient of the area are also likely causes. Riffle areas are significant food-producing areas and provide habitat diversity and increase habitat complexity, thereby increasing the productive capability and stability of the community. Therefore, the greater abundance of fish and relative species distribution at upstream sites is likely because of increased habitat availability, complexity, diversity, stability, and food production capability.

Sculpins are typically sedentary fish with some species having home ranges of 150 to 500 feet making them good indicators of recent (last few years) environmental stress (IDEQ, 2002a). The number of sculpin age classes tend to decline with increasing proportions of fine sediment (IDEQ 2002a). All sites had multiple sculpin age classes indicating that sediment from the Project has not adversely impacted the South Fork or Mica creeks.

Kokanee salmon are known to use (Zaroban, 2004) and have been observed using Mica Creek and its tributaries. Resident kokanee salmon from Coeur d'Alene Lake were observed in the lower South Fork and North Forks of Mica Creek on December 15, 2003 (Miller, 2003). Twenty-four fish total were observed (20 in the lower South Fork and four in the lower North Fork Mica Creeks); however, there could have been more in the area that were not observed. The kokanee salmon were waiting to or had already spawned as evidenced by their red spawning coloration (Miller, 2003). It is likely that some resident fishes in Coeur d'Alene Lake use tributaries such as Mica Creek for spawning, holding, or potential limited rearing during different times of the year. Evidence that lake species utilize the Mica Creek system stems from the collection of three smallmouth bass at the Site MS during the September 2003 sampling event (Figure 8-5) (CH2M HILL 2003a).

8.3.4 Macroinvertebrate Assessment of South Fork and North Fork Mica Creek and Mica Creek

8.3.4.1 Stream Macroinvertebrate Index (SMI) Comparison

This section provides the SMI for each of the sample locations in the Mica Creek watershed averaged over the three sampling events. The overall SMI score was calculated by averaging the individual metrics for each of the three sampling events and then calculating the overall SMI score for each site. The top five taxa overall at each site was calculated by summing the abundance of each individual taxa over the three sampling events and determining, based on abundance, the five most dominant taxa. Macroinvertebrate biological communities in Mica Creek are discussed relative to habitat type (pool and riffle), and by upstream and downstream communities (upstream and downstream of the project area). The upstream South Fork Mica Creek (USF) is being used as a reference site for downstream areas. In addition, the North Fork Mica Creek macroinvertebrate biological community is provided as an additional comparison, or reference site, relative to the sites downstream of the project on the South Fork Mica Creek and Mica Creek. Summary data for the sampled macroinvertebrates are provided in Tables 8-17 and 8-18. Tables 8-19 through 8-24 detail, over the three sampling events, the Wolman pebble count results for each riffle site, Table 8-25 details the results of LWD observations in riffle areas, and Table 8-26 lists the canopy closure measured in riffle areas.

Northern Mountains Ecoregion. Table 8-9 provides values for individual metrics that would be considered as an indicator of good conditions for each individual metric (taxa richness, percent *plecoptera* (stoneflies), clinger taxa etc.). With the exception of the HBI and percent 5 dominant taxa metrics, a lower metric score than provided in Table 8-9 could show impairment. The level of impairment, if any, is dependent upon how low the metric score is as compared to the value in Table 8-9. Metric scores higher than the values in Table 8-9 for HBI and percent 5 dominant taxa could indicate impairment dependent upon how much higher the score is than that provided in Table 8-9. Looking at all nine metric scores individually as well as together can provide insights to the overall assessment of the conditions for the macroinvertebrate community at that site.

Mica Creek Pool SMI Results. For the most part, site NF had the lowest average metric scores of all sites indicating poor conditions relative to the other sites. Sites MS and SF1 had slightly higher average metric scores than NF also indicating degrading conditions relative to more upstream South Fork pool sites. Site NF received the lowest score on all but two metrics calculated followed by Sites SF1, MS, and USF. Overall, Site NF was primarily composed of individuals from the five dominant taxa, 80 percent followed by Sites SF1 and MS, which were composed of 72 and 70 percent, respectively, from the five dominant taxa. The majority of these taxa at these sites (NF, SF1, and MS) are tolerant to sediment and or organic enrichment as shown by the HBI scores of 6.5 for all three sites. Sites SF2, SF3, and USF all scored similarly on individual metrics, which was higher than the other sites, thereby suggesting that these sites had better conditions for macroinvertebrate communities during this sampling event (Tables 8-17 and 8-18). The dominant taxa at each site are shown in Tables 8-27 and 8-28. A FSBI score was not calculated for pool samples because pools typically have substrates that are dominated by sand and fine sediment. Therefore, most taxa found in pools would typically be expected to be somewhat tolerant of fine sediment so a FSBI score would not necessarily demonstrate a potential degraded condition.

Mica Creek Riffle SMI Metric Results. The riffle samples metric scores were generally higher than the pool sample metric scores with all sites being considered as providing better habitat conditions with the exception of Site NF which had average metric SMI scores similar to that of pools indicating poorer, more degraded conditions (Tables 8-17 and 8-18). Analysis of averaged individual metrics indicates that Site NF site scored the worst on almost all metrics when compared to the other sites including having the lowest averaged FSBI score (76). Site NF contained the fewest taxa overall having 70 percent of the sample being composed of five taxa. Most of the taxa are tolerant to sediment and organic enrichment as shown by the HBI score (6.2). The dominant taxa at each site are shown in Tables 8-27 and 8-28.

With the exception of Site NF, averaged FSBI scores from all of the South Fork and the mainstem site ranged from 90 at Site SF3 to 117 for Site USF (Table 8-29). High FSBI scores suggest low fine sediment amounts at the site whereas low FSBI scores suggest high fine sediment amounts at the site. All sites contained taxa that were either moderately tolerant or tolerant to fine sediment but also contained taxa that were intolerant to sediment using taxa with derived FSBI scores. Eighty percent of the organisms in 23 different taxa from Site SF1 were moderately tolerant or tolerant to fine sediment. Site SF3 was slightly less, 77 percent, over 27 different taxa. The lowest proportion of a sample, 57 percent, over 20 different taxa was at Site MS. The proportion of the organisms at Site USF that were moderately tolerant or tolerant to fine sediment was 69 percent in 26 different taxa. The number of taxa and the proportion of the sample those organisms made up are provided in Table 8-29.

All stations also contained taxa that, by FSBI methods, are intolerant or moderately intolerant to fine sediment. Site MS had nine different taxa comprising 21 percent of the total abundance that are moderately intolerant or intolerant to fine sediment. This station was followed by Site SF2 and NF with 12 percent of the sample distributed among 10 to 13 different taxa, respectively, which were moderately intolerant or intolerant to fine sediment. The site with the lowest proportion of moderately intolerant or intolerant taxa was Site SF1 with only 6 percent among 10 taxa. All sites contained one taxa that is considered intolerant to fine sediment with the exception of Site SF3, which contained two taxa that are intolerant to fine sediment (Table 8-29).

8.3.4.2 Macroinvertebrate Statistical Analyses

This section summarizes additional statistical evaluations of collected data from macroinvertebrate sampling sites at the six locations within Mica Creek (Figure 8-5). The statistical evaluation begins with an introductory description of the structure of available biological and sediment pebble count measures collected over the three events: September 2002 and June and September 2003. Seven technical subsections follow that discuss and evaluate sediment structure; counts of biological taxa encountered and individual organisms collected; counts of taxa and individuals, when aggregated by ecological factors; distribution of individual counts over stations and events; comparisons across community diversity indices; agglomerative clustering of station-habitat combinations by species and comparisons among field duplicates.

This section describes available data, followed by brief descriptions of the statistical methods applied and the graphical displays used. This results section summarizes graphical and tabular results compiled found in Appendix N. The final section interprets and summarizes results and salient features observable in the graphical.

Statistical software used includes S+ (distributed by Insightful Corporation, Seattle, Washington), SYSTAT 10 [distributed by SPSS Inc, Chicago, Illinois) and pcORD [MjM Software Design, Gleneden Beach, Oregon). Agglomerative clustering algorithms used in the analysis are documented in: *Analysis of Ecological Communities*, B. McCune and J.B. Grace Mefford (MjM Software, 2002).

TABLE 8-17
Benthic Macroinvertebrate Bioassessment Scoring Summary of All Sampling Events – Pool Northern Mountain Ecoregion
US Highway 95 Bellgrove to Mica

Metrics	Metric Value					
	Mica Creek	South Fork Site 1	South Fork Site 2	South Fork Site 3	Upper South Fork	North Fork
Taxa Richness	40.0	35.7	42.0	46.3	39.7	31.0
Mayfly Richness	7.0	4.3	6.7	6.3	5.0	3.0
Stonefly Richness	3.0	3.3	4.0	2.7	3.0	0.7
Caddisfly Richness	4.7	4.0	5.7	7.3	7.7	4.3
% Plecoptera	1.8	3.9	2.1	1.1	3.5	0.8
Hilsenhoff Biotic Index	6.5	6.5	5.6	5.9	5.4	6.5
Scrapper Taxa	0.7	0.3	0.7	0.7	0.3	0.0
Clinger Taxa	15.3	12.0	20.0	22.0	18.3	8.7
% 5 Dominant	69.8	71.8	64.4	66.5	56.8	80.4

TABLE 8-18
Benthic Macroinvertebrate Bioassessment Scoring Summary of All Sampling Events – Riffle Northern Mountain Ecoregion
US Highway 95 Bellgrove to Mica

Metrics	Metric Value					
	Mica Creek	South Fork Site 1	South Fork Site 2	South Fork Site 3	Upper South Fork	North Fork
Taxa Richness	42.3	42.3	43.0	39.7	44.3	31.3
Mayfly Richness	6.0	7.7	8.0	7.7	7.3	5.0
Stonefly Richness	5.0	4.0	4.7	3.3	4.7	2.3
Caddisfly Richness	6.3	6.7	6.3	7.3	10.3	4.7

TABLE 8-18
Benthic Macroinvertebrate Bioassessment Scoring Summary of All Sampling Events – Riffle Northern Mountain Ecoregion
US Highway 95 Bellgrove to Mica

Metrics	Metric Value					
	Mica Creek	South Fork Site 1	South Fork Site 2	South Fork Site 3	Upper South Fork	North Fork
% Plecoptera	2.2	3.4	4.3	5.5	6.6	2.1
Hilsenhoff Biotic Index	6.0	6.0	5.6	5.7	5.1	6.2
Scrapper Taxa	0.7	0.7	0.3	0.3	0.3	0.7
Clinger Taxa	18.3	22.0	23.3	20.7	24.7	16.0
% 5 Dominant	71.2	73.6	63.1	62.3	57.3	84.2
Fine Sediment Biotic Index[a]	94.7	101.3	95.3	90.0	116.7	76.0

[a] Fine Sediment Biotic Index (FSBI) based on Relyea et al., 2000. The FSBI score is not used in the overall calculation of the Bioassessment Score.

TABLE 8-18
Benthic Macroinvertebrate Bioassessment Scoring Summary of All Sampling Events – Riffle Northern Mountain Ecoregion
US Highway 95 Bellgrove to Mica

Metrics	Metric Value					
	Mica Creek	South Fork Site 1	South Fork Site 2	South Fork Site 3	Upper South Fork	North Fork
% Plecoptera	2.2	3.4	4.3	5.5	6.6	2.1
Hilsenhoff Biotic Index	6.0	6.0	5.6	5.7	5.1	6.2
Scrapper Taxa	0.7	0.7	0.3	0.3	0.3	0.7
Clinger Taxa	18.3	22.0	23.3	20.7	24.7	16.0
% 5 Dominant	71.2	73.6	63.1	62.3	57.3	84.2
Fine Sediment Biotic Index[a]	94.7	101.3	95.3	90.0	116.7	76.0

[a] Fine Sediment Biotic Index (FSBI) based on Relyea et al., 2000. The FSBI score is not used in the overall calculation of the Bioassessment Score.

TABLE 8-19
Wolman Pebble Count Mica Creek, Mainstem (MS) Summary
U.S. 95 Bellgrove to Mica, Idaho

		Riffle 1												Riffle 2											
		Within Wetted			Substrate %			Outside Wetted			Substrate %			Within Wetted			Substrate %			Outside Wetted			Substrate %		
Substrate	Substrate Size	Sep-02	Jun-03[1]	Sep-03[1]	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03
Silt/Clay	0-1 mm	0	0	0	0	0	0	0	1	0	0	1	0	0	-	-	0	N/A	N/A	0	-	-	0	N/A	N/A
Sand	1.1-2.5 mm	3	6	14	6	11	15	0	25	42	0	37	53	2	-	-	4	N/A	N/A	12	-	-	24	N/A	N/A
Very Fine Pebble	2.51-6 mm	1	2	4	2	4	4	8	1	0	16	1	0	1	-	-	2	N/A	N/A	0	-	-	0	N/A	N/A
SUBTOTAL		4	8	18	8	15	20	8	27	42	16	40	53	3	-	-	6	N/A	N/A	12	-	-	24	N/A	N/A
Pebble	6.1-15 mm	2	2	5	4	4	5	0	5	0	0	7	0	0	-	-	0	N/A	N/A	0	-	-	0	N/A	N/A
Coarse Pebble	15.1-31 mm	1	1	4	2	2	4	9	4	3	18	6	4	6	-	-	12	N/A	N/A	6	-	-	12	N/A	N/A
Very Coarse Pebble	31.1-64 mm	13	9	10	26	17	11	11	12	9	22	18	11	13	-	-	26	N/A	N/A	9	-	-	18	N/A	N/A
Small Cobble	64.1-128 mm	11	21	28	22	39	31	16	12	12	32	18	15	24	-	-	48	N/A	N/A	16	-	-	32	N/A	N/A
Large Cobble	128.1-256 mm	15	11	18	30	20	20	5	6	12	10	9	15	2	-	-	4	N/A	N/A	6	-	-	12	N/A	N/A
Small Boulder	256.1-512 mm	4	2	6	8	4	7	0	1	1	0	1	1	2	-	-	4	N/A	N/A	1	-	-	2	N/A	N/A
Medium Boulder	512.1-1024 mm	0	0	2	0	0	2	0	0	0	0	0	0	0	-	-	0	N/A	N/A	0	-	-	0	N/A	N/A
Large Boulder	+1024.1 mm	0	0	0	0	0	0	1	0	0	2	0	0	0	-	-	0	N/A	N/A	0	-	-	0	N/A	N/A
TOTAL		50	54	91	100	100	100	50	67	79	100	100	100	50	-	-	100	N/A	N/A	50	0	0	100	N/A	N/A

[1] - Riffle #1 long: 25 - 30m. Only riffle present. Much columnar basalt.

TABLE 8-20
Wolman Pebble Count South Fork Mica Creek Site 1 (SF1) Summary
U.S. 95 Bellgrove to Mica, Idaho

		Riffle 1												Riffle 2											
		Within Wetted			Substrate %			Outside Wetted			Substrate %			Within Wetted			Substrate %			Outside Wetted[2]			Substrate %		
Substrate	Substrate Size	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03	Sep-02[1]	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03
Silt/Clay	0-1 mm	0	0	0	0	0	0	6	-	-	12	N/A	N/A	3	2	0	6	3	0	4	-	-	8	N/A	N/A
Sand	1.1-2.5 mm	4	15	4	8	28	7	0	-	-	0	N/A	N/A	3	9	4	6	12	7	9	-	-	18	N/A	N/A
Very Fine Pebble	2.51-6 mm	8	13	17	16	25	30	7	-	-	14	N/A	N/A	3	3	4	6	4	7	2	-	-	4	N/A	N/A
SUBTOTAL		12	28	21	24	53	38	13	-	-	26	N/A	N/A	9	14	8	18	19	14	15	-	-	30	N/A	N/A
Pebble	6.1-15 mm	22	14	24	44	26	43	23	-	-	46	N/A	N/A	7	8	11	14	11	19	0	-	-	0	N/A	N/A
Coarse Pebble	15.1-31 mm	6	5	4	12	9	7	6	-	-	12	N/A	N/A	6	10	6	12	14	10	2	-	-	4	N/A	N/A
Very Coarse Pebble	31.1-64 mm	9	1	1	18	2	2	8	-	-	16	N/A	N/A	5	8	7	10	11	12	4	-	-	8	N/A	N/A
Small Cobble	64.1-128 mm	1	4	5	2	8	9	0	-	-	0	N/A	N/A	8	13	11	16	18	19	8	-	-	16	N/A	N/A
Large Cobble	128.1-256 mm	0	1	1	0	2	2	0	-	-	0	N/A	N/A	11	15	9	22	20	16	8	-	-	16	N/A	N/A
Small Boulder	256.1-512 mm	0	0	0	0	0	0	0	-	-	0	N/A	N/A	3	3	6	6	4	10	1	-	-	2	N/A	N/A
Medium Boulder	512.1-1024 mm	0	0	0	0	0	0	0	-	-	0	N/A	N/A	0	1	0	0	1	0	1	-	-	2	N/A	N/A
Large Boulder	+1024.1 mm	0	0	0	0	0	0	0	-	-	0	N/A	N/A	1	2	0	2	3	0	11	-	-	22	N/A	N/A
TOTAL		50	53	56	100	100	100	50	-	-	100	N/A	N/A	50	74	58	100	100	100	50	-	-	100	N/A	N/A

[1] - Large Boulder Is Bedrock
[2] - Large Boulder Includes 7 Bedrock Counts

TABLE 8-21
Wolman Pebble Count South Fork Mica Creek Site 2 (SF2) Summary
U.S. 95 Bellgrove to Mica, Idaho

		Riffle 1											
		Within Wetted			Substrate %			Outside Wetted			Substrate %		
Substrate[5]	Substrate Size	Sep-02[1]	Jun-03[4]	Sep-03	Sep-02	Jun-03	Sep-03	Sep-02[2]	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03
Silt/Clay	0-1 mm	0	1	0	0	2	0	-	-	-	N/A	N/A	N/A
Sand	1.1-2.5 mm	2	7	10	4	11	18	-	-	-	N/A	N/A	N/A
Very Fine Pebble	2.51-6 mm	7	6	4	14	10	7	-	-	-	N/A	N/A	N/A
SUBTOTAL		9	14	14	18	22	25	-	-	-	N/A	N/A	N/A
Pebble	6.1-15 mm	4	5	4	8	8	7	-	-	-	N/A	N/A	N/A
Coarse Pebble	15.1-31 mm	0	13	6	0	21	11	-	-	-	N/A	N/A	N/A
Very Coarse Pebble	31.1-64 mm	3	6	7	6	10	13	-	-	-	N/A	N/A	N/A
Small Cobble	64.1-128 mm	14	10	6	28	16	11	-	-	-	N/A	N/A	N/A
Large Cobble	128.1-256 mm	11	7	10	22	11	18	-	-	-	N/A	N/A	N/A
Small Boulder	256.1-512 mm	2	6	6	4	10	11	-	-	-	N/A	N/A	N/A
Medium Boulder	512.1-1024 mm	3	1	2	6	2	4	-	-	-	N/A	N/A	N/A
Large Boulder	+1024.1 mm	4	1	1	8	2	2	-	-	-	N/A	N/A	N/A
TOTAL		50	63	56	100	100	100	-	-	-	N/A	N/A	N/A

		Riffle 2											
		Within Wetted			Substrate %			Outside Wetted[2]			Substrate %		
Substrate[5]	Substrate Size	Sep-02[3]	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03
Silt/Clay	0-1 mm	0	0	0	0	0	0	7	-	-	14	N/A	N/A
Sand	1.1-2.5 mm	5	2	3	10	4	5	1	-	-	2	N/A	N/A
Very Fine Pebble	2.51-6 mm	4	1	6	8	2	10	1	-	-	2	N/A	N/A
SUBTOTAL		9	3	9	18	5	15	9	-	-	18	N/A	N/A
Pebble	6.1-15 mm	8	3	0	16	5	0	2	-	-	4	N/A	N/A
Coarse Pebble	15.1-31 mm	6	7	5	12	13	8	2	-	-	4	N/A	N/A
Very Coarse Pebble	31.1-64 mm	3	8	8	6	15	14	14	-	-	28	N/A	N/A
Small Cobble	64.1-128 mm	12	9	8	24	16	14	16	-	-	32	N/A	N/A
Large Cobble	128.1-256 mm	6	14	15	12	25	25	7	-	-	14	N/A	N/A
Small Boulder	256.1-512 mm	1	6	10	2	11	17	0	-	-	0	N/A	N/A
Medium Boulder	512.1-1024 mm	1	2	2	2	4	3	0	-	-	0	N/A	N/A
Large Boulder	+1024.1 mm	4	3	2	8	5	3	0	-	-	0	N/A	N/A
TOTAL		50	55	59	100	100	100	50	-	-	100	N/A	N/A

1 - Large Boulder Includes 1 Bedrock Count
2 - Vegetation Too Dense to Conduct Count
3 - Large Boulder Includes 1 Bedrock Count
4 - Riffle #1 is separated by a very large boulder so have two channels. Wolman in both channels
5 - Riffle #1 and #2 have large rip rap in the channel from the road

TABLE 8-22
Wolman Pebble Count South Fork Mica Creek Site 3 (SF3) Summary
U.S. 95 Bellgrove to Mica, Idaho

		Riffle 1												Riffle 2											
		Within Wetted			Substrate %			Outside Wetted			Substrate %			Within Wetted			Substrate %			Outside Wetted[2]			Substrate %		
Substrate[1]	Substrate Size	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03
Silt/Clay	0-1 mm	0	0	0	0	0	0	-	-	-	N/A	N/A	N/A	0	0	0	0	0	0	-	-	-	N/A	N/A	N/A
Sand	1.1-2.5 mm	6	12	8	12	22	14	-	-	-	N/A	N/A	N/A	4	11	6	8	18	9	-	-	-	N/A	N/A	N/A
Very Fine Pebble	2.51-6 mm	1	4	6	2	7	11	-	-	-	N/A	N/A	N/A	3	1	7	6	2	10	-	-	-	N/A	N/A	N/A
SUBTOTAL		**7**	**16**	**14**	**14**	**30**	**25**	**-**	**-**	**-**	**N/A**	**N/A**	**N/A**	**7**	**12**	**13**	**14**	**20**	**19**	**-**	**-**	**-**	**N/A**	**N/A**	**N/A**
Pebble	6.1-15 mm	3	3	5	6	6	9	-	-	-	N/A	N/A	N/A	3	3	4	6	5	6	-	-	-	N/A	N/A	N/A
Coarse Pebble	15.1-31 mm	1	6	7	2	11	12	-	-	-	N/A	N/A	N/A	4	4	8	8	7	12	-	-	-	N/A	N/A	N/A
Very Coarse Pebble	31.1-64 mm	0	2	3	0	4	5	-	-	-	N/A	N/A	N/A	4	2	13	8	3	19	-	-	-	N/A	N/A	N/A
Small Cobble	64.1-128 mm	3	6	7	6	11	12	-	-	-	N/A	N/A	N/A	6	10	3	12	16	4	-	-	-	N/A	N/A	N/A
Large Cobble	128.1-256 mm	4	9	13	8	17	23	-	-	-	N/A	N/A	N/A	10	21	13	20	34	19	-	-	-	N/A	N/A	N/A
Small Boulder	256.1-512 mm	0	8	5	0	15	9	-	-	-	N/A	N/A	N/A	0	8	6	0	13	9	-	-	-	N/A	N/A	N/A
Medium Boulder	512.1-1024 mm	0	1	2	0	2	4	-	-	-	N/A	N/A	N/A	2	1	4	4	2	6	-	-	-	N/A	N/A	N/A
Large Boulder	+1024.1 mm	32	3	1	64	6	2	-	-	-	N/A	N/A	N/A	14	0	3	28	0	4	-	-	-	N/A	N/A	N/A
TOTAL		**50**	**54**	**57**	**100**	**100**	**100**	**-**	**-**	**-**	**N/A**	**N/A**	**N/A**	**50**	**61**	**67**	**100**	**100**	**100**	**-**	**-**	**-**	**N/A**	**N/A**	**N/A**

[1] - Lots of rip rap from road

TABLE 8-23
Wolman Pebble Count (September 21, 2002) Upper South Fork Mica Creek (USF) Summary
U.S. 95 Bellgrove to Mica, Idaho

		Riffle 1												Riffle 2											
		Within Wetted			Substrate %			Outside Wetted			Substrate %			Within Wetted			Substrate %			Outside Wetted			Substrate %		
Substrate	Substrate Size	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03[1]	Sep-03	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03
Silt/Clay	0-1 mm	1	0	0	2	0	0	4	0	0	8	0	0	0	0	0	0	0	0	-	0	1	N/A	0	2
Sand	1.1-2.5 mm	2	3	2	4	5	4	5	11		10	28	12	3	1	1	6	2	2	-	14	7	N/A	22	13
Very Fine Pebble	2.51-6 mm	4	3	4	8	5	8	7	3	11	14	8	21	3	4	2	6	7	3	-	8	7	N/A	13	13
SUBTOTAL		**7**	**6**	**6**	**14**	**10**	**11**	**16**	**14**	**17**	**32**	**35**	**33**	**6**	**5**	**3**	**12**	**9**	**5**	**0**	**22**	**15**	**N/A**	**35**	**28**
Pebble	6.1-15 mm	8	12	9	16	21	17	13	7	10	26	18	19	8	15	7	16	27	11	-	20	10	N/A	32	19
Coarse Pebble	15.1-31 mm	14	15	10	28	26	19	16	10	13	32	25	25	14	16	13	28	29	21	-	12	19	N/A	19	36
Very Coarse Pebble	31.1-64 mm	17	13	15	34	22	28	4	8	8	8	20	15	13	12	18	26	21	30	-	9	8	N/A	14	15
Small Cobble	64.1-128 mm	2	11	11	4	19	21	1	1	4	2	3	8	6	2	9	12	4	15	-	0	0	N/A	0	0
Large Cobble	128.1-256 mm	1	1	2	2	2	4	0	0	0	0	0	0	2	3	10	4	5	16	-	0	0	N/A	0	0
Small Boulder	256.1-512 mm	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	2	5	0	-	0	1	N/A	0	2
Medium Boulder	512.1-1024 mm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	-	0	0	N/A	0	0
Large Boulder	+1024.1 mm	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	0	0	N/A	0	0
TOTAL		**50**	**58**	**53**	**100**	**100**	**100**	**50**	**40**	**52**	**100**	**100**	**100**	**50**	**56**	**61**	**100**	**100**	**100**	**0**	**63**	**53**	**N/A**	**100**	**100**

[1] - Riffle #1 outside wetted Wolman count maximum number pebbles measured Short riffle areas

TABLE 8-24
Wolman Pebble Count North Fork Mica Creek (NF) Summary
U.S. 95 Bellgrove to Mica, Idaho

		Riffle 1												Riffle 2											
		Within Wetted			Substrate %			Outside Wetted			Substrate %			Within Wetted			Substrate %			Outside Wetted[2]			Substrate %		
Substrate	**Substrate Size**	Sep-02	Jun-03	Sep-03[2]	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03	Sep-02[1]	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03	Sep-02	Jun-03	Sep-03
Silt/Clay	0-1 mm	1	0	0	2	0	0	4	0	1	8	0	2	0	0	0	0	0	0	1	-	0	2	N/A	0
Sand	1.1-2.5 mm	3	7	6	6	11	9	9	34	34	18	60	53	2	7	5	4	10	10	5	-	10	10	N/A	18
Very Fine Pebble	2.51-6 mm	3	10	9	6	16	14	5	9	10	10	16	16	1	11	4	2	16	8	7	-	6	14	N/A	11
SUBTOTAL		**7**	**17**	**15**	**14**	**27**	**23**	**18**	**43**	**45**	**36**	**75**	**70**	**3**	**18**	**9**	**6**	**26**	**18**	**13**	**-**	**16**	**26**	N/A	**28**
Pebble	6.1-15 mm	14	16	20	28	25	31	11	11	14	22	19	22	6	21	6	12	30	12	8	-	10	16	N/A	18
Coarse Pebble	15.1-31 mm	24	24	27	48	38	42	20	3	5	40	5	8	19	26	15	38	37	30	13	-	19	26	N/A	33
Very Coarse Pebble	31.1-64 mm	5	6	3	10	10	5	1	0	0	2	0	0	21	5	19	42	7	38	16	-	12	32	N/A	21
Small Cobble	64.1-128 mm	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2	0	2	0	-	0	0	N/A	0
Large Cobble	128.1-256 mm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	0	0	N/A	0
Small Boulder	256.1-512 mm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	0	0	N/A	0
Medium Boulder	512.1-1024 mm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	0	0	N/A	0
Large Boulder	+1024.1 mm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	0	0	N/A	0
TOTAL		**50**	**63**	**65**	**100**	**100**	**100**	**50**	**57**	**64**	**100**	**100**	**100**	**50**	**70**	**50**	**100**	**100**	**100**	**50**	**-**	**57**	**100**	N/A	**100**

[1] - Riffle #2 is very braided with micro glides and micro pools interspersed
[2] - Riffle in broad floodplain in pasture with active grazing

TABLE 8-25
Large Woody Debris Abundance Summary for Mica Creek (Summary September 2002, June 2003, September 2003)[1]
US Highway 95 Bellgrove to Mica

Mica Creek Stream Location	Sample Date	Riffle 1	Riffle 2
Mainstem	Sept 02	0	0
	Jun 03	0	0
	Sept 03	0	0
South Fork Site 1	Sept 02	6	7
	Jun 03	7	6
	Sept 03	7	7
South Fork Site 2	Sept 02	0	0
	Jun 03	0	0
	Sept 03	0	0
South Fork Site 3	Sept 02	0	4
	Jun 03	2	1
	Sept 03	0	1
Upper South Fork	Sept 02	3	3
	Jun 03	1	1
	Sept 03	1	0
North Fork	Sept 02	1	0
	Jun 03	3	4
	Sept 03	1	0

[1] - Number of Pieces larger Than 10 cm Diameter and 1 m Length

TABLE 8-26
Summary Canopy Closure at Wolman Pebble Count Riffles Mica Creek
US Highway 95 Bellgrove to Mica

Direction[1]	Mica Creek, Mainstem (MS)[2]	South Fork Mica Creek Site 1 (SF1)	South Fork Mica Creek Site 2 (SF2)	South Fork Mica Creek Site 3 (SF3)	Upper South Fork Mica Creek (USF)	North Fork Mica Creek (NF)[3]
Riffle 1 Canopy Closure (%)[4]						
Left Bank						
Jun-03	100	19	52	71	62	0
Sep-03	94	18	33	89	85	0
Center Up						
Jun-03	97	33	20	53	48	0
Sep-03	50	51	34	19	96	0
Center Down						
Jun-03	98	20	24	35	57	0
Sep-03	55	33	8	51	100	0

TABLE 8-26
Summary Canopy Closure at Wolman Pebble Count Riffles Mica Creek
US Highway 95 Bellgrove to Mica

Direction[1]	Mica Creek, Mainstem (MS)[2]	South Fork Mica Creek Site 1 (SF1)	South Fork Mica Creek Site 2 (SF2)	South Fork Mica Creek Site 3 (SF3)	Upper South Fork Mica Creek (USF)	North Fork Mica Creek (NF)[3]
Right Bank						
Jun-03	70	60	23	72	63	0
Sep-03	8	64	77	12	99	0
Riffle 2 Canopy Closure (%)[4]						
Left Bank						
Jun-03	-	68	10	18	85	63
Sep-03	-	29	15	40	100	0
Center Up						
Jun-03	-	51	49	23	60	59
Sep-03	-	14	43	1	82	0
Center Down						
Jun-03	-	11	3	16	70	55
Sep-03	-	22	9	23	80	0
Right Bank						
Jun-03	-	49	22	35	64	14
Sep-03	-	48	81	28	51	10
Riffle 3 Canopy Closure (%)[4]						
Left Bank						
Jun-03	-	-	-	-	-	0
Sep-03	-	-	-	-	85	-
Center Up						
Jun-03	-	-	-	-	-	0
Sep-03	-	-	-	-	89	-
Center Down						
Jun-03	-	-	-	-	-	0
Sep-03	-	-	-	-	88	-
Right Bank						
Jun-03	-	-	-	-	-	11
Sep-03	-	-	-	-	96	-

[1] - Facing upstream
[2] - Riffle #1 is very long, 25m - 30m. Only riffle present at this site
[3] - Riffle #3 is a field duplicate sample
[4] - Canopy closure was taken during the habitat survey in September 2002 not during the fish and macroinvertebrate sampling

TABLE 8-27
Dominant Taxa – Pool Benthic Macroinvertebrate Summary of All Sampling Events
US Highway 95 Bellgrove to Mica

Mica Creek		North Fork		South Fork Site 1		South Fork Site 2		South Fork Site 3		Upper South Fork	
Taxa	**%**	**Taxa**	**%**	**Taxa**	**%**	**Taxa**	**%**	**Taxa**	**%**	**Taxa**	**%**
Optioservus	34.2	Optioservus	45.1	Optioservus	33.2	Ephemerella	19.4	Ephemerella	19.8	Heterlimnius	15.5
Acari	11.5	Pericoma	6.6	Acari	10	Optioservus	18.2	Optioservus	15.7	Optioservus	10.8
Oreodytes	4.5	Ceratopogoninae	4.5	Tanytarsus	9.6	Cricotopus (Nostococladius)	11.8	Acari	6.1	Hydroptila	9.9
Polypedilum sp.	3.9	Tanytarsus	3.9	Ephemerella	7	Paraleptophlebia	4.8	Hydroptila	5.4	Micrasema	7
Oligochaeta	3.7	Acari	3.7	Ceratopogoninae	5.8	Pericoma	4.2	Serratella tibialis	4.6	Drunella grandis	4.3
Total	**57.8**		**63.8**		**65.6**		**58.4**		**51.6**		**47.5**

TABLE 8-28
Dominant Taxa – Riffle Benthic Macroinvertebrate Summary of All Sampling Events
US Highway 95 Bellgrove to Mica

Mica Creek		North Fork		South Fork Site 1		South Fork Site 2		South Fork Site 3		Upper South Fork		Field Duplicate	
Taxa	**%**	**Taxa**	**%**	**Taxa**	**%**	**Taxa**	**%**	**Taxa**	**%**	**Taxa**	**%**	**Taxa**	**%**
Optioservus	28.5	Optioservus	54.4	Optioservus	44.9	Optioservus	17.7	Hydropsyche	19.9	Heterlimnius	16.5	Optioservus	26.3
Glossosoma	15.9	Cinygmula	6.7	Micrasema	8.3	Baetis tricaudatus	13.1	Serratella tibialis	16.3	Optioservus	10.5	Elmidae	5.8
Simulium	5.5	Elmidae	3	Heterlimnius	3.7	Hydropsyche	10.3	Micrasema	9.9	Tipula	7.3	Cinygmula	5.7
Serratella tibialis	5	Lopescladius	2.9	Serratella tibialis	3.3	Cricotopus (Nostococladius)	6.7	Optioservus	8.8	Micrasema	6.8	Heterlimnius	5
Cleptelmis	4.5	Epeorus longimanus	2.6	Cleptelmis	2.6	Micrasema	3.9	Baetis tricaudatus	4.7	Pericoma	5.8	Ameletus	4.1
Total	**59.4**		**69.6**		**62.8**		**51.7**		**59.6**		**46.9**		**46.9**

TABLE 8-29
Number of Different Taxa in Each FSBI Category by Station and Proportion of Total Abundance for All Sampling Events Mica Creek
US Highway 95 Bellgrove to Mica

FSBI categories	Mica Creek	% of Sample	North Fork	% of Sample	South Fork Site 1	% of Sample	South Fork Site 2	% of Sample	South Fork Site 3	% of Sample	Upper South Fork	% of Sample	Field Duplicate	% of Sample
Intolerant - 8	1	0.16	1	0.12	1	0.84	1	0.62	2	0.26	1	1.31	1	0.84
Moderately Intolerant - 6, 7	8	20.73	12	12.73	9	5.35	8	12.51	9	10.80	10	6.67	13	11.65
Moderately Tolerant - 4, 5	13	12.40	10	9.07	14	24.82	13	40.67	15	57.72	15	47.32	14	26.46
Tolerant - 1, 2, 3	7	44.95	10	59.52	10	54.79	12	24.72	12	19.26	11	21.39	11	36.26
Moderate + Tolerant	**20.0**	**57.3**	**20.0**	**68.6**	**24.0**	**79.6**	**25.0**	**65.4**	**27.0**	**77.0**	**26.0**	**68.7**	**25.0**	**62.7**

[a] Fine Sediment Biotic Index (FSBI) categories based on Relyea et al., 2000.

Description of Available Data. Samples collected and analyzed statistically include physical structure of sediments and macroinvertebrate data. Physical structure of the sediment analysis uses Wolman pebble classification describing the proportion of materials in each of the 11 pebble sizes classes (ranging from 1 to 2, 048 millimeters) (Table 8-7).

Macroinvertebrates were identified to the lowest taxa level feasible and individual organisms counted; providing the two primary measures of taxa counts and individual counts per sample. The taxa have been assigned taxa-specific ecological values taken from the literature or IDEQ databases with respect to: biotic index, 'clinger' status, functional feeding group, and FSBI. Additional community diversity measures have been derived, based on taxa and count per taxa. Aggregate measures provide alternative grouping categories by which spatial distributions can be assessed.

For some measures, sampled locations included riffle and pool habitats. Details as to the specific events and locations and duplicate samples are described in each of the matrix-specific discussions found in the eight subsections. Duplicate samples were collected during each event. However, in order to eliminate adverse 'weighting' of the duplicated station, statistics have been run only on original samples. The detailed assessment of field duplicate variability in the final section provides a context for comparisons among stations and events that have been restricted to the evaluation of original samples.

Sediment Structure Measure Comparisons: Among Stations. Pebble size composition has been reported from Wolman pebble counts taken in one or more riffle areas at each of the six stations at each sampling event (Figure 8-5). Two riffles were sampled per location and event, with two exceptions. First, the two 2003 events resulted in Wolman pebble counts from a single riffle at Site MS because only one riffle was present. Second, third riffle collections were taken at field duplicate macroinvertebrate riffles at reference (upstream stations; NF (September 2002 and June 2003) and USF [September 2003]). Raw data are listed in Appendix N.

Methods. Comparisons of sediment structure size distributions across stations have been explicitly tested using a contingency table Pearson Chi^2 (χ^2) test. The underlying premise of the test is that the relative percentages of records within each size class from any station would be expected to be comparable to the relative counts of total taxa or total numbers of organisms (across all stations) if stations are similarly distributed.

To assist in interpretation of explicit test results, graphical displays are provided, station-specific histograms of percent occurrence over each sediment size class for all stations (pooled) to be compared to the same histograms generated individually for each station (Appendix N).

Results. Graphical displays of sediment physical structure linear traces and boxplots are found in Appendix N.

Interpretation.

- Linear traces across sediment pebble sizes indicate that the sediment structure in samples collected from upstream locations, Sites NF and USF, is comparatively less variable in range of pebble sizes. These stations are represented by a preponderance of mid-size pebbles (31 to 64 millimeters) and comparatively fewer coarser and fewer finer-size pebbles. The traces of sediment structure within these two stations are relatively consistent, as indicated by the distinct patterns and relative overlap of sample-specific traces.

- Linear traces from South Fork Mica Creek stations, Sites SF1, SF2, and SF3, range more widely over the range of size classes. The stations also exhibit comparatively wider variability (noise) in traces from different sampling events. As indicated by the more comparable (and lower percentages) percentages per category, traces for Site SF2 are most homogenous of any of the stations. There are more peaks in the Site SF1 and Site SF3 traces but the size class in which they occur varies from sample to sample.
- Site MS riffle traces exhibit a consistent and fairly strongly bimodal distribution with primary and secondary peaks on the order of 128 millimeters and 2.5 millimeters sized pebbles, respectively.
- The probability of the test statistic from the χ^2 for independence of stations across sediment size classes is less than 0.001, indicating that the particle sizes differ significantly across stations.
- Sites NF and USF profiles are more similar overall, overlapping with the distribution of smaller classes with Site SF1. Site MS is comparatively unique with a slight shift to coarser-size materials. Sites SF2 and SF3 sediments are more uniformly distributed across the range of size classes. Site SF3 has a unique signature in the coarsest size class.

Taxa and Individual Organism Count Comparisons: Among Stations. In samples collected in the study area over the three sampling events conducted since September 2002, 189 unique taxa have been identified. Total counts of individual organisms collected in the macroinvertebrate samples analyzed range between 1 and 5,674 organisms per taxa. The distribution of counts represents an extremely divergent occurrence of individual taxa over the study area and period of monitoring. While taxa divergences are high, station differences on even a coarse scale look quite comparable. For example, Table 8-30 provides station-specific summaries of average taxa and average counts of individual organisms per sample site, pool, and riffle sample taxa summed together per site (excluding duplicates).

TABLE 8-30
Station-Specific Summaries of Average Taxa and Average Counts of Individuals
U.S. 95 Bellgrove to Mica

Gradient: Station ID	Events	Average Taxa Count	Average Individual Count
DOWN: MS	3	82	1,174
DOWN: SF1	3	78	1,199
DOWN: SF2	3	85	1,110
DOWN: SF3	3	86	1,157
UP: NF	3	62	1,107
UP: USF	3	84	1,107

DOWN refers to stations located down gradient (potentially impacted by the project) of the project (SF1, SF2, SF3, and MS).
UP refers to Station up gradient (not impacted by the project) of the project (USF and NF).

In addition to widely discrepant frequencies of occurrence, habitat-scale distributions of the 189 individual taxa differ with respect to the habitats in which they have been found. Fifty of the 189 taxa were found only in pool habitat samples; and 34 taxa were only found in riffle habitat samples; 103 taxa were found in both pool and riffle habitat samples. The final two taxa were observed once (a single individual) in duplicate samples from riffle stations.

Given the habitat-differences in taxa occurrence, count data for individual taxa, and counts of individuals have been evaluated in two distinct ways. First, distributions of taxa and individual organism are evaluated (independent of habitat type), then separately across the three categories of habitat-specific taxa: pool (only), riffle (only), and pool and riffle taxa. Data used in the comparisons of counts for individual taxa and habitat-specific comparisons are found in Appendix N.

Methods. Simple boxplots and non-parametric comparisons using the Kruskal-Wallis test have been used to compare the counts of taxa and individuals found at the six sample locations over the three sampling events. Comparisons have been limited to original (not field duplicate) samples in order to balance results from the same events across stations that were used in the nonparametric comparisons. Inclusion of the field duplicate sample results would have confounded spatial comparisons with any potential temporal differences among samples, seasons, or events.

Results. Boxplot and non-parametric test results comparing station, gradient (upstream or downstream of the project), and event counts of taxa and individuals (all taxa) are provided in Appendix N.

Interpretation

- Overall taxa counts do not differ significantly among the three sampling events. However, the counts of organisms do differ significantly over the thee events with more individuals occurring in the September 2003 event. Counts from June 2003 and September 2002, both significantly lower than the September 2003 counts, are comparable.
- However, the counts of individual organisms do differ significantly over the three events with more individuals occurring in the September 2003 event. Counts from June 2003 and September 2002, both significantly lower than the September 2003 counts, are comparable.
- Counts of taxa (independent of habitat-type) do not differ significantly across gradient (upstream Sites USF and NF or downstream Sites SF1, SF2, SF3, and MS) or across individual stations. While the count of taxa represented at the upgradient Site NF is comparatively lower than other stations, the difference is not statistically significant.
- Counts of individual organisms (independent of habitat-type) do not differ significantly between up and down gradient or among stations. The relative range of counts (variability) over the three events is widest in Site SF2 and least in Sites NF and MS.
- Neither counts of habitat-specific taxa nor counts of habitat-specific organisms differ significantly between up and down gradient station groupings. Probabilities of non-parametric test comparisons range between 0.21 and 0.92 in the six test results listed. The wider range reflects the inclusion of Site NF in the upgradient subgroup which, as noted above, exhibits a lower (but not significantly lower) count of taxa.

- Station-specific differences in the habitat-specific taxa groupings indicate that Site NF differs consistently from most other stations. For example, in the case of pool (only) taxa, counts found in Site NF over the three events are significantly elevated over the remaining locations while the Sites NF counts of taxa found in both pools and riffles vary more widely and are, overall, lower in number than the other locations. In the case of pool and riffle taxa, NF counts are significantly lower than the other stations. Note, however, that the counts of taxa within the pool-only and riffle-only taxa groupings are comparatively lower (ranging between 1 and 11 and 1 and 8, respectively) as compared to the range of 10+ to > 40+ pool and riffle taxa. Results indicate that stations do differ somewhat within the habitat-specific taxa—but that the differences are less apparent when taxa are handled independently of habitat occurrence. This is to be expected and not unusual as typically the habitat specific taxa (pool or riffle only taxa) are adapted to living in one specific habitat, not both.
- The results of tests independent of habitat type and separately across the three categories of habitat-specific taxa: pool (only), riffle (only), and pool and riffle taxa do not indicate adverse project-related effects. Differences that are observed are related to habitat types that would be expected given the difference between pool and riffle habitat types and taxa that are adapted to one or the other.

Aggregated Measure Comparisons: Among Stations. Four aggregate measures have been used to group taxa, including: biotic index (BI), 'clinger' status (CLNGR), functional feeding group (FFG), and fine sediment biotic index (FSBI) (Table 8-31). Appendix N lists the individual taxa occurring over the study area, including the count of observations, a coded label, the taxa name (as reported), along with the IDEQ identifier and habitat designation and the aggregate measures. Aggregate measure responses have different numbers of coded levels, ranging between 2 and 14 codes as shown in Table 8-31. Two of the measures, CLNGR and FSBI have no designations for some species found in the Mica Creek macroinvertebrate community.

TABLE 8-31
Aggregate Codes and Coded Levels
U.S. 95 Bellgrove to Mica

Aggregate Code	Coded Levels
CLNGR (Clinger)	2 Codes: Yes / - (not designated)
FSBI (Fine sediment Biotic Index)	9 Codes: – (not designated) / 1/2/3/4/5/6/7/8/>8 (ranging from low sensitivity to sediment (low numbers) to reduced tolerance for sediment (high numbers).
BI (Biotic Index)	10 Code: 2/3/4/5/6/7/8/9/10/11
FFG (Functional Feeding Group)	14 Codes: CF = Collector Filterers; CG = Collector Gatherers; DS = Detritus Shredders; EP = Engulfer Predators; MS = Macrophyte Shredders; OM = Omnivore; PA = Piercer Predators; PH = Piercer Herbivore; PP = Piercer Predators; PR = Predator; SH = Shredder; SC = Scraper (grazers); XS = Xylophage Shredders; UN =Unknown

Methods. Comparisons of aggregate measures across stations were explicitly tested using a contingency table Pearson Chi^2 test supplemented with station-specific histograms, as described previously. Displays have included the relative counts of species with no designations. However, explicit tests have been limited to the taxa with assigned designations for the particular aggregate measure.

Results. Appendix N presents the Chi^2 test results as well as table of results.

***Interpretation* Clinger Species.** Counts of Clinger/Not Clinger taxa do not differ significantly across sites. However, the counts of individual organisms in the two classes do differ significantly. While Clinger species are more likely than non-Clinger species, the relative abundance of Clinger taxa is higher at SF1 as compared to SF2, SF3 and USF. Clinger taxa are known to be indicators of environmental disturbance. As environmental disturbance increases the number of clinger taxa typically decreases (EPA, 1999). Habit measures are sometimes better indicators of environmental disturbance than functional feeding group measures (EPA, 1999). The non-difference in counts of clinger taxa (richness) across sites (upstream and downstream of the project) suggests that all sites are experiencing environmental disturbance similarly and equally and that the project did not adversely effect clinger taxa permanently if at all.

Biological Integrity. The counts of taxa and individuals that fall into the 11 BI categories at the six stations differ significantly, at $p = 0.02$ and $p<0.001$, respectively. In terms of the taxa distributions, Site NF is comparatively lower in magnitude across all BI levels (lower number of taxa) but reasonably normally distributed. The NF site contained fewer taxa overall (lower richness), which accounts for the lower magnitude of taxa distributed across BI values. All sites had peak taxa counts at the BI = 6 level indicating that a significant proportion of taxa at all sites are relatively tolerant to environmental disturbance although all sites supported taxa that are sensitive (intolerant) and moderately intolerant to environmental disturbance. Sites MS and SF1 are most alike and most symmetric in profile, while Sites SF2, SF3, and USF profiles exhibit relatively higher proportions of taxa in the low-mid range of BI values. Communities with low-range BI values indicate that the community tends toward being moderately intolerant or intolerant to disturbance. Organism count profiles suggest similarities in distribution of MS, NF, and SF1 sites, each with maximum counts at BI level 7 (tolerant) but with secondary peaks at moderately tolerant values and noticeable peaks at moderately intolerant values. The Site SF3 profile is similar to MS, NF, and SFI, with the maximum occurring at BI = 6 level. The distribution of Site SF2 and, particularly Site USF, are more uniform across the BI levels (the other three have a maximum of 7). The largest proportion of organisms at Site SF2 are tolerant while Site USF organisms are equally proportionate between tolerant, moderately intolerant, and intolerant abundances.

Functional Feeding Groups. Distributions of taxa counts across the aggregate measure of Functional Feeding Groups (FFG) do not differ among stations. However, station differences are apparent in the relative counts of individuals across the 11 categories of feeding groups. The dominant FFG is Collector-Gatherer at all stations. Where profiles differ is in terms of the occurrence and relative heights of secondary peaks. For example, Site NF has a secondary peak of Engulfing Predator (EP) organisms while Sites SF2 and SF3 are similar with secondary peaks in Collector-Filterer (CF) and Detritus Shredder (DS) organisms as compared to the USF and NF sites. Shifts in the dominance of a particular feeding group correspond to the abundance of a particular food source, which typically reflects the type of impact on the community (Plafkin et al., 1989). The dominant FFG, by far, is Collector-Gatherers even at the reference sites (USF and NF), which is an indication that if a specific impact has occurred it has occurred independently of the project. Collectors are generalists and have a broad range of food items and thus tend to be more tolerant to pollution and disturbance that could change food abundance (Barbour et al., 1999).

Fine Sediment Biological Index. FSBI levels range between 1 and 8, exhibiting a range from increasing to decreasing tolerance to fine sediments (less than 2 mm). Taxa counts in the nine FSBI categories do not differ statistically across stations. The profiles exhibit more or less homogeneous distributions of taxa between the FSBI levels of 2 to 7 indicating community make-up of taxa is similar and relatively equal between moderately intolerant and moderately tolerant taxa. However, the primary peak at all sites is at FSBI value 5 (moderately tolerant to fine sediment). The counts of organisms exhibit comparatively more complex profiles that correspond to a statistically significant difference among FSBI levels across stations. There are similarities in profiles between FSBI levels 2 and 8 (tolerant and intolerant to sediment, respectively) at Sites MS, SF1, and NF; each has a primary peak at FSBI level = 3 (indicating relative tolerance to fine sediment loading). Profiles from Sites SF2, SF3, and USF are similar with more uniform distributions between FSBI values 2 and 6 indicating that the individuals making up the communities at these sites are similar and range between moderately tolerant to moderately intolerant to fine sediment. Overall, both taxa counts and individual counts for communities at all sites indicate that the primary make-up of taxa and individuals have some tolerance (moderately tolerant [51 to 70 percent fine sediment] to moderately intolerant [31 to 50 percent fine sediment]) to fine sediment indicating that communities upstream and downstream of the project may experience moderate to high inputs, potentially episodic, of fine sediment. Furthermore, Mica Creek has a sediment Total Maximum Daily Load (TMDL) allocation for sediment indicative of Mica Creek having problems with sediment prior to construction of the project.

Taxa Distributions Across Station and Event. Some of the 186 taxa encountered over the course of monitoring the six Mica Creek watershed locations exhibit habitat-specific occurrences. Of the 189 taxa encountered, 36 occur only in riffle samples and 50 occur only in pool samples. The remaining 103 taxa occur in both pool and riffle samples. The occurrence of taxa unique to only riffle or only pool habitats suggests that gross differences in either counts of taxa or individuals, specific to particular locations would be of interest. Additionally, individual counts of specific taxa occurrences range widely: from single individuals over all stations and events (31 taxa) to 380 individual species of *Optioservus* (riffle beetles) in a single sample (NF pool collection, Fall 2003). The maximum occurrence of *Optioservus* was not unique to the NF site. Rather, *Optioservus* dominated most stations (excluding USF) and most events, as indicated with an 'X' in Table 8-32. *Optioservus* is a Collector-Gatherer beetle that is a clinger, is tolerant to pollution (BI = 7), and is tolerant to fine sediment (FSBI = 3).

TABLE 8-32
Optioservus Dominance at Specific Stations During Specific Sampling Events
U.S. 95 Bellgrove to Mica

		Sample Site					
Sampling Event	**Habitat**	**MS**	**NF**	**SF1**	**SF2**	**SF3**	**USF**
September 2002	Pool		X			X	
	Riffle		X	X			
June 2003	Pool	X	X	X	X		
	Riffle	X	X	X			
September 2003	Pool	X	X	X			
	Riffle	X	X	X	X	X	

Appendix N lists habitat-specific taxa counts per location and event for the Mica Creek macroinvertebrate sampling.

Methods. Graphical displays of the distribution of macroinvertebrate taxa found over the three sampling events have been developed to facilitate visual comparison across stations and events among the multi-species count data and to provide an interpretive tool prior to multivariate analyses and are displayed in Appendix N.

Results. Displays of the 50 pool-only taxa (1 page), the 32 riffle-only taxa (1 page), and the 103 pool-riffle taxa (2 pages) are provided in Appendix N.

Interpretation. The following summarize some of the distributional characteristics that are apparent in the displays:

Riffle-Only Taxa. Of the 32 riffle-only taxa, 12 were detected once only and correspond to R01 to R14 on the plots. Of the remaining 20 taxa, abundances range up to a maximum of 31 individuals. Comparing locations, the plots show that several of these uncommon taxa occurred at Sites USF and SF2 while occurrences are less frequent at SF3 and Site MS. No single-individual taxon was documented at either Site SF1 or Site NF. The more commonly occurring riffle-only taxa (R15 to R34) exhibit distinct distributions. The maximum count of riffle organisms are *Drunella coloradensis*, a mayfly collector-gatherer, which is moderately intolerant to pollution and fine sediment, with 31 and 15 of the 55 total counts found in the June 2003 sample at SF3 and USF, respectively. *Wormaldia*, the second most abundant reaches maximum individuals (16 in a single sample) in the June 2003 sample from Site SF1. Fewer individuals are found in the other sites (USF, SF2, SF3, and MS), excluding Site NF, which had no occurrences of *Wormaldia*. *Wormaldia* is a caddisfly collector filterer that is moderately tolerant (BI = 4) and tolerant to fine sediment (FSBI = 2).

From a strictly visual perspective, the trace patterns of Sites USF, SF2, and SF3 are generally most alike (although there are deviations with respect to individual species; e.g., R08 to R10). The NF site traces indicate comparatively lower counts of riffle-only taxa, overall. Out of the riffle-only taxa 47 and 53 percent are tolerant and moderately intolerant to environmental disturbance, respectively. FSBI proportions are not strikingly different with moderately intolerant taxa making up 60 percent of the taxa while moderately tolerant or tolerant taxa make up 40 percent of the taxa. Overall, riffle only taxa are distributed correspondingly to overall taxa distributions with respect to BI and FSBI values suggesting that the reason for these taxa only appearing in riffles corresponds to anything but habitat preferences and is not project related.

Pool-Only Taxa. The maximum count of individuals found in any single sample is taxon P02 (*Corixidae* [bug], clinging predator, BI = 9) in the June 2003 sample from Site MS. Of the 50 pool-only taxa, 19 (P32 to P50) were found only once. Comparatively, the most single-individual taxa have been found at Site NF, with comparatively fewer occurrences at the remaining sites. Most of the sites exhibit a similar distribution of comparatively few single occurrences, with increased occurrences of more commonly occurring species. The exception to the pattern is NF where there is activity throughout the trace, not simply at the top of the exhibit where the more commonly occurring taxa are displayed. Of the more uncommon of the pool-only taxa (25 or less in abundance) 74 percent were moderately tolerant or tolerant to environmental disturbance and 26 percent were moderately intolerant taxa. Similarly, 80 percent were moderately tolerant or tolerant to fine sediment and 20 percent were intolerant or moderately intolerant taxa. These distributions are somewhat dissimilar to overall distributions but the trend does not suggest that the skewed distributions are project related.

Pool-Riffle Taxa. The first panel of the pool-riffle taxa figure treats the more commonly occurring taxa found in both pool and riffle habitat, PR053 to R103. The most abundant taxa with 5,674 specimens, was PR103 (*Optioservus*). *Optioservus* was the taxon most consistently determined the dominant taxon. As mentioned previously, *Optioservus* is a pollution and fine sediment-tolerant beetle. The next abundant taxa with 991 specimens was PR102 (*Ephemerella*). *Ephemerella* (mayfly) is also moderately tolerant to pollution and fine sediment (BI = 6; FSBI = 4). The less commonly occurring taxa (PR001 to PR052, found on the second panel of the pool-riffle station traces) are represented by between 2 and 48 individuals. The linear traces among the six stations are not strikingly different in the range of PR064 to PR103, although there are occasional discrepancies; e.g., PR101's (Heterlimnius [beetle] BI = 3, FSBI = 5) occurrence at all but NF or PR089's (*Cricotopus* (Nostococladium) [midge] BI = 3) unique appearances at Site SF2. There is no apparent reason for these taxa to be found, or not found, at specific sites in the Mica Creek basin. There is comparatively greater differentiation in the station traces found in the second panel of less frequently occurring taxa (between PR001 and PR063). Similarly to the more uncommon poll-only taxa, the lower abundance pool-riffle taxa show no trends that would indicate project-related effects.

Single-Occurrence Taxa: By Event and Location. As indicated in the previous section, the counts of individual organisms collected over the study area and monitoring period differ widely among taxa identified in Appendix N. Thirty-three individual taxa (19 pool only, 14 riffle only) were observed in an abundance of one and one time only, resulting in the 'piling' up of points on the left side of the plot, clearly exhibiting that the distribution of individuals within taxa is extremely limited in the habitat-specific groups. The distribution of organisms collected representing the pool taxa and riffle taxa is both greater (as indicated by the shift to the right of the blue points) and more normally distributed (as indicated by the comparatively straighter line of the blue points).

Because the spatial and temporal distributions of totally unique individuals could reveal unique conditions, the 31 individual taxa (pool only and riffle only) that have occurred only once (abundance of 1 in only 1 sample during only 1 sampling event) over the 36 samples have been examined to determine whether any single taxa occurrences are more prevalent in a particular event or at a particular location or in a particular habitat. Of the 33 taxa occurring in an abundance of one only once, 8 occurred during the September 2002 event, and 11 during the September 2003 event. The remaining 14 occurred in the June 2003 event. The counts of unique taxa occurrences for the MS, NF, SF1, SF2, SF3, and USF sites was: 4, 7, 3, 10, 4, and 5 (for a total of 33), respectively. The distribution of riffle only taxa and pool only taxa was 14 and 19, respectively. Aggregate measures, specific to the uniquely occurring taxa, are found in Appendix N.

Methods. Contingency tables like those first described previously were used in testing for differences among events and stations for the 31 taxa. Pearson's Chi^2 was the statistic used and interpretation supplemented with bar chart comparisons.

Results. Appendix N includes paired event–station habitat plots, along with probability of the Chi^2 test.

Interpretation. The probability of Pearson's Chi^2 test for differences among events is 0.38, indicating that the number of single-individual taxa occurrences is not statistically significant among sampling events. This means that single occurrence taxa are as likely to be encountered at any of the sampling events and are not limited to any single sampling event or tied to any specific environmental event.

- The probability of Pearson's Chi^2 test for differences among stations is 0.30, indicating that the number of single-individual taxa occurrences is not statistically significant among sampling sites. That is, single occurrence taxa are as likely to be encountered at any of the sites and do not occur only at one particular site or are coupled with any specific environmental event.
- The probability of Pearson's Chi test for differences between habitats is 0.38, indicating that single occurrence taxa are not limited to either riffle or pool habitats.

Community Diversity Index Station Comparisons. Conventional community diversity indices have been generated for each sample within the habitat-specific taxa groupings, using *pcORD* software. Sample collections have been limited to the 18 original samples to retain a balance across events and stations such that sample counts are consistent for the location-type samples. While the events are not independent within station, the events sampled are balanced across locations.

Methods. Four indices are generated, including: richness (the number of non-zero counts for a species); evenness (evenness of non-zero species values across sample units = Shannon's diversity index/natural log of richness); Shannon's diversity index (sum of the proportions of taxa-specific relative abundance across samples); and Simpson's diversity measures (sum of the 'ubiquity' of a species occurring within samples). Boxplot and nonparametric tests have been applied to the community indices calculated in *pcORD* summary algorithms.

Results. Boxplots and nonparametric test comparisons of habitat type, gradient, and individual stations are displayed in Appendix N.

Interpretation

- None of the community indices differ between riffle and pool stations, meaning that taxa diversity, evenness, and richness measures are comparable between habitat types. This is not unexpected although some taxa occur only in either riffle or pool habitat the diversity in each habitat remains similar across habitat types because environmental stressors within the basin are expected to act equally on pool and riffle type habitats. Therefore, taxa diversity, evenness, and richness would be expected to be similar between habitat types. By the community indices being similar at all sites, upstream of the project and downstream of the project, demonstrates that the project did not significantly effect the communities downstream of the project in any long-term manner and potentially not at all.

- None of the community indices differ between gradient groupings (upstream NF and USF versus downstream SF1, SF2, SF3, and MS) meaning community structure is similar at sites potentially impacted by the project and at sites not potentially impacted by the project.

- Station differences in taxa richness are not statistically significant. However, station differences for the two diversity measures and evenness are statistically significant. Stations differ with Sites NF, SF1, and MS having generally lower measures than SF2, SF3, and USF. Site NF, the upgradient station, is consistently the lowest in the three measures (taxa diversity, evenness, and richness measures).

Agglomerative Clustering: By Taxa-Grouping. Macroinvertebrate taxa counts have been cumulated over the three sampling events within each of the 12 location-habitat stations. Cumulative counts of 187 taxa have been clustered to examine which location-habitat groupings are more and less similar. Original data of the 187 taxa are presented in Appendix N. Modifications to the original dataset, based on results from various steps in the sequence of multivariate evaluations are documented below.

Methods. Clustering algorithms have been conducted using *pcORD*, software distributed by MjM software. The particular clustering algorithms used have been based on agglomerative clustering techniques, which build up clusters based on a minimized error per iteration. The analytical sequence included the following steps: data summary, data relativization, agglomerative clustering using two distance-linkage combinations, and sensitivity analyses.

Results. Results of this segment of this analysis can be found in Appendix N.

Interpretation

- Sites MSR and SF1R are most similar among all possible station-habitat combinations and form the first cluster. This is likely explained by the location of the sites in relation to other sites in the watershed. These two sites are low in the watershed and exhibit similar gradients. The next closest pair of station-habitat combinations with respect to the 187 taxa includes the SF2R and SF3R sites combinations; followed by the Site USF riffle and pool combinations; then the SF2P and SF3; followed by the MSP and SF1P sites. The next 'generation' of grouping agglomerates NFR with the SF2R-SF3R cluster and NFP with the MSP-SF1P cluster. Note that NF habitats are the last individual station-habitat combinations to join the clusters meaning they are more dis-similar than the rest of the stations.

- Generalizing across the various dendrograms exhibits some consistent trends. First, the first cluster location-habitat groupings are similar, with only minor variations in the dendrograms, grouping first stations of the same habitat (pool vs. riffle): MSR-SF1R, SF2R-SF3R, SF2P-SF3P, then MSP-SF1P-NFP. That is, in most cases, the outstanding characteristic of the clustering is the differentiation by habitat type, pool and riffle. The single exception occurs at USF where the pool and riffle composite taxa counts cluster first with themselves (rather than pool or riffle habitats at different locations). The second consistent feature is that Site NF habitats cluster after the other station-habitat initial groupings, indicating that other paired stations are more alike than the NF site habitats.
- Contrary to the observed similarity in pool and riffle communities at the USF site, it is typical to observe distinctive taxa within pool and riffle habitat communities resulting from differences in the geomorphology of the habitats and taxa preferences. It is likely that the similarities in the USF riffles and pools can be explained by the smaller size of the stream as compared to downstream stations. A smaller stream will typically have smaller shallower pools, which decreases the difference between pool and riffle habitat, which appears to be true at the USF site.
- The effect on groupings focuses on Site NF, which partitions out into a single group differentially from the riffle and pool-specific groupings stations on the South Fork and mainstem (SF1, SF2, SF3, and MS) and the pool and riffle habitats at the USF site. The direction of this effect (increased separation of the NF site that has exhibited marginally reduced taxa richness and abundance as compared to other sites) is not unexpected and is likely a result of generally small (primarily pebble and coarse pebble [< 31 millimeter]) substrate that may be linked to land use practices in the North Fork Mica Creek subbasin.

Duplicate Evaluation. Three field duplicates were collected at upgradient riffle stations □ one station-habitat location per each of the three events. The September 2002 and June 2003 collections were made at an NF riffle. The third collection (September 2003) was made in a riffle at USF. Duplicate sample results are a useful context for evaluation of the relative statistical differences among stations. Duplicate pairs have been evaluated with respect to taxa counts, individual organism counts, the four sample aggregate measures and graphically displayed in paired taxa traces (Appendix N). Table 8-33 shows the evaluation which included calculation of relative percent difference (RPD) between paired samples and documentation of species counts in-common and unique to the original or duplicate samples.

TABLE 8-33
Duplicate Evaluation
U.S. 95 Bellgrove to Mica

Measure	NF11/12 RPD	NF21/22 RPD	USF31/32 RPD
Taxa Count	12%	32%	14%
Individuals Count	19%	11%	27%
Species Richness	12%	32%	14%

TABLE 8-33
Duplicate Evaluation
U.S. 95 Bellgrove to Mica

Measure	NF11/12 RPD	NF21/22 RPD	USF31/32 RPD
Species Evenness	8%	9%	2%
Shannon Diversity	4%	18%	5%
Simpson Diversity	4%	14%	2%
Taxa in Common	29	24	33
Unique to Sample	11/16	10/23	7/13

Interpretation. Results indicate that split samples are reasonably comparable. The tightness of the taxa traces gives a context for evaluation of the habitat-specific traces from different sampling events at the six sites.

8.3.5 Macroinvertebrate Assessment Discussion

The overall Mica Creek watershed drains 23.3 square miles, with the predominant land uses being pasture (17.4 percent) and forest (82.1 percent) (IDEQ, 1999b); and with land ownership being 2.2 percent Bureau of Land Management, 4.3 percent State, and 93.5 percent private. Highway area represents about 0.4 percent of the watershed (IDEQ, 1999b). The portion of the South Fork Mica Creek and Mica Creek downstream of the project area contains agricultural and forested lands. The Northern Mountains ecoregion is characterized as forested with higher elevations and higher gradients with little or no farming or grazing. Although more than 17 percent of the Mica Creek basin is pasture, the majority of the basin is forest and therefore the Northern Mountains ecoregion is the appropriate ecoregion for metric scoring.

Using the Northern Mountains metric scoring formulas for relative comparison purposes between site metric scores, in general, sites upstream (unimpacted by the project) and downstream (potentially impacted by the project) received similar averaged metric scores ratings for riffle areas, with the exception of the NF site, which received what would be considered poorer conditions as compared to other sites. Mica Creek, Site SF1, and the NF had lower metric site in the pool areas The North Fork Mica Creek site had lower metric scores in general for both pool and riffle sites (Poor) as compared to other sites and had the lowest averaged FSBI score of any of the riffle sites (76) indicating that this site has the worst conditions for the macroinvertebrates.

Based on metric scores for the South Fork and mainstem Mica Creek, it does not appear that there are significant biological differences between the upstream reference site (USF) and areas downstream of the project with the exception of the MS and SF1 pool samples, which had slightly lower metric scores than other sites but still significantly above the North Fork Mica Creek site. The SF1 pool site has lower overall metrics score than other South Fork or Mica Creek sites. Although the SF1 pool site scored low on several individual metrics, the SF1 riffle site scored similarly to all of the other South Fork and Mica Creek sites.

Averaged FSBI scores for the South Fork and mainstem sites ranged from 90 at Site SF3 to 117 at Site USF with Sites MS, SF1, and SF2 receiving scores of 95, 100, and 95 respectively. FSBI scores of 90 or more indicate low amounts of fine sediment at these sites as compared to the NF site (76). The FSBI contains four categories related to sediment tolerance of taxa; fine sediment intolerant (0 to 30 percent fines), moderately fine sediment intolerant (31 to 50 percent fines), moderately fine sediment tolerant (51 to 70 percent fines), and fine sediment tolerant (71 to 100 percent fines) (Relyea et al., 2000). Based on Wolman pebble count data, all sites contained less than 30 percent fines (inorganic sediment ≤ 2 millimeter) with the exception of the MS and NF sites outside the wetted area of the channel. At all stations, numbers of taxa with FSBI values peak at FSBI score of 5 (moderately tolerant to fine sediment) with secondary peaks at FSBI values of 2 (tolerant to fine sediment) suggesting that the communities at all stations are relatively tolerant to fine sediment.

In addition, all sites contained high averaged proportions (57 percent to 80 percent) of taxa that are moderately tolerant or tolerant to sediment as defined in the FSBI protocols. Yet all sites supported taxa that are moderately intolerant or intolerant to sediment, up to 21 percent of the sample, as defined in the FSBI protocols. The FSBI methodology identifies 94 taxa that have varying sensitivities to sediment. One taxa found in riffle samples at the Site MS, *Glossosoma* (caddisfly), have been identified as being sensitive to sediment (OIDEQ, 2002). *Glossosoma* sediment sensitivity is supported by Relyea (2000) by receiving a FSBI rating of 6 (moderately intolerant to sediment). This taxa comprised approximately 16 percent of the sample at Site MS overall and was part of the overall dominant five taxa at the site. *Glossosoma* had an overall abundance of 306 individuals at Site MS with 305 of those individuals being from the September 2002 sample. *Glossosoma* prefers cool water and is multi-voltine (several life cycles per year) and was not found during the June 2003 sampling event at any sites. Overall, there was no statistical significance to number of taxa with FSBI scores between sites.

There are many macroinvertebrate life styles and habits. Many have been found to respond in a specific manner to disturbance. Clinger type taxa (taxa that have a fixed retreat or adaptation for attaching to surfaces in flowing systems) tend to decrease in abundance as disturbance increases (Barbour et. al., 1999). All South Fork and Mica Creek sites supported many types of clinger taxa from 18 to 25 taxa on average in riffles and 12 to 22 taxa in pools. Riffle sites downstream of the project had only marginally lower numbers of clinger taxa as compared to the USF site, with the exception of the Site MS, which had an average of 7 percent lower clinger taxa. Two pool sites had more clinger taxa than did the USF site. The North Fork Mica Creek site supported clinger taxa but had significantly lower numbers of clinger taxa as compared to the South Fork and Mica Creek sites for pool samples but had slightly better proportions in riffle samples.

The average HBI values did not vary greatly between riffle and pool samples at any of the sample sites. The North Fork Mica Creek site received the highest average HBI value for riffle sites (6.2) and tied for the highest score among pool samples (6.5). The Mica Creek mainstem and SF1 sites received an HBI score of 6.5 as well. These HBI values relate to a significant organic pollution load at these stations based on Hilsenhoff (1987) protocols (Mandaville, 2002). Other stations' HBI scores indicate a fairly significant organic pollution load but lower than the North Fork Mica Creek with the above-noted pool exceptions. The HBI for the SF2, SF3, and USF sites (5.6, 5.9, and 5.4, respectively, for pool sample and 5.6, 5.7, and 5.1, respectively, for riffle samples) indicate organic pollution but not to the extent of the other sites. Furthermore, the biotic index (BI) scores for each taxa have overall proportions in the tolerant range indicating that taxa at these stations are tolerant to pollution as well as other disturbance. The number of BI taxa and organisms at all sites differed significantly and are likely due, in general, to the larger proportion of individuals and taxa having BI values in the moderately tolerant range, indicating that communities at these sites are more tolerant than intolerant to pollution and other environmental stressors. However, the taxa at the USF and SF2 sites had higher proportions of moderately intolerant and intolerant taxa than the other sites with the USF site having more moderately intolerant taxa than tolerant taxa.

The dominant feeding category is collector-gatherers even at the reference sites (USF and NF). Because collectors are generalists and have a wide range of food items, they tend to be less impacted by disturbance or pollution. Having one type of feeding category vastly dominate the feeding type suggests that a specific impact may have occurred to alter the food source. This is an indication that a specific impact may have occurred and has impacted the food sources. Because the feeding type is so vastly dominated by collectors at all sites, including the USF site, suggests that the impact occurred independently of the project.

Clinger taxa at all sites were relative to each other especially at riffle sites. All sites contained a relative good diversity and abundance of clinger taxa that appeared stable over the three sampling events. This suggests that the sites are stable and are not deteriorating or degrading because the diversity as well as the abundance of clinger taxa decrease with an increase in environmental disturbance. There were taxa that were found only at riffles and only at pools but these taxa were not specific to any event or site which might suggest that a specific event occurred at, or affected, a specific event or site. These taxa were just as likely to occur any time and at any of the sites upstream or downstream as would be expected to occur randomly in a steam environment. In addition, the habits or preferences of these taxa does not suggest any impropriety in their occurrence in space or time.

Overall, comparing the USF site (reference site) with other South Fork and the mainstem sites, there are no real significant differences in overall average metric scores or overall average SMI scores. All of the sites seem more similar to each other than dissimilar during the cluster analysis, demonstrating that the communities both upstream and downstream of the project on the South Fork and mainstem Mica Creeks are not noticeably different in the number of taxa, taxa diversity, and individual abundances. If the project would have had a noticeable impact it would be expected that the clustering would show the disparity. In general, the North Fork site scored poorer on most individual metrics including the FSBI score than the South Fork and mainstem sites. Impairment at the North Fork site may at least in part be due to active eroding banks increasing sediment loading and land use practices surrounding the stream.

The orders *ephemeroptera, plecoptera, and tricoptera* (mayflies, stoneflies, and caddisflies) are typically considered sensitive groups and are considered to be pollution and disturbance sensitive groups (Plafkin et al., 1989). These sensitive groups were found at all sites, upstream and downstream of the project.

The IDEQ BURP program conducted sampling in the Mica Creek watershed during 1995. Sampling was conducted in the lower South Fork Mica Creek slightly upstream of the confluence with the North Fork (165 feet upstream of the confluence) and in the upper North Fork Mica Creek. According to BURP protocol, only riffle areas were sampled. The SMI scores, although not directly comparable to recent SMI scores, still provide a relative comparison to recent 2002 and 2003 macroinvertebrate sampling. The 1995 SMI scores for the South Fork and North Fork Mica Creeks were 32 and 44, respectively. These scores would be considered as providing Poor and Fair habitat conditions, respectively, in these areas. In addition, the FSBI scores of 36 and 67 for South Fork and North Fork Mica Creeks, respectively, indicate elevated fine sediment at these sites. The Wolman Pebble Counts support this at the lower South Fork site with fine sediment proportions ranging from 30 percent to 50 percent of the substrate being fine sediment. The North Fork site was only marginally better ranging from 19 percent to 58 percent of fine sediment in the riffle areas sampled. The dominant five taxa at the lower South Fork site made up 87 percent of the sample with the top two taxa making up 62 percent of the sample. These metric scores, Wolman Pebble counts, and FSBI scores demonstrate that at least the lower South Fork site was experiencing degraded habitat conditions and macroinvertebrate community structure. The lower South Fork site contained relatively few clinger tax as well, which supports the evidence that this site was disturbed because clinger taxa tend to decrease as disturbance increases. As relatively compared to recent sampling, the Site MS appears to be in better condition (community structure and fine sediment proportion) than the BURP lower South Fork site was in 1995 and the Site MS is 3,300 feet farther downstream. The SF1 site is 2,110 feet upstream of the confluence and approximately 2,000 feet upstream of the 1995 BURP sampling site and has a better community structure and less fine sediment now than the BURP site did in 1995. Additional details regarding the 1995 BUPR sampling is provided in Section 8.3.8.

Many parameters were assessed statistically and multimetrically to assess if the project had an adverse impact on the macroinvertebrate community. All three sampling events were evaluated separately and together during the statistical and multimetric analyses. The multimetric approach was used after each sampling event to discern any potential trends and to assess the health of the community at the time of sampling. No apparent adverse signs of project impacts were observed after each sampling event. The statistical evaluation has confirmed that no statistically significant differences were found between upstream and downstream sites that would suggest the project had a noticeable adverse impact on the macroinvertebrate community. There are differences between some sites and between the USF site and some of the downstream sites but these differences do not suggest, or demonstrate, that the project was the cause of these differences.

8.3.6 Historical Information on Habitat, Fish, and Macroinvertebrates from the Project Area

Previous data were collected to identify additional supporting documents in the impact assessment of the project (Appendix N). This section represents information compiled from various sources with applicable data summarized for use within the stream habitat, fish assessment, and macroinvertebrate assessments.

8.3.6.1 Aquatic Habitat

SHI stream habitat data were collected at two BURP sites in 1995 on lower South Fork Mica Creek and North Fork Mica Creek. For comparison with the SHI data discussed above, the general results for the metrics of concern (i.e., epiphaunal substrate/available cover, embeddedness/heterogeneity of substrate composition, and channel flow status).

Lower South Fork Mica Creek. The lower South Fork Mica Creek site is located just above the confluence with main Mica Creek and falls within the SF1/SF2 reach discussed above. The comparable sediment-related habitat data from the site are summarized in Appendix N. Three metrics fell below the mean values for the NMR ecoregion—instream cover, large organic debris, and fine sediment levels. The SHI score for the 1995 survey rated the site condition as below the 10th percentile for the reach (Table 8-34), placing the site in the lowest condition class for the NMR ecoregion and same as the 2002 survey results.

North Fork Mica Creek. The North Fork Mica Creek site is located high within the North Fork Mica Creek drainage and above the 2002 surveyed sites for this project. The comparable sediment-related habitat data from the site are summarized in Appendix N. Two metrics fell below the mean values (Tables 8-35 and 8-36) for the NMR ecoregion—instream cover and channel shape. The SHI score for the 1995 survey ranked the site conditions as below the 10th percentile for the reaches, placing the sites in the lowest habitat percentile class for the NMR ecoregion.

TABLE 8-34
SHI Scores and Condition Ratings for the Surveyed Reaches in 1995

Reach	Metric Total	NMR Ranking
South Fork Mica Creek	48	Below 10th Percentile
North Fork Mica Creek	50	Below 10th Percentile

Wolman pebble count data was collected at two BURP sites in 1995 and describe the substrate composition within the bankful channel area (i.e., both within and outside wetted width). Tables 8-31 and 8-36 summarize the findings from those surveys.

The lower South Fork Mica Creek (Table 8-35) site contained fine sediments (≤2.5 millimeters) that averaged 45 percent across the three sampled sites and included 10 of the 11 Wolman size classes. Further, the site averaged 57 percent of fine-grained particles (≤ 6 millimeters). Elevated levels of fine sediment (≤ 6 millimeters) adversely affect salmonid embryo survival. Predicting the effects of fine sediment on wild populations remains difficult because some populations persist in streams with very high sediment levels (Magee et al. 1996, cited in Quigley and Arbelbide eds., 1997). Increased fine sediment loads also cause aggradation, filling of pools, and increased channel width and width/depth ratios (Quigley et al., 1997). Scoring criteria for the Stream Habitat Index within the Northern and Middle Rockies Ecoregion rate this site as poor with respect to percent fines (≤2.5 millimeters) and high with regard to Wolman size classes Grafe (2002).

The North Fork Mica Creek (Table 8-35) site contained fine sediments (≤2.5 millimeter) that averaged 30 percent across the three sampled sites and included 10 of the 11 Wolman size classes. Further, the site averaged 32 percent of fine-grained particles (≤ 6 millimeter). Scoring criteria for the Stream Habitat Index (SHI) within the Northern and Middle Rockies Ecoregion rate this site as low with respect to percent fines (≤2.5 millimeter) and high with regard to Wolman size classes (Grafe, 2002).

TABLE 8-35
Wolman Pebble Count (August 2, 1996), Lower South Fork Mica Creek (50 meters Above Confluence with North Fork Mica Creek)

		Riffle 1		Riffle 2		Riffle 3	
Substrate	**Substrate Size**	**Within Bankfull**	**Substrate percent**	**Within Bankfull**	**Substrate percent**	**Within Bankfull**	**Substrate percent**
Silt/Clay	0-1 millimeter	15	26	8	15	7	11
Sand	1.1-2.5 millimeter	14	24	11	20	12	19
Very Fine Pebble	2.51-6 millimeter	6	10	7	13	6	9
SUBTOTAL		**35**	**60**	**26**	**48**	**25**	**39**
Pebble	6.1-15 millimeters	12	21	11	20	6	9
Coarse Pebble	15.1-31 millimeters	4	7	10	19	5	8
Very Coarse Pebble	31.1-64 millimeters	0	0	7	13	10	16
Small Cobble	64.1-128 millimeters	7	12	0	0	6	9
Large Cobble	128.1-256 millimeters	0	0	0	0	1	2
Small Boulder	256.1-512 millimeters	0	0	0	0	1	2
Medium Boulder	512.1-1,024 millimeters	0	0	0	0	0	0
Large Boulder	+1,024.1 millimeters	0	0	0	0	10	16
TOTAL		**58**	**100**	**54**	**100**	**64**	**100**

TABLE 8-36
Wolman Pebble Count (August 2, 1996), North Fork Mica Creek (Upstream of Cabin Creek Confluence)

		Riffle 1		Riffle 2		Riffle 3	
Substrate	**Substrate Size**	**Within Bankfull**	**Substrate percent**	**Within Bankfull**	**Substrate percent**	**Within Bankfull**	**Substrate percent**
Silt/Clay	0-1 millimeter	12	16	10	20	4	7
Sand	1.1-2.5 millimeters	7	10	5	10	6	11
Very Fine Pebble	2.51-6 millimeters	2	3	0	0	2	4
SUBTOTAL		**21**	**29**	**15**	**30**	**12**	**22**
Pebble	6.1-15 millimeters	6	8	3	6	9	17
Coarse Pebble	15.1-31 millimeters	14	19	6	12	12	22
Very Coarse Pebble	31.1-64 millimeters	13	18	10	20	8	15
Small Cobble	64.1-128 millimeters	11	15	11	22	5	9
Large Cobble	128.1-256 millimeters	7	10	3	6	7	13
Small Boulder	256.1-512 millimeters	1	1	1	2	0	0
Medium Boulder	512.1-1,024 millimeters	0	0	1	2	1	0
Large Boulder	+1,024.1 millimeters	0	0	0	0	0	0
TOTAL		**73**	**100**	**50**	**100**	**54**	**100**

Other habitat data (supported by the documents in Appendix N) include some general stream descriptions (Table 8-37), stream discharge measures (Table 8-38), canopy densities (Table 8-39), and large organic debris counts (Table 8-40). The data are summarized in the following tables.

TABLE 8-37
General Comments on Habitat and Conditions

Year	Document	Comments
1995	Beneficial Use Reconnaissance Project (BURP) – Field Forms, Lower South Fork Mica	1) Stream Temp 18°C at 10:50 8/2/1995
1995	Beneficial Use Reconnaissance Project (BURP) – Field Forms, North Fork Mica	Stream Temp 15°C at 15:57 8/2/1995 2) 3 6-inch rainbow trout observed in reach

TABLE 8-37
General Comments on Habitat and Conditions

Year	Document	Comments
2002	Annual Performance Report – Mica Creek Fishery Assessment	Lower S.F. Mica reach
		Some reductions if riparian veg from grazing
		Sediment delivery from highway project
		Upper S.F. Mica reach
		Some riparian clearing from old homestead
		N.F. Mica Creek Reach
		Reduction in riparian area and large organic debris from grazing.

Davis et al. (2001) note that "discharge, at summer base flow, is a measure of minimum stream size and an indicator of potential habitat for fish and aquatic invertebrates."(IDEQ, 2002). Discharge information, particularly annual discharge data, may provide an understanding of natural flow patterns and possible impacts to biological communities. Bauer and Ralph (1999) state that discharge is a useful habitat variable to help describe the flow regime of a stream (IDEQ, 2002a). However, this measure was not included in the SHI scoring criteria for habitat (Table 8-38).

TABLE 8-38
Stream Discharge Summaries

Year	Document	Discharge
1995	Beneficial Use Reconnaissance Project (BURP) – Field Forms, Lower South Fork Mica	0.8 ft^3/sec. 8/2/1995
1995	Beneficial Use Reconnaissance Project (BURP) – Field Forms, North Fork Mica	1.66 ft^3/sec. 8/2/1995

Canopy cover can be a surrogate for water temperature since vegetation can influence the amount of sunlight reaching the stream (IDEQ, 2002). In general, the canopy cover of the sites in 1995 surveys (Table 8-39) scored very low with respect to measures within the Northern and Middle Rockies Ecoregion. Canopy cover was found to be an important variable in water quality (macroinvertebrate) studies by Mulvey et al. (1992, cited in IDEQ, 2002) and studies of fish by Overton et al. (1993, cited in IDEQ, 2002). Temperature and canopy cover helped explain differences in fish occurrence and abundance in these studies as well as in the Robinson and Minshall (1992, 1994, cited in IDEQ, 2002) ecoregion studies.

TABLE 8-39
Canopy Cover Density Summaries

Year	Document	Density Averages by reach (percent cover)
1995	Beneficial Use Reconnaissance Project (BURP) – Field Forms, Lower South Fork Mica	15.2 8/2/1995
1995	Beneficial Use Reconnaissance Project (BURP) – Field Forms, North Fork Mica	9.1 8/2/1995

Large organic debris has been found to be important for the complexity it adds to stream habitats, retention of allochtonous matter and sediment, and stability it imparts to streams under high flow conditions. Some species of salmonids show a high affinity for LOD (Rieman and McIntyre 1993, cited in IDEQ, 2002). It serves to stabilize the stream channel, retard the export of organic matter and nutrients, and provides protection and habitat for invertebrates and fish (Davis et al. 2001, cited in IDEQ, 2002). In general, the LOD of the sites in 1995 surveys (Table 8-40) scored very low with respect to measures within the Northern and Middle Rockies Ecoregion.

TABLE 8-40
Large Organic Debris Data

Year	Document	LOD (≥ 10cm and ≥ 1m in length)
1995	Beneficial Use Reconnaissance Project (BURP) – Field Forms, Lower South Fork Mica	4 8/2/1995
1995	Beneficial Use Reconnaissance Project (BURP) – Field Forms, North Fork Mica	6 8/2/1995

Bacteria levels for fecal coliform and *E. coli* were collected at the North Fork Mica Creek (1999) and within main Mica Creek (1999) where the levels for fecal coliform exceeded 500/100 ml levels and required multiple repeated samples. The presence of fecal coliform and *E. coli* suggest fecal matter (possibly from cattle) within the North Fork and main Mica Creek streams.

8.3.6.2 Fisheries

Fisheries data was collected during 1993, 1997, and 2002 (Table 8-40). The summaries of the fishes sampled and their corresponding densities are found in Table 8-40. Table 8-40 fisheries data consists primarily of data summaries from surveys although the 1997 BURP survey included the field forms and the 2002 IDFG report includes a graph of the length frequencies for cutthroat trout.

Most of the fisheries data are lacking one or more of the criteria used in scoring the condition of the fisheries using the Stream Fish Index (SFI) as described in Grafe (2002). The SFI evaluates the relationships of six metrics in assigning bioassessment value to sampled sites. These metrics include the following:

- Number of cold water native species
- Percent of cold water individuals
- Percent of sensitive native individuals
- Number of sculpin age classes
- Number of selected salmonid age classes
- The relative abundance of cold water individuals

Only one site has enough information to assign a SFI score—the lower South Fork Mica Creek, 1997 (Table 8-41). The sample data from this site contains all of the information required to calculate the SFI score, but is based on a sample of only 10 fish. The SFI score for this site rated as 72 both rangeland and forested systems Mountain index. This score is within the range for reference streams in both systems, suggesting an appropriately functioning condition based on the bioassessment of fishes, however Grafe (2002) suggest returning to sites that report few fish (less than 10) for follow-up investigations.

Other fisheries data (1993 and 2002 data) within the Mica Creek area are lacking electrofishing timing information for a single pass (for use in calculating relative abundance), or age-class data. All sites describe a number and combination of coldwater-adapted individuals (i.e., cutthroat trout and sculpin, Table 8-41). These data fit within the reference ranges described in Grafe (2002) for the number and percent of coldwater native species and percent sensitive individuals. With regard to the first three metrics used to calculate the SFI score, the fisheries data for all of the sites suggest appropriate conditions for native coldwater fishes. However, age-class data and relative abundance information are not available for these surveys.

An annual performance report was conducted by IDFG (2002) within Mica Creek. The report was conducted specifically to assess the impact of the project on the Mica Creek fishery. The report states that the surveyors are uncertain if the project has depressed the cutthroat trout population but that the sediment from the project may have resulted in localized effects to the channel. The report further observes impacts from years of cattle grazing, noting a lack of stream shade, large organic debris, and pools within the surveyed reaches. The report further suggests that the conditions will improve with the recent fencing of the cattle from the stream.

TABLE 8-41
Summarized Electrofishing Data from 1993 – 2002

Year	Location (Date/Time/Temp C)	Area Sampled (m^2)/ Number of passes	Number of Fish by Species			Density of Fishes by Species (Fish/m^2)		
			Brook Trout	Cutthroat Trout	Torrent Sculpin	Brook Trout	Cutthroat Trout	Torrent Sculpin
1993	N.F. Mica Creek - Confluence of N.F. Mica and Mica Creek (Unconfirmed)	200/ Unknown	-	5	4	-	0.06	0.05
1997	S.F. Mica Creek – 50 m upstream of Mica Creek (7-16-97/?/8)	200/ 1	-	6	4	-	0.03	0.02
2002	Lower S.F. Mica Creek –Lowest site (S4) (7-1-02/12:30/15)	330.4/ Multiple	-	50	56	-	0.15	0.17
2002	Lower S.F. Mica Creek Middle site (S23) (7-1-02/14:30/15)	358.6/ Multiple	-	108	22	-	0.3	0.06
2002	Lower S.F. Mica Creek Upper site (S32) (7-2-02/8:30/12)	187.8/ Multiple	-	17	21	-	0.09	0.11
	Lower S.F. Mica Reach Average	876.9		175	99	-	0.18	0.11
2002	Upper S.F. Mica Creek Lower site (U4) (7-2-02/16:00/13)	178.8/ Multiple	5	7	14	0.03	0.04	0.08
2002	Upper S.F. Mica Creek Upper site (U11) (7-2-02/14:30/12)	105.8/ Multiple	-	16	4	-	0.15	0.04
	Upper S.F. Mica Creek – Reach Average	284.6/ Multiple	5	23	18	0.02	0.1	0.06
2002	N.F. Mica Creek – Lower site (N10) (7-2-02/10:00/12)	550.8/ Multiple	-	17	50	-	0.03	0.09
2002	N.F. Mica Creek – Upper site (N14) (7-2-02/10:50/13)	510.4/ Multiple	-	15	61	-	0.03	0.12
	N.F. Mica Creek – Reach Average	1061.2	0	32	111	0	0.03	0.11

8.3.6.3 Macroinvertebrates

Macroinvertebrate data was gathered from two BURP sites in 1995, lower South Fork Mica Creek and upper North Fork Mica Creek. Summaries of the data are found in Tables 8-42 and 8-43 and include the metric summaries, the biotic indices, and the dominant taxa. The

SMI scores for the South Fork and North Fork rated as Poor and Fair (one point above Poor), respectively, within the Northern Mountain Ecoregion (Grafe 2002). The same taxa represented the two dominant species at both sites (Table 8-43). The dominant taxa (the top five present) represented species that are eurythermal with a strong association with warm summer temperatures and accounted for more than 75 percent of the total species present at both sites. These findings suggest that the site conditions may be suitable to a limited number of organisms and that the conditions may stem from limited food resource types, habitat degradation, or competitive displacement. Further, both sites scored below the range of the least impacted site indexes and within the range of stressed sites as described in Grafe (2002). Using the macroinvertebrate biocriteria from Grafe (2002) the SMI scores for the two sites suggest that the sites may be candidates for resource management changes.

TABLE 8-42
Benthic Macroinvertebrate Summaries from 1995 BURP Surveys in Mica Creek

	1995 North Fork Site	1995 South Fork Site
Abundance	457	612
Taxa Richness	24	22
Mayfly Richness	5	3
Stonefly Richness	5	4
Caddisfly Richness	6	3
percent Stoneflies	11.8	6.9
Hilsenhoff Biotic Index	5.4	5.0
Scraper Index	0	0
Clinger Index	17	11
percent 5 Dominant	76.37	86.77
Fine Sediment Biotic Index	67	36
Most Dominant Taxa	*Chironomidae*	*Microcylloepus*

TABLE 8-43
Dominant taxa Summaries for 1995 BURP Surveys in Mica Creek

Taxa	1995 NF Mica (percent)	Taxa	1995 SF Mica (percent)
Chironomidae	42.9	*Microcylloepus*	31.4
Microcylloepus	12.5	*Chironomidae*	30.4
Baetis tricaudatus	10.9	*Ordobrevia nubifera*	15.2
Suwallia	6.1	*Skwala*	5.6
Zaitzevia	3.9	*Baetis tricaudatus*	4.3
Total	76.4	Total	86.8

8.4 Conclusions

8.4.1 Mica Bay Assessment

Coeur d'Alene Lake supports a variety of game and nongame fish species. Average and maximum depths in the lake are 70 feet and 200 feet, respectively, and provide good habitat for deep water fish species including kokanee and chinook salmon. However, many bays in the lake, including Mica Bay, are vegetated and relatively shallow, and these conditions provide good habitat for bass and northern pike as well as good nursery areas for juvenile fish of various species.

Fisheries habitat and vegetative surveys were conducted within Mica Bay in the early and late 1990s that describe aquatic species, abundance, and depth of occurrence of aquatic vegetation. Qualitative comparisons of the early surveys were made with recent underwater video. These comparisons found no indication of a change in aquatic vegetation (fish habitat) based on species presence and densities or depth of occurrence, that could be attributed to an input of sediment from the project. Further, the hydrographic surveys conducted in 2002 indicated that no fish passage impediment to Mica Creek occurred across the delta resulting from the project.

Fish have a tolerance to brief periods of high sediment load—a trait that is essential to survival in environments with runoff and flood events; therefore, short exposures to high turbidities generally have no lasting effect. Information available on the magnitude, frequency, and duration of turbidity levels in Mica Bay during the project, along with what the scientific literature describes about turbidity and suspended sediment effects on fish (Appendix M), provide evidence that lethal effects (e.g., mortality) or sublethal effects (e.g., physiological stress) on fish within the bay were not likely caused by the project.

8.4.2 Fisheries Conclusions

8.4.2.1 Habitat

The project area and the reference reaches upstream of the project have a history of land uses that have contributed to the existing stream habitat conditions. Stream channelization and subsequent downcutting have created unstable channel conditions within the lower portions of the South Fork and North Fork Mica Creeks. Heavy cattle use within the North Fork and lower South Fork Mica Creeks is currently contributing to bank erosion. Large sand bars within the North Fork suggest that a contributing source of sediment exists upstream of the surveyed reaches. Aerial photos of the watersheds depict riparian roads and stream crossings that contribute sediment into the creeks. Further, beaver activities within the South Fork have altered the sediment transport conditions to create large storage areas for natural and anthropogenic-derived sediments within the upper portions of the South Fork Mica Creek. This includes a large beaver dam complex both upstream and downstream of the project sediment basin breach. It is likely that a portion of the sediment delivered to the South Fork from the breach is being stored within this beaver dam complex.

Stream habitat index comparisons show that, on average, the stream reaches on the South Fork Mica Creek have higher habitat quality than either the lower mainstem Mica Creek or the North Fork Mica Creek. Both the North Fork and the mainstem showed substantially greater bank erosion than the South Fork. Both watersheds show evidence of high flow events, both annual and periodic flood events. Based on the comprehensive stream habitat survey there was no evidence of altered channel morphology due to the project.

Beaver dams are natural sediment traps that can reduce the amount of downstream sedimentation, during storage cycles, as much as 90 percent (Swanston, 1991). The amount of sediment stored within the channel and behind the beaver dams upstream of the project area suggest sediment sources above the project area within the South Fork Mica Creek; however, the relative proportion of sediment sources remains unknown. These sediments would likely be mixed with the sediments that were released from the project area. Periodic beaver dam failures could release the stored fine sediments and contribute to the sand bars found in South Fork Mica Creek, as well as downstream. The debris that was observed in the branches above the stream channel in SF1/SF2 suggests flows of sufficient magnitude to blow out portions of the beaver dams as often as every year. Changes in sand bar character between 2002 and 2003 suggest that fine sediment is being transported through the system. The recent and continuing beaver activity in the South Fork should, at least temporarily, attenuate sediment delivery to the lower South Fork and mainstem.

8.4.2.2 Fisheries Assessment for South Fork and North Fork Mica Creek and Mica Creek

Based on the averaged SFI ratings for the South Fork Mica Creek sites there are negligible evident differences between upstream and downstream sites and all sites would be considered good and not impaired. However, the Mica Creek site had a significantly lower average SFI than all of the other sites (68), which indicates impairment. This impairment was primarily due to three factors: 1) the limited number of cutthroat trout abundance and age classes through out the three events; 2) the presence of smallmouth bass being captured at the site; and 3) degraded habitat including sloughing banks, limited instream habitat complexity, lack of large woody debris, and limited undercut banks. Therefore, the greater abundance of fish and relative species distribution at upstream sites is likely because of increased habitat availability, complexity, diversity, stability, and food production capability.

All sites had multiple age classes of cutthroat trout and torrent sculpin present, indicating a good stable age structure with the exception of the mainstem site where multiple age classes were present during one sampling event only. Multiple age class presence is an indicator of successful spawning and incubation and that aIDEQuate spawning gravel is present and being utilized.

The highest number of fish collected (81) at any of the stations during the three events occurred at Site SF2 during the September 2003. The SF2 site received the highest average SFI rating (94) followed closely by USF, NF, and SF1 with average SFI scores of 91, 90, and 87, respectively. These were followed by Sites SF3 and MS with average SFI scores of 82 and 68, respectively.

Kokanee salmon and smallmouth bass have been observed using Mica Creek and its tributaries during different times of the year. It would not be unexpected for other resident fish species to utilize portions of Mica Creek as well.

8.4.2.3 Macroinvertebrate Assessment of South Fork and North Fork Mica Creek and Mica Creek

In general, sites upstream (unimpacted by the Project) and downstream (potentially impacted by the Project) received similar averaged metric scores for riffle areas, with the exception of the NF site which had lower metric scores indicating poorer conditions and had the lowest averaged FSBI score of any of the riffle sites (76). Averaged FSBI scores for the South Fork and mainstem sites ranged from 90 at Site SF3 to 117 at Site USF with Sites MS, SF1, and SF2 receiving scores of 95, 100, and 95 respectively. In addition, all sites contained a high averaged proportions of taxa that are moderately tolerant or tolerant to sediment but all sites supported taxa that are moderately intolerant or intolerant to sediment as well. Furthermore, Mica Creek has had a Total Maximum Daily Load (TMDL) for sediment indicating that sediment has been an issue in the past in this basin.

All South Fork and Mica Creek pool and riffle sites supported many types of clinger taxa with taxa diversity remaining stable throughout the three sampling events. Stable clinger taxa diversities indicate that the sites are not enduring additional environmental stressors at this time.

The average HBI values did not vary greatly between riffle and pool samples at any of the sample sites with the NF site having the highest rating at riffle sites and among the highest at pools 6.2 and 6.5, respectively. The biotic index (BI) scores for each taxa have overall proportions in the tolerant range. However, the taxa at the USF and SF2 sites had a higher proportion of moderately intolerant and intolerant taxa than the other sites with the USF site, which had more moderately intolerant taxa than tolerant taxa.

The dominant feeding category is collector-gatherers, which suggests that a specific impact may have occurred to alter the food source. Because all stations are greatly dominated by collector-gatherers suggest that an impact has potentially occurred independently of the project. For this type of stream, the predominance of the Collector-Gatherer is not unusual.

Overall, comparing the USF site (reference site) with other South Fork and the mainstem sites, there are no real significant differences in overall average metric scores or overall average SMI scores suggesting that these sites seem more similar to each other than dissimilar. This is supported by the cluster analysis, which also demonstrated that the communities both upstream and downstream of the project on the South Fork and mainstem Mica Creeks are not noticeably different in the number of taxa, taxa diversity, and individual abundances. If the project would have had a noticeable impact it would be expected that the clustering would show the disparity. Of all of the stations, the NF site seemed more dissimilar to the other sites but yet not significantly.

Many parameters were assessed statistically and multimetrically to evaluate if the project had an adverse impact on the macroinvertebrate community. The multimetric approach was used after each sampling event to discern any potential trends and to assess the health of the community at the time of sampling. No apparent adverse signs of project impacts were observed after any of the three sampling events. The statistical evaluation supports the conclusion that no noteworthy differences were found between upstream and downstream sites that would suggest the project had a no noticeable adverse impact on the macroinvertebrate community. There are differences between some sites and between the USF site and some of the downstream sites but these differences do not suggest, or demonstrate, that the project was the cause of these differences.

9.0 Water Supply and Treatment Systems

9.1 Methods

The purpose of this chapter is to evaluate potential effects of turbidity in Mica Bay on residential water supply and treatment systems that use water from the bay. A list of homeowners around the bay was compiled by comparing Kootenai County property tax records and plat maps identifying parcel locations. Fifty-four property owners were identified.

A one-page letter, with a one-page questionnaire attached, was sent to each of the 54 identified property owners by ITD District 1 on July 10, 2003. Two letters were returned as not deliverable. Twenty-six responses were received. The responses are included in Appendix O.

Of the 26 responses, 18 used water from the bay. Twelve of the 18 indicated that their water system was affected in an out-of-the-ordinary way by sediment or turbid conditions in the bay sometime since fall 2001.

ITD attempted to contact each of the residents who responded that their water systems had been affected by sediment/turbidity. The purpose of the follow-up contact was to gather additional information via personal interviews from these water users regarding the types of water systems involved, and what specific effects were believed to have occurred.

Personal interviews were conducted with the homeowners who were successfully contacted. The interviews covered seven water systems serving 13 separate residences, as described in more detail below.

9.2 Results

This section summarizes interviews conducted with Mica Bay homeowners that draw water from Coeur d'Alene Lake. Seven separate interviews were conducted with Mica Bay homeowners. Table 9-1 (at the end of this chapter) presents a summary of the interviews. Narrative summaries of the interview results are presented below.

9.2.1 Water Supply and Usage

Seven water systems serving thirteen separate residences are represented in the homeowner interviews. Five of seven water systems serve individual residences. The remaining two water systems serve five homes and three homes, respectively.

The Mica Bay homeowners that participated in the personal interviews utilize both well water and lake water to meet their needs. Three of seven water systems utilize a combination of well water and lake water, with the four remaining systems relying exclusively on lake water.

For those water systems that utilize a combination of well water and lake water, the well water is used exclusively for indoor domestic purposes, and the lake water is primarily restricted to outdoor uses such as irrigation and landscaping. One homeowner (Joan

Simpson) that has both lake water and well water supplies reported using untreated lake water for a hot tub and toilet located in her barn. The homeowners that rely solely on lake water use the water for both indoor and outdoor domestic purposes.

9.2.2 Lake Water Intakes and Conveyance Systems

The majority of Mica Bay homeowners that draw water from the lake have water intakes consisting of slotted standpipes or drum screens. For the homeowners participating in the interviews, the depth of submergence of the intakes ranges from 2 feet to 37 feet.

An example of a standpipe having slotted openings is shown in Photos 5 through 8 (see Appendix I). The standpipe consists of 4-inch-diameter polyvinyl chloride (PVC) pipe with approximately 1/16-inch slotted openings. This standpipe is thought to be owned by John Griffin and is submerged at a water depth of 15 feet.

Photos 9 through 13 show an example of a drum screen intake. The drum screen is located on top of a vertical 3-inch-diameter PVC pipe that is attached to a horizontal 3-inch-diameter PVC conveyance pipe. This series of photographs shows the drum screen before and after the diver removed accumulated organic matter and silty detritus from the surface of the screen. An examination of the photographs suggests that the intake screen is composed of stainless steel slotted wedge wire. The resolution of the photos is insufficient to estimate the size of the slot opening on the screen.

Two types of conveyance systems are being used by the Mica Bay homeowners that participated in the interviews: 1) submersible pumps, and 2) centrifugal pumps. The submersible pumps are in-line pumps located offshore near the water intakes. The centrifugal pumps are located onshore in dedicated pump houses or in boat houses. Because the centrifugal pumps are located onshore above the lake level, they are usually equipped with a foot valve which maintains a prime on the pump. The foot valve is typically located offshore near the water intake.

9.2.3 Water Treatment Systems

For those Mica Bay homeowners that rely solely on water from Coeur d'Alene Lake for their domestic water supply, water treatment systems are being used to treat the lake water. The treatment systems generally consist of filtration followed by some form of disinfection. The water treatment apparatus used by Mica Bay homeowners are typically located onshore, either in pump houses or individual residences.

Bag filters and cartridge filters are the two most common forms of filtration devices used by Mica Bay homeowners. These devices are designed to remove suspended particulate matter larger than approximately 1 micrometer (µm). Included in this size classification are microbial contaminants such as bacteria, and protozoan oocysts of *Giardia* and *Cryptosporidium*. Microbial contaminants that are not included in this size classification are viruses, which can readily pass through 1-µm pore openings.

None of the water treatment systems represented in this survey are equipped with backwashing capabilities for removing accumulated sediments from filters. Both bag filters and cartridge filters are passive devices that can experience clogging and reduced performance as sediment accumulates on the filter surface. The most common indication of reduced performance associated with sediment accumulation is loss of water pressure. The remedy for clogged cartridge filters and bag filters typically involves manual cleaning and/or replacement of the filters.

Some form of disinfection is used by all Mica Bay homeowners participating in the interview process that use lake water for indoor domestic purposes (drinking, cooking, bathing, etc.) Two types of disinfection apparatus were reported during the interviews: 1) ultraviolet (UV) disinfection, and 2) chlorination. UV disinfection is the exposure of water to UV light generated by lamps. UV disinfection is an effective means of inactivating oocysts of *Giardia* and *Cryptosporidium*, but does little to disinfect viruses. Chlorination is a disinfection process that adds chlorine to water. Mica Bay homeowners use liquid sodium hypochlorite as the source of chlorine disinfectant in their chlorination systems. Chlorine is very effective for killing viruses, but is less effective than UV against *Giardia* and *Cryptosporidium*.

9.2.4 Effect of Sediment Loading on Mica Bay Water Systems

For those homeowners having wells, no incidences of adverse impacts on well water quality resulting from project-related sediment loading to Mica Bay were reported.

Owners of two of seven water systems represented in the interviews that draw water from Coeur d'Alene Lake reported experiencing no operational problems that can be attributed to increased sediment loading to Mica Bay. Of the systems reporting no problems, one system filters its lake water prior to use (Leach/McKernan/Pennington system) while the other system uses unfiltered lake water that is obtained from a screened intake (Orland Scott).

Owners of five of seven water systems represented in the interviews reported some type of operational problem that may be a result of episodes of increased sediment loading to Mica Bay. Two homeowners (James Yates and Daniel Blair) reported mud-clogged filters that require monthly replacement. Two water systems reported operational problems with submersible pumps during 2002 and 2003 that were presumably caused by mud and sediment (White Sands Estates and John Griffin). For both systems, homeowners reported a significant decrease in pressure which necessitated replacement of the submersible pumps. During replacement, an excessive amount of mud and sediment were noticed inside the pump casing. The original pump for White Sands Estates had been installed in 1974 and had not required replacement until May 1999, at which time no silt had been observed in the pump. The pump had to be replaced again in June 2003; the casing around the pump was reported to full of silt at that time. One of the five homeowners reporting operational problems (Joan Simpson) reported cloudy lake water in late 2002. This homeowner uses unfiltered lake water for irrigation and also for a hot tub and toilet located in a barn. During late 2002, dirty water was noted in the toilet, and the filter on the hot tub became clogged with a red, gritty material. The homeowner also reported that her irrigation sprinklers have been clogging much more frequently in recent years.

The reported operational problems noted above suggest that some of the systems have been impacted by sediment/turbidity in Mica Bay. The reports also suggest that these operational problems were primarily caused by suspended sediments in Mica Bay. Suspended sediments can cause the drop in pressure noted by two homeowners that have submersible pumps. Suspended sediments in the water column can also increase the frequency of clogged filters and clogged irrigation sprinklers, as noted by several homeowners. Therefore, it appears that episodes of suspended sediments in the water column have had an adverse impact on some Mica Bay homeowners. The extent to which these problems may be project related can be evaluated by other evidence as described elsewhere in this assessment.

The short-lived turbidity exceedances that occurred in Mica Bay since September 2001 are not likely to have had a long-term adverse impact on water quality for those homeowners that draw water from Mica Bay. The water systems that use lake water for indoor domestic purposes have treatment systems that filter and disinfect the water prior to use. This type of treatment system is designed to handle turbidity spikes in the raw water supply similar to those experienced in Mica Bay since September 2001. The main effect that these periodic turbidity exceedances would have on water systems would be reduced pumping pressures, clogged filters, and clogged sprinklers caused by short-term episodes of cloudy water.

One would expect complaints about turbidity exceedances from Mica Bay homeowners that do not filter lake water prior to use. In fact, two water systems that use unfiltered lake water did report cloudy water (Leach/McKernan/Pennington, and Joan Simpson). Joan Simpson reported problems in late 2002. Inspection of Figures 6-5 through 6-7 show that there were no project-related turbidity spikes in late 2002. Leach/McKernan/Pennington did not provide a specific time period for the problems they reported.

9.3 Conclusions

Fifty-four property owners were identified around the bay. A one-page letter, with a one-page questionnaire attached, was sent to each of the identified property owners. Twenty-six responses were received; of these 18 used water from the bay. Twelve of the 18 indicated that their water system was affected in an out-of-the-ordinary way by sediment or turbid conditions in the bay sometime since fall 2001. Personal interviews were conducted with the homeowners who were successfully contacted. The interviews covered seven water systems serving 13 separate residences.

Mica Bay homeowners utilize both well water and lake water for domestic purposes. Some homeowners obtain their water supply from deep wells, whereas others get their entire water supply from Coeur d'Alene Lake. Some homeowners use a combination of well water and lake water, with the well water being used for indoor domestic purposes such as drinking and bathing, and the lake water being used for irrigation and lawns. Mica Bay homeowners that rely solely on Coeur d'Alene Lake filter and disinfect the water prior to consumption.

Most Mica Bay homeowners that draw water from Coeur d'Alene Lake have water intakes consisting of slotted standpipes or drum screens. For the homeowners participating in the interviews, the depth of submergence of the intakes ranges from 2 feet to 37 feet. Diving records and photographs of intakes indicate that many of the screen surfaces contain a thin layer of organic matter and sedimentary detritus, but otherwise appear to be functional and operating as intended. Diving records did not reveal the presence of deposited sediments on intakes or conveyance piping.

Some Mica Bay homeowners have noticed an increase in the frequency of operational problems associated with their water systems that draw water from the lake. Problems reported by homeowners during interviews included: 1) reduced water pressure, 2) mud-clogged filters and sprinkler heads, and 3) cloudy/muddy water.

TABLE 9-1
Summary of Interviews with Mica Bay Homeowners

Homeowner	Source Water Supplies	Lake Water Usage	Intake	Conveyance System	Treatment System	System Maintenance	Reported Problems
White Sands Estates[a]	Lake water	Domestic & irrigation	Tee, no screen, 35-37 foot depth	Submersible pump	**All Uses:** Bag Filter → Chlorine → Carbon Filter	North Idaho Pump for submersible pump & bag filter; homeowners maintain chlorine & carbon filters	The original pump was installed in 1974 and did not require replacement until May 1999 at which time there was no silt observed in the casing. On June 30, 2003, submersible pump was replaced after 4 years of service. During replacement, the pump casing was observed to be full of mud.
James Yates	Lake water	Domestic & irrigation	Standpipe, no screen, 37-foot depth	Submersible pump	**Domestic:** Coarse Filter → Fine Filter → UV Light → Post Filter **Irrigation:** No treatment	R. C. Worst for submersible pump; homeowner maintains filters and UV system.	Filters require replacement on a monthly basis. Homeowner are not happy with mud.
Daniel Blair	Lake water	Domestic & irrigation	Standpipe, no screen, 37-foot depth	Submersible pump	**All Uses:** Bag Filter → UV Light	R. C. Worst for submersible pump; homeowner maintains filter and UV system	Filters require replacement on a monthly basis. Homeowner are not happy with mud.
Leach / McKernan / Pennington System[b]	Lake water	Domestic & irrigation	Intake estimated @ 15-foot depth, no screen.	Centrifugal pump located in pump house	**Domestic:** Bag Filter → Chlorine **Irrigation:** No treatment	North Idaho Pump maintains pump & bag filter; homeowners maintain chlorine	No problems reported with operation of treatment system. Some discoloration of water noted.
Orland Scott	Well water & lake water	Well water for domestic; Lake water for irrigation	Screened intake @ 9-12 foot depth	Well pump @ 135-foot depth; centrifugal pump in pump house	**Domestic:** No treatment of well water **Irrigation:** No treatment of lake water	Both water systems maintained by homeowner	No operational problems reported for either water system. Noted a huge increase in vegetation and decrease in water depth during past 50 years.
Joan Simpson	Well water & lake water	Well water for domestic; Lake water for irrigation, and hot tub and toilet in barn.	Screened intake @ 2-foot depth	Well pump @ 325-foot depth; centrifugal pump in boathouse	**Domestic:** No treatment of well water **Irrigation:** No treatment of lake water	Both water systems maintained by homeowner	Cloudy lake water noted in late 2002. Sprinkler heads plug more frequently than in past. Lake water seems muddier, especially during spring. Hot tub filter had lots of red grit. Toilet in barn had dirty water.
John Griffin	Well water & lake water	Well water for domestic; Lake water for irrigation.	Standpipe w/ slotted openings @ 15-foot depth	Well pump @ 135-foot depth; submersible pump	**Domestic:** No treatment of well water **Irrigation:** No treatment of lake water	Both water systems maintained by homeowner	Lake intake covered with sediment plume. Pump was replaced in 2002 due to loss of pressure. Noticed lots of sediment during pump replacement.

[a]White Sands Estates has a single water system that serves five residences. The residences are owned by Elizabeth Ries, Peretti Family LLC, Tsalaky Family Trust, James Bourekis, and Allen Roy.

[b]A single water system serves the homes owned by Edward Leach, Steven Pennington, and Richard McKernan.

10.0 Recreation

10.1 Background and Methods

For the purpose of assessing potential impacts to recreation in Mica Bay as a result of theproject, the recreational opportunities considered were the following:

- Swimming
- Fishing
- Boating

The potential impacts to be considered result from either elevated turbidity (magnitude and frequency) or sediment deposition. Examples of potential impacts include sustained high turbidities that might deter people from choosing the bay as a destination location for swimming or fishing, or reduce the health of the fishery. Another would be extensive sediment deposition precluding access or use of boat launches and docks.

There is a designated swimming area at the Bureau of Land Management (BLM) boater park on the south side of the bay. The boater park also has four docks for overnight mooring to support the camping opportunities at the park. Swimming can also occur at any of the private residences along the bay.

The Kootenai County boat launch is a popular access point to the lake. It is the most westerly facility on the north shore of the bay. This facility includes parking, a restroom, and two docks adjacent to the concrete launch ramp. The County docks are not intended for overnight mooring. Other public launches exist in the bay; however, they are located east of the delta in more open water nearer the main body of the lake. In addition, some of the private residences in the bay have private boat ramps. Private boat docks are prevalent throughout the bay, especially along the north shore (see Figure 2-1).

10.2 Results

The amount of turbidity and sediment deposition in the bay are addressed in previous chapters; therefore, the results provide a basis for assessing potential impacts to the recreational opportunities described above.

10.2.1 Swimming and Fishing

Because the elevated turbidities resulting from the project construction (described in Chapter 6, *Turbidity Analysis*) occurred during the winter and early spring seasons, it is not likely that any impacts to swimming resulted. In addition, as described in Chapter 8, *Fisheries*, there were likely no, or only temporary, minor direct or indirect (habitat) impacts on the fishery. During the 2-week hydrographic surveying effort and the 1-week coring effort, multiple fishing parties were observed using the County boat ramp. In addition, it was not uncommon to observe people fishing from the County docks or from boats in the bay. On more than one occasion, relatively large (16- to 22-foot) fiberglass boats with

V-shaped hulls were observed fishing all the way to Loff's Bay Road in both the Mica Creek channel and the channel to the south (see Figure 2-1).

10.2.2 Boating

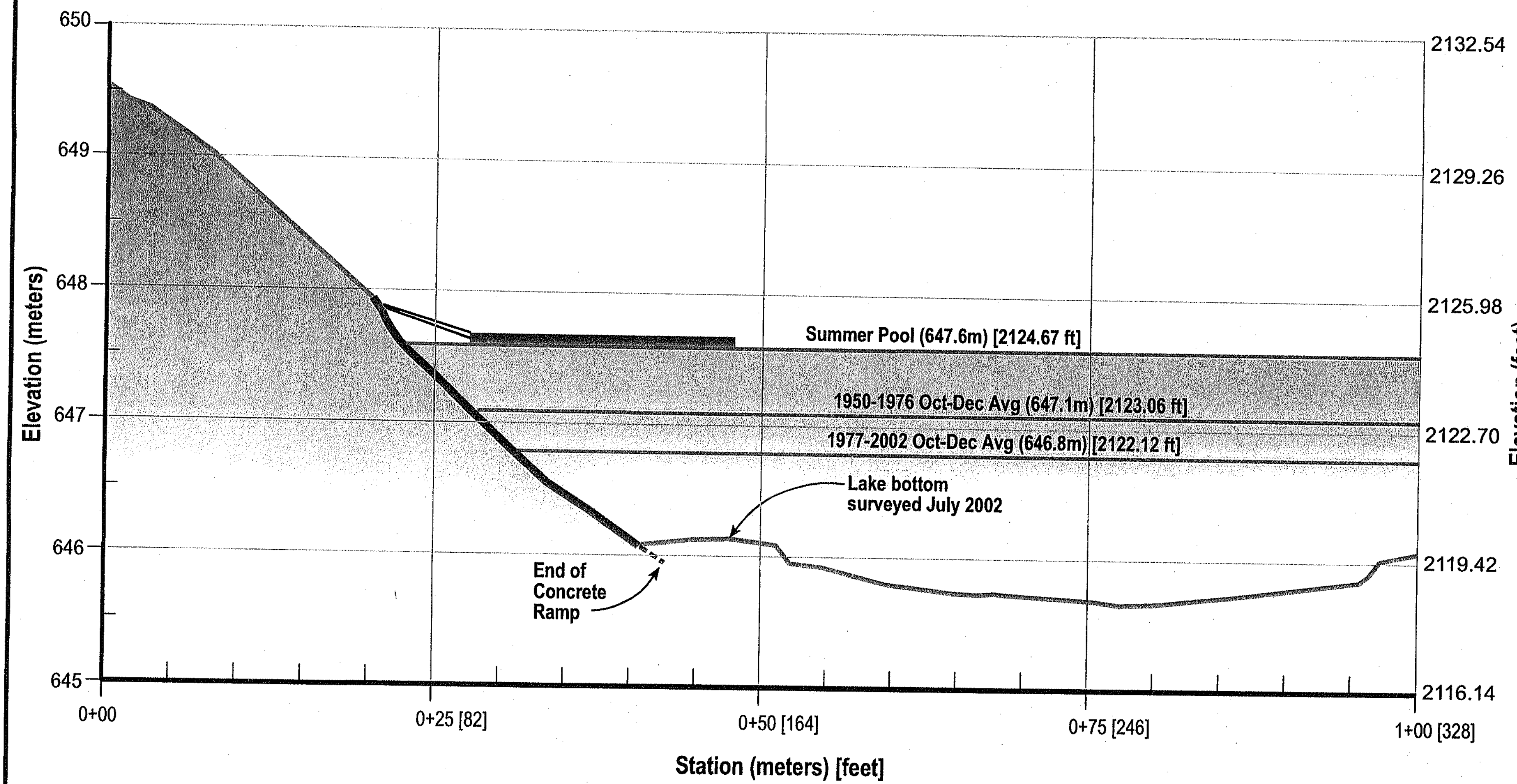
During summer-pool conditions while conducting the hydrographic survey and coring efforts, significant boat use was observed in the bay. Many different boat sizes, including those large enough to have closed-cabins (estimated lengths up to approximately 26 feet) were observed accessing the lake from the County launch. It was not uncommon for the parking area at the launch to be full. On one weekday during the coring effort in late August, a commercial kayaking tour was launched from the County ramp to explore the wildlife and scenery in the bay.

While gathering data and conducting field work for this assessment, comments from some local residents pertaining to boat access at the County ramp were obtained. The general theme of the comments were that "it used to be easier to launch a boat here (at the County ramp) during the late season." It remains unclear as to when the conditions precipitating this sentiment began; however, the perception is that it has been recent. It is also unclear as to whether or not any changes happened abruptly or gradually over time.

Two lines of evidence discussed in previous chapters may reveal the reasons behind this opinion. There are two primary variables that would influence boat access at the ramp during the late season: water surface elevation and sediment deposition. Figure 10-1 illustrates late-season water surface elevations in relation to the concrete ramp and lake bottom at the Kootenai County boat launch as surveyed in July 2002. The end of the concrete ramp, which was extended in 1977 (Robinson, 2003), is shown on the figure. As illustrated, the average water surface elevation during the months of October through December (late season) from 1950 through 1976 was 647.1 meters (2,123.0 feet) (Mica Bay elevation datum). In comparison, the late season average from 1977 through 2002 is now 0.3 meter (1 foot) lower.

Figure 10-2 illustrates a more detailed analysis of the late season water surface elevations since 1950. This figure illustrates that the water surface elevations in all three late season months has dropped since the 1950s and 1960s (up to 1.5 meters [5 feet]). Since 1970, the water surface elevations during the month of October have remained relatively constant. The levels during 2000 through 2002 become noticeably and progressively lower in November and December. With the exception of the 1950s and 1960s, the greatest difference between any two time periods occurred between the 1990s and the 2000-2002 data (with the 2000-2002 being the lowest).

Based on the data presented in previous chapters, the project did not result in enough sediment deposition in the bay to even quantify; however, as described in Chapter 4, *Aerial Photography*, the primary channel across the delta has migrated toward the north shore (near the boat ramp) prior to 1999, likely exacerbated during the 1996 flood. Because it is not uncommon for submerged levees (sediment aggradation) to form along delta channels (*Summerfield, 1991*), the channel shifting that occurred prior to 1999



Note: Kootenai County boat ramp was extended March 10, 1977. Elevations are based on the Mica Bay datum (see Chapter 2).

FIGURE 10-1
Late Season Water Surface Elevations at the Kootenai County Boat Ramp, Coeur d'Alene Lake
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

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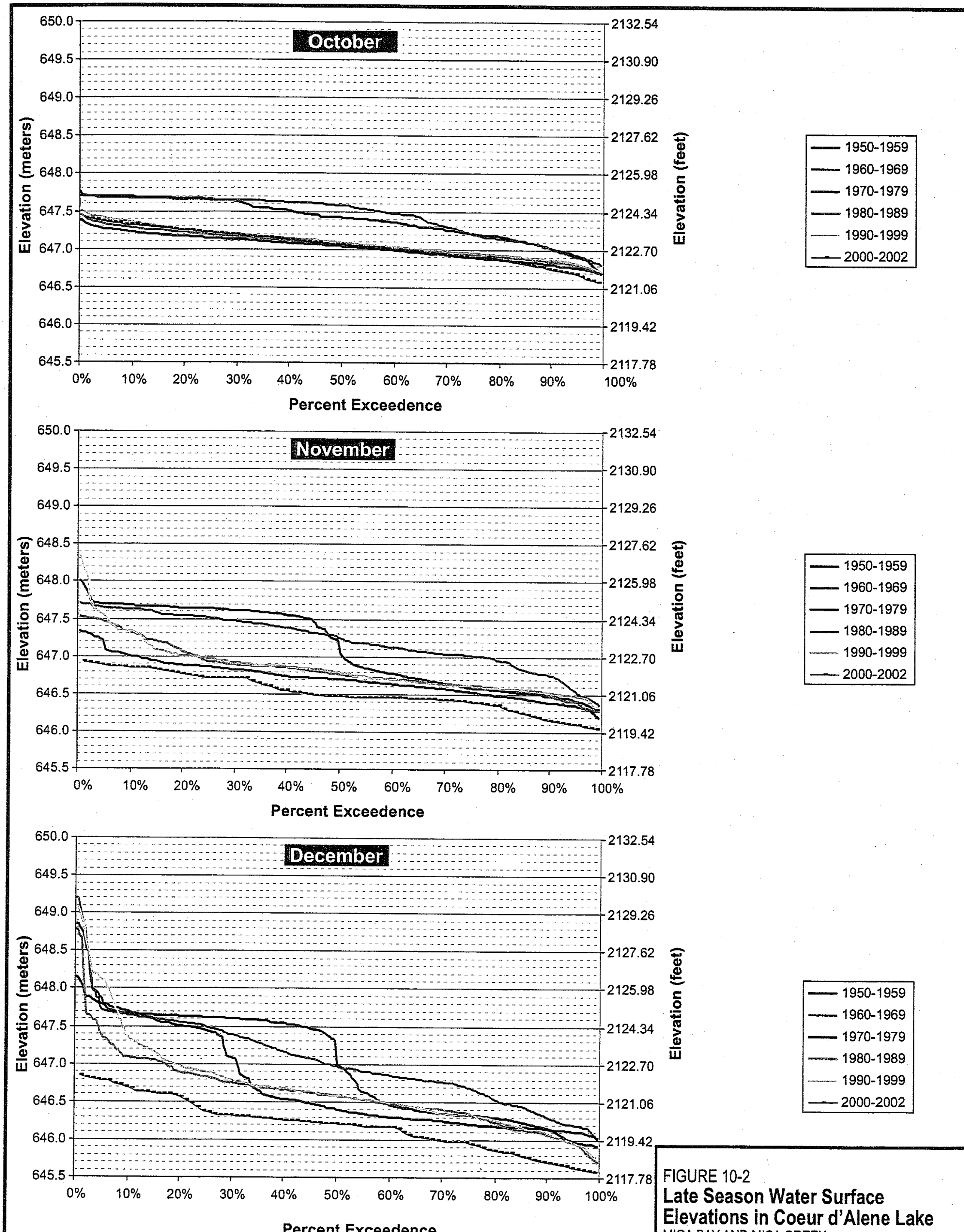

FIGURE 10-2
Late Season Water Surface Elevations in Coeur d'Alene Lake
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

may have contributed to the opinion of more difficult access at the boat ramp. However, a diver measured a depth of only 1 to 2 inches of sediment over the end of the concrete boat ramp on August 12, 2003 (during underwater still photography effort described in Chapter 5).

10.3 Conclusions

Based on findings presented in other chapters, in addition to an analysis of historical lake water surface elevations, the project did not likely impact any recreational opportunities in the bay. If any impacts occurred, they would have been temporary and associated with elevated turbidity during the winter months when recreational activity on the lake is at a minimum.

Comments received during the course of this assessment have relayed concerns pertaining to difficult boat access during the late season resulting from sedimentation in Mica Bay. Lower water surface elevations during the more recent late season months has likely contributed to the concern of more difficult boat access at the Kootenai County boat ramp during the late season. The lateral movement of the primary channel location across the delta, which was a pre-project event, may have exacerbated this perception because it resulted in the area of active deposition being closer to the north shore near the County boat launch. A detailed analysis of the late season water surface elevations revealed that the lake levels in all three late season months has dropped since the 1950s and 1960s up to 5 feet. Since 1970, the water surface elevations during the month of October have remained relatively constant; however, since 2000 the levels have become progressively lower in November and December. With the exception of the 1950s and 1960s, the greatest difference between any two time periods analyzed occurred between the 1990s and the 2000 to 2002 data—with the 2000 to 2002 being the lowest lake levels during these months.

11.0 Conclusions

11.1 Hydrographic Survey and Historical Lake Water Surface Elevations (Chapter 2)

There is extremely close agreement between the location and shape of the leading edge of the delta measured during the July 2002 hydrographic survey and its location in the 1999 pre-project aerial photograph. This demonstrates that the project did not result in enough sediment deposition in Mica Bay to extend the delta farther out into the lake as evidenced by aerial photgraphs.

The minimum lake water surface elevation and the 2002 lake bed elevation at the delta pivot point are the same, providing strong evidence that the vertical and lateral extent of the delta front was established by the minimum lake drawdown.

The Mica Creek channel remains relatively deep (approximately 4 to 6 feet deep in summer) through the delta upstream as far as Loff's Bay Road.

11.2 Sediment Analysis (Chapter 3)

Sediment cores up to 8.6 feet long were successfully extracted from 10 locations in Mica Bay. To help assess the potential impact of the project site as a source of sediment to Mica Bay, sediment and soil samples were collected from the watershed. Sixteen different locations in the watershed were sampled to define soils from the dominant land use types, including the project construction site, as well as stream sediments from the South Fork Mica Creek (upstream and downstream of the project), North Fork Mica Creek, and Main Stem Mica Creeks.

The physical characteristics of the core contents were described and documented based on a visual inspection during processing of the cores in the field. Sediment samples were extracted from these visible core depth intervals for laboratory analysis. Samples collected from the watershed were analyzed for the same physical and chemical parameters as the core samples. The physical analyses included grain size and specific density. The chemical analyses included both major-rock forming and trace element chemistry as well as an evaluation of nutrient and total organic carbon concentrations. In addition to providing quantitative descriptive information of the Mica Bay and watershed samples, the chemical data were analyzed in an attempt to define the relative contributions of sediment sources to Mica Bay.

As a result of these analyses, Mount Saint Helens ash was identified in the cores. The Mount Saint Helens ash provides a means to estimate a post-May 1980 average sedimentation rate. Based on the thickness of sediments in core depth intervals that are above the ash-dominant depth interval, the estimated average sedimentation rate within the Mica Bay delta environment ranges from 0.8 to 1.7 inch per year.

The sediments throughout all the core depth intervals, as well as those overlying the Mount Saint Helens ash dominant layer, exhibited highly variable physical and chemical characteristics. This indicates a complex history of both continuous and episodic deposition rates that have varied in both time and location. In other words, sediments forming a more uniform physical and chemical signature overlying the top of a series of cores, as might be expected from a recent, singular, and significant source of sediment was not found. This finding, along with the relatively shallow sediment depths to ash leads to a conclusion that the project has not resulted in an adverse impact as a result of sediment deposition in Mica Bay.

This conclusion is further supported by the x-y scatter plot analyses conducted to determine the relative contributions of watershed soil and sediment sources to the Mica Bay sediments. These analyses utilized the major rock-forming elements silica, alumina, and potassium oxide; and the trace element pairs barium versus zinc and cerium versus lanthanum to evaluate the probable watershed sources to core depth intervals in Mica Bay. No depth interval was found to be unequivocally associated with project-related soils or stream sediments that potentially contain project-related soils and/or sediments.

If project-related material were present, the most likely depth interval that would be expected to contain identifiable amounts of the soil or sediment would be the uppermost depth interval of any core location. Metals concentrations in all the watershed sources are quite small. However, except for the uppermost core depth interval of Core 7, uppermost depth intervals are significantly enriched with metals. Zinc is used as an indicator for the metals present in these uppermost depth intervals. The metals originate from mine sources up-lake of Mica Bay and their high concentrations require that the sediments be exposed for a considerable time to the lake waters to acquire and retain such high metals and particularly zinc concentrations. On the other hand, a recent release of project-related soil or sediment would be expected to have a very low metals concentration reflecting the low metals concentrations of the watershed sediments. Except for the uppermost depth interval of Core 7, none of the uppermost core depth intervals exhibited this characteristic. The uppermost depth interval of Core 7 has the average watershed source zinc concentration of 85 mg/kg. However, it also has the highest barium concentration of both watershed and core depth intervals and it shares these characteristics with a pre-1980 core depth interval from Core 1. These relationships indicate that the watershed source(s) and depositional conditions of this uppermost depth interval of Core 7 and the pre-1980 core depth interval from Core 1 were essentially the same. In other words, the uppermost core depth interval of Core 7 is not unique and does not indicate a project-related sediment deposition in Mica Bay.

Ultimately, the project construction soil samples were not uniquely chemically separable from the forest soil samples, so the exact contribution of soils originating from the project site could not be determined. However, as stated above, the sediment source analysis did reveal that the agricultural soils contribute most of the finer-grained sediment in Mica Bay with lesser contributions from road construction and forest soils. Also, as stated above, it was determined that the primary sources of coarser-grained sediments to Mica Bay are from the background locations in the South Fork Mica Creek and the North Fork Mica Creek.

Some conclusions derived from the nutrient and total organic carbon (TOC) data provide further insight to the Mica Bay delta environment. Both the visual assessment of the cores and the analytical chemistry data reveal that aquatic vegetation is a very significant component of many depth intervals within the cores. During the visual assessment of the cores, certain depth intervals were estimated to contain as much as 50 percent vegetation over depth intervals up to 6 feet long. Even higher percentages of vegetation were observed in shorter depth intervals. These observations indicate that aquatic vegetation has been a significant component of the delta for many decades (at least). The conclusions related to the analytical nutrient and organic data are as follows:

- Nitrogen dominates the nutrients within the Mica Bay core depth intervals.
- Organic nitrogen dominates the Mica Bay depth interval nutrients.
- Phosphorus is contributed by the watershed soils and sediments but less than 5 percent of the total phosphorus is available.
- Nitrogen is dominantly contributed by an anthropogenic source unrelated to watershed soils and sediments.
- Analytical values for TOC includes both aquatic vegetation and microbes in the Mica Bay sediments. Wood fragments/debris and the larger aquatic vegetation were sieved out.
- Although not included in the TOC concentration, wood fragments are variably abundant in discrete Mica Bay depth intervals both above and below ash-dominant depth intervals.

Collectively, all the analyses presented in this chapter support the conclusion that the project did not result in an adverse impact as a result of sediment deposition in Mica Bay.

11.3 Aerial Photography (Chapter 4)

Although delta relief can not be quantified using the aerial images, a comparison of pre-project photos to 2002 and 2003 photographs indicate the project did not result in enough sediment deposition in Mica Bay to extend the delta farther out into the lake. In fact, the photos exhibit the most apparent morphological change occurred prior to even 1999. This change was the shift in alignment of the primary channel closer to the north shore of the bay, which appears to have been progressing at least as far back as 1984, became more defined by 1992, and by 1999 the channel to the north had become the primary channel across the delta. Based on the difference between the 1992 and 1999 photos, it is likely that the flood of 1996 exacerbated this change and may have increased the size of the fan-shaped lobe at the mouth of the channel at the delta margin. At other locations on the delta, there are channels visible in aerial photographs taken 35 years ago that are still visible today.

11.4 Underwater Photography (Chapter 5)

Underwater video footage was recorded at nine different locations in Mica Bay in July 2002. Color still photographs were taken at five underwater locations by a diver in August 2003. The underwater video effort included areas along the outer edge of the delta near the mouth of the active channel paralleling the north shore of the bay. The video footage recorded many bottom features such as wood pilings, logs, tires, a sunken boat, water intake structures, and accompanying pipes that had been submerged before the project began. Dense stands of well developed rooted aquatic plants were observed that showed no signs of burial. The underwater photography conducted by the diver revealed that every water intake structure (conveyance piping and slotted or screened intake standpipe) was fully exposed on the lake bed. The video and color still photographs show that the project has not resulted in an observable accumulation of a recent sediment layer at the many locations photographed in Mica Bay.

11.5 Turbidity Analysis (Chapter 6)

Turbidity is a term commonly used to describe the appearance of water (cloudy, muddy, or colored). It is also a scientific unit of measurement quantifying the degree to which light traveling through a water sample is scattered by the suspended organic (including algae) and inorganic particles. The scattering of light increases as the concentration of particles increases. Turbidity is commonly measured in Nephelometric Turbidity Units (NTU). There are other ways to measure the concentration of soils and sediments in water. These include total suspended solids and suspended sediment methods. These are usually reported as milligrams of solids or sediment per liter of water (mg/L).

IDEQ criteria for turbidity restrict the increase to no more than 50 NTU above background on an instantaneous basis, and to no more than 25 NTU over background for 10 consecutive days or more.

There were 21 days from September 2001 through September 2003 on which instantaneous turbidity readings on South Fork Mica Creek exceeded upstream background conditions, at a minimum of one sampling station, by more than 50 NTU. On 10 individual days, instantaneous readings on Mica Creek exceeded background conditions of South Fork Mica Creek, at a minimum of one sampling station, by more than 50 NTU, and on 6 days the readings exceeded conditions of North Fork Mica Creek, at a minimum of one sampling station, by more than 50 NTU. In total, there were 25 days when readings at either South Fork Mica Creek or Mica Creek exceeded background conditions of either North Fork Mica Creek or South Fork Mica Creek. The greatest occurrence of values that exceed background conditions by more than 50 NTU was during fall 2001 through winter 2002 (17 days). There were fewer measured turbidity events in Mica Bay, with most data indicating that levels in Mica Bay tended to be about 25 percent of the values measured in the project-influenced reaches of the South Fork Mica Creek.

None of the monitoring sites within South Fork Mica Creek or Mica Creek had extended periods during which turbidity measurements that exceeded background conditions by more than 25 NTU lasted for more than 10 days. Available turbidity data also does not reveal any events of elevated turbidity in Mica Bay lasting 10 days or longer. This does not necessarily mean that there were no such exceedances in the creeks or bay because there were several periods prior to March of 2002 when there were more than 10 days without available turbidity data. ITD construction diaries and climatological information were examined to qualitatively evaluate the potential for prolonged elevated turbidity during periods without measured data. Considering all information, more than 10 days of elevated turbidity could likely only have occurred on one occasion (11 days from November 10 through November 20, 2001).

Based on measured turbidity data, elevated levels that were influenced by the project returned to levels that were comparable to pre-event or background conditions in no more than 9 days, and usually much sooner.

Information on watershed soils shows that soils from the project were similar in physical characteristics to other soils, and contained a much higher fraction of silt/clay (approximately 40 percent) than in-creek sediment samples (1 to 2 percent silt/clay). Most project area runoff samples tested for settleability showed very poor settleability.

In addition, turbidity data collected show that turbidity levels within the watershed naturally fluctuate and are influenced by factors other than construction activity such as agriculture, logging, and eroding stream banks. There were also occasions when turbidity levels at the sampling location in the bay were higher than upstream in the South Fork and North Fork Mica Creek and the mainstem Mica Creek; this generally occurred during the winter drawdown of Coeur d'Alene Lake.

11.6 Mica Creek Watershed Characterization (Chapter 7)

Based on sediment loads reported in the 1999 Total Maximum Daily Load for Mica Creek, the primary source of sediment in the watershed historically has been logging, with agricultural activities being a secondary source. A substantial increase in logging activities in the watershed occurred in 2000. Streambank encroachment and erosion, as well as stream channelization also appear to have contributed sediment based on records of activities and observations of deeply cut banks. Alterations or disturbances to the streambanks are most apparent in the downstream reaches of the North Fork and South Fork Mica Creeks and essentially the entire length of Mica Creek.

11.7 Fisheries (Chapter 8)

11.7.1 Mica Bay Assessment

Coeur d'Alene Lake supports a variety of game and nongame fish species. Average and maximum depths in the lake are 70 feet and 200 feet, respectively, and provide good habitat for deep water fish species including kokanee and chinook salmon. However, many bays in the lake, including Mica Bay, are vegetated and relatively shallow, and these conditions provide good habitat for bass and northern pike as well as good nursery areas for juvenile fish of various species.

Fisheries habitat and vegetative surveys were conducted within Mica Bay in the early and late 1990s that describe aquatic species, abundance, and depth of occurrence of aquatic vegetation. Qualitative comparisons of the early surveys were made with recent underwater video. These comparisons found no indication of a change in aquatic vegetation (fish habitat) based on species presence and densities or depth of occurrence, that could be attributed to an input of sediment from the project. Further, the hydrographic surveys conducted in 2002 indicated that no fish passage impediment to Mica Creek occurred across the delta resulting from the project.

Fish have a tolerance to brief periods of high sediment load—a trait that is essential to survival in environments with runoff and flood events; therefore, short exposures to high turbidities generally have no lasting effect. Information available on the magnitude, frequency, and duration of turbidity levels in Mica Bay during the project, along with what the scientific literature describes about turbidity and suspended sediment effects on fish (Appendix M), provide evidence that lethal effects (e.g., mortality) or sublethal effects (e.g., physiological stress) on fish within the bay were not likely caused by the project.

11.7.2 Fisheries Conclusions

11.7.2.1 Habitat

The project area and the reference reaches upstream of the project have a history of land uses that have contributed to the existing stream habitat conditions. Stream channelization and subsequent downcutting have created unstable channel conditions within the lower portions of the South Fork and North Fork Mica Creeks. Heavy cattle use within the North Fork and lower South Fork Mica Creeks is currently contributing to bank erosion. Large sand bars within the North Fork suggest that a contributing source of sediment exists upstream of the surveyed reaches. Aerial photos of the watersheds depict riparian roads and stream crossings that contribute sediment into the creeks. Further, beaver activities within the South Fork have altered the sediment transport conditions to create large storage areas for natural and anthropogenic-derived sediments within the upper portions of the South Fork Mica Creek. This includes a large beaver dam complex both upstream and downstream of the project sediment basin breach. It is likely that a portion of the sediment delivered to the South Fork from the breach is being stored within this beaver dam complex.

Stream habitat index comparisons show that, on average, the stream reaches on the South Fork Mica Creek have higher habitat quality than either the lower mainstem Mica Creek or the North Fork Mica Creek. Both the North Fork and the mainstem showed substantially greater bank erosion than the South Fork. Both watersheds show evidence of high flow events, both annual and periodic flood events. Based on the comprehensive stream habitat survey there was no evidence of altered channel morphology due to the project.

Beaver dams are natural sediment traps that can reduce the amount of downstream sedimentation, during storage cycles, as much as 90 percent (Swanston, 1991). The amount of sediment stored within the channel and behind the beaver dams upstream of the project area suggest sediment sources above the project area within the South Fork Mica Creek; however, the relative proportion of sediment sources remains unknown. These sediments would likely be mixed with the sediments that were released from the project area. Periodic beaver dam failures could release the stored fine sediments and contribute to the sand bars found in South Fork Mica Creek, as well as downstream. The debris that was observed in the branches above the stream channel in SF1/SF2 suggests flows of sufficient magnitude to blow out portions of the beaver dams as often as every year. Changes in sand bar character between 2002 and 2003 suggest that fine sediment is being transported through the system. The recent and continuing beaver activity in the South Fork should, at least temporarily, attenuate sediment delivery to the lower South Fork and mainstem.

11.7.2.2 Fisheries Assessment for South Fork and North Fork Mica Creek and Mica Creek

Based on the averaged SFI ratings for the South Fork Mica Creek sites there are negligible evident differences between upstream and downstream sites and all sites would be considered good and not impaired. However, the Mica Creek site had a significantly lower average SFI than all of the other sites (68), which indicates impairment. This impairment was primarily due to three factors: 1) the limited number of cutthroat trout abundance and age classes through out the three events; 2) the presence of smallmouth bass being captured at the site; and 3) degraded habitat including sloughing banks, limited instream habitat complexity, lack of large woody debris, and limited undercut banks. Therefore, the greater abundance of fish and relative species distribution at upstream sites is likely because of increased habitat availability, complexity, diversity, stability, and food production capability.

All sites had multiple age classes of cutthroat trout and torrent sculpin present, indicating a good stable age structure with the exception of the mainstem site where multiple age classes were present during one sampling event only. Multiple age class presence is an indicator of successful spawning and incubation and that aIDEQuate spawning gravel is present and being utilized.

The highest number of fish collected (81) at any of the stations during the three events occurred at Site SF2 during the September 2003. The SF2 site received the highest average SFI rating (94) followed closely by USF, NF, and SF1 with average SFI scores of 91, 90, and 87, respectively. These were followed by Sites SF3 and MS with average SFI scores of 82 and 68, respectively.

Kokanee salmon and smallmouth bass have been observed using Mica Creek and its tributaries during different times of the year. It would not be unexpected for other resident fish species to utilize portions of Mica Creek as well.

11.7.2.3 Macroinvertebrate Assessment of South Fork and North Fork Mica Creek and Mica Creek

In general, sites upstream (unimpacted by the Project) and downstream (potentially impacted by the Project) received similar averaged metric scores for riffle areas, with the exception of the NF site which had lower metric scores indicating poorer conditions and had the lowest averaged FSBI score of any of the riffle sites (76). Averaged FSBI scores for the South Fork and mainstem sites ranged from 90 at Site SF3 to 117 at Site USF with Sites MS, SF1, and SF2 receiving scores of 95, 100, and 95 respectively. In addition, all sites contained a high averaged proportions of taxa that are moderately tolerant or tolerant to sediment but all sites supported taxa that are moderately intolerant or intolerant to sediment as well. Furthermore, Mica Creek has had a Total Maximum Daily Load (TMDL) for sediment indicating that sediment has been an issue in the past in this basin.

All South Fork and Mica Creek pool and riffle sites supported many types of clinger taxa with taxa diversity remaining stable throughout the three sampling events. Stable clinger taxa diversities indicate that the sites are not enduring additional environmental stressors at this time.

The average HBI values did not vary greatly between riffle and pool samples at any of the sample sites with the NF site having the highest rating at riffle sites and among the highest at pools 6.2 and 6.5, respectively. The biotic index (BI) scores for each taxa have overall proportions in the tolerant range. However, the taxa at the USF and SF2 sites had a higher proportion of moderately intolerant and intolerant taxa than the other sites with the USF site, which had more moderately intolerant taxa than tolerant taxa.

The dominant feeding category is collector-gatherers, which suggests that a specific impact may have occurred to alter the food source. Because all stations are greatly dominated by collector-gatherers suggest that an impact has potentially occurred independently of the project. For this type of stream, the predominance of the Collector-Gatherer is not unusual.

Overall, comparing the USF site (reference site) with other South Fork and the mainstem sites, there are no real significant differences in overall average metric scores or overall average SMI scores suggesting that these sites seem more similar to each other than dissimilar. This is supported by the cluster analysis, which also demonstrated that the communities both upstream and downstream of the project on the South Fork and mainstem Mica Creeks are not noticeably different in the number of taxa, taxa diversity, and individual abundances. If the project would have had a noticeable impact it would be expected that the clustering would show the disparity. Of all of the stations, the NF site seemed more dissimilar to the other sites but yet not significantly.

Many parameters were assessed statistically and multimetrically to evaluate if the project had an adverse impact on the macroinvertebrate community. The multimetric approach was used after each sampling event to discern any potential trends and to assess the health of the community at the time of sampling. No apparent adverse signs of project impacts were observed after any of the three sampling events. The statistical evaluation supports the conclusion that no noteworthy differences were found between upstream and downstream sites that would suggest the project had a no noticeable adverse impact on the macroinvertebrate community. There are differences between some sites and between the USF site and some of the downstream sites but these differences do not suggest, or demonstrate, that the project was the cause of these differences.

11.8 Water Supply and Treatment Systems (Chapter 9)

Fifty-four property owners were identified around the bay. A one-page letter, with a one-page questionnaire attached, was sent to each of the identified property owners. Twenty-six responses were received; of these 18 used water from the bay. Twelve of the 18 indicated that their water system was affected in an out-of-the-ordinary way by sediment or turbid conditions in the bay sometime since fall 2001. Personal interviews were conducted with the homeowners who were successfully contacted. The interviews covered seven water systems serving 13 separate residences.

Mica Bay homeowners utilize both well water and lake water for domestic purposes. Some homeowners obtain their water supply from deep wells, whereas others get their entire water supply from Coeur d'Alene Lake. Some homeowners use a combination of well water and lake water, with the well water being used for indoor domestic purposes such as drinking and bathing, and the lake water being used for irrigation and lawns. Mica Bay homeowners that rely solely on Coeur d'Alene Lake filter and disinfect the water prior to consumption.

Most Mica Bay homeowners that draw water from Coeur d'Alene Lake have water intakes consisting of slotted standpipes or drum screens. For the homeowners participating in the interviews, the depth of submergence of the intakes ranges from 2 feet to 37 feet. Diving records and photographs of intakes indicate that many of the screen surfaces contain a thin layer of organic matter and sedimentary detritus, but otherwise appear to be functional and operating as intended. Diving records did not reveal the presence of deposited sediments on intakes or conveyance piping.

Some Mica Bay homeowners have noticed an increase in the frequency of operational problems associated with their water systems that draw water from the lake. Problems reported by homeowners during interviews included: 1) reduced water pressure, 2) mud-clogged filters and sprinkler heads, and 3) cloudy/muddy water.

11.9 Recreation (Chapter 10)

Based on findings presented in other chapters, in addition to an analysis of historical lake water surface elevations, the project did not likely impact any recreational opportunities in the bay. If any impacts occurred, they would have been temporary and associated with elevated turbidity during the winter months when recreational activity on the lake is at a minimum.

Comments received during the course of this assessment have relayed concerns pertaining to difficult boat access during the late season resulting from sedimentation in Mica Bay. Lower water surface elevations during the more recent late season months has likely contributed to the concern of more difficult boat access at the Kootenai County boat ramp during the late season. The lateral movement of the primary channel location across the delta, which was a pre-project event, may have exacerbated this perception because it resulted in the area of active deposition being closer to the north shore near the County boat launch. A detailed analysis of the late season water surface elevations revealed that the lake levels in all three late season months has dropped since the 1950s and 1960s up to 5 feet. Since 1970, the water surface elevations during the month of October have remained relatively constant; however, since 2000 the levels have become progressively lower in November and December. With the exception of the 1950s and 1960s, the greatest difference between any two time periods analyzed occurred between the 1990s and the 2000 to 2002 data—with the 2000 to 2002 being the lowest lake levels during these months.

11.10 Overall Conclusions Regarding Impacts to Mica Bay, South Fork Mica Creek and Mica Creek

Sediment Transport and Deposition Concepts Relevant to This Impact Assessment

As described above, project-related sediment was at times observed in the South Fork Mica Creek, mainstem Mica Creek and Mica Bay as measured by elevated turbidity relative to upstream or pre-event conditions. ITD has also estimated a volume of sediment delivered to the South Fork Mica Creek as a result of the sediment pond breach (135 cubic yards). It is likely that a portion of the sediment delivered to the South Fork from the breach is being stored within the beaver dam complex immediately downstream of the project. Project related sediments also are likely present to some extent in other depositional areas of the lower South Fork and mainstem Mica Creeks. Multiple lines of evidence described above also have shown that the project did not result in an adverse impact to Mica Bay as a result of sediment deposition.

The above findings lead to logical questions: What was the ultimate fate of the sediment observed at times to be suspended in the creek water and as turbid plumes in the bay? Where did the sediment go? Understanding some of the fundamental concepts of sediment transport and deposition can help answer these questions.

The factors affecting sediment transport and the response of the receiving waters and their biological community are numerous, and interrelationships between these processes, environments, and communities are complex and vary considerably over time and space. Nonetheless, there are some basic concepts that help explain what likely occurred in the creeks and bay downstream of the project. Perhaps the most important of these basic concepts is the mode of transport and the importance of sediment "grain size" as described below:

- *Bed load* consists of the coarse sediment that moves on or near the bed of the stream by rolling, bouncing, or sliding
- *Suspended load* consists of finer material that moves by suspension in the water column
- *Wash load* is the finest portion of sediment, generally silt and clay, that is washed through the channel, with an insignificant amount of it being found in the bed

Figure 11-1 provides a schematic representation of the modes of sediment transport.

Note: Wash load can be transported in both the suspended load as well as the bed load component. In this schematic figure, wash load is depicted by the background shading.

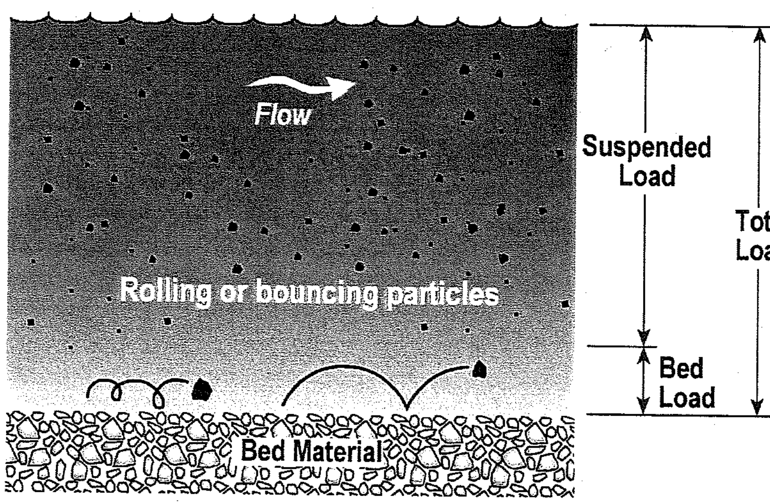

FIGURE 11-1
Schematic representation of sediment transport in a stream.

The soil samples collected from the various land uses in the Mica Bay watershed, including the project area, have an average clay and silt content of 41 percent by weight. The sediment samples collected in the watershed had a clay and silt content ranging from 0.3 to 2 percent, demonstrating that only a very small portion of the clay and silt particles settled in the creek. As described in Chapter 6, suspended sediment samples collected downstream of the project exhibited poor settleability. These data indicate that much of the sediment transported from the project into the South Fork Mica Creek was transported in suspension. Because of the poor settleability of this sediment, combined with the changing water levels and velocities in the lower Mica Creek and into Mica Bay, and the findings of this assessment, it is evident that nearly all of the wash load stayed in suspension as it was transported into the lake proper. This is supported by visual observations from Mica Bay homeowners reporting turbidity plumes in the bay.

A portion of the suspended load comprised predominately of sand particles likely settled into low-velocity environments such as low-gradient stream reaches, pools, and upstream of beaver dams. The larger grain-sized material, such as coarse sand and gravels, are typically transported as bed load. Bed load normally comprises less than a third of the total sediment load (Reid, 1993; Morris and Fan, 1998). Some portion of the bed load from the project was deposited in the floodplain of either a tributary or the South Fork Mica Creek, and was subsequently removed or stabilized by seeding in-place. That portion of the bed load that entered the South Fork Mica Creek likely deposited into the low-velocity environments of the creek.

Based on the findings presented in this assessment, the amount of sediment that did settle in the creek did not alter the biological community or stream habitat beyond conditions found within the watershed.

Overall Conclusions Regarding Impact Assessment

The multiple lines of evidence described above lead to the overall conclusion that the U.S. 95 Bellgrove to Mica project has not had an adverse impact on fish or recreation uses in Mica Bay. The project did not change the shape, size or lateral extent of the delta. Underwater video and photographs show no evidence of recent sediment deposition that has adversely impacted fish habitat, recreational opportunities, or water intake systems. Furthermore, an analysis of the sediment cores from the bay revealed no distinct blanket of visually identifiable project-related sediments in the upper depth interval of the cores. A thorough review of physical and chemical data from the cores revealed that there was an insufficient amount of project-related sediments accumulated within the core layers to quantify as a source within the mixture of sediments from the Mica Creek watershed, the lake, and Mount Saint Helens ash.

There were periods of project-related instantaneous turbidity exceedances in Mica Bay and the creeks. Turbidity data, construction diaries, and climatological information indicate that periods of elevated turbidity were not longer than 10 days and usually much shorter in duration. Some Mica Bay homeowners reported that they had noticed an increase in the frequency of operational problems associated with their water systems that draw water from the lake. Problems reported by homeowners during interviews included: 1) reduced water pressure, 2) mud-clogged filters and sprinkler heads; and 3) cloudy/muddy water.

It is likely that a portion of the sediment delivered to the South Fork Mica Creek from the project sediment pond breach is being stored within the beaver dam complex. Project related sediments also are likely present to some extent in other depositional areas of the lower South Fork Mica Creek and mainstem Mica Creek. From an ecological standpoint, the fish and macroinvertebrate data demonstrate that there are no statistical differences between the upstream and downstream sites throughout the watershed. Cutthroat trout and sculpin were collected at all sampling sites and their presence and multiple age classes are an indicator of successful spawning and incubation, and that adequate spawning gravel is present.

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Final Report

Volume 2 of 3, Appendixes A-G

U.S. 95, Bellgrove to Mica
Project No. DHP-NH-CM-5110(119)

Mica Bay and Mica Creek Final Impact Assessment

Prepared for

Idaho Transportation Department and Idaho Department of Environmental Quality

March 18, 2004

CH2MHILL

Final Report

Volume 2 of 3, Appendixes A-G

U.S. 95, Bellgrove to Mica
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Mica Bay and Mica Creek Final Impact Assessment

Prepared for

Idaho Transportation Department and Idaho Department of Environmental Quality

March 18, 2004

CH2MHILL

Appendix A

Methodology for Impact Assessment

STATE OF IDAHO
DEPARTMENT OF
ENVIRONMENTAL QUALITY

2110 Ironwood Parkway • Coeur d'Alene, Idaho 83814-2648 • (208) 769-1422

Dirk Kempthorne, Governor
C. Stephen Allred, Director

February 26, 2004

L. Scott Stokes, P. E.
District Engineer
600 West Prairie
Coeur d'Alene, Idaho 83815-8764

RE: Mica Bay Sediment Impact Assessment and Fish Impact Assessment

Dear Mr. Stokes:

This letter is a follow-up to the February 19, 2004 meeting between ITD, DEQ and CH2M Hill staff. There is a need to address three important items. First, there is an upcoming deadline for DEQ to respond to your January 30, 2004 written response to our November 26, 2003 letter of deficiency regarding the draft Mica Bay Sediment Impact Assessment. Second, you requested to submit the final Fish Impact Assessment as a chapter in the Mica Bay Sediment Impact Assessment. Finally, we need to establish a deadline for the submittal of the final Mica Bay Sediment/Fish Impact Assessments.

1. As discussed at the February 19 meeting, DEQ will delay final approval/disapproval of the Mica Bay Sediment Impact Assessment until the final document is submitted to our office. This means ITD will not be receiving a separate response to the January 30, 2004 submittal that responded to DEQ's letter of deficiency of November 26, 2003. Per the December 31, 2003 letter from Douglas Conde, Deputy Attorney General, DEQ will have 30 days from the date of submittal of the combined final assessments for this response.

2. DEQ approves of your request to submit the Fish Impact Assessment as a separate chapter in, and at the same time as, the Mica Bay Sediment Impact Assessment. As we discussed, to meet the requirements of paragraph 3 of the Consent Order, the Fish Impact Assessment must be a stand alone chapter in the combined Mica Bay/Fish Assessment document. It is appropriate for chapter(s) discussing the Mica Bay Assessment to reference the Fish Assessment.

3. The new deadline for submittal of the combined final Mica Bay Sediment and Fish Impact Assessments document is March 19, 2004. DEQ's response will be due 30 days from that date. All other deadlines remain in effect per the Consent Order.

Hopefully, this has clarified several outstanding questions on procedure and deadlines. We will continue to be available to discuss any additional findings with your consultants up to the March 19, 2004 deadline.

Sincerely,

Gwen P. Fransen

Gwen P. Fransen, Regional Administrator
Coeur d'Alene Regional Office

cc: Douglas Conde
Toni Hardesty
Don Zarobin

STATE OF IDAHO

OFFICE OF THE ATTORNEY GENERAL

LAWRENCE G. WASDEN

December 31, 2003

Steve Bywater
ITD Contracts & Admin. Law Div.
P.O. Box 7129
Boise, ID 83707-1129

Re: Mica Bay Impact Assessment

Dear Steve,

This is a follow-up to our recent meeting regarding the Mica Bay Impact Assessment. As requested by ITD, and in accordance with paragraph 7 of the Consent Order, DEQ approves extending the deadline for responding to DEQ's deficiency letter regarding the Sediment Impact Assessment until January 30, 2004. Likewise, DEQ will need additional time to resolve issues, and therefore, suggests extending from 14 to 30 days the time for it to review ITD's response. The extension of these two deadlines will also mean we will have to extend the deadline in paragraph 5 of the Consent Order for a final document that meets the requirements of the Consent Order. My suggestion, at this point, is to see how we progress before setting a final date for the document. In the meanwhile, DEQ and ITD technical staff and consultants have agreed to meet and continue the discussions towards resolving the questions raised by DEQ.

In addition, ITD has requested extending the date by which they must submit the Fish Impact Assessment until February 27, 2004. DEQ approves of this extension. As set forth in paragraph 7 of the Consent Order, the new compliance dates set forth herein shall be enforceable under the Consent Order.

Please let me know if you have any questions regarding this letter, and if you have any objections to extending DEQ's time for review. We look forward to resolving outstanding issues.

Very truly yours,

Douglas M. Conde
Deputy Attorney General

DMC/kma

cc: Gwen Fransen
June Bergquist
Ed Tulloch
Don Zarobon
Bob Steed

RECEIVED

JUL 1 1 2002

I.T.D. DIV OF HIGHWAYS
COEUR D'ALENE, IDAHO

STATE OF IDAHO
DEPARTMENT OF
ENVIRONMENTAL QUALITY

2110 Ironwood Parkway • Coeur d'Alene, Idaho 83814-2648 • (208) 769-1422

Dirk Kempthorne, Governor
C. Stephen Allred, Director

July 9, 2002

Scott Stokes, P.E.
District 1 Engineer
Idaho Transportation Department
600 W. Prairie Ave.
Coeur d'Alene, ID 83815

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Dear Mr. Stokes:

On June 6, 2002 we approved the Erosion and Sediment Control Action List, but noted that the response to item 3.A.(4) of the Consent Order was missing from the List. Your June 20, 2002 letter satisfied this requirement.

On June 18, 2002 we sent you a letter addressing the *Action List for Accumulated Sediment*. We received your July 1, 2002 response letter and acknowledge your plans for Station 356+80 Rt.. If you have not already done so, we encourage you to resolve the issue of the fill already placed in the stream channel with the Corps, prior to stabilizing this site. Your letter also expressed the desire to extend the deadline of the sediment basin restoration work to October 1, 2002. In light of the difficulties of last fall, with erosive soils and considerable runoff from the site, we continue to support our purposefully conservative completion date of September 1, 2002.

On June 27, 2002 we received the final version of the *Methodology for Impact Assessment of South Fork Mica Creek, Mica Creek and Mica Bay in Relation to the U.S. 95 Bellgrove to Mica Project*. This document, along with your June 26, 2002 response letter comprises the methodology to be used for this project and is approved for use per Consent Order item 3.H. We suggest that you submit this final version to the Corps and EPA for their files, if you have not already done so. We look forward to the results of your assessment.

Sincerely,

Gwen P. Fransen

Gwen P. Fransen
Regional Administrator

cc: EPA-Kristine Karlson
ACOE-Gregg Rayner
IFG-Ray Hennekey

STATE OF IDAHO Dirk Kempthorne, Governor
TRANSPORTATION DEPARTMENT
DISTRICT 1 • 600 W. PRAIRIE • COEUR D'ALENE, ID • 83815-8764 • (208) 772-1200

June 26, 2002

Gwen P. Fransen
Regional Administrator
Idaho Department of Environmental Quality
2110 Ironwood Parkway
Coeur d'Alene, ID 83815

Dear Ms. Fransen:

Subject: U.S. 95 Bellgrove to Mica Project—Response to Deficiencies Letter

The Idaho Transportation Department (ITD) received your letter of June 11, 2002, regarding the deficiencies the Idaho Department of Environmental Quality (IDEQ) noted regarding the "Proposed Methodology for Impact Assessment of South Fork Mica Creek and Mica Bay" (Methodology). We appreciate the time IDEQ spent with ITD, CH2M HILL, the U.S. Army Corps of Engineers and Idaho Fish and Game at a meeting on Friday June 14 (14th Meeting) to discuss the points in your letter.

It is our belief that we made significant progress at the June 14 meeting; therefore, the responses provided in this letter, along with the proposed revisions to the document, should get us close, if not all the way, to agreement on the Methodology. A modified version of the Methodology is attached.

Below you will find our point-by-point responses and a description of the revisions that were incorporated into the Methodology dated June 26, 2002.

1. The proposed Methodology included total metals analyses. The deficiency noted thus pertained to "dissolved" metals analyses. IDEQ clarified at the 14th Meeting that the purpose of dissolved analyses relates to a potential future dredging alternative. It was agreed at the meeting that it would be premature to conduct chemical analyses on sediment cores in anticipation of dredging because the Assessment may or may not point in that direction. If dredging is ultimately determined to be a potential corrective action, then substantial additional studies, engineering, and regulatory permitting will be needed to further assess this option. That would be the appropriate time to conduct further chemical analyses of sediments that may be candidates for dredging.

   Revisions: Revisions to the Methodology are not needed at this time.

2. IDEQ clarified in the 14th Meeting that the proposed Methodology would not directly address impacts to domestic water users whose treatment systems may have been

affected by water column turbidity that may have passed through the bay from the Project. To do that, we would need to find out who and where the users are, and assess if they were affected. Information on users may be available from a number or sources discussed at the 14th Meeting.

Revisions: The proposed Methodology (page 8) stated that existing information will be gathered regarding the number and location of intakes and that these intakes will be surveyed to the best extent practicable. Various agencies (e.g., IDEQ, IDWR, Idaho Department of Lands, and the local health deparment) will be contacted to determine if records are available. Reasonable attempts will be made to contact domestic water users who are identified in such agency records to determine the type of treatment system used. This information will then be used in the Assessment.

3. We agreed at the 14th Meeting that other available data will be used to the extent that it can be reasonably obtained.

   Revisions: This has been clearly stated in the revised Methodology.

4. IDEQ clarified at the 14th Meeting that the proposed approach to use sieve analyses may not be refined enough to characterize the finer clay particles. IDEQ suggested that hydrometer analyses would be preferable.

   Revisions: Testing to characterize the particle-size distribution of silts and clays in the watershed will be included. ITD will consider more than one type of analytical test to quantify the fine particle-size distribution, such as a Sedigraph and hydrometer test. This is partly because techniques such as a Sedigraph require a more reasonable, minimal sample volume than hydrometer tests and provide comparable information. This will allow for needed flexibility in methods as related to sample volume requirements.

5. It was agreed in the 14th Meeting that information on other bays may be relevant to provide some overall perspective and to fill in data gaps that exist for Mica Bay; but, the primary focus of the Assessment will be the Mica Creek watershed.

   Revisions: The document has been revised to state clearly that the primary focus of the study will be the Mica Creek watershed.

6. We agreed at the 14th Meeting that this information is available and will be added to the Methodology.

   Revisions: This information has been added to the revised Methodology.

7. IDEQ clarified at the 14th Meeting that the intent was to use underwater video for occasional "snapshots" rather than intensive transect-type surveys. It was also noted

that video may be useful to confirm the presence of a "ghost-layer" of unconsolidated sediments that may not be clearly present from depth soundings alone.

Revisions: The document has been revised to add the use of limited underwater video for the above purposes assuming that IDEQ's equipment is available at the time of the survey.

8. We agreed at the 14th Meeting that additional information about the grid layout will be added to the Methodology.

   Revisions: Detailed information about depth sounding has been added to the revised Methodology in Appendix A. You will note that a specific grid layout is not provided. Line spacing will vary in the field somewhat depending on water depth. Also, sounding density varies over the area because of imperfect line running, vessel turns, and variations in vessel speed.

9. We agreed at the 14th Meeting that this type of available information will be useful.

   Revisions: The document has been revised to state clearly that this type of available information will be sought and included in the Assessment.

10. It was reiterated at the 14th Meeting that the proposed Methodology included review of the hydrographic survey results with DEQ prior to core sampling so that specific locations can be agreed upon at that time.

    Revisions: This has been clearly articulated in the revised Methodology.

11. IDEQ clarified at the 14th Meeting that the intent was that the cores be archived in a form that could be used for physical analyses in the distant future for historical purposes, not stored in a form that would be suitable for chemical or biological analyses. It was noted that ITD is a public agency and will have ownership of the cores because they will be collected under ITD contract.

    Revisions: ITD appreciates the potential usefulness of the cores for future historical purposes and will consider archival alternatives after the cores are no longer needed for the Assessment. However, ITD does not believe this is something that needs to be part of this Assessment; thus, revisions to the Methodology are not needed.

12. ITD clarified at the 14th Meeting that it intended to use actual turbidity data, turbidity standards, information from the literature review on impacts of sediment on fish, and semi-quantitative/qualitative analyses of meteorological and Project records to assess the duration and location of impacts. This approach was already included in the proposed Methodology (see page 14, Water Quality Measurements). It was agreed by all at the meeting that a semi-quantitative/qualitative analysis coupled with professional

judgement will be the best that can be accomplished at times when actual turbidity data are not available.

Revisions: Explicit verbiage has been added to the revised Methodology that makes it clear that semi-quantitative/qualitative analyses and professional judgement will be used for periods when turbidity data are not available.

13. ITD noted at the 14th Meeting that it planned to obtain existing data, which was already described in the proposed Methodology (see pages 12 and 13). ITD also agreed that it would consider use of specific BURP sites if they were representative and relevant to the Assessment.

    Revisions: It has been stated in the revised Methodology that existing BURP data will be obtained and BURP sites will be considered and used if appropriate for the purposes of the Assessment.

14. It was clarified by IDFG at the 14th Meeting that the methods identified in the IDEQ letter on this point are an important Quality Control (QC) aspect of fish sampling. ITD had no objection to including this in the revised Methodology. However, ITD also believes that this type of effort will only be necessary if fish density sampling (per item 15) is necessary. As discussed under item 15, ITD does not believe that fish density sampling will be necessary for the Impact Assessment.

    Revisions: Revisions to the Methodology have not been made at this time. This item will be discussed with IDFG for concurrence.

15. There was extensive discussion at the 14th Meeting of fish and macroinvertebrate sampling objectives, methods, and locations. It was generally agreed to that macroinvertebrate sampling would provide information more useful to the Assessment than the fish sampling. This is because fish are more mobile than benthic invertebrates, and thus fish sampling represents more of a single "snapshot in time." It was also agreed that the fish sampling would be useful to the Assessment primarily from the standpoint of identifying what fish species and life stages potentially could have been impacted. Knowledge of species and life stages using the impacted reach can then be coupled with other information (see item 12) to arrive at a professional judgement of potential impact. ITD noted that fish sampling techniques in the proposed Methodology would provide the information needed for the fish impact assessment (e.g., they would determine presence/absence of species and the size of fish would be measured to determine life stage). Thus, ITD is not planning to revise the Methodology to include determination of fish densities. It was also agreed that any biological sampling upstream of the Project in the South Fork of Mica Creek would not represent "control site" information because the habitat and physical conditions upstream of the Project are much different than downstream because of long-standing historical conditions

unrelated to the Project. Sampling upstream on the South Fork might provide information on the overall South Fork aquatic ecosystem, but should not be used for comparisons between reaches. The North Fork may provide an opportunity for control sites, but it remains to be determined if comparable habitat and other physical conditions exist even there.

Revisions: The Methodology has been revised to delete the upstream fish sampling sites on the South Fork. It also states that the North Fork will only be sampled for fish if locations can be identified that have habitat and other physical conditions that are comparable to the South Fork downstream of the Project.

16. IDFG clarified that it believed weed surveys now would not be all that useful because to do so once would only be a "snapshot in time," which would not reveal Project impacts. ITD agreed that a weed bed survey now would define only the current condition, and that current weed bed information would have to be combined with the hydrographic survey and coring information to assess if sedimentation as a result of the Project may have created shallower areas that could develop further weed bed area in future years. With that intent clarified, all agreed that a fish survey of Mica Bay would not be needed.

    Revisions: The intent and applicability of the weed bed survey as described above has been clearly delineated in the revised Methodology.

17. ITD stated in the 14th Meeting that it will provide the references from the literature review.

    Revisions: The Methodology has been revised to state that the references will be provided to IDEQ.

Please review these point-by-point responses to confirm that we have addressed your comments satisfactorily. We appreciate your continued cooperation in this matter.

Sincerely,

Idaho Transportation Department

L. SCOTT STOKES, P.E.
District Engineer

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cc: Ray Hennekey, IDFG w/att

Methodology for Impact Assessment of South Fork Mica Creek, Mica Creek and Mica Bay in Relation to the U.S. 95 Bellgrove to Mica Project

June 26, 2002

Approved:

Idaho Department of Environmental Quality — Date: 7/9/02

Idaho Department of Fish and Game — Date: 8/26/02

Idaho Transportation Department — Date: 7/9/02

Contents

Introduction and Purpose

Description of U.S. 95 Bellgrove to Mica Construction Project

The U.S. 95 Bellgrove to Mica project (Project) involves the reconstruction of approximately 5.5 miles of the existing highway from Milepost 415.832 just north of Fighting Creek to Milepost 421.324 just south of Mica Creek (see Figure 1). The Project is being reconstructed on new alignment for most of this segment. From the beginning of the Project to the south end of the South Fork Mica Creek canyon, the new highway is being reconstructed to a four-lane divided roadway section generally west of the existing highway. The highway section transitions to a four-lane undivided roadway section through the South Fork Mica Creek canyon segment and follows a new alignment on the east side of the South Fork Mica Creek. The new alignment crosses the South Fork Mica Creek near the north end of the canyon and connects to the existing roadway just south of Mica Creek. Construction on the Project began on or about June 25, 2001.

The segment of the old Highway 95 adjacent to the west side of the South Fork Mica Creek that will no longer be needed to maintain public access will be obliterated when the new highway is completed. Two existing box culverts will be removed and portions of the South Fork Mica Creek will be restored to a meandering pattern. This stream restoration work will address restoration of stream pattern, form and function, and re-vegetation with woody species to maintain and restore bank stability.

Description of Mica Creek Watershed

The Mica Creek watershed is located within Hydrologic Unit Code (HUC) 17010303, Unit P-4, while Fighting Creek and Bellgrove Creek (a tributary to Fighting Creek) are Unit P-5 of the same HUC. Both watersheds flow into the northwestern section of Coeur d'Alene Lake—Mica Creek into what is known as Mica Bay and Fighting Creek into Rockford Bay (see Figure 2).

As discussed later in this document, this assessment will be focused on potential impacts to the South Fork Mica Creek, Mica Creek downstream of the confluence with the North Fork, and Mica Bay. The overall Mica Creek watershed drains 23.3 square miles, with the predominant land uses being pasture (17.4 percent) and forest (82.1 percent) (Idaho Department of Environmental Quality [IDEQ] 1999); and with land ownership being 2.2 percent Bureau of Land Management, 4.3 percent State, and 93.5 percent private. Highway area represents about 0.4 percent of the watershed (IDEQ 1999).

Mica Creek and a number of other tributaries to Coeur d'Alene Lake were identified by IDEQ as water quality limited for sediment and several other pollutants, leading to preparation of a Total Maximum Daily Load (TMDL) for these water bodies (IDEQ 1999). The TMDL concluded that the existing sediment load in the Mica Creek watershed is 648 tons per year on average, and that rate exceeds the natural background load by 80 tons per year leading to a need to reduce the overall load in the watershed by about 12 percent. The TMDL report also noted that the majority of sediment resident in the creek beds and affecting beneficial uses is loaded in large discharge events that have a return period of 10 to 15 years, with the 1996 flood event alone possibly delivering 801 tons of sediment to the bed

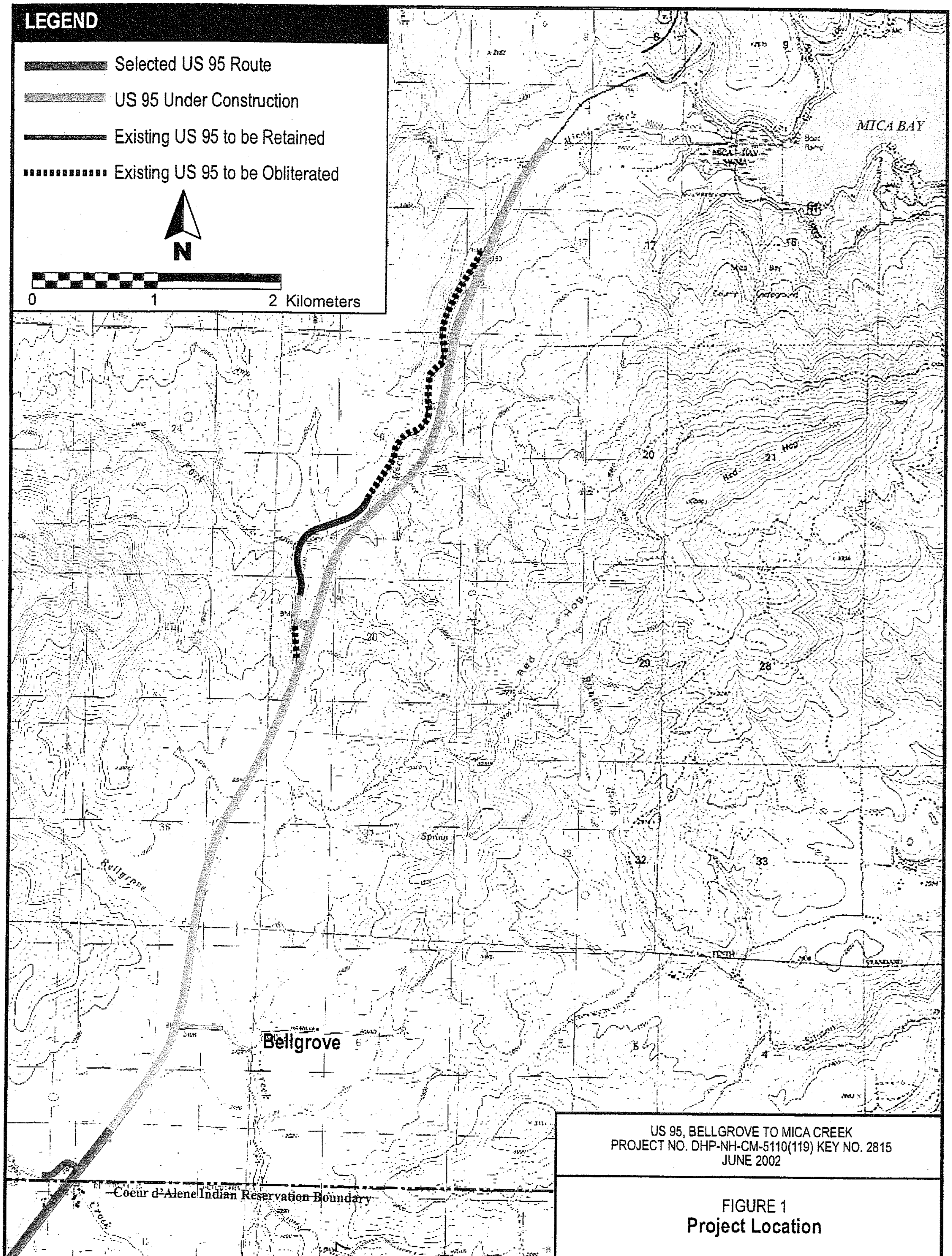

FIGURE 1
Project Location

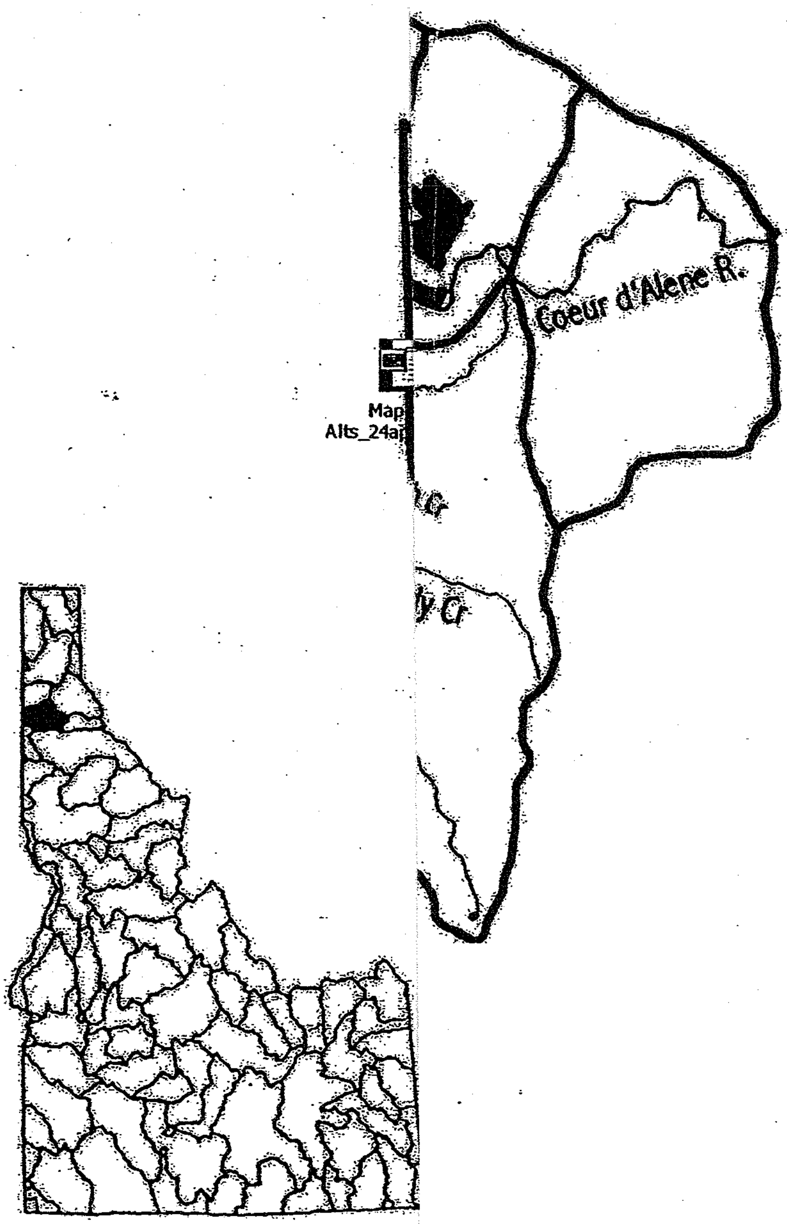

FIGURE 2
Mica Creek and Fighting Creek Drainage Boundaries

of Mica Creek (IDEQ 1999). No specific sediment load allocation was given to the Idaho Transportation Department (ITD) under the TMDL, but a draft Implementation Plan for all state highways and public roads has been prepared by ITD to comply with the TMDL (ITD 2002).

Purpose of Methodology

The purpose of this methodology is to conduct the Impact Assessment pursuant to the Consent Order between IDEQ and ITD effective May 8, 2002, as quoted below:

> *Impact Assessment*
>
> H. *ITD shall develop a methodology and conduct an Impact Assessment to determine impacts of the Project, if any, on the South Fork Mica Creek, Mica Creek, and Mica Bay. Timeframes for submitting and conducting the Assessment are as follows:*
>
> (1) *Within 21 days of the effective date of this Consent Order, ITD shall submit to DEQ for approval, the proposed methodology and timeframe for completing the Assessment described in paragraph I below.*
>
> (2) *Upon approval of the methodology and timeframe described in paragraph H(1), ITD shall perform the Assessment described in paragraph I within the approved timeframe.*
>
> (3) *Based on the findings of the completed Assessment, if corrective action is required, ITD shall submit to DEQ for approval a proposed Corrective Action Plan, as described in paragraph J below, within 60 days of DEQ's approval of the completed Assessment.*
>
> (4) *ITD shall implement any approved Corrective Action Plan within the timeframe set forth in the approved Plan.*
>
> I. *Assessments. Upon approval of the methodology and timeframe outlined in Paragraph H above, ITD shall conduct the Impact Assessment as follows:*
>
> (1) *The Mica Bay Sediment Impact Assessment shall include:*
>
> (a) *Using qualified engineers and scientists, an assessment of the sediment strata present in the Bay to determine the extent of sediment contributions that may have come from the Project, quantity, depth, type, and metals content relative to other sediment sources.*
>
> (b) *An assessment of the extent of any damages to Mica Bay of Coeur d'Alene Lake, including any damages to recreational uses of the Bay and potential damage to domestic water supply systems in the Bay, as a result of sediment from the Project.*

(2) The Fish Impact Assessment shall include:

(a) The extent and duration of adverse effects to the fisheries resource and habitat, including without limitation stream morphology and any other physical characteristics of the stream that affect habitat for fish, macroinvertebrates or other aquatic life, in the South Fork Mica Creek, Mica Creek, and Mica bay as a result of sediment from the Project. This Assessment, as a minimum, will be based on a field reconnaissance of the affected waters, historical data, interviews with Idaho Fish and Game fisheries biologists, and will utilize existing scientific studies regarding effects of sediment on fish behavior and habitat utilization to determine the extent of adverse effects.

The assessment will focus on potential impacts that have occurred from the U.S. 95 Bellgrove to Mica Project from the start of Project construction to the present.

If this Impact Assessment indicates that adverse impacts have occurred as a result of the Project, ITD will then develop a Corrective Action Plan (CAP) to mitigate or compensate for damages caused by these impacts. The specific elements of the CAP are described in the Consent Order.

Impact Assessment Methodologies

Mica Bay Sediment Impact Assessment

Overall Work Approach

The Mica Bay Sediment Impact Assessment will be conducted in three principal tasks: 1) hydrographic survey and mapping; 2) sediment coring; and 3) turbidity monitoring. The combined results will be used to determine the following:

- Physical extent of sediment accumulation in the bay
- Sediment deposition rate in the bay (at least as far back as 1980 if the Mt. St. Helens ash layer is present and discernable)
- Extent of sediment deposition that may have come from the Project

The hydrographic survey and mapping will be completed prior to the coring effort because the mapping information will be necessary in developing the scope of the coring task, as described later. If the rate of sediment deposition attributable to the Project is larger than the historical rates of sediment deposition found in the cores, then the Project-related sediment will be analyzed to determine the type of sediments and metals content relative to other sediment sources. By coupling the results of the surveying and coring efforts, potential impacts to domestic water supply systems and recreation in the bay as a result of Project-related sediment deposition will be defined. These results will also help determine potential impacts to fish habitat in the bay as a result of sediment deposition.

In addition to the surveying and coring efforts, turbidity data and any other available water quality data for Mica Creek, South Fork Mica Creek, North Fork Mica Creek, Mica Bay, and other nearby embayments and stream outlets will be analyzed. This includes data collected by the Coeur d'Alene Tribe and IDEQ. ITD has been collecting daily turbidity samples at the Mica Bay county boat ramp since February 8, 2002; and from the bridge over Mica Creek at Loff's Bay Road since April 1, 2002. Turbidity data from the other numerous sampling locations that ITD has been monitoring in the Mica Creek watershed will be analyzed as well (see Figure 3 located in a map pocket at the end of this report). ITD has also collected periodic turbidity samples from other embayments not impacted from the Project construction for comparison purposes. These data will be analyzed as well to help assess the impacts to Mica Bay by providing some overall perspective and to fill in data gaps that exist for Mica Bay; but, the primary focus of the Assessment will be the Mica Creek watershed.

Hydrographic Survey and Mapping

Mica Bay is approximately 10,000 feet (3,048 meters) in length with an average width of approximately 3,000 feet (914 meters) (see Figure 4). This equates to an area of approximately 700 acres (283 hectares). The upper end of the bay, from Loff's Bay Road extending east approximately 2,600 feet (792 meters), has an average width of approximately 1,600 feet (488 meters). This equates to roughly 100 acres (40 hectares), which is the proposed area to be mapped based on the visible extent of sediment in a 1999 color aerial photograph.

The bay will be mapped using two different surveying techniques: 1) manual surveying using GPS instrumentation; and 2) depth sounding. The purpose of using two techniques is to increase the surveying accuracy and extent of coverage necessary for developing a quality digital topographic/bathymetric map. A digital terrain model (DTM) will be used to generate a map with a contour interval of 1.6 feet (0.5 meter).

A Lieca SR530 Geodetic (Real Time Kinematic) RTK system will be used for providing accurate three-dimensional positions of the surveyed points. Depth sounding will be used in areas where water depth prohibits the ability to attain accurate manual readings. The depth sounding equipment and methodology are described in detail in Appendix A. Because of the efficiency of depth sounding, this technique will be employed wherever possible, so that comparison and data overlap is provided from the two different methods.

The combination of the two surveying techniques is intended to provide extensive mapping coverage into deep water areas as needed and allow for data comparison where the two techniques are overlapped. Some of the challenges and limitations of the survey include the following:

- Shallow water depths that will govern the vessel(s) used for surveying and the extent of access into the shallow areas.
- Potential for aquatic vegetation that will reduce the accuracy of the depth sounding survey as a result of signal interference.
- Potential down-time resulting from windy conditions that would prohibit accurate depth sounding, since a small vessel required for shallow-water access will be more prone to surface waves and drift.

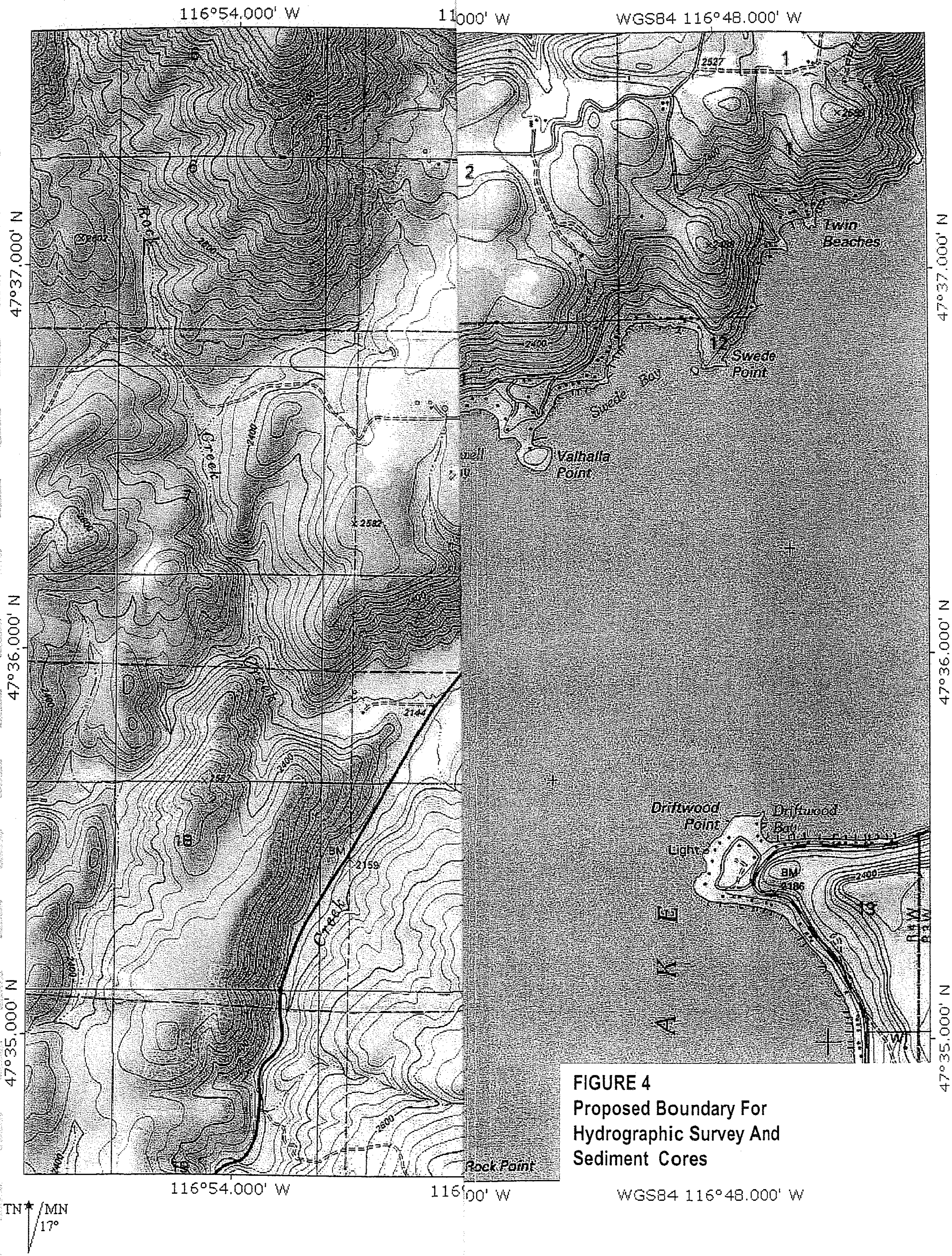

FIGURE 4
Proposed Boundary For Hydrographic Survey And Sediment Cores

- If the surface sediments are unconsolidated, discerning the exact elevation of the bottom may be difficult, but it is anticipated that the extent of unconsolidated surface sediments will be no thicker than the level of accuracy provided by the GPS instruments (accuracy = ± 2 centimeters in calm surface conditions).

As part of the survey, specific features in the bay will be targeted. These include the cross-sectional geometry and plan form of the submerged channel (thalweg) that traverses the delta, water intake structures, and boat docks. Existing information will be gathered regarding the number and location of water intake structures in the bay. Various agencies (e.g., IDEQ, IDWR, IDL, and the local health department) will be contacted to determine if records are available. Reasonable attempts will be made to contact domestic water users who are identified in such agency records to determine the type of treatment system used. This information will then be used in the Assessment. Wherever possible, the location and depth of these structures will be surveyed to the best extent practicable. To help address potential recreational impacts, the location of boat docks and associated water depths will be surveyed. The water level in the bay will be determined at the time of the survey, and historical water level data will also be obtained and used in the assessment.

An underwater video camera, to be furnished by IDEQ, will be used to provide visual data of the sediment/water interface at various locations during the survey. This video camera will be used assuming it is available from IDEQ during the survey.

Sediment Coring

Compilation of Existing Information.

Existing information pertaining to lake sediment studies will be collected and assessed for background information. Some published information pertaining to the surface and subsurface sediments in the Lake Coeur d'Alene is available. This information will be used along with the findings of this assessment to help draw conclusions.

A summary of significant hydrologic events and land alteration in the watershed will be compiled as far back as the mid to late 1980s. This information will be used to assist in the identification and interpretation of discernable layers in the sediment strata. Useful information includes precipitation and runoff records, aerial photographs, and construction logs. In addition, Forest Practice Act notifications will be examined for pertinent information.

Number and Location of Sampling Stations.

A pair of cores will be collected at 10 different locations in the upper (western) end of Mica Bay for a total of 20 cores. At each site, one core will be used for processing and the other will be archived. The size of the sampling area is estimated to be approximately 100 acres (40 hectares), resulting in a minimum sampling density of one core per 10 acres (or, one core per 4 hectares). The size of the anticipated sampling area is shown in Figure 4. Additional cores within this area or beyond may be needed if the hydrographic survey or other available information suggest that additional locations will be needed for a complete assessment.

Prior to the hydrographic surveying being conducted, the proposed sample locations will be established based on a grid system. Each pair of cores will be extracted from the center of individual 10-acre (40-hectare) or 660-square-foot (201-square-meter) grids. If the hydrographic survey provides information that suggests a different sampling location scheme should be used, then adjustments to the locations will be made accordingly. A map of the sample locations will be developed prior to collection. All samples will be located in the field using latitude and longitude coordinates using a differential GPS unit. The proposed core sampling locations will be submitted to IDEQ for review and approval.

For comparison purposes to the bay sediments, grab samples will be collected from numerous upstream sediment source areas, including Mica Creek, South Fork Mica Creek, and the North Fork Mica Creek. In addition, representative soil samples will be collected from the Project site, as well as locations from other land uses within the watershed, such as logging areas and agriculture land. It is estimated that the following 16 samples will be collected from these locations:

- Two in Mica Creek
- Four in South Fork Mica Creek downstream of the Project
- Two in South Fork Mica Creek upstream of the Project
- Two in North Fork Mica Creek
- Two from logging areas
- Two from the Project area
- Two from agricultural areas

Exact locations will be determined in the field based on stream gradient and morphology, and proximity of overland areas that have likely contributed sediment to streams in the past. It is assumed that access to private property will be granted as necessary. These samples will be analyzed only if it is determined that Project-related sediment deposition sufficient enough to cause adverse impacts has occurred in the bay (or creeks as described later in this document). In that case, these samples can be analyzed as needed to provide insight to sediment sources.

Sampling Equipment.
All work in the bay is planned to be done from the water. Therefore, water surface elevation and the associated water depth will govern the extent of access into the shallow areas of the bay. Coordination with entities that control the water surface elevation of the lake will be planned so that the work schedule can be optimized.

Preliminary negotiation has begun with a specialty firm that can provide the services and equipment necessary to collect the sediment cores. Their equipment consists of a 20- to 30-foot pontoon barge and an electric vibracorer fitted with a 4-inch (outside diameter) barrel. Rigid CAB core liners will be used. The proposed equipment can sample to a maximum depth of 12 feet (3.7 meters) below the sediment surface or to the point-of-refusal. Refusal can occur if a thick layer of compacted clay or large gravel is encountered, but these are not anticipated in the sampling area. Oftentimes the point-of-refusal represents an indicator that original bed material has been reached, or the strata has changed significantly enough that it represents a layer that is out of the scope of the study.

Grab samples collected from the upstream source areas will be collected using a McNeil sampler (or similar) for in-water sites, and hand-corers or shovels for dry sites as needed.

Sample Handling.

Once the core liners are extruded from the core barrel, the liners can be cut, capped, tapped, labeled, and stored for processing or archiving. All cores will be kept on ice until stored in either a freezer (for archiving) or cold storage (for processing).

Sample Processing and Analytical Work

Pretreatment.

One core from each site will be split longitudinally for description and analysis. The second core from each site will be frozen and stored for archiving. Each processed core will be described, measured, and photographed with appropriate labels and color scales. Visual descriptions of color, grain-size/texture, and material characteristics will be recorded. Discernable layering (for example, seasonal varving) will be described and measured.

If the Mt. St. Helens ash layer is visible in at least some of the cores, than the total amount of sediment deposited since 1980 can be determined at those locations. The number and thickness of individual discernable layers above the ash can be used to determine whether or not recent depositional layer(s) (potentially Project-related) are similar to those in the recent past represented by these cores. Because this analysis could provide the basis of determining the extent of sediment contribution from the Project, the ash layer would be analytically tested using geochemical techniques to positively identify it as Mt. St. Helens ash. The Mt. St. Helens ash layer has been previously documented in Lake Coeur d'Alene subsurface sediment studies conducted by the U.S. Geological Survey, and its chemical signature has been well documented in the literature.

If the findings from the visual assessment are inconclusive, a minimum of five cores will be sub-sampled for analytical work; however, the final number of cores to be sub-sampled will be dependent upon the lateral continuity of the layering in cores from one location to another and the mass of material required for the various analytical tests.

If core profiles are found to be visually similar from one location to the next, it may not be necessary to repeat the same analytical tests on every core. Consideration will be given to the mass of material required for the various analytical tests versus that which is available from obvious layers within each core. The thickness and density of the layers present will dictate the available mass from any given layer, but this will not be known until the samples are collected.

Analytical Tests.

If analytical tests are required beyond those that would positively identify Mt. St. Helens ash, the following tests will be performed to define the physical and chemical attributes of the sediments (as both dry and wet weight for each sample):

- Grain size by sieve analysis
- Specific gravity
- Nitrate
- Ammonia
- Total Kjeldahl Nitrogen (TKN)
- Total phosphate

- Total organic carbon (TOC)
- Whole rock analysis by lithium meta or tetra borate fusion and XRF, includes the following: Si, Al, Fe, Ca, Mg, Na, K, Cr, Ti, Mn, P, Sr, Ba, and Loss on Ignition
- 47 elements by four acid "near-total" digestion, includes the following: Ag, Al, As, Ba, Be, Bi, Ca, Cd, Ce, Co, Cr, Cs, Cu, Fe, Ga, Ge, Hf, In, K, La, Li, Mg, Mn, Mo, Na, Nb, Ni, P, Pb, Rb, Re, S, Sb, Se, Sn, Sr, Ta, Te, Th, Ti, Tl, U, V, W, Y, Zn, and Zr

Testing to characterize the particle-size distribution of silts and clays in the watershed will be included. ITD will consider more than one type of analytical test to quantify the fine particle-size distribution such as a Sedigraph and hydrometer test. This is partly because techniques such as a Sedigraph require a more reasonable minimal sample volume than hydrometer tests and provide comparable information. This will allow for needed flexibility in methods as related to sample volume requirements.

In addition, age estimating techniques using ^{137}Cs activity can be used if the Mt. St. Helens ash layer is absent from the cores or if its presence is inconclusive. If needed, it is anticipated that no more than three to five cores will be required to draw conclusions using age estimating techniques to determine sediment deposition rates.

Quality Assurance and Quality Control (QA/QC).

Duplicate samples will be collected from some locations (or strata within a given core) to be analyzed for QA/QC purposes. Proper sample collection techniques and containers will be used to avoid contaminating any of the samples. All samples will be clearly identified with a sample ID number or code, location, date, and time. Chain-of-custody procedures will be followed so that the possession of samples will be traceable from the time they are collected through the time they are analyzed. A signed chain-of-custody form, from both the sender and receiver, will be completed for each shipping container whenever samples are shipped.

A field notebook will be maintained that contains the information described for this field sampling program. Corrections will be made by crossing out the error with a single horizontal line, initializing the correction, and entering the correct information. Crossed-out information should be readable.

Mica Bay Sediment Impact Assessment Reporting

A total of three technical reports will be developed to document the Mica Bay Sediment Impact Assessment.

The first technical report will be submitted with the bathymetric map developed from the hydrographic survey. The purpose of the report will be to document the methodology of the survey and mapping effort as well as any unique or significant findings during the survey pertinent to either the Fish Impact Assessment or the coring effort.

Two technical reports will be prepared to document the methods, results, and conclusions of the sediment coring effort. The first report will be an interim report describing the sampling effort, as well as the initial description of the sediment cores and the presence or absence of the Mt. St. Helens ash layer. The findings and implications associated with the presence or absence of the ash layer will be documented in the interim report, as well as what the recommended ensuing steps should be.

A final report will be developed after the analytical work has been completed on the core samples. This report will incorporate information from the two preceding reports, as well as document the conclusions of the Mica Bay Sediment Impact Assessment.

The submittal schedule for the reports to IDEQ is as follows:

- Hydrographic Survey Report: within 10 weeks of approval of this methodology by IDEQ
- Interim Sediment Coring Report: within 18 weeks of approval of this methodology by IDEQ
- Final Mica Bay Sediment Impact Assessment: within one year of completion of the interim sediment core report

Fish Impact Assessment

Mica Creek Fish Impact Assessment

Sample Site Locations.

The geographic area of the impact analysis is on Mica Creek from its confluence with Mica Bay upstream 1.1 miles to the North Fork/South Fork Mica creeks confluence and extending upstream on South Fork Creek approximately to river mile (RM) 2.8 near the upper most U.S. 95 bridge crossing.

Specific locations for fish and macroinvertebrate sampling will be determined during the physical habitat survey and may coincide with previous Beneficial Use Reconnaissance Program (BURP) survey sites if the sites are within or downstream of the Project and are representative of the stream area. Physical habitat surveys will cover the entire mainstem Mica Creek, the South Fork up to RM 2.8, and the lower 0.5 mile of the North Fork. Up to five sites will be sampled and will be dependent upon results of the habitat survey. The general locations are as follows or will coincide with BURP survey sites:

- Two or three sites (dependent upon results of the habitat survey) will be located on the South Fork between the upper most U.S. 95 bridge and the confluence of the North Fork. At least one of the sites will be in a low-gradient reach and one in a higher-gradient reach.
- One site may be located on the North Fork in the reach just above the confluence with the South Fork, if the area is found during the habitat survey to be representative and to contain similar stream characteristics as the South Fork. If applicable, the site will be located in a representative area.
- One or two sites (dependent upon results of the habitat survey)will be located on the mainstem of Mica Creek between the North Fork/South Fork confluence and the lake. All of this reach is low gradient.

Physical Habitat Survey.

Standard protocols will be used for the physical habitat survey. Additional parameters will be documented that pertain directly to the purpose of this study, such as sediment depositional features. Each reach or mesohabitat unit (pool, riffle, glide) will have the following characteristics described or measured:

- Unit length
- Channel type (Rosgen)
- Estimated discharge (at beginning of reach)
- Temperature
- Substrate composition and percent embeddedness
- Wolman pebble count (one per reach)
- Presence of depositional features
- Bankfull width and depth
- Wetted width and depth
- Pool type and quality rating
- Residual depth (pools)
- Streambank condition and percent bank cover
- Percent undercut banks
- Instream cover
- Riparian vegetation composition and buffer width
- Percent canopy cover
- Large woody debris count

A plan view of the mesohabitat length/width data will be presented as a graphic overlaid on aerial photographs. The other information gathered will be used to calculate the Stream Habitat Index (described later).

Fish Survey Methods.

Existing information regarding fish populations in the Mica Creek system will be evaluated and summarized. Existing information will include interviews with Idaho Department of Fish and Game (IDFG) fisheries biologists, IDEQ TMDL documents, IDEQ BURP reports, and other available data.

Fish monitoring studies will involve collecting, identifying, measuring, assigning a life stage, and releasing fish, as well as field measurements of water quality parameters. Fish sampling will utilize a backpack electrofishing unit. It will include one pass electrofishing in a channel area that is 40 times the wetted width of the stream at each sampling location.

Sampling effort related to electrofishing will be documented as the number of seconds the probes are in the water and activated. Sampled fish will be held in fresh, well-oxygenated water and only for the minimum time necessary for measurement and data recording. Collected fish will be identified to species, measured (standard fork length), assigned a general life stage category (fry, juvenile, or adult) or age class, and released onsite. Data will be recorded on fish sampling datasheets. Handling of fish will be minimized to the extent possible.

At least one staff member experienced in electrofishing will participate in each sampling event. Prior to fish sampling, a Scientific Sampling Permit will be obtained from the IDFG.

Macroinvertebrate Survey Methods.

Existing information regarding macroinvertebrate populations in the Mica Creek system will be reviewed and summarized. Existing information may include IDFG surveys, IDEQ TMDL documents, IDEQ BURP reports, and other available data.

Macroinvertebrate sampling sites will be in the same locations as fish survey sites. The kick-net method (500 micron mesh) is recommended for sampling a range of instream habitat types at a stream site. The kick-net method will be applied to instream riffle and pool areas and adjacent microhabitats during all sampling events. One riffle composite sample and one pool composite sample will be collected from each site. Two kick samples will be taken from each habitat type and will be repeated at two locations in the same habitat type. Each composite will therefore consist of equal effort, multiple (four) kick samples per habitat type per sampling station.

Benthic macroinvertebrate samples will be collected using kick nets. No side channel samples will be collected. Similar microhabitats (riffles and pools) will be sampled at each site. Equal effort will be spent sampling at each site: the same number of samples will be taken at each sampling station. The general sample location and specific microhabitat sample sites will be marked with survey tape and photographed during each sample event.

Metrics regarding species composition will be calculated. These metrics will focus on the following species composition:

- Taxa richness
- Mayfly richness
- Stonefly richness
- Caddisfly richness
- Hilsenhoff Biotic Index
- Percent dominant (five taxa)

Sample collection procedures for riffle (gravel/cobble) and pool areas will be as follows:

Four 2-square-foot areas will be sampled and combined for each of these habitats at each site. All four benthic samples for each habitat type at each sampling station will be combined into one composite, preserved with 90 percent ethanol, and transported to the laboratory for identification. A minimum of 300 specimens will be identified for each habitat type composite sample.

Water Quality Measurements.
Water quality field measurements will be collected at each of the seven proposed monitoring sites. Field water quality measurements will include temperature, conductivity, pH, and dissolved oxygen.

In addition, turbidity data for Mica Creek, South Fork Mica Creek, North Fork Mica Creek, Mica Bay, and other nearby watersheds will be compiled, analyzed, and compared to the literature data describing turbidity impacts on fish. ITD has been collecting periodic turbidity data at numerous sampling locations in the vicinity of the Project since September 2001 and daily data since March 2002. These and other available and pertinent water quality data from these areas will be compiled and analyzed to help assess the potential extent and duration of water quality impacts to fish. For periods when data gaps exist in the historical turbidity data, the assessment will rely on available observations regarding conditions and construction activities at the Project and meteorological data (to determine when freezing, snowmelt, and precipitation events occurred). Semi-quantitative/ qualitative analyses and professional judgement will be used for periods when turbidity data are not available.

Bed Sediment Sourcing.
Representative samples of the bed sediments in the South Fork Mica Creek, North Fork Mica Creek, and Mica Creek will be analyzed using geochemical techniques in an effort to assess their origin or source. By comparing various samples from impacted reaches of the creeks to background conditions and to soil samples of the constructed road fills on the Project, it may be possible to determine the source of the sediment based on chemical and physical signatures of the sediment. This effort is similar to that described in the Sediment Coring section addressing the Mica Bay Sediment Impact Assessment, so it might be possible to address both needs with one set of samples. The exact sampling locations will be determined during the habitat mapping effort so that the results can be used to help assess potential impacts to the fishery.

Fish Data Analysis.
Data analysis for fish sampling will include calculating metrics that describe assemblage attributes as described in the IDEQ Water Body Assessment Guidance (IDEQ 2002) for forested systems. Six metrics, representing significant aspects of fish assemblage integrity, will be used to characterize the fish population in the Mica Creek system. These metrics will be rated and combined to provide an overall Index of Biological Integrity (IBI). These metrics are described in Table 1.

TABLE 1
Fish Assemblage Metrics for Forested Streams

Metric Categories	Metric	Definition	Predicted Response to Increasing Perturbation
Richness and composition	Number of cold water native species	Number of native fish species typically found in cold water streams. Excludes introduced or tolerant native fish species.	Decrease
	% cold water individuals	Percent of individuals found in cold water streams. Includes introduced trout species.	Decrease
	% sensitive native individuals	Percent of native individuals sensitive to perturbations, such as increased turbidity, sediment, and warmer temperatures.	Decrease

TABLE 1
Fish Assemblage Metrics for Forested Streams

Metric Categories	Metric	Definition	Predicted Response to Increasing Perturbation
Reproductive function	Number of sculpin age classes*	Number of sculpin age classes (use measured size classes to infer) reflects the ability of unembedded cobble substrate required for cavity nesters and juvenile refuge.	Decrease
	Number of salmonid age classes	Number of salmonid age classes reflects suitability and stability of conditions for salmonid spawning, juvenile rearing, and adult salmonids.	Decrease
Abundance	Catch per unit effort (CPUE)	Number of cold water individuals per minute of single-pass electrofishing.	Decrease

* Number of sculpin age classes is not included if the sample is comprised solely of salmonids.

Macroinvertebrate Data Analysis.

Benthic invertebrate samples will be sorted and identified to the lowest practicable taxonomic level.

Benthic invertebrate data for each sampling site will be summarized as abundance of individual organisms by taxa, number of taxa (taxa richness), and relative abundance according to major taxonomic group and feeding type. A Hilsenhof Biotic Index (HBI) will be calculated as well. Samples collected by kick-net will also be evaluated using other specific metrics stated in the IDEQ Water Body Assessment Guidance (IDEQ 2002). These metrics will be rated and combined to indicate the overall IBI as well as used to evaluate the overall health of the macroinvertebrate community at each sampling site. Metrics to be used are listed in Table 2.

TABLE 2
Macroinvertebrate Metrics

Metric Categories	Metric	Definition	Predicted Response to Increasing Perturbation
Richness	Total taxa	Number of distinct taxa in the macroinvertebrate assemblage	Decrease
	Ephemeroptera taxa	Number of mayfly taxa	Decrease
	Plecoptera taxa	Number of stonefly taxa	Decrease
	Tricoptera taxa	Number of caddisfly taxa	Decrease
Composition	Percent plecoptera	Percent of sample that is stonefly nymphs	Decrease

TABLE 2
Macroinvertebrate Metrics

Metric Categories	Metric	Definition	Predicted Response to Increasing Perturbation
Pollution tolerance	Hilsenhoff Biotic Index	Abundance-weighted average tolerance of organisms to pollution	Increase
Diversity	Percent five dominant taxa	Percent of sample in the most abundant five taxa	Increase
Feeding group	Scraper taxa	Number of taxa that scrape periphyton from substrates	Decrease
Habit	Clinger taxa	Number of taxa that have fixed retreats or adaptations for attachment to surfaces in flowing water	Decrease

The HBI is used to represent the benthic community response to organic pollution, and the HBI will be calculated as described in Plafkin, et. al. (1989). The tolerance values used for the HBI will range from 0 to 10, with higher values assigned to pollution-tolerant taxa and lower values assigned to pollution-sensitive taxa (Hilsenhof 1987).

In addition to the above metrics, taxa that are sensitive as well as tolerant to sediment will be identified and their abundance quantified.

Stream Habitat Analysis.

Stream Habitat Index (SHI) will be calculated and analyzed as described in the IDEQ Water Body Assessment Guidance (IDEQ, 2002) to evaluate human disturbance. The SHI will be calculated for a number of reaches, to be determined after the physical habitat survey. All survey reaches will be included. Metrics for the SHI will include instream cover, large organic debris, percent fines (<2mm), embeddedness substrate size classes, channel shape, percent bank cover, and the types of disruptive pressures.

SHI will be used to evaluate of the potential impacts due to sedimentation from the Project. Metrics to be evaluated are listed in Table 3.

TABLE 3
Stream Habitat Index Metrics

Metric Categories	Metric	Field Rated or Measured	Predicted Response to Increasing Perturbation
Epifaunal substrate/available cover	Instream cover	Rated	Decrease
	Large organic debris	Measured	Decrease
Embeddedness/ heterogeneity of substrate composition	Percent fines <2mm	Measured	Increase
	Embeddedness	Measured	Increase
	Wolman size classes (number	Measured	Decrease

TABLE 3
Stream Habitat Index Metrics

Metric Categories	Metric	Field Rated or Measured	Predicted Response to Increasing Perturbation
Channel flow status	Channel shape	Rated	Decrease
Bank vegetation protection	% Bank cover	Measured	Decrease
	% Canopy cover	Measured	Decrease
	Disruptive pressures	Rated	Increase
Riparian vegetation zone width	Zone of influence	Rated	Decrease

Water Quality Analysis.

Water quality data for each sampling event will be summarized in tabular format by monitoring station. Water quality data will provide supplemental information to assist in evaluating and interpreting biological monitoring data.

Quality Assurance and Quality Control.

The QA/QC objectives for the benthic biomonitoring studies are to collect field measurements and perform laboratory analyses that are of known and acceptable quality. One duplicate gravel/cobble benthic macroinvertebrate sample will be collected using the kick net method, and analyzed during each sample event as a quality assurance check. One of the samples collected will be re-identified by an experienced taxonomist independently of the first identification.

Literature Review of Sediment Impacts on Fish

A review of scientific literature on the magnitude and duration of sediment impacts on fish and habitat will be conducted. This review will evaluate the effects of sedimentation on the water column with regard to turbidity as well as effects on fish (feeding, behavior, and reproduction), fish habitat, and the effects on other aquatic fauna such as macroinvertebrates. All references will be provided in the Literature Cited section of the report.

Mica Bay Fish Habitat Impact Assessment

The analysis of lake habitat impacts on fish will be performed using information collected for the hydrographic survey and mapping and sediment deposition characterization. These data sets will provide enough information to evaluate the shift in habitat suitability for salmonids and other key species, if any. During the hydrographic survey, multiple beam depth sounding will be used to spatially delineate weed beds as well as depth. Weed beds are known to harbor salmonid predators such as bass and northern pike. Hydrographic survey data coupled with the sediment coring data and visual observations will allow for an assessment of potential habitat changes resulting from the Project. This assessment will focus on potential changes in habitat that would enhance or increase habitat for predator species and potentially change predator/prey relationships. Habitat changes could consist of increasing shallow water areas that would support an increase in weed bed presence. An assessment of potential habitat changes will allow for inferences to be made regarding predator/prey relationships. In addition, the hydrographic survey and mapping information will be used to assess the potential for impacts to fish movement between Mica Bay and Mica Creek because of potential changes in channel geometry in the bay and creek.

Fish Impact Assessment Reporting

Individual Event Reports.

Individual technical reports will be prepared following each fish and benthic invertebrate sampling event. The reports will be submitted to IDEQ within 3 months of the sampling event. Each technical report will include the following information:

- General information:
  - Locations and description of monitoring sites
  - A map showing monitoring site locations
  - Date of field work; in the event field work is delayed because of high flows, an explanation will be included
- Macroinvertebrate monitoring:
  - Description of sampling methods
  - Field measurements and observations recorded on field data sheets
  - Laboratory identification summary by taxa
  - Stream habitat descriptions
  - Benthic community statistics
  - Field water quality measurements
  - Individual metric scores for each factor at each site
  - Brief discussion of the results
- Fish monitoring:
  - Description of methods
  - Raw data presented in field data sheets
  - Summary table(s) of raw data
  - Field water quality measurements
  - Stream habitat descriptions
  - Individual metric scores for each factor at each site
  - Brief discussion of the results
- Stream habitat:
  - Description of methods
  - Raw data presented in field data sheets
  - Summary table(s) of raw data
  - Brief discussion of the results

Final Summary Report.

A final summary report will be prepared following the same format as the individual monitoring events reports. This report will include raw data as well as individual metric scores for each factor during each event at each site. In addition, the final summary report will include an evaluation of the results. The final summary report will be submitted to IDEQ by January 31, 2004.

Impact Assessment Timeframe

The Mica Bay sediment impact assessment will be completed in several steps as described earlier in this document. The Hydrographic Survey report will be submitted to IDEQ no later than 10 weeks after the approval of this methodology by IDEQ, the Interim Sediment Coring Report no later than 18 weeks after the approval of this methodology by IDEQ, and the final Mica Bay Sediment Impact Assessment no later than one year after submittal of the interim coring report.

Macroinvertebrate communities change seasonally. Therefore, it is important to have more than one year of data and data taken during the same time period to be able to determine trends. Therefore, sampling events will occur three or four times over the next 2 years. Sampling events are scheduled to occur during the spring/summer and fall of 2002 and 2003. The spring/summer 2002 event will only be conducted if this protocol is approved by IDEQ in time for a spring sampling. Fish sampling and evaluation of stream habitat will be conducted during each macroinvertebrate sampling event to determine if any changes occur to the instream habitat or fish assemblage. The final fish impacts report will be submitted by January 31, 2004.

Qualifications of the Impact Assessment Team

The impact assessment team includes the following CH2M HILL staff:

- Tom Dupuis—Overall assessment direction and coordination
- Steve Miller—Sediment impact assessment
- Dick Glanzman—Geochemistry
- Steve Hicks—Field sampling coordinator
- Mike Mischuk, Greg White, Randy Whitman, and Lynn Foster—Aquatic ecology and biology

Detailed resumes are provided for CH2M HILL staff in Appendix B.

In addition, specialized subconsultants are likely to be retained for the hydrographic survey and core sampling in Mica Bay, laboratory analyses, and biological sample analyses (e.g., taxonomy).

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APPENDIX A

Depth Sounding Survey at Mica Bay

Depth Sounding Survey at Mica Bay

Survey Equipment

Sonar System

The Reson Seabat 8101 multibeam sonar will be used to obtain soundings of the underwater region at Mica Bay. The Seabat, operating at 240 kHz, transmits a 170° by 15° acoustic beam. On return, the acoustic beam is divided into 101, 1.5° by 1.5° acoustic soundings.

The Seabat 8101 Sonar system consists of the transducer head, an onboard processor, and a video monitor. The transducer is deployed on a fixed mount over the side of the vessel. The mount is firmly fixed in position during data collection such that all motion sensors, located at different points on the vessel, reflect the true motion of the sonar. An interactive mouse uses the video monitor to adjust system settings such as gain, power, and range. During data collection, the video monitor also shows the acoustic signal being collected along with each digitized beam.

Seabat data rates vary depending on the depth of measurement and baud rate of the serial line to the data acquisition computer. During this survey, the system will produce between 15 and 20 swaths/second, providing approximately 1,500 to 2,000 soundings/second. Accuracy of each beam's range measurement is 1.25 cm.

Heave, Pitch, and Roll

A TSS DMS05 motion sensor will monitor and measure vessel roll (rotation port and starboard), pitch (rotation fore and aft), and heave (vertical displacement) during data collection. The DMS05 is interfaced to both the Differential Global Positioning System (DGPS) and the SG Brown Meridian gyrocompass to reduce heave error during vessel turns and speed changes. The sensor provides data at a rate of up to 32 Hz at 9600 baud transmit. Manufacturer specifications of accuracy are as follows:

Roll, Pitch;

Range: +/- 50 degrees
Accuracy: +/- .03 to .05 degrees

Heave:

Range: +/- 99m
Accuracy: 5 cm or 5%, whichever is greater

Vessel Yaw/ Heading

The SG Brown Meridian GyroCompass will monitor vessel and sonar yaw (rotation about the Z axis) during sonar data collection. A gyrocompass is used during high resolution acoustic surveys because of its accuracy (0.5 degree) and its immunity to varying magnetic fields (e.g., motors). The SG Brown Meridian updates at a rate of 2 Hz.

Vessel Positioning

Vessel positioning is obtained by using a Lieca SR530 Geodetic (Real Time Kinematic) RTK system. A Lieca radio base station, placed on known survey control monuments set with Static GPS methodology, is used in conjunction with the Lieca Geodetic Receiver to obtain a corrected geodetic position of the vessel coinciding with the bathymetric mapping measurements.

Speed of Sound Measurements

Sound velocity profiles of the water column will be recorded with a Seabird SBE-19 CTD (Conductivity, Temperature, Depth). The SBE-19 is a self-contained measurement device with on-board memory that calculates sound velocity (SV) from the measured values of C,T, and D. SV is calculated using the Chen-Millero equations. The profiler, recording at 2 Hz, is lowered at a rate of approximately 1 meter/sec. The resulting data set represents SVs recorded approximately every 0.5 meter of water column.

Hydrographic Data Acquisition System(DAS)

Coastal Oceanographics Hypack Max version 0.5B software, running on a Pentium 533 MHz laptop PC, will be used to collect all sensor data and provide vessel guidance during field operations. The data acquisition computer receives all multibeam system data (Seabat, Gyro, TSS, DGPS) through a multiport PCMCIA card. A critical feature of Hypack during surveying will be real-time presentations of bottom coverage during data collection.

Survey Methodology

Line Spacing

Existing bathymetric maps will be used to develop preliminary survey line spacing. Line spacing will vary depending on depth but will adjust to maintain accuracy and resolution requirements as required.

Sound Velocity Profiles

The Seabat 8101 measures time of travel of the acoustic beam from the sonar to the bottom and back. To resolve the time to distance (range and depth), the speed of sound in the water must be known. Sound speed is a function of water density, and in the ocean this is primarily due to temperature and salinity. As such, it is site-specific, requiring accurate measurement and monitoring. The non-vertical nature of the majority of the beams in a multibeam sonar and refraction requires measurements of the sound speed to be fully described in both the horizontal and vertical. Analogous to an ocean wave turning on approach to a beach at an oblique angle, refraction in the water column causes an acoustic beam to change direction when traveling through a density interface or gradient. The error can be substantial, and when not corrected, causes both depth and position errors of individual soundings. Although significant density gradients are not anticipated at the site, sound velocity profiles, to full water depth, will be obtained at least twice per survey day and any time significant changes are anticipated as a result of tidal changes or changes in survey location.

Sound velocity variations obtained during surveying will be used to correct sonar data in post-processing by applying Snell's Law.

Positioning

Position system checks will be performed once per day. The RTK/GPS system will be placed over a known point (e.g., survey monument, navigation aid) and accuracy of system will be determined.

Water Level

At least three staff gages will be placed at the existing water level and known elevations around the project site. The gages, affixed to existing piers or set posts, will be used to monitor daily water levels during the bathymetric surveys.

Quality Control and System Accuracy Test

Prior to commencing survey operations, a Patch Test will be conducted. The Patch Test is a series of parallel and perpendicular tracklines that are run over known bathymetry to determine navigation latency and roll, pitch, and yaw angular offsets.

Processing

Processing of multibeam sonar data to end products of bathymetric datasets, contour maps, and three-dimensional presentations is a multilevel task with each level requiring attention to data quality and a firsthand understanding of the manner in which the fieldwork was accomplished. Field log sheets describing site conditions, instrument operations, and field calibrations are invaluable to accurate and economical post-survey data reductions.

Coastal Oceanographics HYSWEEP software will be used for the processing and analysis of multibeam sonar data.

Inspection and Analysis of Vessel Orientation, Attitude, and Position Data

Post processing begins with inspection and analysis of gyrocompass, heave, pitch, roll, and vessel position data. Time series of each data stream are previewed for obvious spikes, data dropouts, and instrument malfunctions. In particular, heave and position data are inspected closely for roll-induced heave and GPS multi-pathing errors. Any data suspected of not being of high quality or in error are either eliminated or corrected if possible.

Resolving Sonar Ranges to X, Y, Z

The second step in multibeam data processing is the merging of all vessel sensor data with Seabat sonar range data. During this step, the aforementioned time base established during data acquisition with Hypack is used to match heading, pitch, roll, and position data with sonar range data. As each sensor's update rate is different, linear interpolation is used to match vessel motion and position data with each beam's actual bottom ensonification time.

During this step, instrument draft, angle, or distance offsets between sensors, and speed of sound adjustments are accomplished. Additionally, water level data, as collected during the survey, is merged with the sounding data to produce a dataset reduced to the required vertical datum.

Automated filtering techniques are applied to economically eliminate bad data points caused by acoustic noise in the water column (aeration, kelp), crosstalk (when acoustic energy from one beam affects adjacent beams), and multipathing (where the sonar erroneously detects a multiple of the first echo as the correct return). Much of the questionable data are eliminated using the Seabat's Quality Index (QI) value, a number from 0 to 3 (with 0 being bad, 3 being best) returned with each sonar beam. The Seabat assigns the value to each beam according to strength of return and adjacent beam comparisons.

Gridding Data

At this point the data are typically 95 percent clean and in the form of X, Y, Z bathymetric dataset. It is reduced to both horizontal and vertical datum as required by the survey. A typical multibeam survey produces 1 million soundings per hour of survey. Sounding density varies over the area because of imperfect line running, vessel turns, and variation in vessel speeds. You may get 10 soundings in one square meter in one area and less than 1 sounding per square meter in others. Initially, this doesn't seem like a problem; however, subsequent steps in the processing reveal that the variation in sounding density needs to be addressed, not only to reduce the data set size but to provide a more 'well-behaved' database for modeling and contouring.

A relatively simple but data input/output intensive process of gridding the sounding data to a desired density is employed at this stage of the processing. A square grid of the desired density is laid over the entire survey area and one sounding is chosen for each grid square within the area. If desired, the gridding process can also select either the shallowest, deepest, most centered, or average sounding within the grid square.

Model and Edit

The next and final step in processing the bathymetric data is in modeling and interactive editing of the soundings. Spectra Precision TerraModel and Terra Vista is used to model, interactively edit, and contour the gridded soundings. TerraModel produces a Digital Terrain Model (DTM) from a Triangular-Irregular-Network (TIN) to form contours and subsequent three-dimensional presentations. This method of modeling uses actual data points, as opposed to smoothed gridded datasets common to most contouring software. As such, in a dataset with varying densities of data, the contours looked very jagged in dense data areas and smoother in less dense areas. The gridding/thinning process described above, although not producing truly evenly spaced datasets, alleviates much of the contour aliasing described here.

TerraModel is a screen interactive package that allows editing of the data that produce the DTM. With contours on the screen, any bad points left in the data set produce 'bulls eye' contours and are easily eliminated.

APPENDIX B

Project Team Resumes

Thomas V. Dupuis, P.E.

Principal Water Resources Engineer

Education

M.S., Environmental Engineering, Marquette University
B.S., Civil Engineering, Marquette University

Professional Registrations

Professional Engineer: Wisconsin

Distinguishing Qualifications

- Strategy Team Leader for the Lower Boise River Water Quality Plan (LBRWQP) as it grapples with the TMDL process
- Provided National Pollutant Discharge Elimination System (NPDES) permit assistance to dozens of municipal and industrial clients throughout the U.S.
- Firmwide Technology Services Leader for Watershed Management Managed a use attainability/site-specific criteria development project for tuna canneries in American Samoa
- Experienced water quality and water resources modeler; includes use of QUAL2E, SWMM, STORM, PLUMES, CORMIX, UDKHDEN, PDS, CDIFF/RDIFF, HEC2, and HEC5 as well as the development and use of other spreadsheet and programmed models

Relevant Experience

Mr. Dupuis is a senior water resources engineer and has more than 24 years of professional experience in the water quality arena. He previously worked for state water agencies in North Carolina, and has been with CH2M HILL for more than 12 years. He is Strategy Team Leader and Facilitator for the Lower Boise River Water Quality Plan (LBRWQP) as it grapples with the TMDL process, and has been a key participant in that watershed effort since 1992. He was also the senior technical lead for development of sediment and bacteria TMDLs for the lower Boise River (via DEQ funding to LBRWQP). He is the lead technical consultant for the City of Boise for ongoing NPDES permitting activities. He has worked for numerous other CH2M HILL clients in over 25 states on NPDES issues. He is an experienced water quality modeler, and has extensive knowledge of storm water and water quality regulatory programs.

Representative Project Experience

Stormwater Quality and Stormwater NPDES Permitting

- Principal Investigator for a recently completed research study for the National Academy of Sciences, National Cooperative Highway Research Program (NCHRP) relating to bridge runoff impacts. He developed a *Practitioner's Handbook* that will be used by highway agencies throughout the country to evaluate and mitigate effects of bridge runoff, including watershed approaches, BMPs, and effluent trading.

- Mr. Dupuis has been helping CH2M HILL clients comply with NPDES stormwater regulations. He was senior consultant for development of the Phase I stormwater program for the City of Omaha. He also has conducted facility evaluations and prepared permit applications for a variety of industrial facilities in a number of states. These evaluations have included site drainage delineation, assessment of materials storage and handling practices, identification of illicit connections, development of storm event sampling protocols, and preparation of Storm Water Pollution Prevention Plans (SWP3s). The most recent study included an update of the SWP3 for Potlatch's Lewiston pulp and paper mill to address the new EPA general permit and related Endangered Species Act requirements.
- Currently managing a contract with the Idaho Department of Environmental Quality to assist with NPDES primacy program development. The project includes review of innovative NPDES approaches, funding strategies, and guidance and rule development. Stormwater and water quality-based effluent limits are two major technical areas in which CH2M HILL is providing NPDES guidance.
- He recently completed a study for the Michigan DOT related to storm water quality, permitting, and management. The project included monitoring and research of storm water quality and impacts on receiving waters and development and regulatory negotiation of SWP3s for Phase I NPDES permits for State highways in 4 municipalities.
- Senior consultant for a project for 6 municipalities in the Hampton Roads, Virginia area related to compliance with Phase I NPDES storm water regulations. The project included development of innovative performance and compliance indicators for storm water pollution prevention programs.
- While working for the State of North Carolina, conducted a special study of the effects of storm water discharges and marina development on water quality in rapidly developing coastal areas.
- Senior consultant for development of a *Dry Weather Screening Analysis Protocol, Training Manual* for the Denver area Urban Drainage and Flood Control District.
- Principal Investigator of a comprehensive nationwide study of the effects of highway storm water runoff on receiving waters. He planned and coordinated field monitoring and developed impact assessment methodologies; biological, sediment, and water column effects were quantified. He developed several guidelines manuals being used by FHWA and highway agencies for planning and conducting field studies and writing environmental assessments of storm water runoff effects. These include 1) *Resource Document for Environmental Assessments;* 2) *Procedural Guidelines for Environmental Assessments;* and 3) *Guidelines for Conducting Field Studies.*
- For the NCHRP, he also studied the feasibility of wetland use to mitigate highway storm water runoff effects and helped develop a national *Guidelines Manual* for that purpose.

NPDES Permitting

- Lead technical consultant to City of Boise in wide-ranging NPDES permit negotiations involving EPA Region 10 and Idaho DEQ; including permits for two wastewater treatment plants and a geothermal discharge.
- Permitting consultant for other Idaho clients, including cities of Meridian and Idaho Falls, and J.R. Simplot and McCain Foods.
- Lead strategy consultant for major TMDL for Lower Boise River, including participation in the ongoing Effluent Trading Demonstration Project as a member of the point/point and point/nonpoint trade team and the municipal framework team
- Senior technical reviewer and task leader for a major regional water quality study for the U.S. Navy in the Hampton Roads, Virginia area. The study addresses NPDES permitting issues for the Navy's 5 bases and more than 300 permitted outfalls, including mixing zone modeling and field dye dispersion studies, development of site specific criteria for copper using the Water Effect Ratio procedure, and development of chemical translators (partitioning coefficients) for 3 metals. Most of the permitted outfalls contain storm water discharges.
- Directed or provided senior review for numerous water quality and effluent toxicity projects in more than 25 states and two territories. These projects focused on the development of compliance strategies and NPDES permit negotiations and included field studies, mixing zone and water quality modeling, and anti-degradation/anti-backsliding evaluations.
- Gained in-depth knowledge of regulatory programs and technical issues covering a wide spectrum of natural resource disciplines through his experience with state water quality and water resource agencies in North Carolina. Technical projects he performed for the state included assessment of the effects of storm water discharges on coastal water quality; multipurpose reservoir modeling; groundwater/surface water conjunctive use modeling; comprehensive river basin studies; hydroelectric evaluations; aquatic habitat in-stream flow needs studies; and assessments of animal feedlots and phosphate detergents.

Water Quality Modeling and Evaluation

- Conducted more than a dozen mixing zone modeling projects related to thermal and toxic constituents for municipal and industrial clients (e.g., CORMIX, UDKHDEN, PLUMES, RDIFF/CDIFF, PDS)
- Developed wasteload allocation for storm water and deicer discharges to Mill Creek for Dayton International Airport (MULTID and SIMULA models); also provided extensive technical support to DIA for related NPDES permitting and litigation activities
- For the Port of Portland (PDX airport) conducted water quality modeling for potential discharge of aircraft and airfield deicers to the Columbia River
- Providing water quality assessment and modeling services to Pittsburgh International Airport related to discharge of deicing materials to local streams

With co-authors. *St. Louis River Basin Environmental Impact Statement*. Federal Energy Regulatory Commission, Office of Hydropower Licensing. FERC/EIS-0073F. February, 1995.

With Phillip Benson. *Determining Actual Background Concentrations of Toxics in Receiving Waters: Alternative Approaches and Regulatory Implications*. Presented at Spring 1995 AICLE meeting, Houston, Texas. March 22, 1995.

With Nancy Schultz. *Understanding Effluent Toxicity*. Presented at the ASCE National Environmental Engineering Conference, Reno, Nevada. July 8-10, 1991.

With James S. Albrecht. *Mosinee Paper Effluent Toxicity and Dilution Studies*. Presented at the 1990 TAPPI Environmental Conference, Seattle, Washington. April 11, 1990.

Mosinee Paper Effluent Dilution Studies. Presented at the 1989 NCASI Central-Lake States Regional Meeting, Dayton, Ohio. September 20, 1989.

With Nancy Schultz. *Hydrologic Criteria for Assessment of Water Quality Impacts from Nonpoint Sources*. Presented at the 1989 American Society of Civil Engineers National Water Conference and LIFE Symposium, Newark, Delaware. July, 1989.

With Nancy Schultz. *Harbor Uses, Water Quality, and Use Attainability*. Presented at the 11th Conference of the Coastal Society, Boston, Massachusetts. October, 1988.

With John Vogt. *Jordan Lake Hydrology and Downstream Water Quality Considerations. Final Report*. North Carolina DNRCD, Division of Water Resources/Division of Environmental Management. February, 1988.

Conjunctive Use Modeling of Ground and Surface Water, Southside Hampton Roads, Virginia. Final Report for the North Carolina Department of Natural Resources and Community Development, Division of Water Resources. September, 1987.

With James Mead. *Potential Effects of Proposed Wastewater Discharges to Middle Creek on Flooding, Streambank Erosion, and Fish Habitat*. North Carolina DNRCD, Division of Water Resources. July, 1987.

With co-authors. *Dan River Basin Study A: Phase I. Final Report*. North Carolina DNRCD, Division of Water Resources. November, 1986.

Animal Operations and Water Quality in North Carolina. Report No. 86-05. North Carolina DNRCD, Division of Environmental Management. June, 1985.

With George Everett. *Coastal Development and Shellfish Waters*. Report No. 85-05. North Carolina DNRCD, Division of Environmental Management. April, 1985.

With George Everett. *Water Quality Criteria for Primary Nursery Areas in North Carolina*. Report No. 84-10. North Carolina DNRCD, Division of Environmental Management. April, 1985.

With co-authors. *Effects of Highway Runoff on Receiving Waters*. 1985. FHWA-RD-84/062: Vol. I. Executive Summary; FHWA-RD-84/063: Vol. II. Results of Field Monitoring Program; FHWA-RD-84/064: Vol. III. Resource Document for Environmental Assessments; FHWA-RD-84/065: Vol. IV. Procedural Guidelines for Environmental Assessments; FHWA-RD-84/066: Vol. V. Guidelines for Conducting Field Studies.

Lynn E. Foster

Aquatic Biologist

Education

MS, Fisheries, University of Wyoming
BS, Biology, Ohio State University

Distinguishing Qualifications

- More than 25 years of experience as a consulting biologist specializing in aquatic biology
- Investigated major river systems, including the Columbia, Snake, Salmon, and Mississippi
- Served as the team leader, senior reviewer, fisheries biologist, and surface water quality specialist for EIS assessments
- Served as the EIS/HCP task leader for Plum Creek's Native Fish Habitat Conservation Plan

Relevant Experience

Mr. Foster has more than 25 years of experience as a consulting biologist specializing in aquatic biology. He has investigated major river systems, including the Columbia, Snake, Salmon, and Mississippi. Mr. Foster has served as the team leader, senior reviewer, fisheries biologist, and surface water quality specialist for National Environmental Policy Act (NEPA) assessments.

Representative Project Experience

Salmon-Challis National Forest Noxious Weed Management Program, Idaho. Task leader and fisheries biologist on the preparation of an EIS for the intensive management of noxious weeds on the 3-million acre Salmon-Challis National Forest and assessing the effects on natural resources. Sensitive fish species and habitat being evaluated in this document include bull trout, westslope cutthroat trout, and the Evolutionarily Significant Units of the Snake River steelhead, spring/summer chinook salmon, and sockeye salmon. Documented infestations of noxious weeds on the Forest now exceed 65,000 acres and have the potential to adversely affect vegetative cover, wildlife habitat, riparian corridor health, and the erosion and delivery of sediment to Forest drainages occupied by protected/sensitive fish species.

Plum Creek Native Fish Habitat Conservation Plan (NFHCP), Montana, Idaho, and Washington. Task leader on the preparation of the combined EIS and HCP for Plum Creek, the U.S. Fish and Wildlife Service (FWS), and the National Marine Fisheries Service (NMFS). Covers 1.7 million acres of timber lands in Montana, Idaho, and Washington and 17 species of federally listed or unlisted native salmonids under an Incidental Take Permit. Prescriptions have been developed by Plum Creek and negotiated with the FWS and NMFS for eight categories of conservation commitments designed to benefit native salmonids such as bull trout, steelhead, westslope cutthroat trout, redband trout, chinook salmon, and others either listed under the Endangered Species Act or having sensitive status.

Richard K. Glanzman

Senior Geohydrologist-Geochemist

Education

M.S., Geochemistry, Colorado School of Mines
B.S., Geology, University of Utah

Distinguishing Qualifications

- Formulated the physiochemical alteration zonation associated with the deposition of precious, base, and industrial metal deposits
- Developed a geochemical and mineralogical exploration method for mineral deposits in the caldera environment
- Developed a soil gas technique to evaluate and discriminate massive sulfide geophysical anomalies

Relevant Experience

Mr. Glanzman is a senior geohydrologist-geochemist in CH2M HILL's Geosciences Discipline. He is responsible for planning, developing, interpreting, and reviewing geohydrological and, particularly, geochemical investigations in water supply and hazardous waste. His publications deal with geohydrology, geochemistry, hydrology, geology, field geochemical techniques, and remote sensing. Most of his work has been in the western United States, working for CH2M HILL, the U.S. Geological Survey, and the mining industry..

Confidential Client. For a confidential client in Idaho, Mr. Glanzman was the project geochemist responsible for interpreting, analyzing, and reporting geochemical data for a large reservoir sediment study. Sediment cores up to 40 feet long were collected from multiple locations within the reservoir. Numerous layers within the cores were sub-sampled to describe the physical and chemical properties of the sediment, which included pre-impoundment and post-impoundment substrate. The samples were analyzed using numerous geochemical tests to assess the metals and nutrient content, as well as physical properties such as grain size and density. Sediment dating was also performed using lead-210 and radium-226 dating techniques. To assess the source of sediment to the reservoir, sediment from the major tributaries was also analyzed and compared to the reservoir sediments.

Physiochemical Alteration Zonation. Mr. Glanzman has formulated the physiochemical alteration zonation associated with the deposition of precious, base, and industrial metal deposits. He has assessed the subsequent response of this alteration zonation to present environments. These data have been applied for both exploration and environmental purposes. It has been used to identify and quantify the extension of producing ore deposits and the location of blind mineralization. The application of this information has resulted in the discovery of a major lithium clay deposit in the McDermitt Caldera Complex in Nevada and Oregon.

Geochemical and Mineralogical Exploration. Mr. Glanzman has developed a geochemical and mineralogical exploration method for mineral deposits in the caldera environment. The major effort started with the gold, mercury, lithium, and uranium deposits in the McDermett caldera in Nevada and Oregon. It then extended to the gold and mercury mineralization associated with the Weiser and Thunder Mountain calderas in Idaho and the Hog Ranch caldera in Nevada. These studies expanded into other gold-mercury associated ore deposits that include Hemlo, McLaughlin, and 16 other sites in hot spring geothermal cell environments. The work developed the geochemical and mineralogical signature that can extend to as much as half a mile from mineralization. It included geochemical and mineralogical problems associated with heap leach recovery of gold from these deposits.

Clay Minerals Study. He was the project manager of a clay minerals program with the U.S. Geological Survey that involved the geochemistry of lithium. The physicochemical paths for the formation, preservation, and alteration of clay minerals in all environments (intense differences in chemical, pressure, temperature, and salinity) were defined along with their stability, fluid-retaining and permeability-reducing characteristics that make them suitable for use as hydrologic barriers.

Geochemical Reactions. Mr. Glanzman has a key role in the evaluation of geochemical reactions involved in hazardous wastes, water supply systems, and aquifer recharge. Mr. Glanzman uses both field- and computer-based (thermodynamic) models such as PHREEQE, MINTEQ, WATEQ, and the EQ3NR/EQ6 to evaluate potential inorganic geochemical reactions within the hydrologic system. He has applied these and reviewed other geochemical methods to evaluate hazardous waste fate and transport at sites related to metals (California Gulch, Colorado; Cherokee County, Kansas; Silver Bow Creek and East Helena sites, Montana), solvents (South Valley site, New Mexico; Des Moines, Iowa), radioactivity (Paducah, Kentucky; Rocky Flats, Colorado), and landfills (OII, California; IWC, Arkansas; Lowry, Colorado). In addition to the Superfund sites, he has worked with many private industry clients involving hazardous wastes in air, water, and many forms of solids.

Mr. Glanzman developed geochemical programs to evaluate the distribution and future concentration of major ions and dissolved metals (specifically arsenic) in a master plan for the groundwater drinking water supply of a major western city. This involved the application of several innovative field methods for both geohydrological and geochemical techniques. Appropriate groundwater sampling and monitoring methodology is critical to an understanding of the groundwater system, particularly to predict the water chemistry of drinking water 10 to 20 years in the future.

Mr. Glanzman has developed and applied several analytical techniques at the field site, generally considered laboratory techniques, to expedite the nature and extent determination of both natural and synthetic chemical elements, compounds, and minerals. X-ray fluorescence (XRF), infrared (IR), and soil gas techniques have been developed for application at field sites. Field portable XRF can be used to both screen and analyze the total metals concentration at the field site. IR can determine the presence and amount of organics as well as the types and relative proportion of clay minerals. Soil gas can determine the presence and amount of organic and inorganic gases at a site that can be used to distinguish between natural and anthropogenic sources.

Mr. Glanzman has a key role in evaluating the geochemical reactions involved in recharge and aquifer storage retrieval. He developed an initial screening analysis that forms a basis for judging geochemical reaction potential between the recharge water and the in situ groundwater at many recharge sites across the United States (Tucson, Arizona; Myrtle Beach, South Carolina; Kerrville, Texas; Chesapeake, West Virginia; Swimming River, New Jersey; Seattle, Washington; and Los Posas, California). This initial evaluation is a fatal flaw analysis of existing physical, chemical, and biological data for the site or area. From this analysis, specific tests are designed to address the potential problems. His experience in geochemical processes (organic, inorganic, and biological) and clay mineralogy is particularly applicable to the development of a successful recharge project.

In addition to equilibrium geochemical conditions involving concentration, pH, oxidation-reduction potential, complexing, ion-exchange, and adsorption, Mr. Glanzman includes volatilization, kinetics, and the role of microbiota in evaluating the nature/extent and fate/transport of geochemical phases involving most media. Both aqueous and vapor phase isotope evaluations have been applied to separate natural and anthropogenic sources. Quality assurance and control involves the application of both parametric/nonparametric statistical techniques and geostatistical techniques. Basic statistical functions are typically applied. However, other tests that are appropriate for specific applications include discriminate function analysis, several types of cluster analysis, principal components analysis, and factor analysis. Geostatistics provides an effective technique to objectively and quantitatively determine the most effective and efficient sample density of physical and chemical parameters in three-dimensional multimedia.

Several levels of remote sensing have been applied by Mr. Glanzman to the physical and geochemical characterization of areas and sites. Relatively inexpensive, rapid, and highly sophisticated computer processing techniques have been developed that can be used to define not only the present surficial conditions but also surficial conditions since the early 1970s through Landsat imagery. Recent improvements in spectroscopy allow fixed-wing imagery that allows the identification, relative quantification, and mapping of such surficial properties as expandable clay and nonexpandable clay, oxidizing sulfide minerals, and geological structures that control groundwater movement on a 10- to 20-foot scale.

Superfund. Mr. Glanzman oversaw Superfund work on the Cal Gulch, Asarco, IWC, and UNC sites. Cal Gulch is a mine tailings water resource Superfund site at Leadville, Colorado. Leadville is a historic silver-rich base metal sulfide mining community built adjacent to mine tailings being oxidized and leached. The Asarco site is a smelter site near Helena, Montana. IWC is a closed industrial waste landfill established in a coal strip mine area near Fort Smith, Arkansas. UNC is a mine tailing site adjacent to a uranium milling facility near Church Rock, New Mexico.

Radon Gas. Mr. Glanzman, working with the U.S. Bureau of Mines, evaluated techniques for the measurement and removal of radon gas from the mine and industrial environment. His work involved the definition of gas transport, physicochemical interaction between groundwater under unsaturated and saturated conditions, and in both porous media and fracture flow. A position paper on health physics of radon gas was produced and test environments were established for the assessment of removal methods.

Geochemical Anomalies. In addition to the application of statistical techniques to quality assurance and control, Mr. Glanzman utilized statistics to more accurately define and discriminate geochemical anomalies. Basic statistical functions and tests included discriminate function analysis, several types of cluster analysis, factor analysis, and kriging. The geostatistical technique, kriging, was successfully applied to analyze and interpret three-dimensional multimedia (soil, vegetation, stream sediment, rock, drill cuttings, and remote sensing) sample data. Kriging is an effective technique to quantitatively determine the most efficient and effective sample density to define physical and chemical parameters.

Publications

Mr. Glanzman is the author of 29 publications dealing with geochemistry, hydrology, and geology. The following are several pertinent publications.

With Dumeyer, R.K. and J.M. Klein. *Chemical Quality of Water in the San Luis Valley, Colorado.* Colorado Water Conservation Board. 1970. 43 p.

With Coffin, D.L. and F.A. Welder. *Geohydrology of the Piceance Creek Basin between the White and Colorado Rivers, Colorado. U.S. Geological Survey Hydrologic Investigations Atlas HA370.* 1969.

With Coffin, D.L., F.A. Welder, and X.W. Dutton. *Geohydrologic Data from the Piceance Creek Basin between White and Colorado River, Northwestern Colorado*. Colorado State Circular No. 12. 1968. 38 p.

With Mason, M. Analytical Data Reliability. Presented at the American Institute of Mining Engineers Meeting, Atlanta, Georgia. 1983.

With Lindsey, D.A., C.W. Naeser, and D.J. Nichols. Upper Oligocene Evaporites in Basin Fill of Sevier Desert Region, Western Utah. *Bulletin of the American Association of Petroleum Geologists*. Vol. 65, No. 2. 1981. Pp. 251-283.

With Leach, D.H., and K.P. Puchlik. Geochemical Exploration for Uranium in Playas. *Journal of Geochemical Exploration*. Vol. 13. 1980. Pp. 251-283.

With Asher, Bolinder, S. and J.R. Davis. *Chemistry of Groundwater from Test Holes Drilled in Esmeralda and Nye Counties, Nevada. U.S. Geological Survey Open File Report 80-672*. 1980. p. 31.

With Rytuba, J.J. *Zeolite-Clay Mineral Zonation of Volcaniclastic Sediments within the McDermitt Caldera Complex of Nevada and Oregon. U.S. Geological Survey Open File Report 79-1668.* 1979. p. 25.

With Taylor, M.E. *Implications of Evaporites in the Upper Cambrian-Lower Ordovician Notch Peak Formation, Southern House Range, Western Utah. U.S. Geological Survey Open File Report 79-1428*. 1979.

With Rytuba, J.J. Relation of Mercury, Uranium, and Lithium Deposits to the McDermitt Caldera Complex, Nevada, Oregon. *Mineral Deposits of Western North America*. J.D. Ridge, ed. Nevada Bureau of Mines of Geology Report 33. 1979.

With Rytuba, J.J. and W.K. Conrad. Uranium, Thorium, and Mercury Distribution through the Evolution of the McDermitt Caldera Complex. *Basin and Range Symposium of the Rocky Mountain Association of Geologists and Utah Geological Association*. 1979. Pp. 405-412.

With Otton, J.K. Geochemical Association of Lithium and Uranium. Abstract in *Exploration Geochemistry in the Basin and Range Province, Tuscon, Arizona, Program and Abstracts*. 1979. p. 17.

With Rytuba, J.J., and W.K. Conrad. Uranium, Thorium, Mercury, and Lithium Distribution through the Evolution of the McDermitt Caldera Complex. *U.S. Geological Survey Open File Report 79-542*. 1979. p. 27.

With Meier, A.L. Preliminary Report on Samples Collected During Lithium Reconnaissance Studies in Utah and Idaho. *U.S. Geological Survey Open File Report 79-279*. 1979. p. 52.

With Brenner-Tourtelot, E.F. Lithium-bearing Rocks of the Horse Spring Formation, Clark County, Nevada. *Energy*. Vol. 3, No. 3. 1978. Pp. 255-262.

With Rytuba, J.J. Relation of Mercury, Uranium, and Lithium Deposits to the McDermitt Caldera Complex, Nevada-Oregon. *U.S. Geological Survey Open File Report 78-926*. 1978. p. 19.

With Rytuba, J.J., and J.H. McCarthy, Jr. Lithium in the McDermitt Caldera, Nevada and Oregon. *Energy*. Vol. 3, No. 3. 1978. 347-353.

With Rytuba, J.J., and J.H. McCarthy, Jr. Diagenetic and Hydrothermal Alteration and Trace Element Distribution in Tuffaceous Sediments within the McDermitt Caldera, Nevada-Oregon. *Geological Society of America, Abstracts with Programs*. Vol. 9, No. 7. 1977. p. 1151.

Geochemical and mineralogical Comparison of Surficial Materials in the Great Salt Lake Desert, Pilot Valley and Sevier Lake, Utah. *Proceedings from the International Conference on Desertic Terminal Lakes; Weber State College, May 2-5, 1977, Utah Water Research Laboratory, Utah State University Logan*. Greer, Deon C., ed. Pp. 183-196.

With Meier, A.L. Lithium Brines associated with Nonmarine Evaporites. *Lithium Resources and Requirements by the Year 2000: U.S. Geological Survey Professional Paper 1005*. 1976. Pp. 88-92.

With Davis, J.R. et al. Lithium and Future Energy. *Geological Society of America, Abstracts with Programs*. Vol. 7, No. 2. 1975. Pp. 157-158.

With Vine, J.D. et al. Are Lithium-Rich Sedimentary Rocks and Brines Related to Tectonic Activity? *9th International Sedimentological Contress, Nice, France, Theme 9, La Sedimentologie et al geologic economiques; les gisements sedimentaires*. 1975. Pp. 105-110.

With Vine, J.D. et al. Geochemical Prospecting for Lithium. *Geological Society of America, Abstracts with Programs*. Vol. 7, No. 5. 1979. Pp. 608-609.

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With Richards, D.B. and L.A. Hershey. *Hydrogeologic Data from Baca and Southern Prowers Counties, Colorado. Colorado State Basic Data Release 19*. 1968. 123 p.

With Brennan, R. Groundwater observations and sedimentation sections. *Watershed Program Evaluation, Kiowa Creek Watershed, Colorado*. Soil Conservation Service, Economic Research Service, and U.S. Department of Agriculture for the U.S. Geological Survey. 1967. Pp. 1930.

Steven Lee Hicks

Geological/Environmental Engineer

Education

B.S., Engineering, Colorado School of Mines

Professional Registration

EIT: Colorado

Distinguishing Qualifications

- Experience with the evaluation of conditions and mitigation design and implementation for impacted surface water bodies in response to Total Maximum Daily Load (TMDL) and Endangered Species Act (ESA) requirements.
- Experience with monitoring network design and installation for various sites
- Experience with monitoring well installations and drilling methods including direct push, hollow-stem auger, air rotary, and rotosonic
- Experience with conducting field sampling activities for surface water, groundwater, and soil investigations
- Experience with design and implementation of geographical information systems (GIS) for several sites
- Groundwater and surface water modeling of both flow, groundwater/surface water interaction, and fate and transport

Relevant Experience

Mr. Hicks is a geological/environmental engineer with CH2M HILL's Energy, Environment, and Systems Group. He has a strong technical background and project management experience in geological and environmental engineering, and hydrogeology. He has worked on Resource Conservation and Recovery Act/Comprehensive Environmental Response, Compensation, and Liability Act (RCRA/CERCLA), and soil, groundwater, and surface water contaminated projects for federal, state, industrial, and municipal clients. His project experience includes site characterization; remedial investigations/feasibility studies; remedial design/remedial action; site closure; hydrogeological investigations; and groundwater modeling of flow, groundwater/surface water interaction, and contaminant fate and transport. He has used his knowledge of GIS to design and implement GIS for several sites as a data management and analysis tool. He also has extensive field management and oversight experience in these areas.

Representative Project Experience

Bunker Hill Superfund Site, USEPA, Kellogg, Idaho, 2001. Design and implementation of a GIS for data management and analysis for the site that will be accessible to all interested parties through the internet. Provide an evaluation of the current groundwater and surface water sampling program including review of existing data and recommendations for future site-wide monitoring activities. Provide recommendations for future remedial actions based on evaluation of current and historical site data. Provide assistance to USEPA personnel in response to public comments on USEPA technical documents.

City of Spokane Lead Paint Removal Project, Spokane, Washington, 2001. Field oversight for removal of lead contaminated sand blast media at city water towers. Provided monitoring of dust and erosion control measures employed for open excavations.

Previous Experience

Stone and Webster, Inc., Denver, Colorado, 2001.

Air Force Plant PJKS, USAF Aeronautical Systems Command, Waterton Canyon, Colorado, 2001. Project Hydrogeologist/Engineer responsible for development of work plans, implementation, and reporting for site characterization and investigation activities of TCE contamination in an interconnected alluvial/fractured bedrock aquifer impacting surface water. Developed soil remediation objectives and soil concentrations protective of groundwater and surface water and negotiated their approval with the Colorado Department of Public Health and Environment. Designed and implemented a GIS for use as a data management and analysis tool.

Parsons Engineering Science, Inc., Denver, Colorado, 1999-2000.

Natural Attenuation Initiative, Air Force Center for Environmental Excellence, Country-wide, 1999 – 2000. Collected, reviewed, and interpreted data for several USAF natural attenuation sites. Duties included field work, report preparation, GIS, and groundwater modeling.

Enhanced Bioremediation Studies, AFCEE, Country-wide, 2000. Evaluated the effects of enhanced bioremediation of chlorinated solvents via vegetable oil injection at several USAF and Navy sites. Responsible for site management, drilling oversight, oil injection, field sampling, and report writing.

Canal Leakage Evaluation, Central Nebraska Public Power and Irrigation District, Nebraska, 1999 – 2000. Performed a groundwater modeling study with GMS and GIS to determine the effects of irrigation canal improvements on groundwater recharge and surface water recharge in support of Endangered Species Act requirements on the South Platte River.

Stephen D. Miller

Water Resources Engineer

Education

M.S., Environmental Engineering, Clemson University
B.S., Agricultural Engineering, Clemson University

Distinguishing Qualifications

- Firmwide technology lead for stream restoration
- Proficient in NPDES permitting efforts, including stormwater quality issues
- Hydrologic, hydraulic, and water quality modeling experience encompassing hydroelectric facilities operations, watershed and stormwater drainage improvements, flood analyses, irrigation canal systems, county-wide infiltration/inflow reduction analyses, mixing zone studies, and fish habitat assessments
- Assists in watershed planning and management strategies, including development of a draft TMDL Strawman Urban/Residential Water Quality Plan for the Lower Boise River Water Quality Plan
- Conducts biological studies of streams, wetlands, and reservoir sites
- Extensive field experience evaluating water quality, stormwater quality and quantity, and fish habitat
- Develops erosion control plans

Relevant Experience

Mr. Miller is an engineer in CH2M HILL's Water Resources group. He has contributed to a variety of water quality, hydrologic, and hydraulic modeling studies, conducted diverse regulatory assessment and permitting projects, and led extensive fieldwork efforts for a variety of studies with CH2M HILL during the last 10 years.

Steve Miller is a water resource specialist in CH2M HILL's Boise office. Steve has worked on a variety of projects involving water quality and sediment issues, mixing zone studies, fish habitat suitability, stormwater modeling and management, and stream restoration. Most recently Steve was a major contributor to the technical work on the Lower Boise River Water Quality Plan for the Lower Boise River TMDL. Steve developed instream total suspended sediment target concentrations for protecting aquatic biota in the Boise River; wrote the Problem Assessment for the sediment TMDL; and, drafted the Load Allocation for sediment.

Representative Project Experience

Confidential Client. For a confidential client in Idaho, Mr. Miller managed and conducted a reservoir sediment study. Sediment cores up to 40 feet long were collected from multiple locations within the reservoir. Numerous layers within the cores were sub-sampled to describe the physical and chemical properties of the sediment, which included pre-impoundment and post-impoundment substrate. The samples were analyzed using numerous geochemical tests to assess the metals and nutrient content, as well as physical properties such as grain size and density. Sediment dating was also performed using lead-210 and radium-226 dating techniques. To assess the source of sediment to the reservoir, sediment from the major tributaries was also analyzed and compared to the reservoir sediments.

Corps of Engineers, Walla Walla District, Washington. Mr. Miller managed and conducted a sediment sampling and analysis project as part of the Lower Snake River Juvenile Salmon Migration Feasibility Study. This study was conducted in two phases. During the first phase, a total of 487 sediment samples were collected in the Snake River from Lewiston, Idaho, to the mouth of the river. These samples were used to generate particle size distributions that provided the basis for sediment coring in the second phase. Approximately 100 sediment cores were collected from the same study area and sub-sampled for chemical analysis including metals and nutrients.

Bunker Hill Superfund Site, Kellogg, Idaho. Mr. Miller designed and conducts the water quality monitoring program associated with the hillsides revegetation at the Bunker Hill Superfund site. The objective of the monitoring is to measure the performance of the revegetation efforts with respect to hillslope runoff and erosion. Mr. Miller installed five flow monitoring meters and four turbidity sondes for continuous monitoring at various locations. Mr. Miller manages, analyzes, and reports the data.

Lower Boise River TMDL Stakeholders, Idaho. Mr. Miller was the lead technical expert for developing a load capacity and allocation for sediment in the Lower Boise River TMDL process and was active in the Stormwater Working Group. Mr. Miller was responsible for developing target water quality total suspended sediment concentrations for protection of the beneficial uses in the river. He is also assisting in the development of a load capacity and allocation process for sediment and bacteria.

Idaho Transportation Department. Mr. Miller designed the stormwater drainage facility for the US-95 Bonners Ferry North Hill project in Idaho. His responsibilities as lead engineer were to complete a detailed hydrologic and hydraulic analysis for controlling runoff during the construction and final highway design. Two detention ponds were designed to capture runoff from approximately 1 square mile of mixed land use and steep slopes.

St. Luke's Regional Medical Center, Boise, Idaho. Mr. Miller provided senior-level input to St. Luke's in the conceptual design stage of their stormwater control system for their new, three-level parking deck. Based on his experience with Boise City and Ada County Highway District, Mr. Miller made recommendations on such issues as subsurface disposal and stormwater treatment on the physically confined site. The central issue of the project was compliance with City and Highway District stormwater regulations.

Confidential Client, Virginia. For a synthetic organic chemical manufacturing plant located on the New River in Virginia, Mr. Miller served as project engineer on a 316(a) demonstration. Project responsibilities included identifying and measuring the thermal boundaries of discharges from the plant; determining whether the discharges precluded fish passage or affected the reproductive uses of the river by fish; and performing a Btu analysis.

Stormwater Drainage Master Plan, Atlanta, Georgia. Mr. Miller was the project engineer responsible for sizing culverts to ensure adequate discharge capacities, field checking erosion sites and recommending methods and materials for control, and presenting results in a manner suitable for capital appropriations requests.

Water Quality Modeling, Reservoirs, Idaho. Mr. Miller was responsible for evaluating and presenting results of two water quality models of two reservoirs in Idaho. The models are being used as a tool for identifying cost effective water quality management strategies for the reservoirs. Various management scenarios were simulated, including manipulation of flows into and out of the reservoir by controlled withdrawals and controlled discharges from upstream reservoirs, as well as decreased nutrient loading to the reservoir through reduction of point and non-point sources (including agricultural runoff) by implementing watershed management programs. The U.S. Army Corps of Engineers' model CE-QUAL-W2 was used to model the reservoirs.

For the U.S. Army Corps of Engineers, Mr. Miller managed and conducted water quality sampling on Lucky Peak Reservoir near Boise, Idaho. The Lucky Peak project provides the Treasure Valley with water for recreation, irrigation, wildlife habitat, and many other purposes. The goal of the sampling effort was to provide long-term water quality monitoring data and to track progress towards meeting the project water quality objectives. Sampling was conducted from a boat during three seasons throughout the reservoir. A Hydrolab H_2O Multiprobe was used to record temperature, dissolved oxygen, depth, pH, conductivity, total dissolved solids, and turbidity to depths of 200 feet. In addition, photic zone measurements are taken at each station using a 200-mm limnological Secchi disk. Grab samples were also collected for analysis of calcium, chloride, magnesium, hardness, ammonia nitrogen, nitrite nitrogen, nitrate nitrogen, total Kjeldahl nitrogen, fluoride, ortho-phosphorus, total phosphorus, silica, sulfate, suspended solids, chlorophyll a, and alkalinity.

Mixing Zone Study, Snake River, Idaho. Mr. Miller managed and conducted a mixing zone study for an industrial facility discharging to the Snake River in Idaho. The CORMIX3 model was used to characterize the zone of initial dilution and the mixing zone boundary associated with proposed discharge limits and existing conditions for a non-contact cooling water discharge. The model results were used to determine if the State water quality standards were being met for water temperature and residual chlorine concentration.

NPDES Permitting, Various Locations. Mr. Miller has been involved in the completion of numerous NPDES permitting efforts. These include stormwater permitting assistance for Hoechst Celanese Corporation, the City of Atlanta, and numerous Georgia-Pacific facilities. This work included developing a user-friendly computer model for calculating stormwater pollutant loads, selecting stormwater monitoring locations for the City of Atlanta, and performing various runoff analyses for numerous industrial facilities.

Other water quality/permitting-related project responsibilities include the following:

- Miscellaneous stormwater planning for the Ada County Highway District in Boise Idaho and Department of Public Utilities in Gwinnett County, Georgia
- A waste load allocation study on the Saco River in Maine

- Data analyses for use-attainability studies
- Surface water quality study for an industrial client to analyze trends in hexamethylphosphoramide concentrations in the James River, Virginia
- Thermal mixing zone study for Monsanto Chemical in Alabama
- Development of a Facility Response Plan as required by the Oil Pollution Act of 1990 for an industrial client

Biological Studies, Various Locations. Mr. Miller developed a stream restoration design for an impaired stream reach in western Idaho and wrote the Aquatic Environment sections of the associated Environmental Assessment. The restoration methods involved reestablishing old river meanders, improving fish habitat, providing bank stability, and establishing grade control.

Mr. Miller contributed to a biological monitoring project on Noonday Creek in Cobb County, Georgia. He was responsible for assisting in the collection of fish samples (electroshocking) and aquatic macroinvertebrates. This project followed the Draft Georgia Standard Operating Procedure for collecting benthic macroinvertebrates and the U.S. EPA Rapid Bioassessment Protocol V for fish sampling.

For a 316(a) demonstration on the New River in Virginia, Mr. Miller helped establish the protocol for collecting juvenile fish. Analysis of the seasonal abundance, distribution, and species diversity of juvenile fish was one method used to assess the impact of thermal discharges on the reproductive uses of the river near the chemical manufacturing plant.

Other biological studies to which Mr. Miller has contributed include a biological survey of the Chattahoochee River in Atlanta and a wetlands delineation at a potential reservoir site in western Georgia. The biological survey focused on collecting benthos with secondary emphasis on water chemistry. Hester-Dendy, Surber, and Ponar samplers were used to collect aquatic macroinvertebrates. The wetlands delineation involved extensive map work, soil sampling, and plant identification. For mapping purposes, Mr. Miller operated a backpack-mounted global positioning system (GPS). Experience was gained using PFINDER software used to upload position and attribute information collected in the field to a PC for manipulation.

Prior to joining CH2M HILL, Mr. Miller was a member of a graduate assistant research team responsible for monitoring and assessing the environmental impacts on a mountain stream influenced by construction of a pumped-storage hydroelectric power facility. Duties included collecting, measuring, and reporting baseflow and stormflow data on water quality, hydrology, and sedimentology. For his master's thesis, Mr. Miller correlated long-term sediment and fisheries data to identify and assess the best indicator of sedimentation impacts on a wild trout population.

Hydrologic/Hydraulic Modeling. Using the U.S. Army Corps of Engineers HEC-2 model, Mr. Miller modeled a large portion of the Snake River to provide input data to a large-scale, regional water quality model. The river model was run with pre- and post-impoundment conditions. Water surface elevations and velocities associated with the two different scenarios were used in the water quality model.

For the City of Charlotte, Mr. Miller served as project engineer on a hydrologic and hydraulic stormwater study for a 16-square-mile basin. Detailed HEC1, HEC2, and SWMM modeling was performed to provide the City a GIS tool for watershed management and stormwater drainage improvements. In addition to responsibilities associated with completing the computer models, Mr. Miller led the field teams responsible for measuring structures and channel geometry and estimating Manning's roughness coefficients for more than 70 miles of stream length.

Michael W. Mischuk

Senior Scientist/Freshwater Ecologist
Environmental Risk Assessor

Education

M.A., Biology, St. Cloud State University, 1976
B.A., Biology, St. Cloud State University, 1972

Distinguishing Qualifications

- More than 20 years of experience evaluating both natural and anthropogenic disturbances to freshwater ecosystems
- Expertise is in algal, macroinvertebrate, and fish systematics, and biomonitoring of aquatic ecosystems

Relevant Experience

Mr. Mischuk is a senior freshwater ecologist in CH2M HILL's Water Business Group, primarily engaged in water resource management issues and the assessment of biological integrity of freshwater ecosystems. He is responsible for budgets, conducting field studies, and analyzing data and reporting on instream bioassessments as part of site characterizations and regulatory compliance issues. Mr. Mischuk has conducted ecological risk assessments as part of CERCLA hazardous waste sites and RCRA corrective actions and conducted ecological investigations and acted as a senior reviewer of ecological risk assessments for USEPA and as part of military base closures.

Mr. Mischuk was a senior biologist for Integrated Paper Services, Inc., of Appleton, Wisconsin. His responsibilities included the design and implementation of research to investigate and evaluate the effects of pulp and paper mill effluent discharges on receiving stream water quality.

As an associate scientist at the Institute of Paper Chemistry, Mr. Mischuk spent 12 years conducting investigations aimed at assessing the effects of pulp and paper wastewater discharges on freshwater ecosystems. His work included instream bioassessments with macroinvertebrates and algae as indicators of biological integrity. He also used bioassays to perform compliance monitoring for NPDES permits and conducting eutrophication assessments using algal bioassays and nutrient loading modeling.

Mr. Mischuk developed an instream assessment technique that uses filter-feeding caddisfly larvae to determine dioxin and furan (2,3,7,8-TCDD/TCDF) levels in the secondary aquatic food chain. The technique was used as a quick response method for evaluating the effectiveness of in-plant process changes that reduced dioxin and furans in treated effluent.

While working for the Minnesota Department of Natural Resources as an aquatic biologist, Mr. Mischuk served as field operations coordinator and principal investigator on a regional EIS. Mr. Mischuk was responsible for the design and implementation of a study to characterize periphyton populations in rivers and streams within a 600-square-mile area for a proposed copper/nickel mining industry in northern Minnesota. The work included obtaining technical information for development of public policy and regulation for a new mineral industry in Minnesota.

Mr. Mischuk conducted research on algal populations in the Mississippi River near Monticello, Minnesota. His efforts were in support of an ecological monitoring program for a nuclear power plant owned by Northern States Power Company.

Representative Project Experience

Stream Relocation, Ohio. Developed and assisted in the design and relocation of a section of Mill Creek as part of an airport expansion at the Dayton International Airport. The design was modified from its original trapezoidal configuration to a more environmentally friendly design in order to meet the necessary 401 water quality permit from the State of Ohio. The modified design was meet with satisfaction from the State biologists and the 401 permit was approved.

Highway Runoff Study. For the National Cooperative Highway Research Program (NCHRP), assessed impacts of bridge deck runoff contaminants on receiving waters. Effects based on *In Situ* evaluation of benthic macroinvertebrate community structure in freshwater system (Mallard Creek, North Carolina) and infaunal benthic macroinvertebrate community structure in marine system (San Francisco Bay, California).

Sediment Sampling. Provided oversight of sediment sampling in the Menominee River below the Moss-American superfund site.

Biological Assessment. Conducted biological assessment of Catoma Creek downstream of the effluent discharge from the City of Montgomery's wastewater treatment plant.

Biomonitoring and Bioassessment. Provided NPDES permit assistance for the City of Boise, Idaho. Acted as senior review for biomonitoring conducted by USGS for the City of Boise. Also provided review of state bioassessment criteria and documents for the city.

Biological Survey, Georgia. For the City of Atlanta, Georgia, participated in the Chattachoochee Biological Survey. Objectives of this project were to: 1) determine if the State-designated use for fish and aquatic life was being attained in the study area, 2) provide background information about water quality in the Chattahoochee River at biological sampling locations, 3) provide background information about chemical contaminants in edible fish tissue , and 4) satisfy requirements of a Consent Order by providing information about the quality and health of the Chattahoochee River.

Fisheries Survey, Arizona. Performed a fisheries survey of Salt River below the City of Phoenix, Arizona's municipal wastewater treatment plant. The objective of the survey was to assess fish community structure in the vicinity of constructed wetlands that were used to polish the final effluent.

Water Quality Evaluation, Virginia. For Chesterfield County in Virginia, provided an evaluation of water quality in Swift Creek Watershed using bioassessments. Developed biocriteria based on benthic macroinvertebrate community structure to evaluate water quality in the counties streams.

For Henrico County, Virginia, conducted an initial evaluation of water quality in two watersheds, Deep Run and Four Mile Run using benthic macroinvertebrate community structure. After the initial evaluation, conducted bioassessment studies in White Oak Creek, Fourmile Run, Upham Brook, Bottom Bridges, and Highland Springs subwatersheds using benthic macroinvertebrates as indicators of stream health.

Ecological Risk Surveys. Site safety coordinator and field team leader for the collection of sediment, surface water, and benthic invertebrate samples. Work was conducted as part of the ecological risk assessment for the remedial investigations at several superfund sites. Provided field oversight of work at several other Superfund sites for the U.S. EPA.

At the Boarhead Farms Superfund site in Pennsylvania, served as site safety coordinator and field team leader for the collection of sediment, surface water, fish and benthic invertebrate samples. This work was conducted as part of the ecorisk assessment for the remedial investigation at the site. Also provided field oversight at several other Superfund sites for the U.S. EPA.

Field team leader for the Ecological Risk Assessment portion of the Remedial Investigation (RI) at the Kerr-McGee Kress Creek/West Branch DuPage River site in West Chicago. This is a mixed waste site involving radioactive contaminants and other inorganic components. Responsible for developing and implementing field studies aimed at obtaining data for the Ecological Risk Assessment. Will also complete the analysis of information and the write up of the risk assessment.

For Union Pacific Railroad, provided senior review of ecological risk assessments at a CERCLA site. Identified potential impact of railroad yard stormwater runoff on biota of receiving stream adjacent to the site.

Analyzed benthic invertebrate data on Nevada Creek, Juneau, Alaska for the USEPA and presented results as part of the EIS for expansion of mine tailings discharge.

Site Characterization, Various Locations. At the Kerr Mcgee-Kress Creek, Reed Keppler Park, and West Chicago Sewage Treatment Plant Sites, West Chicago, Illinois, developed Work Plans and Field Sampling Plans for conducting characterization of surface soils, surface waters, sediments, and biota as part of the risk characterization for the RI/FS at these superfund sites for U.S. EPA Region V. Main contaminants of concern were Thorium and Lead releases from the old Kerr McGee Rare Earth Metals Processing Plant.

For the Springfield Dump site in Michigan, provided oversight of RD/RA work conducted at the site which included construction of extraction well, and pump and treat system.

For the Smeltertown Site in Colorado, provided senior review of ecological risk assessment.

Floodplain Soil and Stream Sediment Sampling. Under the ARCS III contract, developed work plan and field sampling plan for conducting floodplain soil and stream sediment sampling to characterize stream sediment deposits for PCB contamination in a 25-mile section of two watersheds, as part of RA for the Paoli Railroad Yard. Conducted sampling, analyzed data, and developed report.

Bioassessment and Biomonitoring. For Douglas Road Landfill in Southbend, Indiana, developed a work plan and field sampling plan to conduct bioassessment of Juday Creek as part of a long term biomonitoring program for the creek which will receive treated groundwater from the Douglas Road Site. The biomonitoring program includes characterization of benthic macroinvertebrate populations, fish populations, and habitat assessment as well as characterization of surface water and sediments for contaminants of concern.

Ecological Assessment, Utah. For the Central Utah Water Conservation District in Roosevelt, Utah, delineate aquatic communities as part of an ecological assessment (EA) of several streams (Uinta River, Lake Fork River, Whiterocks River, and Yellowstone River). The EA was part of an EIS to create five new reservoirs to increase water resources within their water distribution system.

NPDES Assistance. Conducted a field investigation of benthic macroinvertebrates and fish community structure as part of NPDES permit assistance for Duke Power North America's new generating facility on the South Branch Rock River in Kankakee, Illinois.

Provided NPDES permit assistance for the McKenzie River bioassessment for Weyerhauser Co. in Oregon. Analysis of macroinvertebrate data on the effects of the mill effluent discharge on the biota of the McKenzie River, downstream of the discharge. Required as part of NPDES permit. Required the use of RBP technology with the State of Oregon modifications.

Biomonitoring Plan. Developed a biomonitoring plan as part of a Consent Order to determine the potential toxicity of stormwater runoff from the North Chicago Refiners & Smelter facility in North Chicago, Illinois.

Publications

With J. Stark and K. Brandt. *Missouri's Water-Quality-Based Toxicity Regulations*. Missouri Environmental Law Letter. 1991. Vol.1(5):3-4.

With D.L. Rades. *Use of Filter-feeding Caddisfly Larvae to Assess Instream Reductions of 2,3,7,8-TCDD and TCDF*. Monograph No. 90-001M. 1990. Integrated Paper Services Inc.

With J. R. Weber, Jr. *A Synopsis of Twenty-Five years of Instream Biomonitoring in the Vicinity of a Bleached Kraft Mill*. Proceedings, Environmental Aspects of Pulping Operations and Their Wastewater Implications. Edmonton, Alberta. July 27-28, 1989.

With D. L. Rades. *A Stable Artificial Substrate Device (Tri-Basket Sampler) for Collecting Macroinvertebrate Samples from Streams and Rivers*. Wisconsin Academy of Science, Arts and Letters 137 (1985): 186-188.

With M. Tesmer and J. Teed. *A Modified Approach to Community Comparison in Aquatic Systems*. Institute of Paper Chemistry Technical Series No. 137. 1984.

Use of the Algal Assay Bottle Test in Assessing Nutrient Effects of Pulp and Paper Effluents on Receiving Streams. Proceedings of the Technical Association of the Pulp and Paper Industry, Environmental Conference. 1983.

Heated Water Effects Upon Primary Production. Master's Thesis. St Cloud State University. 1976.

Gregory V. White

Senior Fisheries and Aquatic Biologist

Education

M.S., Oceanography, emphasis on fisheries, Old Dominion University, Norfolk, Virginia
B.S., Fishery Science, New Mexico State University

Professional Registrations

Washington Department of Natural Resources Watershed Analysis Certification
NAUI Scuba Diving Certification, Open Water II

Distinguishing Qualifications

- Extensive watershed analysis and evaluation
- Extensive Ecological Risk Assessment experience
- 16 years of experience in fisheries management strategy and policy development, with expertise in aquatic habitat and watershed impacts assessment and evaluation
- Extensive Endangered Species Act strategy and policy development, consultation, and compliance experience, including National Pollution Discharge Elimination System, U.S. Army Corps of Engineers 404, and Clean Water Act (401) permitting and permit compliance
- Conducts various studies and participates in environmental assessments and environmental impact statements for proposed actions to fish habitat and populations, particularly salmonid species

Relevant Experience

Mr. White has been a fisheries and aquatic biologist since 1985 and has conducted work related to fisheries policies, watershed assessment, fish and macroinvertebrate evaluations, habitat restoration, aquatic and sediment toxicology and risk assessment, population dynamics, and age and growth studies. Much of his aquatic ecology work has involved salmonids, including salmonid species listed under the federal Endangered Species Act (ESA) including Gila trout and Pacific Northwest listed species. This work has involved policy decisions and developing regulatory and management strategies based on watershed evaluation. Mr. White has foot surveyed over 1,000 miles of streams and rivers in Oregon, Washington, Alaska, New Mexico, Texas, and Virginia and used the data in watershed assessments, restoration planning, Environmental Impact Statements, Environmental Assessments, Resource Inventory Reports, and Watershed Management Plans. Mr. White has worked closely with landowners and agencies in resolving environmental conflicts and developing aquatic management strategies to meet the needs of the owner and comply with local, state and federal regulations.

Mr. White's responsibilities have included project management, regulatory compliance, study design, data analysis and interpretation, and data collection. Mr. White has made policy and management recommendations based on environmental regulation evaluation, watershed assessments, field surveys, and data analyses in accord with the Clean Water Act, National Environmental Policy Act, ESA, Resource Conservation and Recovery Act (RCRA), and Best Management Practices (BMPs) guidelines to local, State, and Federal agencies.

Representative Project Experience

OREMET Oak Creek Study, Willamette Valley, Oregon. Project manager for the OREMET *Overall Environmental Benefit Study*, which was conducted to evaluate the effects of OREMET's wastewater discharge on water quality and aquatic communities in Oak Creek, a tributary of the Calapooia River. The study determined that the discharge provides an overall environmental benefit to the native aquatic biological community in the creek. This required calculating indices of biological integrity for fish and macroinvertebrates and comparing the aquatic communities of five Willamette Valley streams to the communities upstream and downstream of the discharge point. In addition, extensive water and sediment quality modeling and evaluation were conducted to demonstrate compliance with state and federal water quality criteria. The study and other information provided to the Oregon Department of Environmental Quality (DEQ) was submitted under the Alternate Mixing Zone Rule to allow an expanded mixing zone as part of the renewal of OREMET's NPDES permit. This was the first NPDES permit of its kind to be issued in Oregon.

Aquashade NPDES Risk Assessment Project. Mr. White designed and managed an ecological risk assessment study to determine the risk and potential downstream effects of a chemical added to noncontact bypass and stormwater detention ponds to fish, macroinvertebrates, and zooplankton. The study included calculating biological metrics to assess community health. The Washington Department of Ecology (WDOE), which issued a NPDES permit to the company requested the study before authorizing continued use of the chemical, because pond discharge enters a creek that supports anadromous fish. The chemical is used to control algae and macrophyte production in the detention ponds. The study was used to support regulatory discharge compliance standards and guide policy direction and was submitted to the WDOE, which reviewed and subsequently allowed the continued use of the chemical.

Wastewater Facility Expansion and NPDES Permitting, City of Dallas, Oregon. Task manager for the aquatic resource portion of the expansion. The project involved discharge to a stream that has been placed in the *Federal Register* as a water quality-limited stream and supports ESA and state-sensitive anadromous fish species. The project involved conducting environmental risk assessments for fish and macroinvertebrates and provided environmental documentation supporting policy decisions and regulatory compliance relating to fish passage statutes and Oregon DEQ NPDES regulations. The permit also included obtaining a waiver of state temperature standards, which required approval by the Oregon Environmental Quality Commission, the policy and administrative body of the Oregon DEQ. This was the first permit of its type to be authorized in Oregon.

Fish and Crustacean Assessments, Chesapeake Bay Area, Virginia. Conducted stream surveys, habitat evaluations, and sediment sampling in Chesapeake Bay tributaries in Virginia. Analyzed data obtained from these surveys including habitat types, quality and quantity of habitat, discharge rates, crustacean and fish species, and crustacean population assessments.

anadromous, primarily coho salmon and steelhead trout, and resident salmonid species. Mitigation of fisheries impacts relating to project activities were assessed, designed, and implemented.

Barney Reservoir Expansion, Barney Reservoir Joint Ownership Commission, Hillsboro, Oregon. Environmental construction manager, which included providing oversight and guidance on environmental issues and coordinating among state and federal agencies, the project owner, and contractors. Designed and constructed stream restoration along 3,000 feet of the Middle Fork North Fork Trask River. Also, oversight of implementation of wildlife, and wetland mitigation activities.

Mercer Reservoir Expansion Project, City of Dallas, Oregon. Fisheries task manager for the project, which involves increasing the city's municipal water supply and evaluating alternatives for constructing another reservoir on the system. The stream system supports ESA and state-sensitive anadromous fish species.

Fish Passage Legislation. Worked with legal counsel and biologists from the Oregon Department of Fish and Wildlife (ODFW) and with state legislators during the 1997 Oregon Legislature to draft House Bill 2607, which would allow the Oregon Statutes requiring fish passage to be waived under specific conditions. House Bill 2607 was passed and signed into law July 1997.

Eight Fathom Bight US Forest Service Environmental Impact Statement, Alaska. Supervised and conducted salmonid stream surveys in an area over 200 square miles of Southeast Alaska which contained over 500 miles of streams. Surveys were conducted in compliance with US Forest Service Region 10 Tongass National Forest stream typing and survey protocols, Alaska Department of Fish and Game, NEPA, and Best Management Practices guidelines and procedures. Conducted multiple analyses utilizing an innovative watershed assessment approach based upon, existing road systems, previously harvested acreage, year of harvesting, proposed acreage harvested, harvest technique, length and location of roads being constructed, stream channel types, stream crossing structures, and stream habitat.

Ushk Bay US Forest Service Environmental Impact Statement, Alaska. Supervised and conducted stream surveys encompassing over 70 square miles of Southeast Alaska and containing over 200 miles of streams in compliance with NEPA, US Forest Service Region 10 Tongass National Forest stream typing and survey protocols, Alaska Department of Fish and Game, and Best Management Practices guidelines and procedures.

City of Seattle Cedar River Watershed. Supervised and conducted a municipal watershed management study involving watershed assessment for the City of Seattle Watershed which encompasses over 200 square miles and contains numerous streams and reservoirs. The detailed resource inventory study included fisheries habitat quality and quantity, fish species present, sources of habitat and water quality degradation, and potential enhancement/restoration opportunities and management strategies for use as the information base for the aquatic resources portion of an integrated multidisciplinary management system.

Instructor of Fisheries Portion of Stream Restoration Workshop. Workshop was hosted by Unified Sewerage Agency (now Clean Water Services) and Stop Oregon Litter and

Vandalism (SOLV). The course provided enhancement training to local Tualatin watershed agency personnel interested in increasing their technical knowledge and effectiveness with large-scale community-based projects and permitting. The fisheries portion of the course emphasized salmonid ecology, salmonid habitat requirements by life stage, geographical differences in habitat, elevational habitat differences, priority enhancement/restoration areas, enhancement/restoration techniques, and monitoring.

Publications

"Effects of Two Polycyclic Aromatic Hydrocarbons, Benzo[a]pyrene and Naphthalene, on Reproductive Success and Embryological Development of the Mud Crab Rhithropanopeus harrisii." paper presented at SETAC Annual Meeting, Seattle WA, 1991.

Randall P. Whitman

Senior Fisheries Biologist

Education

M.S., Fisheries Biology, University of Washington
B.S., Fisheries Biology, Humboldt State University

Distinguishing Qualifications

- Considerable experience and knowledge of sedimentation issues. Most of the projects he has worked on over the years have included erosion, sediment delivery and sediment deposition as a central issue for environmental impact analysis
- Fisheries biologist with experience in freshwater, marine, and estuarine ecology, fisheries, aquatic toxicology, stream restoration and environmental impact analysis

Relevant Experience

Mr. Whitman is a fisheries biologist with experience in freshwater, marine, and estuarine ecology, fisheries, aquatic toxicology, stream restoration and environmental impact analysis. He specializes in salmonid life history, ecology, and habitat. His 22 years of professional experience are concentrated in the Washington State, but also include projects in Alaska, Idaho, Oregon, British Columbia, Utah, Wyoming, Arizona, Montana, California, and Guam.

Mr. Whitman has considerable experience and knowledge of sedimentation issues. Most of the projects he has worked on over the years have included erosion, sediment delivery and sediment deposition as a central issue for environmental impact analysis. As a result, he has developed a strong understanding of the sources, causes, impacts, and processes of sedimentation and the remedial actions required for mitigation or compensation.

Mr. Whitman has a strong background in salmonid ecology, specializing in anadromous life history, behavior, physiology, and habitat requirements. He has conducted numerous habitat inventory and evaluation studies using a number of different methodologies, including Washington, Oregon, and Alaska State methods, King County, Snohomish County, Urban Stream Baseline Evaluation method (USBEM), and US Forest Service Regions 1,4,6,and 10 methods. Mr. Whitman has a thorough knowledge and experience in watershed processes. He has training and experience in hydrology, water quality, sediment transport and quality, fluvial processes in geomorphology, and riparian zone dynamics, as they relate to fish habitat. His extensive professional experience in critically evaluating riverine habitats, has given him the opportunity to examine a wide range of fluvial system types and habitat quality ranging from intermittent desert streams to mainstem rivers and from highly altered or degraded habitat to pristine. He regularly uses these skills in environmental impact analyses and mitigation design on a broad range of project types.

Mr. Whitman has conducted numerous fisheries investigations in the Columbia basin. He was a project manager on several projects with Grant County PUD at Wanapum and Priest Rapids dams where responsibilities involved fish passage/by-pass systems design and effectiveness evaluation, and a trucking/barge transport system over a 5-year period. He was involved with a systems mortality study of smolts released from Winthrop through six Columbia River dams. Mr. Whitman conducted an environmental assessment of the impacts of the Yakima/Klickitat production project on existing aquatic resources in those river systems. He has also conducted numerous stream surveys in various watersheds of the Columbia Basin as a part of EIS preparation and Hydropower relicensing efforts.

He has been involved with a number of stream restoration/design projects in Washington, California and Guam. The Manenggon Hills project in Guam involved the design and construction of a 1.5-mile-long artificial stream channel around and above a 110-foot-high dam on the Manenggon River costing nearly $2 million. He has prepared conceptual or detailed designs for a number of stream restoration projects in the Pacific Northwest including Bear, Little Bear, Soosette, Bear (BC), Willow, Perrigo, Lyon, Powder mill, Goldsborough, and unnamed Creeks.

Representative Project Experience

Stream 10-0040 Channel Relocation Design, Pierce County Department of Public Works, Tacoma, Washington. Provided Pierce County with design specifications and bid documents for the relocation of a lowland stream. The reach involved is about 1/2 mile long and will be followed by another ½ mile in a future phase. The stream is presently best characterized as a roadside ditch. It was once a coho salmon and sea-run cutthroat trout producing stream before agricultural and road development. The stream relocation is being necessitated by a roadway widening project to serve a large suburban development area adjacent to Lake Tapps. CH2M HILL Fisheries Biologists are designing the channel to establish high quality spawning and rearing habitat in a higher gradient section while using a low gradient section (<0.1% slope) for enhanced riparian wetland function and fish passage. Habitat enhancement structures such as log weirs, deflector logs, cover logs, and boulder placements are being used to create complex habitat diversity. The integrated vegetation planting design is being used to create a natural riparian community in a 175-foot wide corridor. A three stage design is being employed to maximize wetland function while confining the low-flow channel for optimal summer rearing conditions. This project provides an excellent example of how urbanization problems can be reversed in strategic locations.

Woodinville ESA Response Strategy, City of Woodinville, Washington. Currently preparing watershed corridor management and enhancement plans for Little Bear Creek, Woodin Creek, and tributary 0090. Conducted a habitat survey and evaluated potential sites for restoration or enhancement. Identified limiting factors for salmonid production. Prepared a strategy for salmonid habitat recovery focussing on chinook salmon, coho salmon and sea-run cutthroat trout requirements.

Lakepointe Development SEIS Fisheries Analysis, King County DDES, Seattle, Washington. Prepared a third party fisheries analysis for the potential impacts of a substantial mixed-use development at the mouth of the Sammamish River. The development covers about 45 acres and would completely reconfigure the Kenmore harbor area into a marina. The major issue was the potential for increased predation on salmonids, particularly chinook stocks recently proposed for listing under ESA, by bass and other piscivorous fish that might benefit from the marina development. We conducted an extensive literature review and characterized the salmonid resources in the basin. We prepared an analysis based on the behavior and physiology of predators and the timing, numbers, and migrational characteristics of outmigrant smolts. Ultimately, project permits were granted based on the mitigation measures we recommended for the marina design.

Lower Colorado River Fish Habitat Restoration Plan, Bureau of Reclamation, Boulder City, Nevada.
Currently preparing conceptual and detailed plans for habitat restoration for two species of fish listed as endangered under ESA, the razorback sucker, and the bonytail chub, in the Lower Colorado River. The Bureau is proceeding in response to the "reasonable and prudent activities" outlined in the U.S. Fish and Wildlife Service (USFWS) Biological Opinion and agreed to during Section 7 consultations. This is a pilot project for use in guiding future restoration efforts developed for the Long-term Multi-Species Conservation Program (MSCP), in which over 100 listed species are involved. The project involves large-scale floodplain process restoration within the operational constraints of the Colorado River water delivery system. The object of this task is to develop the techniques for habitat restoration on a large scale for the recovery of these two species.

Kuskokwim River Hovercraft EIS Special Studies, U.S. Postal Service, Bethel, Alaska.
Task leader for aquatic resource studies to support of the EIS for the use of a hovercraft to deliver mail and supplies to a number of native villages in the vicinity of Bethel, Alaska. The 50-foot long hovercraft would traverse the lower sections of the Kuskokwim, Johnson, and Pikmiktalik Rivers on a daily basis. The issues for aquatic resources include fry and smolt stranding, direct mortality, effects on adult salmon catch, and disruption of commercial and subsistence fishing operations. The river system is host to salmon runs of over a million fish.

Central Utah Project, USDI, Roosevelt, Utah. Technical support in a number of special studies supporting an environmental impact statement for the Uintah Basin sub-unit of the Central Utah Project. The project involves the construction of as many as four major storage reservoirs and modification of the flow regimes in the Lakefork, Yellowstone, Uintah, Whiterocks, and Duchesne Rivers, as well as the modification to as many as 20 water diversion dams. Lead the aquatic habitat characterization study in which several study reaches in each of the four rivers were surveyed. Participated in a major instream flow incremental methodology (IFIM) study to establish minimum flow recommendations for the project. Lead the fish population characterization study. Prepared an assessment of fish passage. Prepared the Biological Assessment for four species of endangered fish native to the project area.

Eastside Ecosystem Management Support, Boise Cascade, Walla Walla, Washington.
Participant in efforts to support Boise Cascade and indirectly the US Forest Service in shaping the policies and technical direction of the Interior Columbia Basin Ecosystem Management Project. Prepared an evaluation and comparison of various state and federal watershed analysis and management programs such as PACFISH.

Lewiston Dam Litigation Support, Washington Water Power, Spokane, Washington.
Provided litigation support to Washington Water power for a law suit initiated by the Nez Perce tribe to recover past damages for Lewiston Dam. Lewiston Dam, removed from the Clearwater River in 1974, was a partial block to salmon and steelhead runs from 1927 to 1974. Prepared a report evaluating fish passage at the dam. Prepared an evaluation and

estimation of the fish production potential of the Clearwater River using a variety of approaches.

SR-18/Soosette Creek Restoration, Washington State Department of Transportation (WSDOT), Kent, Washington. Designed stream channel restoration for a section for a small anadromous stream (3 to 120 cfs). Conducted a stream survey of adjacent reaches of the creek to establish criteria for restitution. The area to be restored has been buried for decades by SR-18 under 80 feet of fill. Static and dynamic Large Woody Debris technique are employed to provide diverse habitat at all flows. The flood plain is tiered to produce secondary and tertiary channels depending on flow rate.

Goldsborough Creek Restoration, Simpson Timber Company, Shelton, Washington. Prepared a preliminary design for the rehabilitation of a large anadromous stream (20 to 1500 cfs). Conducted a stream survey in adjacent reaches to establish goals for habitat creation. A 13 foot high dam will be removed which currently creates a partial block for anadromous species. The reach to be rehabilitated is either filled behind the existing dam or scoured to a depth as much as 12 feet below its bed depth when the dam was built. The design of the channel was unique in that grade control weirs were incorporated into such deep channel fill. The 2000 foot long reach drops 24 feet.

Lyons Creek Restoration, Lincoln Development Company, Mountlake Terrace, Washington. Designed an artificial stream segment of Lyons Creek to replace a small impoundment for the Lincoln Development Corporation. Instead of removing the dam, it was modified to back up water only during high flows to create a wetland area beside the stream.

Mt. St. Helens Salmon Homing Studies, Washington Water Resources, Seattle, Washington. Performed a behavioral bioassay study to evaluate the effects of suspended volcanic ash from the Mt. St. Helens eruption on the homing ability and survival of adult chinook salmon. Funded by the Washington Water Resource Center. Resulted in one publication.

Anchorage, Alaska. Prepared an environmental impact analysis for a roadway extension and widening project in suburban Anchorage. Issues included elevated sediment loading into a locally important salmon stream and a potentially unstable embankment just upstream of a spawning area.

METRO Extension Permits, Sammamish Plateau Sewer Utility, Issaquah, Washington. Conducted site investigations. Negotiated with agency representatives to determine project alternative with minimum mitigation and permit acquisition. Prepared permits. The project involved the construction of either a 4000-foot long pipeline using either Horizontal Directional Drilling (HDD) techniques or a 13,000-foot long open trench along roadways. The HDD alternatives would either go under Lake Sammamish or wetland in Lake Sammamish State Park.

Creston Gas Turbine Power Plant EIS, KVA, Creston, Washington. Conducted environmental impact analyses for the construction and operation of a natural gas power plant in Eastern Washington. Issues included Columbia River water rights, water for salmon passage, and surface fluctuations in Lake Roosevelt.

Belmor Regional Stormwater Detention Facility, City of Federal Way, Federal Way, Washington.
Prepared permits for the construction and operations of a large regional stormwater detention facility tributary to Hylebos Creek. The channel modifications needed for local flood protection included instream excavation, channel relocation and widening, in-channel retaining wall construction, and culvert replacements.

Twin Bridges EIS, Benton County, Richland, Washington. Conducted the environmental impact analysis for the construction of a pair of bridges over the Yakima River. The main fisheries issue was a chinook salmon spawning area immediately downstream of the proposed bridges.

North Lake Tapps Transportation Corridor EIS, Pierce County, Sumner, Washington. Conducted the environmental impact analysis on the various alternative for this roadway project. Developed mitigation strategies for the relocation of about 1.5 miles of a salmonid bearing stream. This was incorporated into wetland and stormwater mitigation. The result was the development of a preliminary design for a constructed stream channel. The stream was designed to provide enough riparian wetland function to mitigate for wetland losses elsewhere in the corridor.

The Foothills Development, City of Issaquah, Issaquah, Washington. Conducted an environmental impact analysis on a controversial residential development adjacent to Issaquah Creek. The issues included stormwater runoff and steep unstable slopes on the property. Of particular concern was the fact that the proposed development was located just upstream of the water supply intake for the Issaquah state salmon hatchery.

Appendix B

Mica Bay Hydrographic Survey Report

CH2MHILL

CH2M HILL
700 Clearwater Lane
Boise, ID
83712-7708
P.O. Box 8748
Boise, ID
83707-2748
Tel 208.345.5310
Fax 208.345.5315

September 16, 2002

173986.A1.01

Steve Bywater
Deputy Attorney General
c/o Idaho Transportation Department
P.O. Box 7129
Boise, ID 83707-1129

Dear Steve:

Subject: US 95, Bellgrove to Mica
Project No. DHP-NH-CM-5110(119); Key No. 2815

Enclosed is one copy of the Mica Bay Hydrographic Survey Report for the U.S. 95 Bellgrove to Mica Project, dated September 16, 2002. By copy of this letter, we are transmitting eight copies of the report to ITD District 1. It is our understanding that District 1 will submit the report to IDEQ in Coeur d'Alene on September 17, 2002.

Please call me if you have any questions concerning this report.

Sincerely,

CH2M HILL

Dick Jacobson

Richard L. Jacobson, P.E.
Project Manager

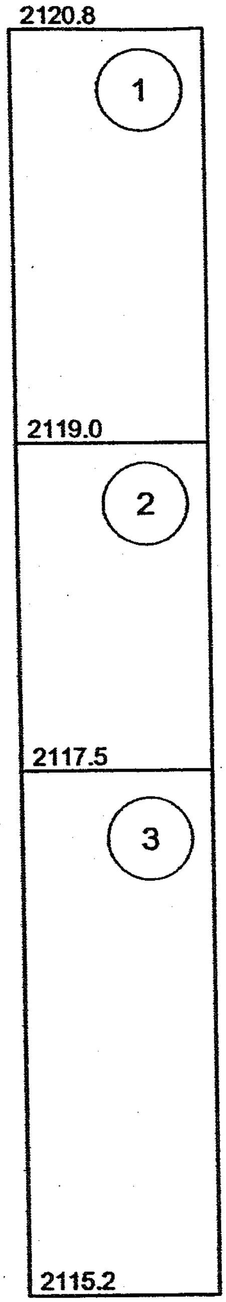
Enclosure

C: Scott Stokes/ITD with 8 copies of the report

Elevation (top – bottom)	Segment	COLOR	DESCRIPTION
2119.8 – 2118.4	1	DARK YELLOWISH BROWN (10 YR 4/2)	0" TO 16": CLAYEY SILT; VARYING AMOUNTS OF VEGETATION, MORE PREVALENT IN UPPER 7"; CLAY INCREASING TOWARD BOTTOM OF SEGMENT AS VEGETATION DECREASES; LESS THAN 5 PERCENT VEGETATION.
2118.4 – 2117.9	2	GRAYISH BROWN (5 YR 3/2)	16" TO 23": ORGANIC RICH OF BLADED VEGETATION. 60 TO 70 PERCENT VEGETATION IN CLAY MATRIX.
2117.9 – 2116.9	3	MEDIUM GRAY	23" TO 34 1/2": SILTY/CLAY DOMINATES. < 5 PERCENT BROKEN VEGETATION.
2116.9 – 2113.9	4	OLIVE GRAY (5 Y 4/1) TO OLIVE BLACK (5 Y 2/1)	34 1/2" TO 71": MICACEOUS; FINE-GRAINED SAND; INCREASING SILT TO BASE; MICA ≤ 5 PERCENT (~1 MM MICA). OCCASIONAL VEGETATION THROUGHOUT LENGTH OF SEGMENT AND WOODY DEBRIS PARTICULARLY NEAR BASE. HIGH ABUNDANCE OF TWIG DEBRIS AND OTHER WOODY FRAGMENTS UP TO ½" DIA. CONCENTRATED IN 37" TO 50" AND 63" TO 71". VERY DISTINCT WOOD DEBRIS LAYER FROM 43" TO 44 1/2" WITH LARGE WOOD FRAGMENTS UP TO 1/2" TO 3/4" DIA.
2113.9 – 2113.4	5	DARK YELLOWISH BROWN (10 YR 4/2)	71" TO 77": MEDIUM- TO COARSE-GRAINED SANDS; POORLY SORTED; ABUNDANT LITTLE BLACK PARTICLES; MICACEOUS; SUBANGULAR SAND GRAINS; QUARTZ FELDSPATHIC; SLIGHT DEGREE OF COARSENING UPWARD.
2113.4 – 2111.9	6	OLIVE GRAY (5 Y 4/1) TO OLIVE BLACK (5 Y 2/1)	77" TO 95": FINE SAND/SILT; HIGHLY MICACEOUS; BUT VERY FINE-GRAINED; ORGANICS DO NOT APPEAR TO BE PRESENT. AT 91", ONE LARGE WOOD CHIP FOUND IN CENTER OF CORE, ~1" X ½", RECTANGULAR SHAPE.

CORE 5A

ELEVATIONS BASED ON THE NVGD29 MICA BAY ELEVATIONS DATUM



COLOR

① OLIVE BLACK (5 Y 2/1)

② DARK GREENISH GRAY (5 GY 4/1)

③ OLIVE BLACK (5 Y 2/1)

DESCRIPTION

THROUGHOUT CORE, ALL TRANSITIONS BETWEEN CORE SEGMENTS ARE VERY ABRUPT EXCEPT ~1" TRANSITION BETWEEN 0" TO 22" AND 22" TO 39 1/2".

(1) 0" TO 22": UNIFORM ROOT-ORGANIC RICH; FINE-GRAIN SAND TO SILT; MICACEOUS; VEGETATION NOT MATTED. NO LENSES; CONTINUOUS SERIES. LARGE WOOD CHIP AT 17", 3" X 2" IN SIZE. LOWER 1" TO 2" TRANSITION INTO CLAY SEGMENT BELOW.

(2) 22" TO 39 1/2": CLAY; MOTTLED GRAY AND GREEN; DRY; CONCHOIDAL FRACTURING; NO VISIBLE VEGETATION; IT IS A MASS - NO LENSING; ABRUPT CONTACT AT BASE.

(3) 39 1/2" TO 67 1/2": MASS IS MICACEOUS; FINE-GRAINED SILT TO COARSE SAND; LENSES OF COARSE-GRAIN SANDS; HIGHLY MICACEOUS THROUGHOUT; MICA GRAINS COARSER IN THE COARSE SAND; 2-3 MM MICA GRAINS IN COARSE-GRAIN SAND.
COARSER-GRAINED SAND AT 43" TO 51" AND 63 1/2" TO 67 1/2"; IN-BETWEEN AND ABOVE THESE LAYERS ARE SILTY/FINE-GRAINED SAND LENSING:

39 1/2" TO 44": FINE-GRAINED ROOTS, VERY-FINE SANDS. THIS LAYER IS VERY SIMILAR TO 0" TO 22".

44" TO 50": COARSE SAND

50" TO 51": WOOD

60": PIECE OF WOOD

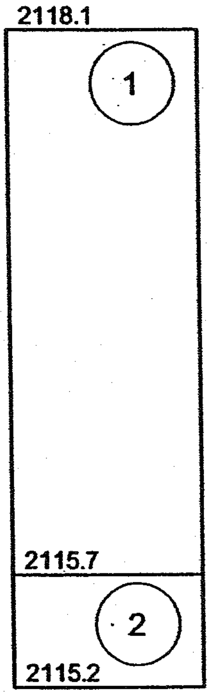
64 1/2" TO 67 1/2": COARSE SAND WITH WOOD

CORE 6A

ELEVATIONS BASED ON THE NVGD29 MICA BAY ELEVATIONS DATUM

CH2MHILL

COLOR



DRY: PALE YELLOWISH BROWN (10 YR 6/2); WET: MODERATE YELLOWISH BROWN (10 YR 5/4)

DARK GREENISH GRAY (5 GY 4/1)

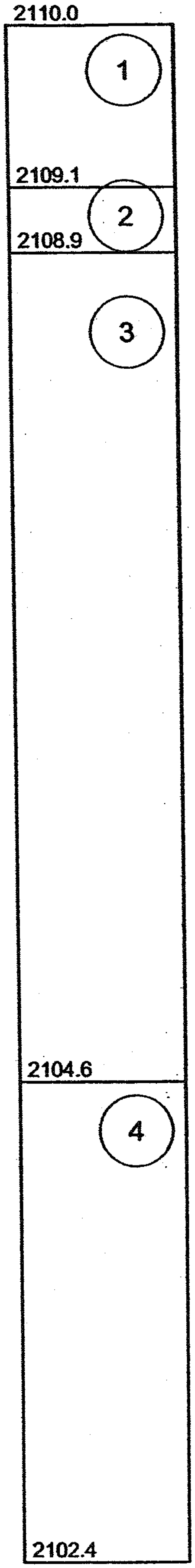
DESCRIPTION

1. 0" TO 29": POORLY SORTED, FINE- TO COARSE-GRAIN SAND; COMMON PRESENCE OF PEBBLES UP TO 1 CM DIAMETER; MICACEOUS THROUGHOUT; SPRINKLED WITH DARK BLACK MINERAL SPECS; NO ORGANIC MATTER OF ANY NATURE IS VISIBLE, EXCEPT ONE TWIG AT 22".

2. 29" TO 35": SIMILAR TO UPPER LAYER, COLOR IS ONLY DIFFERENCE IN THIS SECTION; SUBTLE LENTICULAR MASSES THROUGHOUT, BUT FEATHER OUT AT EDGES; INDISTINCT LAYERS; MICA FLAKES UP TO 3 TO 4 MM BUT QUITE VARIABLE; MODERATE AMOUNT OF TWIGS; COLOR DIFFERENTIAL LOOKS TO BE REDUCED CONDITION DUE TO ORGANIC MATTER AT THAT POINT (MORE WOODY DEBRIS AT LAYER DIFFERENTIAL BETWEEN 0" TO 29" AND 29" TO 35"); FROM 30 1/2" TO 31", ONE FINE-GRAINED SAND LENS IS VISIBLE.

CORE 7B

ELEVATIONS BASED ON THE NVGD29 MICA BAY ELEVATIONS DATUM



COLOR

TOP 13" TO 16" IS GRAYISH BLACK TO BLACK (NO CODE)

BELOW 13" TO 16" IS OLIVE GRAY (5 Y 4/1) TO DARK YELLOWISH BROWN (10 YR 4/2)

DESCRIPTION

NO ODOR PRESENT EXCEPT A SLIGHT GRASSY ODOR, LIKE A HINT OF FRESH CUT GRASS, NOT STRONG.

(1) 0" TO 10"/12": SILT TO FINE SAND DOMINANT; HIGHLY MICACEOUS, ~5 PERCENT MICA, 1/2 TO 1MM MICA FLAKES; FINE HAIR ROOTS, WELL DISTRIBUTED; NO LAYERING IN COLORING OR GRAINS; VERY FEW GREEN GRASS BLADES ARE PRESENT, BUT COULD BE MIXING FROM CORE TUBE WALLS. VERY, VERY FINE HAIR-LIKE, FIBROUS MATERIAL, 1/2" TO 1" MAX LENGTH, ORGANIC FIBER, POSSIBLY AGRICULTURALLY DERIVED; AT ~6" DEPTH, 1"X1/8"X1/2" BARK FRAGMENT IN CENTER OF CORE.

(2) 10"/12" TO 12"/14": ~2" THICK, SIGNIFICANT LAYER OF 1" TO 1 1/2" MAX DIMENSION OF BARK FRAGMENTS; MIGHT BE VERY LITTLE FINE-GRAINED MICA IN BARK LAYER BUT NOT LIKE 0" TO 10"/12", MORE SIMILAR TO LOWER CORE SEGMENTS; WHEN INDIVIDUAL BARK FRAGMENT IS SCRAPED, COLOR OF BARK IS REDDISH/DARK MAROON, EXPOSED IT BECOMES BLACK.

(3) ~ 14" TO 65": LARGER BLADES OF GRASS UP TO 1" LENGTH; UP TO 30 TO 50 PERCENT OF TOTAL MATERIAL; BLADE WIDTH ≤1/4"; MATTED; EVENLY DISTRIBUTED WITHIN SILT AND CLAY; LARGE TWIG AT ~33" (FROM CORE TOP), 1 1/4" LONG, 1/4" DIAMETER, ROUGH SURFACE INDICATING TRAVEL.

(4) 65" TO 91": DECREASING PRESENCE OF VEGETATION; MORE SILT AND CLAY; SMALLER FRAGMENTS OF VEGETATION LOOK MORE TUBULAR AND HAIR-LIKE, LESS THAN 20 PERCENT, LOOK MORE LIKE DEBRIS RATHER THAN MATTED LAYERING, LONGEST DIMENSION ~ 3/8"; EVIDENCE OF HAIR-LIKE FIBERS SPLITTING OFF OF LARGER GRASS BLADES IS APPARENT; SO, DIFFERENCE IN THE TOP LAYER IS ABSENCE OF BLADES.

CORE 8B

ELEVATIONS BASED ON THE NVGD29 MICA BAY ELEVATIONS DATUM

CH2MHILL

2112.5

1

COLOR

DESCRIPTION

1 0" TO 71 1/2": MIXTURE OF SILT/CLAY/VEGETATION; VEGETATION UP TO 50 PERCENT; CONSISTENTLY MIXED WELL; BLADED/GRASSY; NO LAYERING; NO MICAS; UNIFORM/CONSISTENT TO 71 1/2"; NON-COHESIVE/LOOSE MIXTURE.

2 71 1/2" TO 97 1/2": FINE-GRAINED CLAYEY SILT; DISPERSED FRAGMENTS OF VEGETATION < 5 PERCENT; NO VISIBLE LAYERING; VERY-FINE MICA (WHITE MICA) INCREASING IN PERCENTAGE WITH DEPTH, AT TOTAL DEPTH (BOTTOM) 20 TO 30 PERCENT MICA. THROUGHOUT SEGMENT, AMOUNT OF VEGETATION DECREASES WITH DEPTH AS MICA INCREASES.

DARK YELLOWISH BROWN (10 YR 4/2)

2106.6

2

OLIVE GRAY (5 Y 4/1)

2104.4

CORE 9A

ELEVATIONS BASED ON THE NVGD29 MICA BAY ELEVATIONS DATUM

CH2MHILL

2079.2

COLOR

OLIVE BLACK (5 Y 2/1)

DESCRIPTION

0" TO 86": APPEARS CLAY DOMINATED; SILTY / CLAY, CLAYEY / SILT; VERY UNIFORM GRAIN SIZE; UNIFORM COLOR; RANDOM BUT RARE ORGANIC FRAGMENTS; NO VISIBLE LAYERING; NO ODOR PRESENT.

2072.0

CORE 10B

ELEVATIONS BASED ON THE NVGD29 MICA BAY ELEVATIONS DATUM

CH2MHILL

Appendix B

Mica Bay Cores: Mt. St. Helen's Ash Analysis

APPENDIX B: INTERIM CORE SAMPLING REPORT – MICA BAY SEDIMENTS VERSUS MT. ST. HELEN'S ASH

SUMMARY

The physical characteristics and chemical analyses of a segment of core sediments from four Mica Bay cores 1B, 2A, 3 redo B and 6A are consistent with Mount St. Helen's ash. These samples appear to represent Mount St. Helen's ash within Mica Bay sediments.

PURPOSE

The purpose of this draft technical memorandum is to compare samples of Mica Bay cores, 1B, 2A, 3 redo B, and 6A, with Mount St. Helen's ash erupted in 1980 to determine if the samples represent this ash.

CORE SAMPLE CHEMICAL ANALYSIS

The four Mica Bay sediment core segments were sent to Chemex Laboratory for both a lithium-borate-fluxed-x-ray fluorescence (XRF) analysis for aluminum, barium, calcium, chromium, iron, potassium, magnesium, manganese, sodium, phosphorus, silica, strontium and titanium oxides plus loss on ignition (essentially the water of hydration and carbonate), three-acid-digestion-Mass-Spectrometic-Inductively-Coupled-Plasma (MS-ICP) analysis for 47 elements, some of which duplicated the XRF, percent moisture and, finally the nutrient species: available phosphorus, ammonia-nitrogen, Total Kjeldahl Nitrogen (TKN), nitrate-nitrogen and total organic carbon.

The analytical results from these determinations are listed in Table 1 along with the average and standard deviation for most of the same determinations on Mount St. Helen's ash (Fruchter et al., 1980) expelled by the May 18, 1980 eruption of Mount St. Helen. The average value represents ash collected from nine sampling locations ranging from 98 (Tieton, OR) to 644 kilometers (Missoula, MT) from Mount St. Helen. Chemical analysis of two U.S. Geological Survey surface bed sediment samples (CDA50 and CDA51) from Mica Bay are also included. These two surface (upper 2 cm) grab samples were collected in August 1989 (Horowitz et al. 1993). Core 10 (from the August 2002, CH2M HILL core sampling effort) was collected near CDA50; and, CDA51 was collected from the Mica Bay delta.

PHYSICAL CHARACTERISTICS

The core segment samples represent a consistently monotonous very-fine-grained sediment colored (mottled) gray, dark greenish-gray to greenish-black. Neither organic debris nor extraneous minerals of any form or grain-size were visible in the core segments. The sediment is typically compacted, had a dry-like conchoidal habit when broken and sharp lower but gradational upper contact with obvious fluvial/lacustrine sediments. These physical characteristics are indicative of an ash partially to completely reduced by, the lacustrine/deltaic environment of Mica Bay.

COMPARISON WITH MOUNT ST. HELEN'S ASH

There are many ways in which the core sediment can be compared with the ash but the simplest and probably most robust method is assume that the ash chemistry has a normal distribution defined by the average (mean) plus or minus the standard deviation. In a normal distribution, the mean plus and minus one standard deviation defines 68 percent of the chemical concentration range for individual elements. The mean plus and minus two standard deviations defines 98 percent of a normal distribution and three standard deviations, 99.7 percent. In other words, there is only 0.15 percent chance that a chemical concentration of an element present, in this case an ash, will be less than or more than the mean concentration minus or plus three standard deviations. The closer the element concentration is to the mean ash concentration, the more assurance that the element may represent an ash. The more elements that are within these boundaries, the more confidence that the sediment represents the Mount St. Helen's ash.

Mean concentrations of silica, iron and titanium oxide, barium, nickel and zinc in the core sediments are all well within one standard deviation of their respective mean ash concentration. Silica is variable in the individual core sediment samples, with a mean concentration very close to the mean ash silica percentage and the only element in this group that is higher than its mean concentration of the ash. The variability and higher percentage probably reflects the transport of the ash plus a component of very fine-grained quartz and feldspar from the basin sediments. Iron, titanium and barium are elements that typically have minimal, if any, aqueous solubility. Therefore, they are much more indicative of sediment source and indicate that the sediment is dominantly ash. Nickel has essentially the same concentration in the ash, core sediment and even Coeur d'Alene lacustrine sediment so it is not a definitive element. Zinc, however, is relatively mobile and significantly lower than the extremely high zinc concentration in the Coeur d' Alene lacustrine sediment so it is a strong supporting element again indicating that the sediment is ash.

Potassium and magnesium oxides plus molybdenum and sulfur concentrations in the core sediments are within two standard deviations of their respective mean ash concentration. All of the elements in this group have a moderate degree of solubility and probably lost some of their concentrations when the ash was transported into Mica Bay. Therefore, most of the oxides plus barium, zinc, molybdenum and sulfur support a conclusion that these sediments represent ash transported into Mica Bay.

Manganese oxide, phosphorus pentoxide, cobalt, lead and vanadium concentrations in the core sediments are within three standard deviations of their respective mean ash concentrations. The color of the core sediments and nutrient concentrations suggest that the core sediment is at least partially reduced. This sediment reduction could mobilize manganese and significantly reduce its concentration compared to its original concentration. Cobalt is typically readily mobile and since both manganese and calcium oxide have been significantly decreased, cobalt is easily mobile. Cobalt and vanadium are typically preferentially adsorbed to manganese oxyhydroxide but since manganese is mobilized it cannot form an adsorption media. Lead, as opposed to the other elements in this group, has a higher mean than that of the ash but higher lead is a ubiquitous condition in the Coeur d'Alene lacustrine sediments. It would take only a small contribution of Coeur d'Alene lacustrine sediment mixed with the core sediment to increase the lead concentration. This conclusion is supported by the fact that lead, along with calcium, sodium and many of the other element concentrations are highest in the core sediment from 2A, indicating a larger mixture of lacustrine/basin sediment into this sample than in the other three cores.

The mean chromium is the only trace element that is higher than chromium concentrations in both the ash and the Coeur d'Alene sediment. The mean is strongly impacted by the 203 milligram per kilogram (mg/kg) chromium concentration in the core sediment for 1B. The chromium concentrations in the other three core sediment samples have a significantly lower range from 26 to 40 mg/kg. This range is significantly lower or equal to Coeur d'Alene sediments but higher than chromium in the Mount St. Helen's ash.

Mean aluminum oxide and copper concentrations are moderately lower than their mean ash concentrations but both calcium and sodium oxides plus strontium are significantly lower than their mean ash concentrations. Calcium, sodium and strontium losses from an ash are expected because they are among the most mobile elements. The aluminum and copper may be reflecting a formation of an organic complex resulting from the microbial activity within the sediment. Therefore, although the concentrations of this group of elements are lower to significantly lower than the ash, their loss is explainable to expected from a water-transported ash into the lacustrine environment of Mica Bay.

Nutrient concentrations are generally well within those of a slightly reducing lacustrine environment. Ammonia-nitrogen is higher than nitrate-nitrogen and TKN is orders of magnitude higher than both ammonia and nitrate. The considerably elevated TKN indicates that the organic form of nitrogen is by far the dominant form of nitrogen. The organic form of nitrogen is indicative of enzymatic nitrogen compounds related to microbial activity. Their high concentration and dominance over other forms of nitrogen in the sediments indicate a strong microbial population in the core sediments that is typical of lacustrine sediments. Available phosphorus concentrations also support this conclusion. Total organic carbon, however is about half or less than the TOC in the Coeur d'Alene lacustrine sediments further supporting the conclusion that this part of the sediment cores is probably Mount St. Helen's ash.

REFERENCE

Fruchter, J.S., Robertson, D.E., Evans, J.C., Olsen, K.B., Lepel, E.A., Laul, J.C., Abel, K.H., Sanders, R.W., Jackson, P.O., Wogman, N.S., Perkins, R.W., Van Tuyl, H.H., Beauchamp, R.H., Shade, J.W., Daniel, J.L., Erickson, R.L., Sehmel, G.A., Lee, R.N., Robinson, A.V., Moss, O.R., Briant, J.K. and Cannon, W.C., 1980, Mount St. Helens Ash from the 18 May 1980 Eruption: Chemical, Physical, Mineralogical, and Biological Properties: Science, Volume 209, pp. 1116-1125.

Horowitz, A. J., Elrick, K. A. and Robert B. Cook. 1993. Effect of Mining and Related Activities on the Sediment Trace Element Geochemistry of Lake Coeur d'Alene, Idaho, USA. Part I: Surface Sediments. Hydrological Processes, Vol. 7, 403-423.

Table 1. Comparison of ash-query samples in Mica Bay sediments with average Mount St. Helen's ash and two USGS Coeur d'Alene Samples

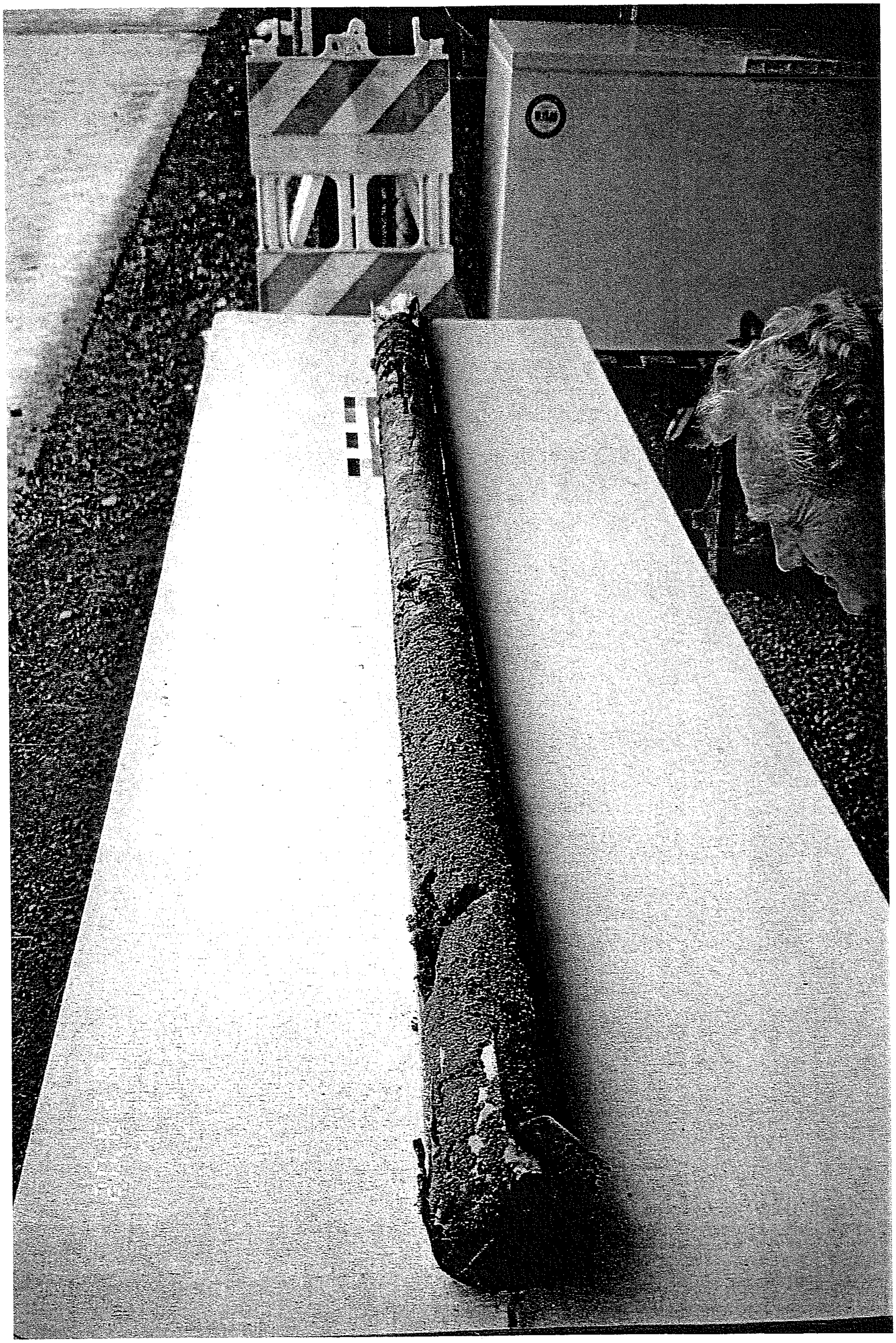
Column:	1	2	3	4	5	6	7	8	9
Parameters	Ash 1B Mica Bay	Ash 2A Mica Bay	Ash 3 redo B Mica Bay	Ash 6A Mica Bay	Mt.St.H.Ash Average	Mt.St.H.Ash Standard Dev.	CDA-50 USGS	CDA-51 USGS	Average Columns 1 - 4
Al_2O_3 (%)	13.84	13.22	12.98	12.16	16.90	0.70			13.05
BaO (%)	0.05	0.07	0.05	0.05					0.06
CaO (%)	0.53	1.08	0.97	0.56	4.94	0.92			0.79
Cr_2O_3 (%)	0.05	0.01	0.01	< 0.01					0.02
Fe_2O_3 (%)	4.27	4.87	5.69	3.97	4.81	1.10			4.70
K_2O (%)	1.02	1.84	0.76	0.93	1.47	0.28			1.14
MgO (%)	0.76	1.26	0.82	0.73	2.21	0.94			0.89
MnO (%)	0.02	0.04	0.02	0.02	0.08	0.02			0.03
Na_2O (%)	0.52	1.30	0.48	0.50	4.57	0.17			0.70
P_2O_5 (%)	0.11	0.19	0.16	0.11	0.37	0.09			0.14
SiO_2 (%)	62.75	67.39	62.74	67.11	65.00	3.30			65.00
SrO (%)	< 0.01	0.02	< 0.01	< 0.01					0.01
TiO_2 (%)	0.65	0.85	0.60	0.59	0.69	0.13			0.67
Loss on Ignition (%)	15.14	7.62	14.69	13.12	0.56	0.16			12.64
Ag (ppm)	0.10	0.12	0.08	0.10			5.00	1.00	0.10
Al (ppm)	68,400	64,600	65,500	62,300			83,000	80,000	65,200
As (ppm)	4.6	5.0	10.0	4.4	2.8		96.0	24.0	6.0
B (ppm)					30	9			
Ba (ppm)	437.5	652.0	500.1	424.5	340	60			503.5
Be (ppm)	1.60	1.80	1.70	1.45					1.64
Bi (ppm)	0.43	0.24	0.33	0.32					0.33
Ca (ppm)	3,700	7,300	6,600	3,800					5,350
Cd (ppm)	0.08	0.02	0.02	0.20			80.00	27.00	0.08
Ce (ppm)	68.9	90.6	64.2	74.0					74.4
Co (ppm)	7.7	10.4	8.0	6.8	19	5	31	14	8.2
Cr (ppm)	164	39	34	27	17.0	8.0	50.0	54.0	66
Cs (ppm)	4.50	4.80	3.80	4.40					4.38
Cu (ppm)	24.2	24.4	26.6	22.6	36.0	5.0	71	33	24.5
Fe (ppm)	28,000	30,900	36,500	26,900			53,000	38,000	30,575
Ga (ppm)	19.20	17.95	17.45	17.10	18	1.2			17.93
Ge (ppm)	0.30	0.35	0.30	0.30					0.31
Hf (ppm)	2.0	2.0	2.0	2.0					2.0
Hg (ppm)					0.0097	0.0027	2.50	0.36	
In (ppm)	0.100	0.055	0.055	0.050					0.065
K (ppm)	7,800	14,000	5,800	7,400					8,750
La (ppm)	36.0	48.0	31.5	35.5					37.8
Li (ppm)	29.4	30.6	29.6	27.6					29.3
Mg (ppm)	4,100	6,800	4,700	4,100					4,925
Mn (ppm)	135	275	125	125			6,200	1,100	165
Mo (ppm)	1.35	0.70	0.65	0.60	2.8	1.1			0.83
Na (ppm)	4,800	11,300	4,500	4,500					6,275
Nb (ppm)	9.3	8.6	8.5	9.1					8.9
Ni (ppm)	30.0	21.8	26.6	23.4	15	8	29	22	25.5
P (ppm)	490	830	680	480					620
Pb (ppm)	17.5	18.5	15.5	17.0	8.7	2.9	1,800	370	17.1
Rb (ppm)	48.3	84.6	36.5	44.7					53.5
Re (ppm)	< 0.002	< 0.002	< 0.002	< 0.002					< 0.002
S (ppm)	500	100	100	200	840	380			225
Sb (ppm)	0.50	0.35	0.55	0.60			27	4	0.50
Se (ppm)	1	1	1	1			0.4	0.1	1
Sn (ppm)	2.2	1.8	1.6	1.6					1.8
Sr (ppm)	78.6	161.0	94.1	69.6	460	110			100.8
Ta (ppm)	0.35	0.15	0.35	0.35					0.30
Te (ppm)	< 0.05	< 0.05	< 0.05	< 0.05					< 0.05
Th (ppm)	12.0	13.0	10.2	11.4					11.7
Ti (ppm)	3,300	4,100	3,100	3,100			4,000	4,800	3,400
Tl (ppm)	0.52	0.46	0.22	0.28					0.37
U (ppm)	4.0	3.0	3.7	4.1					3.7
V (ppm)	62	85	88	66	140	23			75
W (ppm)	1.5	0.7	1.2	1.2					1.2
Y (ppm)	17.4	20.5	18.8	19.4					19.0
Zn (ppm)	50	58	54	52	53	7	5,500	2,200	54
Zr (ppm)	75.5	76.0	72.5	72.5	170	90			74.1
Nutrient analysis:									
Moisture (percent)	43.7	43.9	47	53.2					
Available P (ppm)		5	32	6					
Ammonia-N (ppm)	13.2	2.67	7.26	17.2					
TKN (ppm)		500	1,300	1,400					
Nitrate-N (ppm)	2.4	1.3	1.4	1.2					
TOC (ppm)	1.3	0.36	1.34	1.12			2.4	2.6	

Notes:

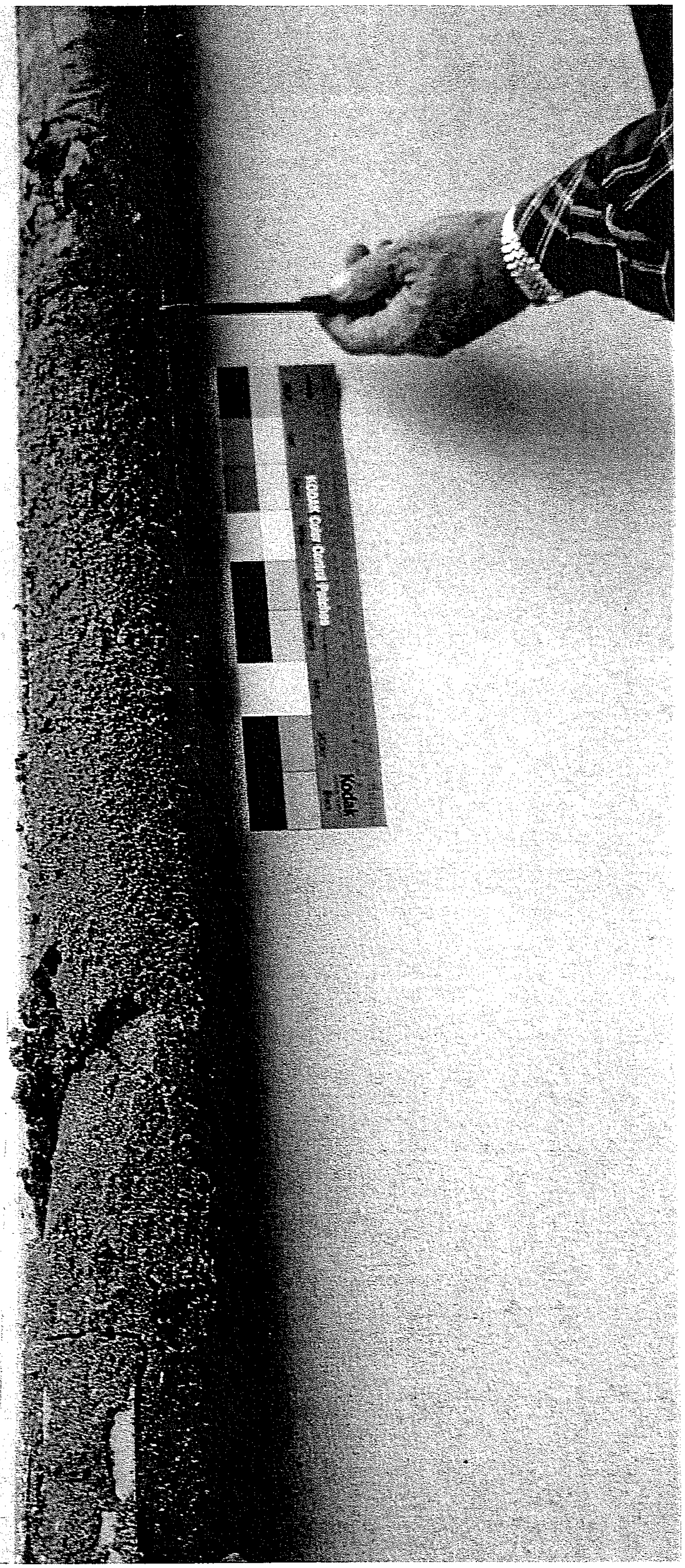
1.) Shading indicates a computed average where one or more of the values in the computation was assumed to be one-half of the reported detection limit.

Appendix D

Mica Bay Core Photographs



ROLL3DX-0A.JPG   1B   Entire Core

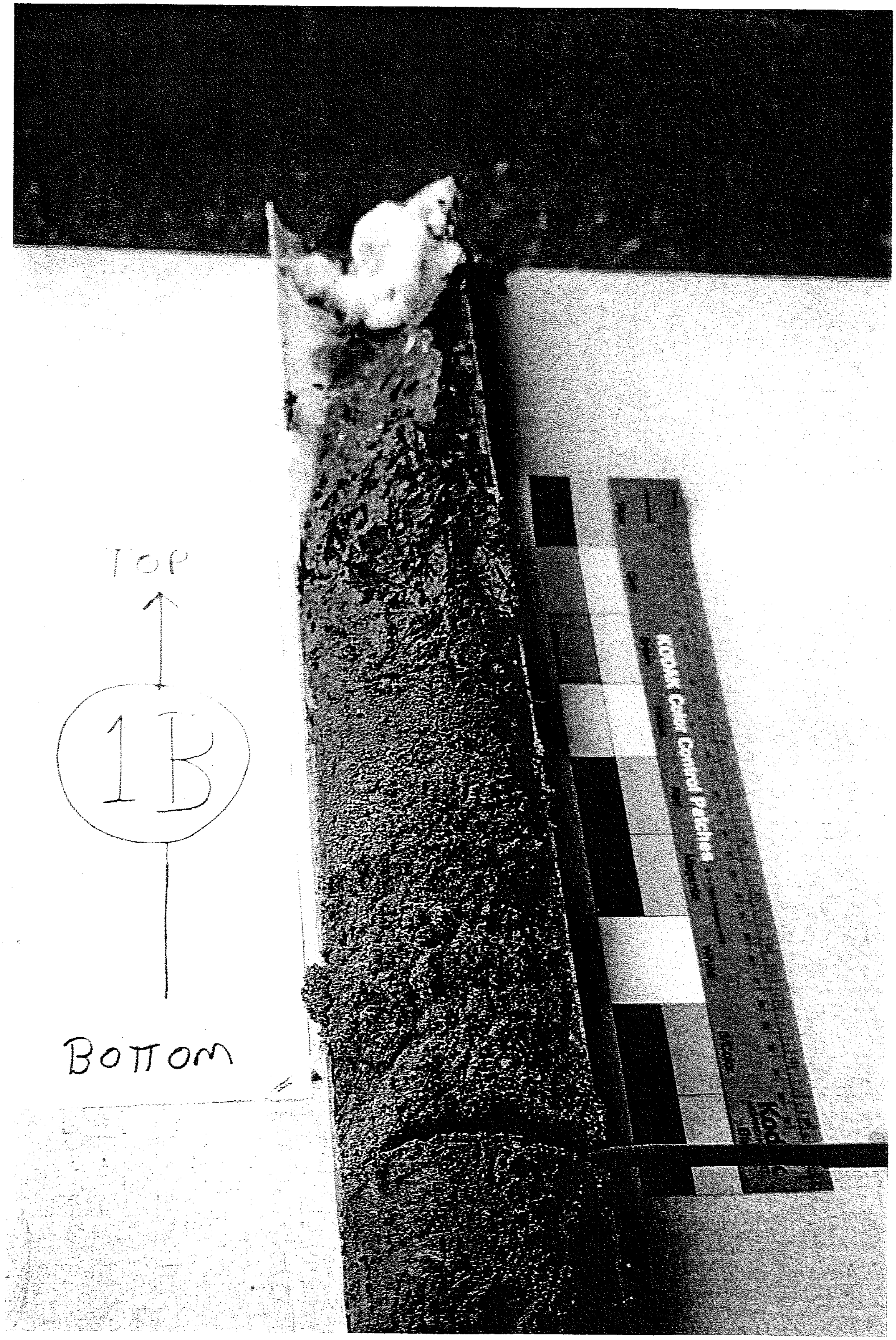


TOP

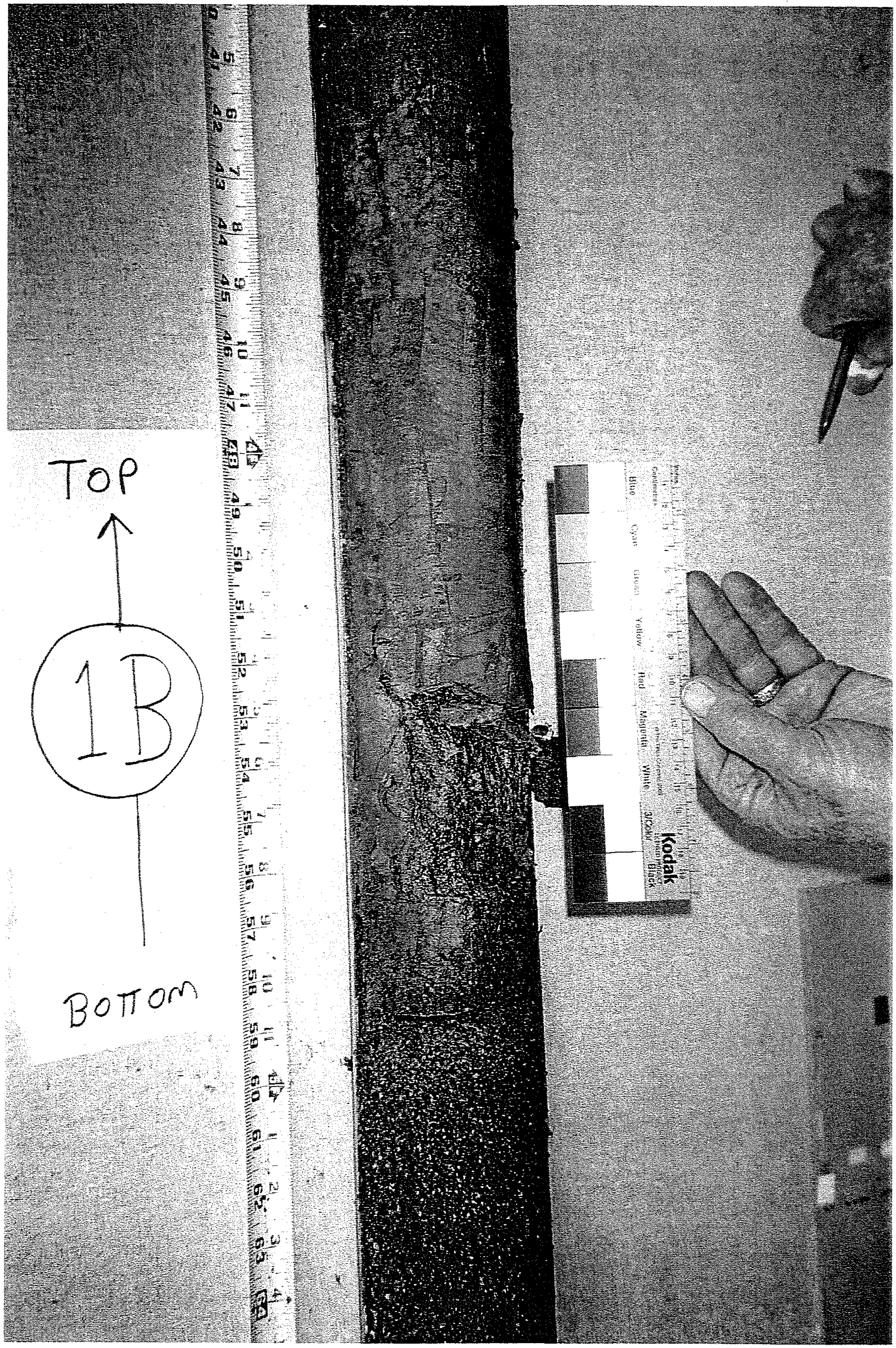
1B

Bottom

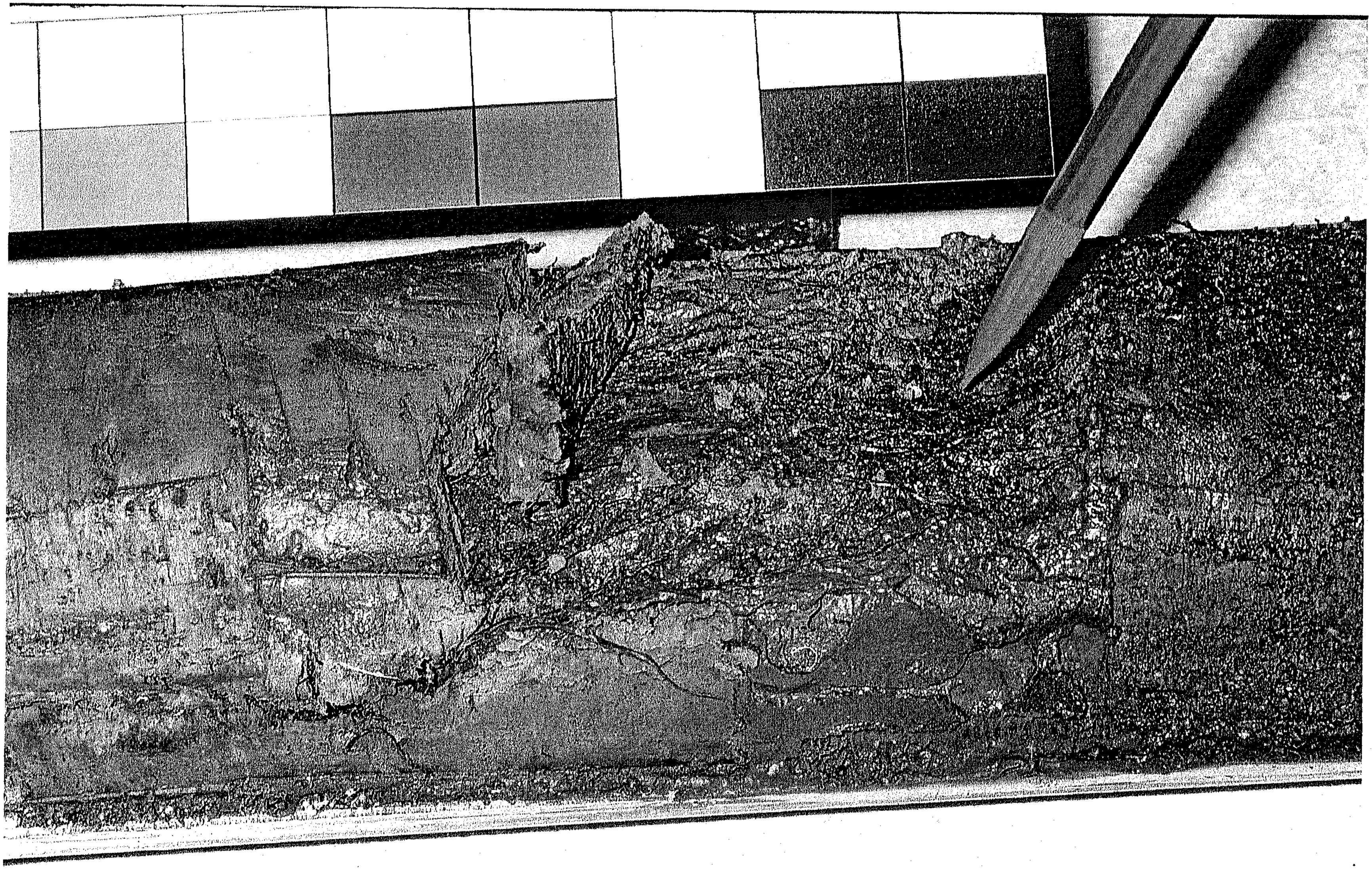
ROLL3DX-01A.JPG 1B Bottom



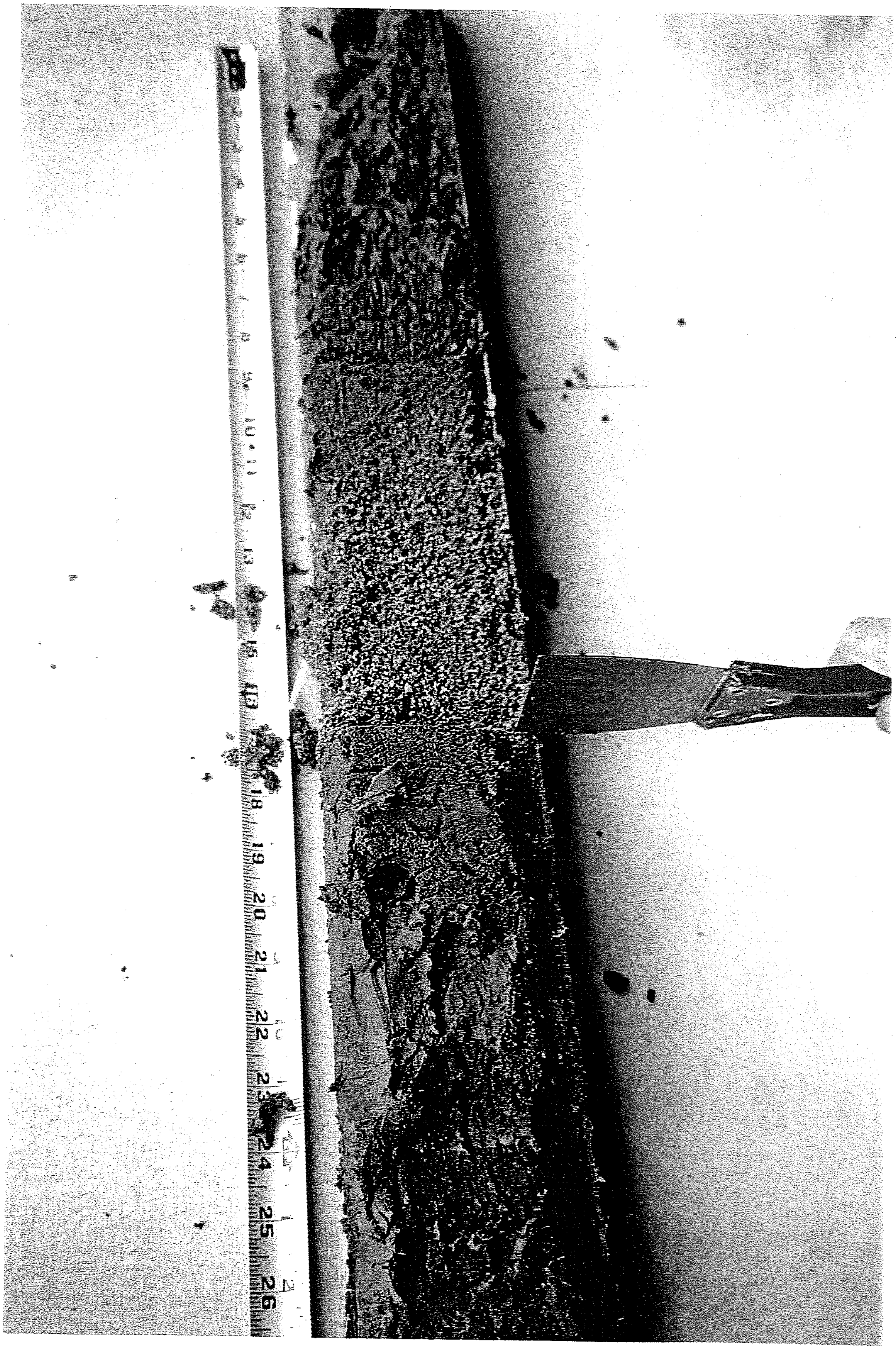
ROLL3DX-03A.JPG 1B Top



ROLL3DX-04A.JPG 1B 41 to 64 inches



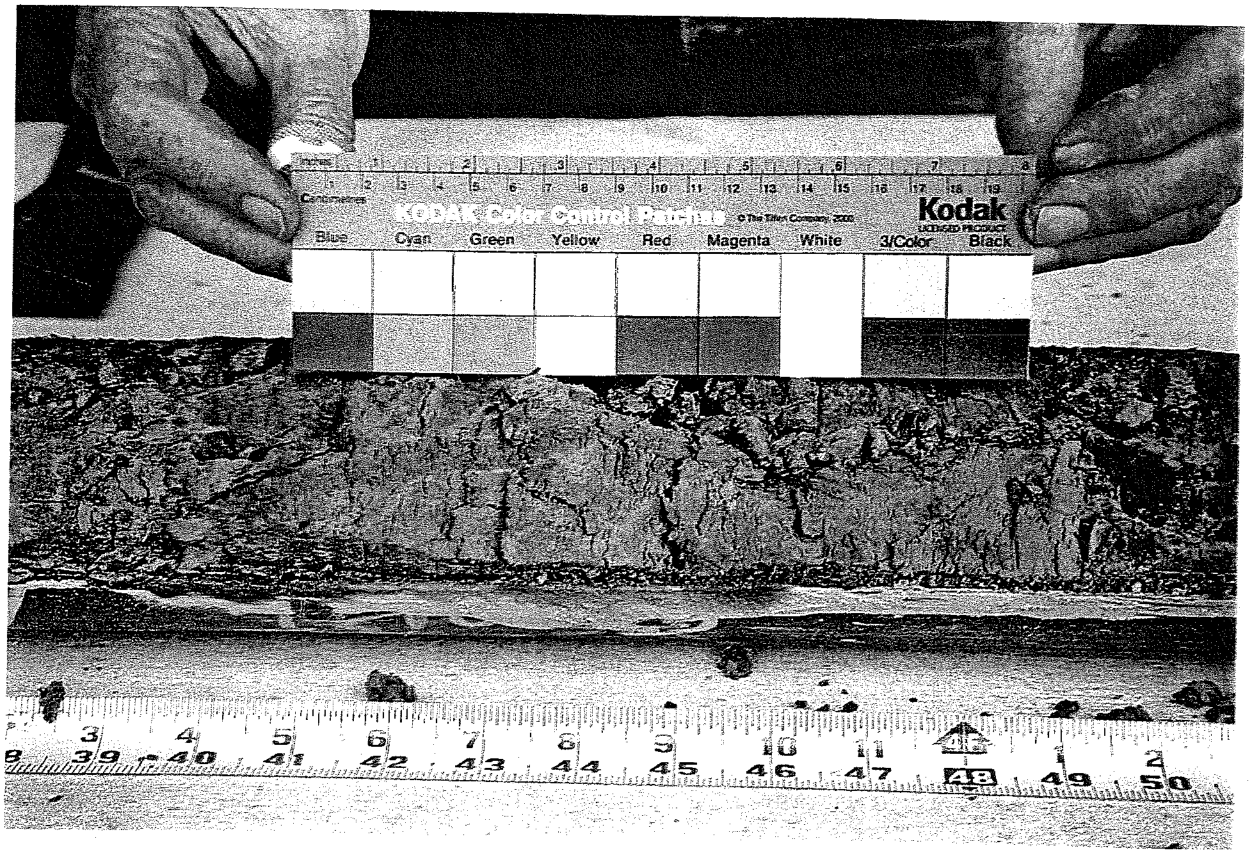
ROLL3DX-05A.JPG 1B 53 to 58.5 inches, pen pointing to abundant roots



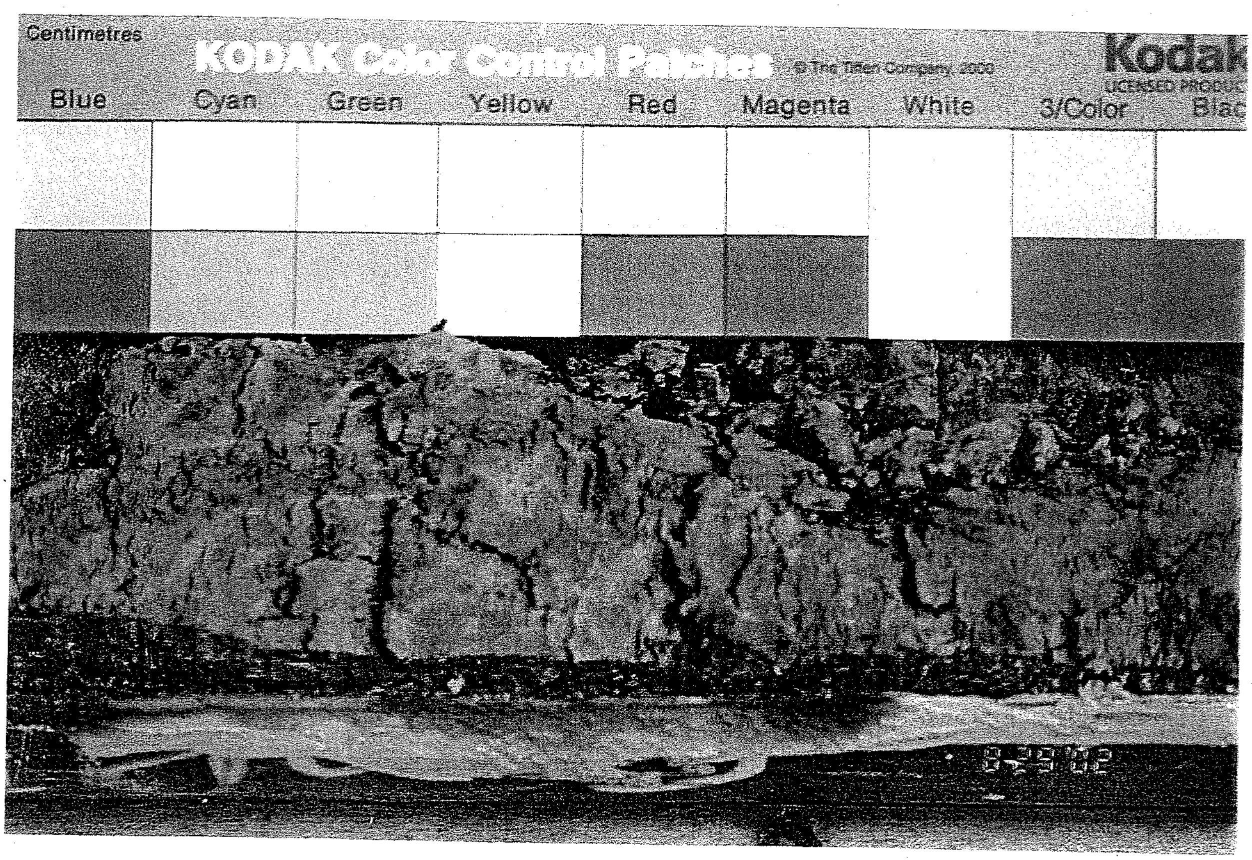
ROLL3DX-06A.JPG 1B Breakpoint at 18 inches

ROLL3DX-07A.JPG 1B Breakpoint at 58.5 inches

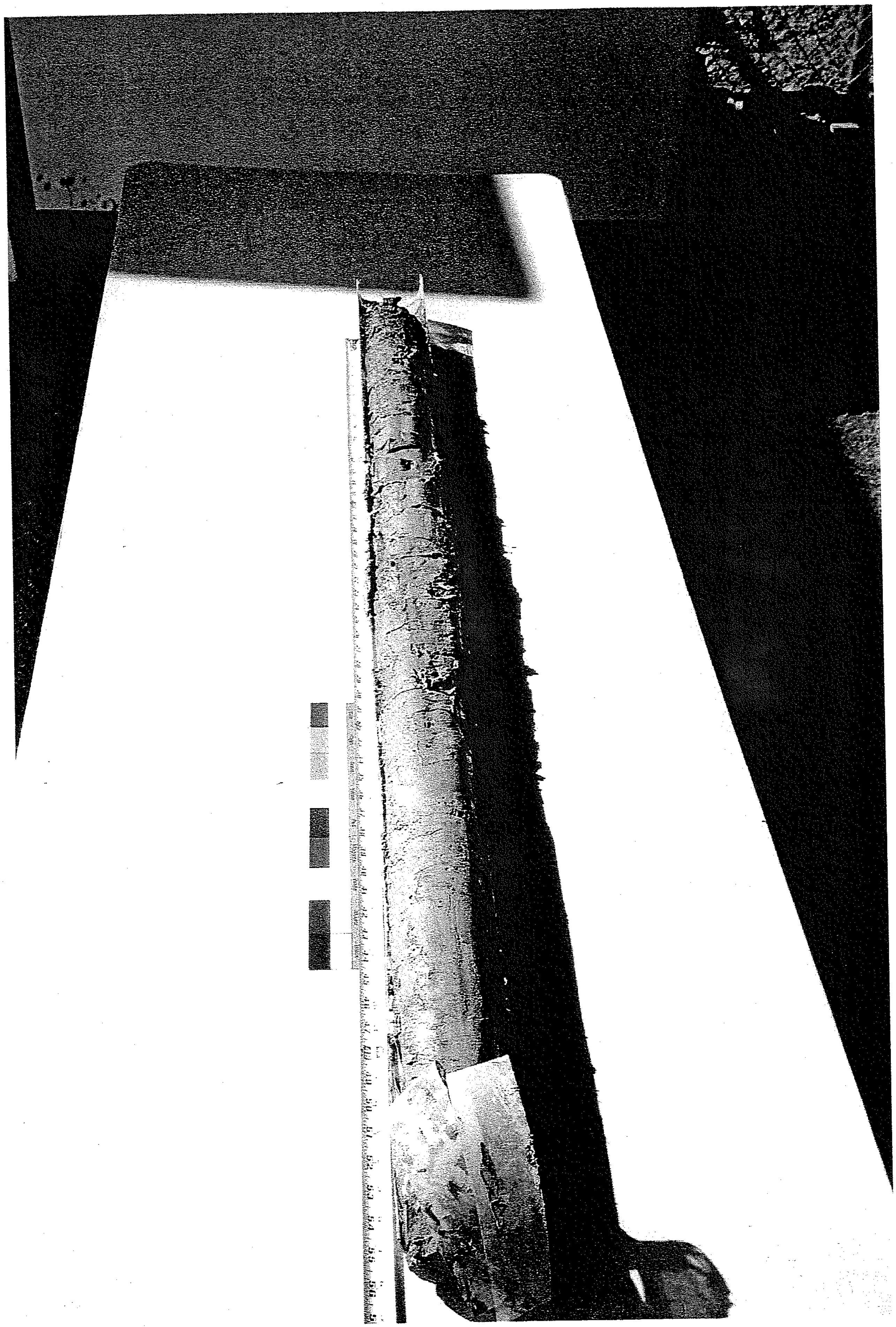
ROLL3DX-08A.JPG 1B Approx. 43 to 46 inches



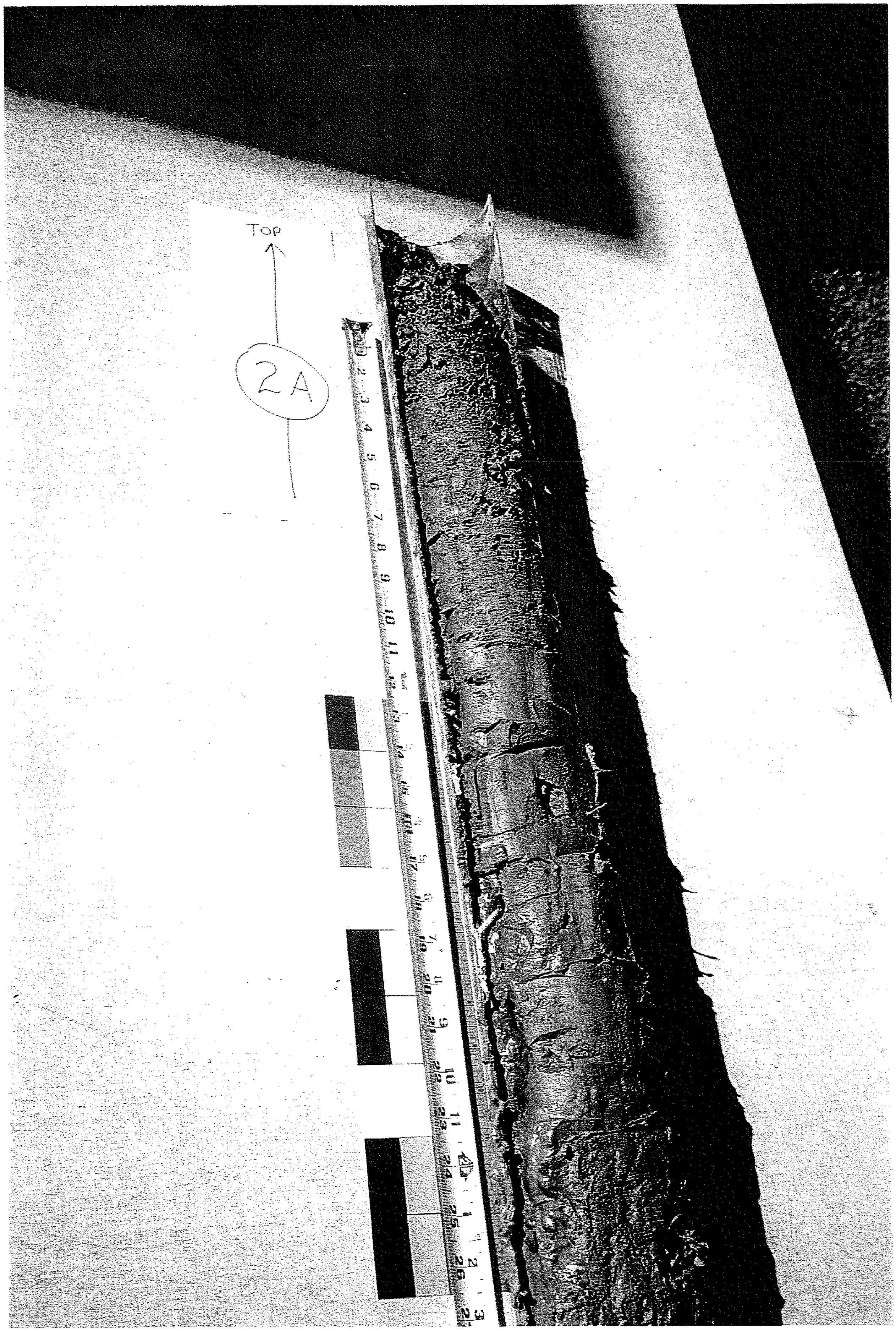
ROLL3DX-09A.JPG 1B 42 to 48 inches



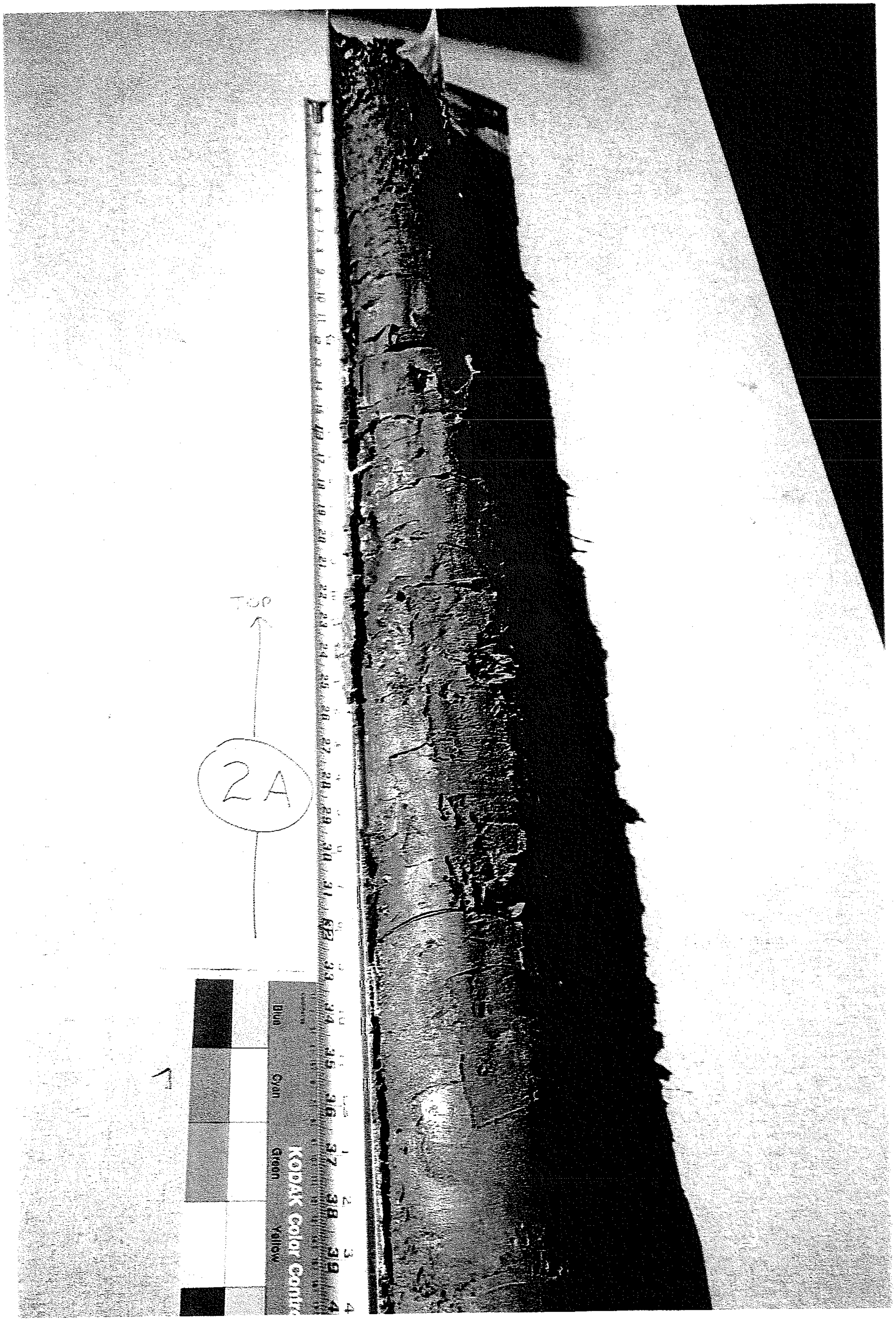
ROLL3DX-10A.JPG 1B 42 to 48 inches



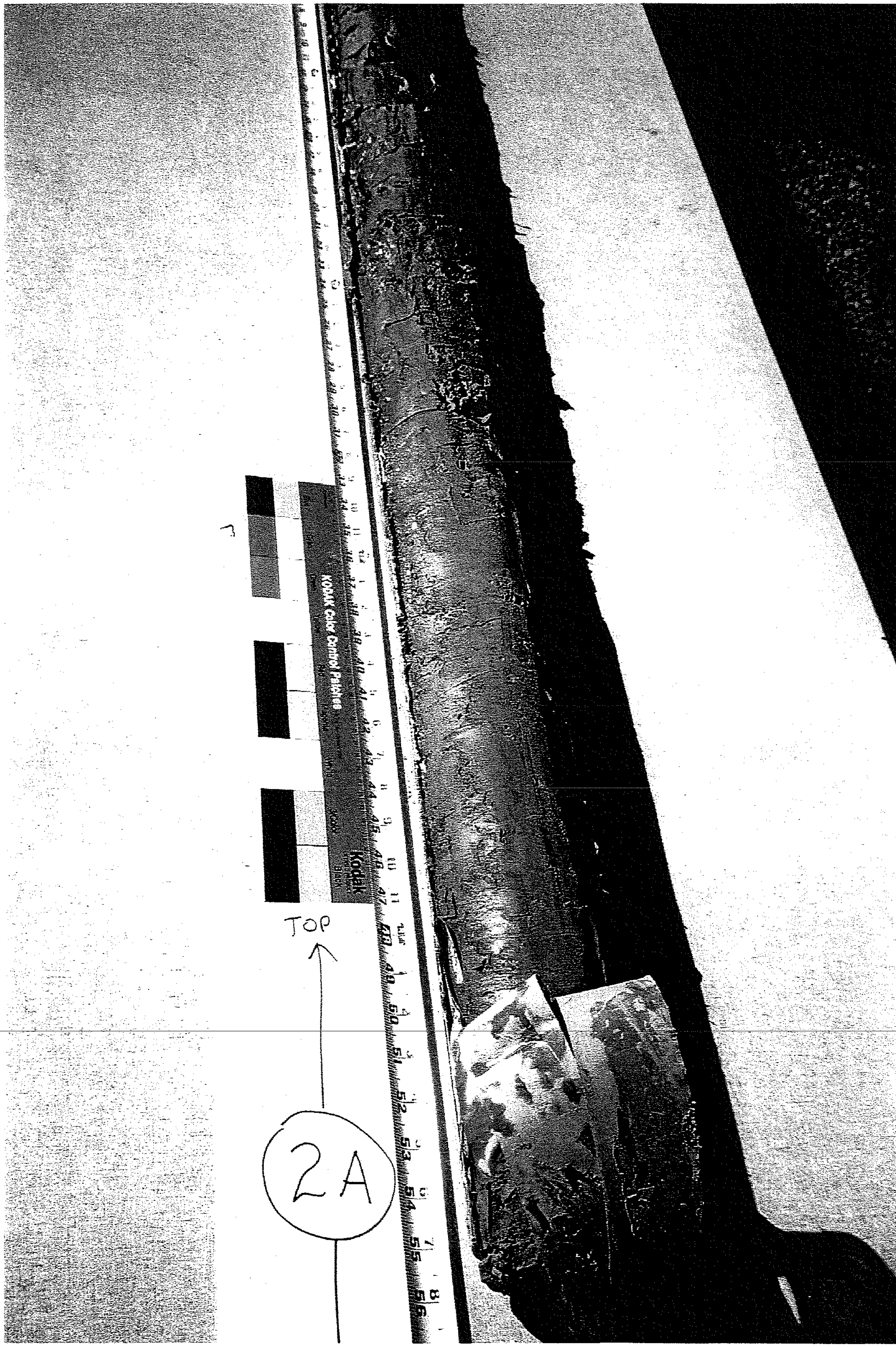
ROLL4DX-13A.JPG 2A Entire



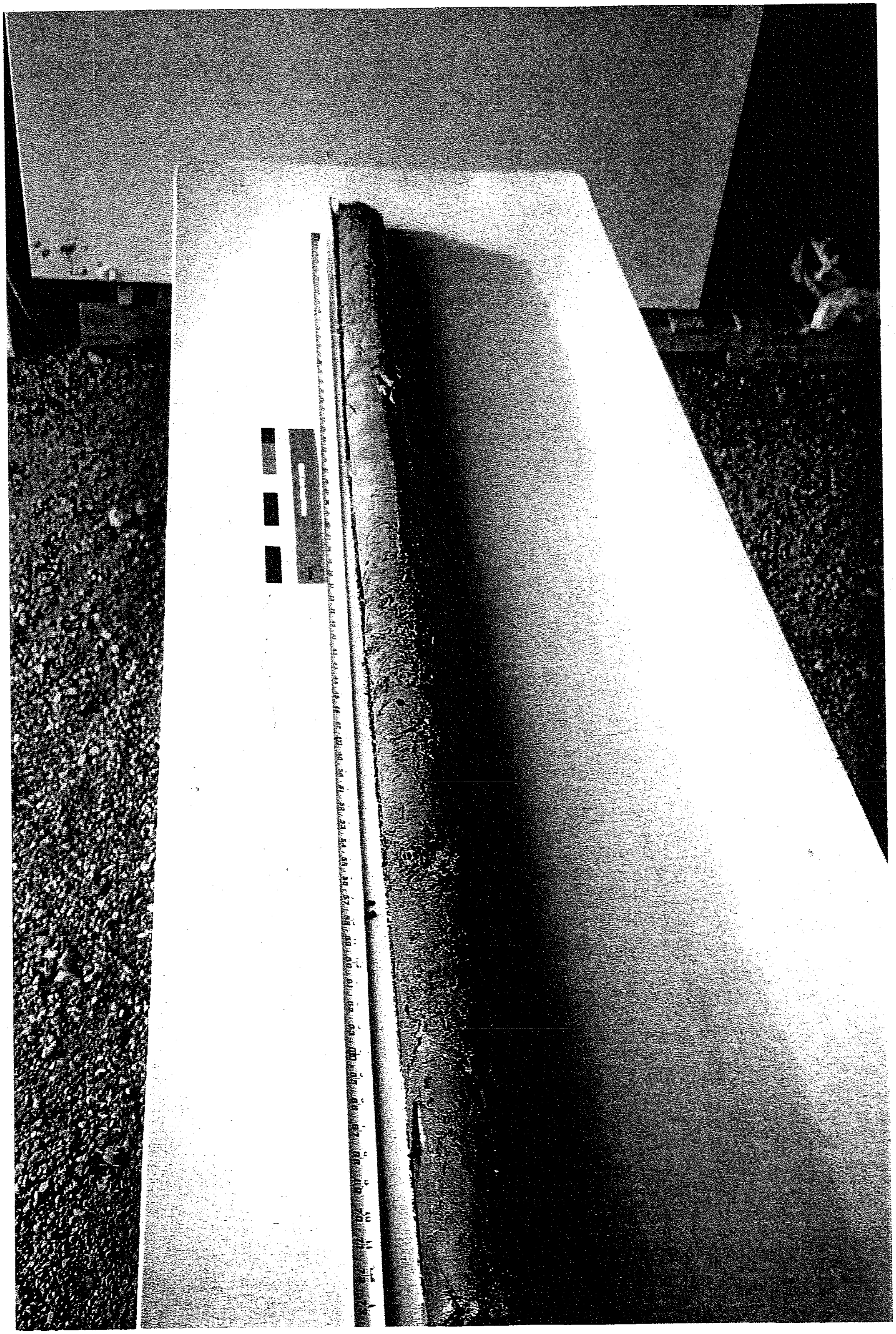
ROLL4DX-14A.JPG 2A Top



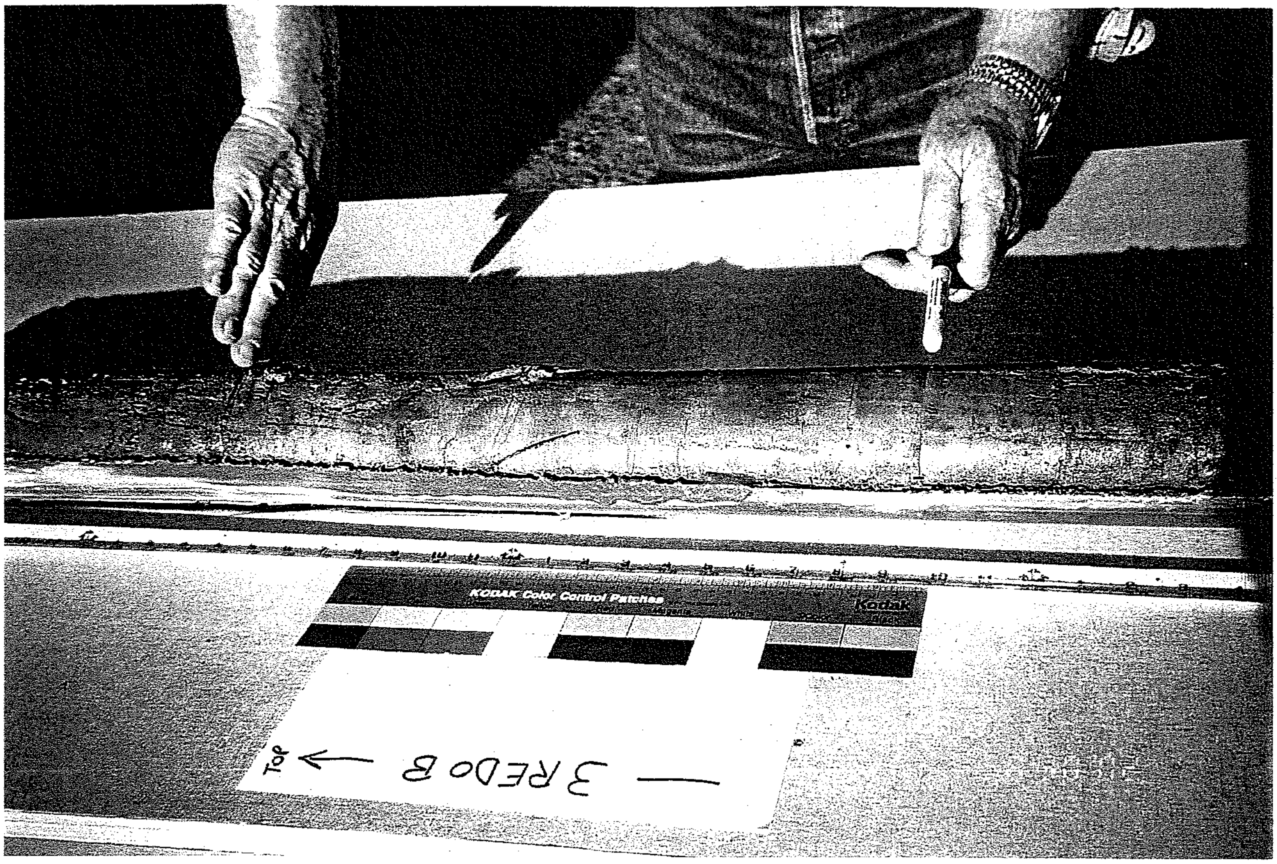
ROLL4DX-15A.JPG 2A Mid



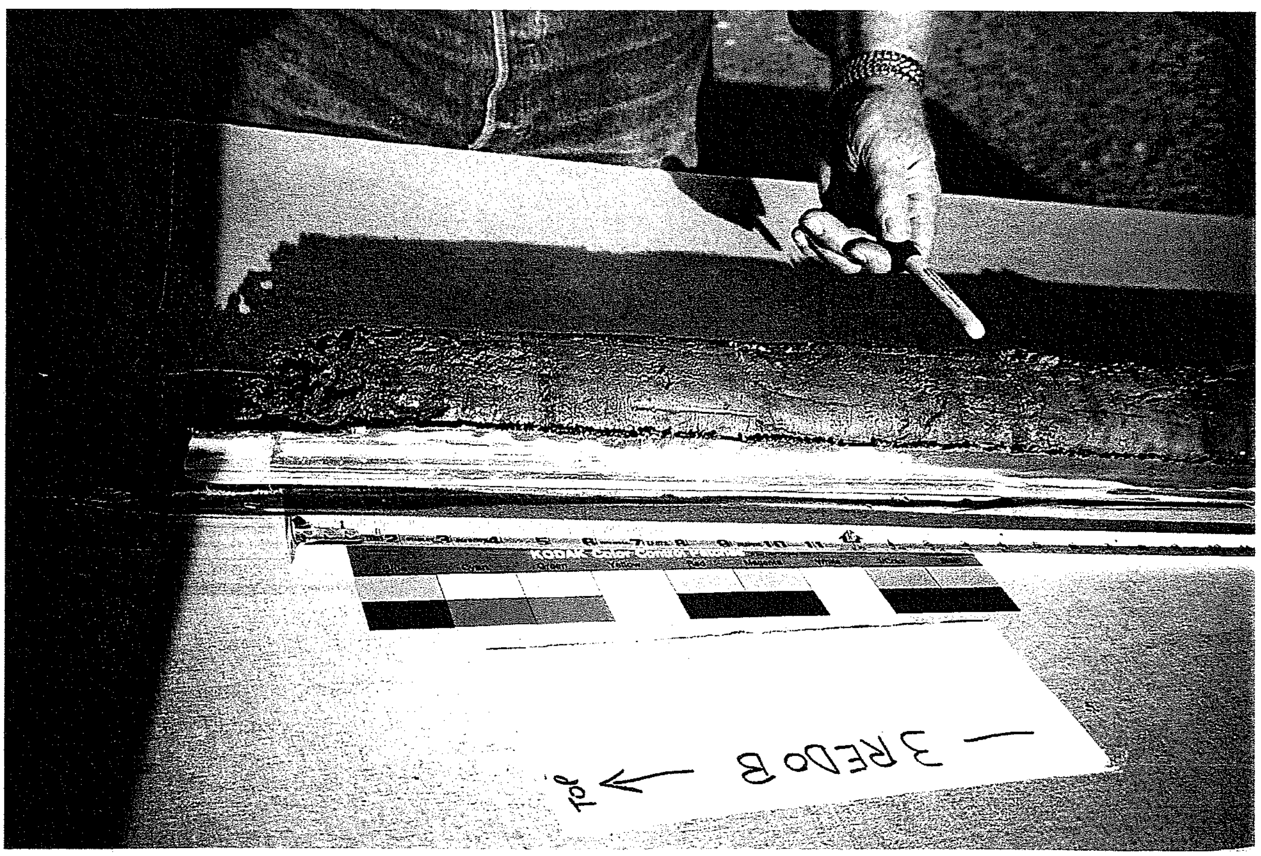
ROLL4DX-16A.JPG 2A Bottom



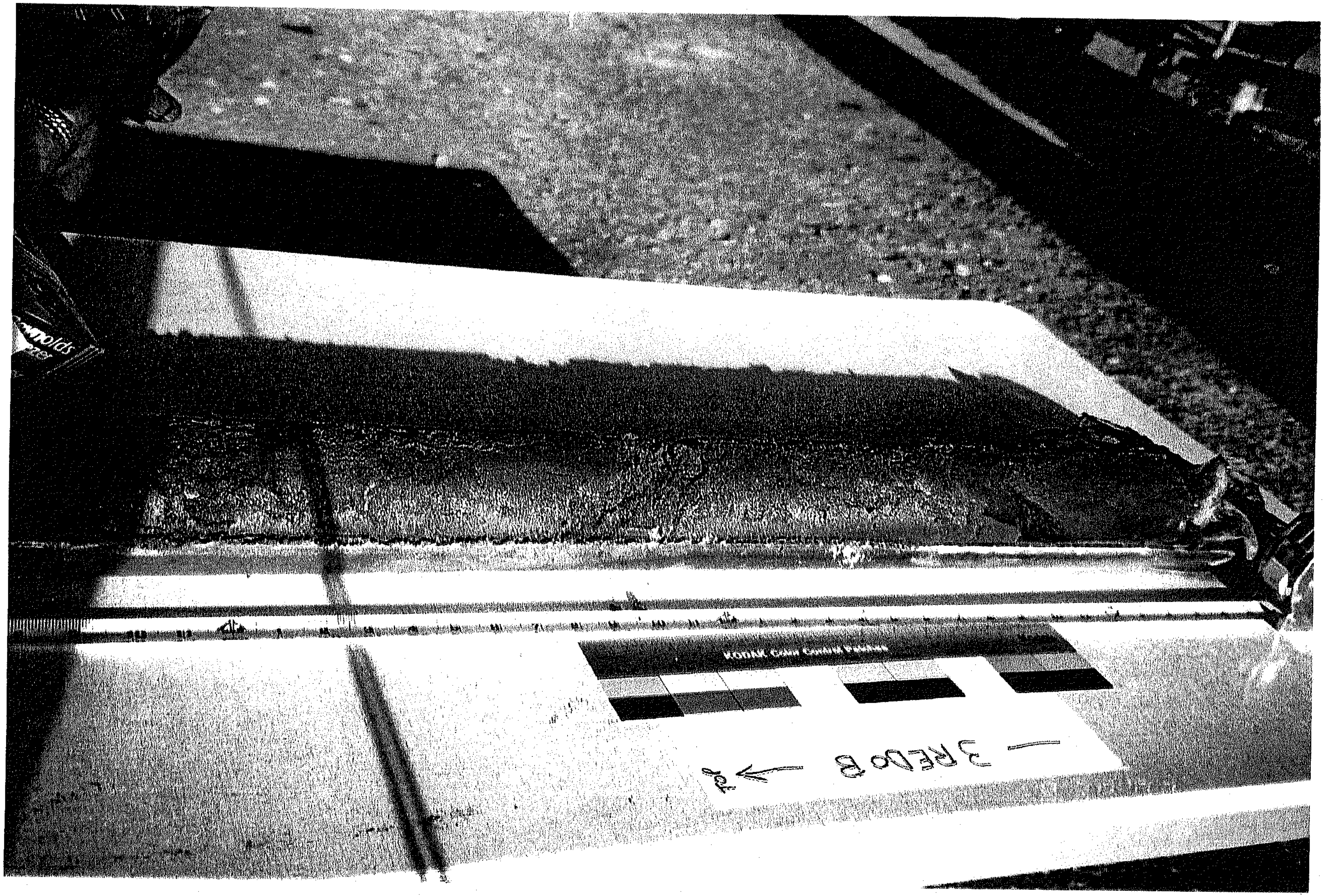
ROLL4DX-0A.JPG 3 REDO B Entire core



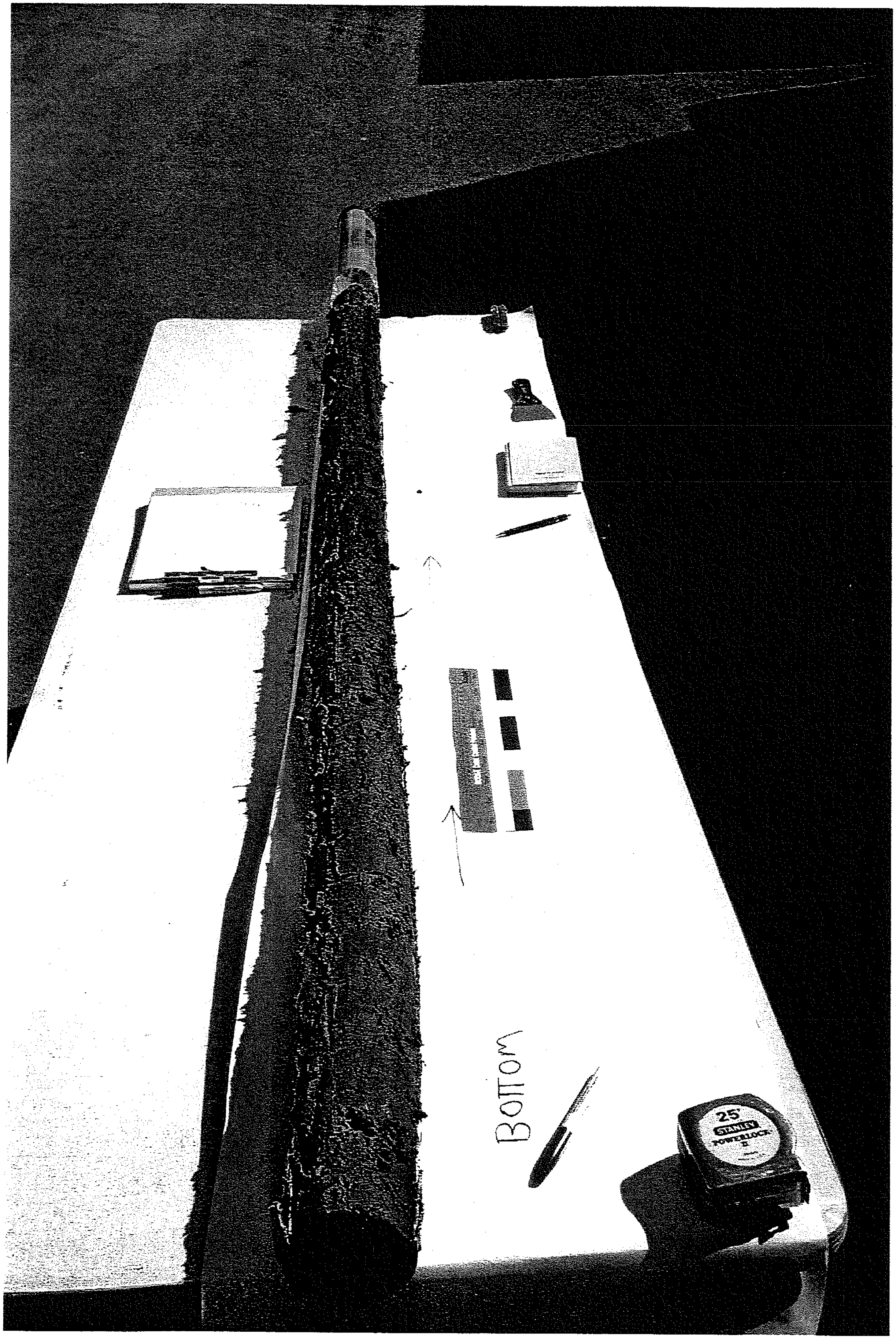
ROLL4DX-01A.JPG 3 REDO B Mid



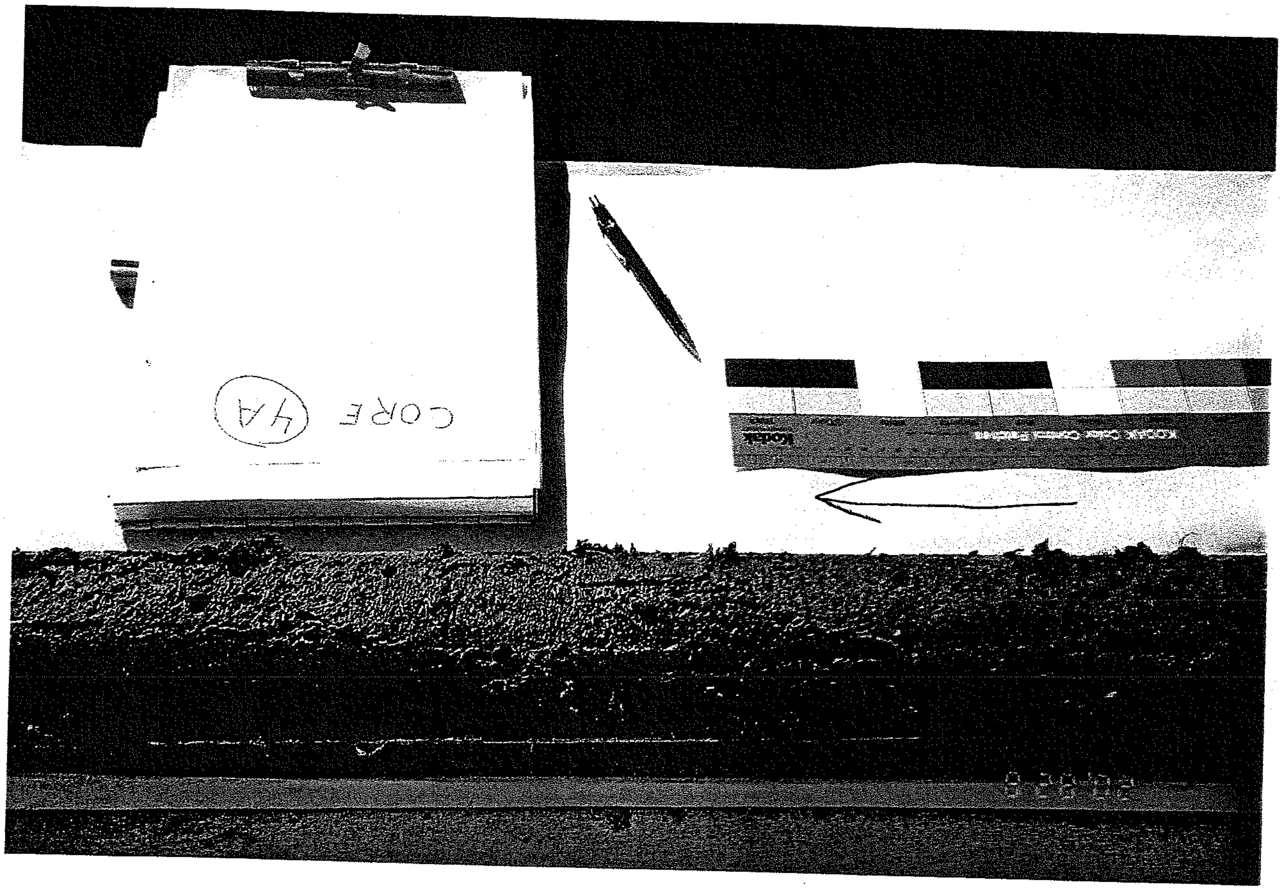
ROLL4DX-02A.JPG 3 REDO B Top



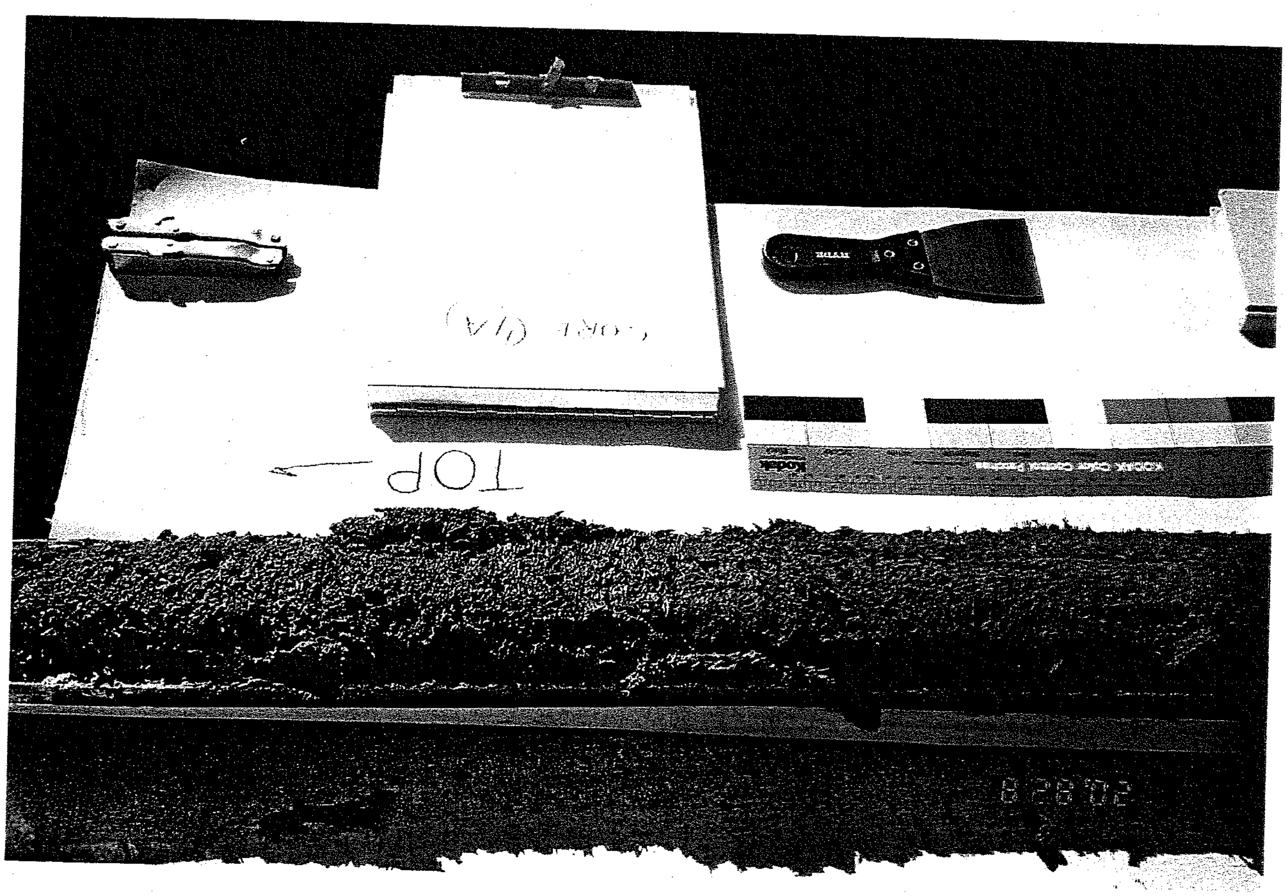
ROLL4DX-03A.JPG 3 REDO B Bottom



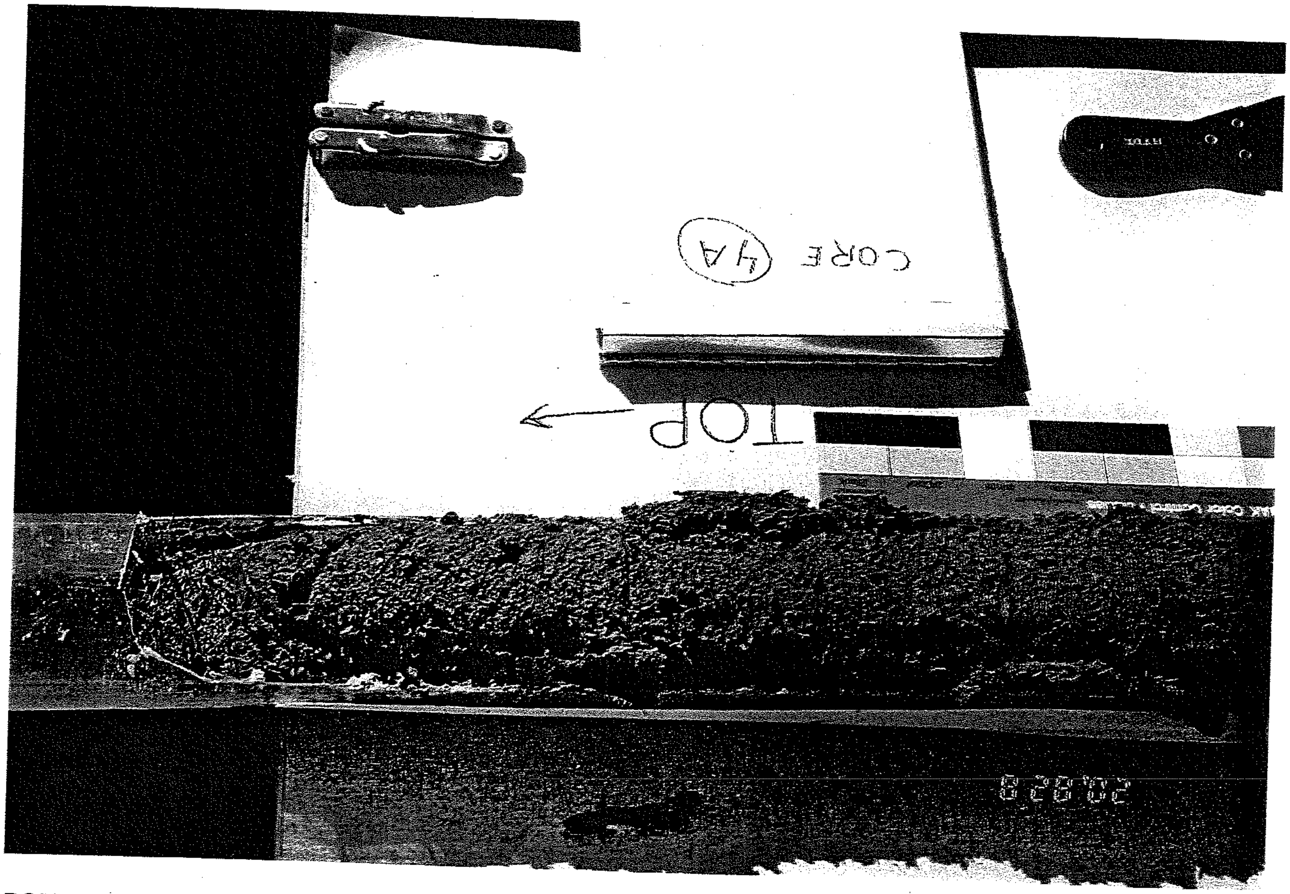
ROLL1DX-06A.JPG 4A Entire core



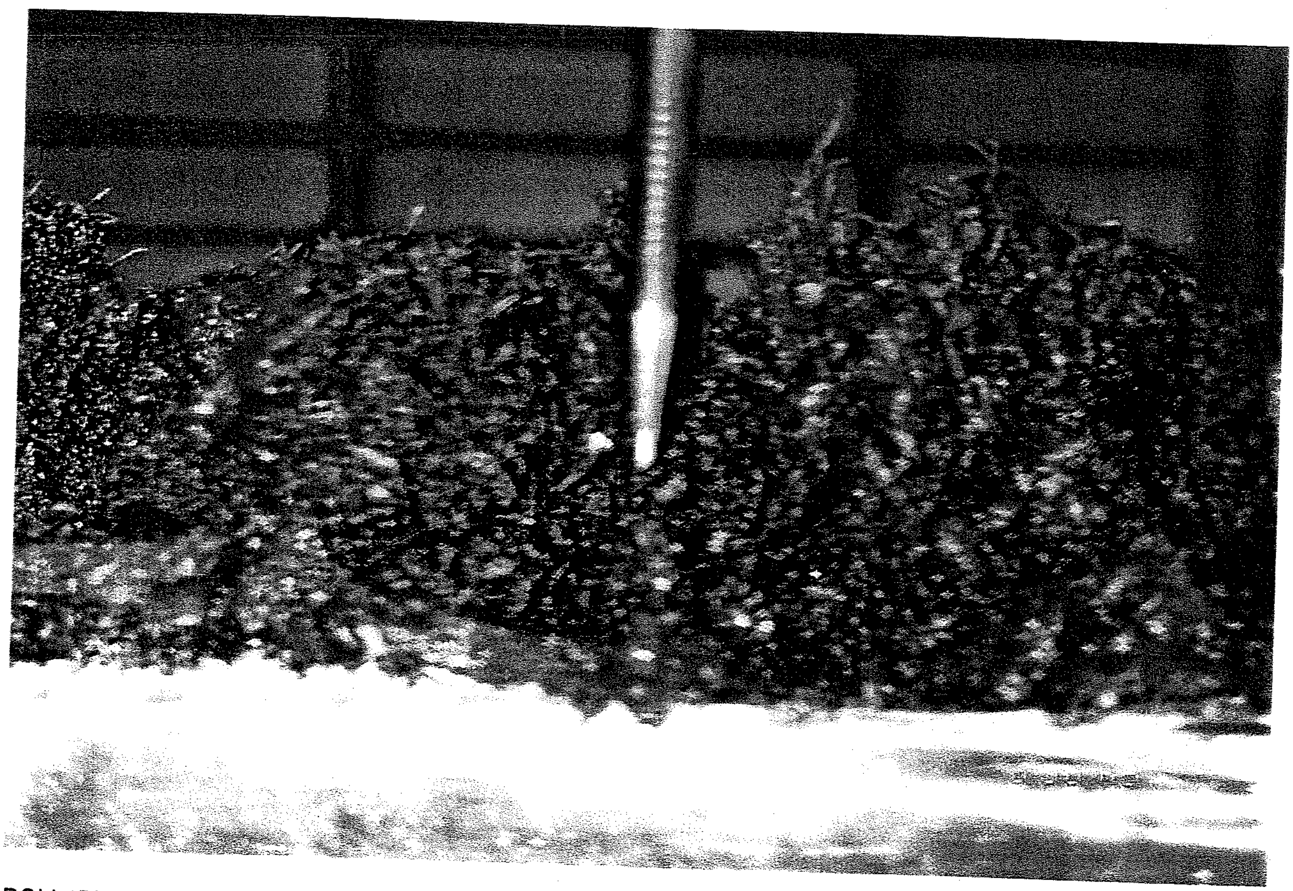
ROLL1DX-07A.JPG 4A Mid



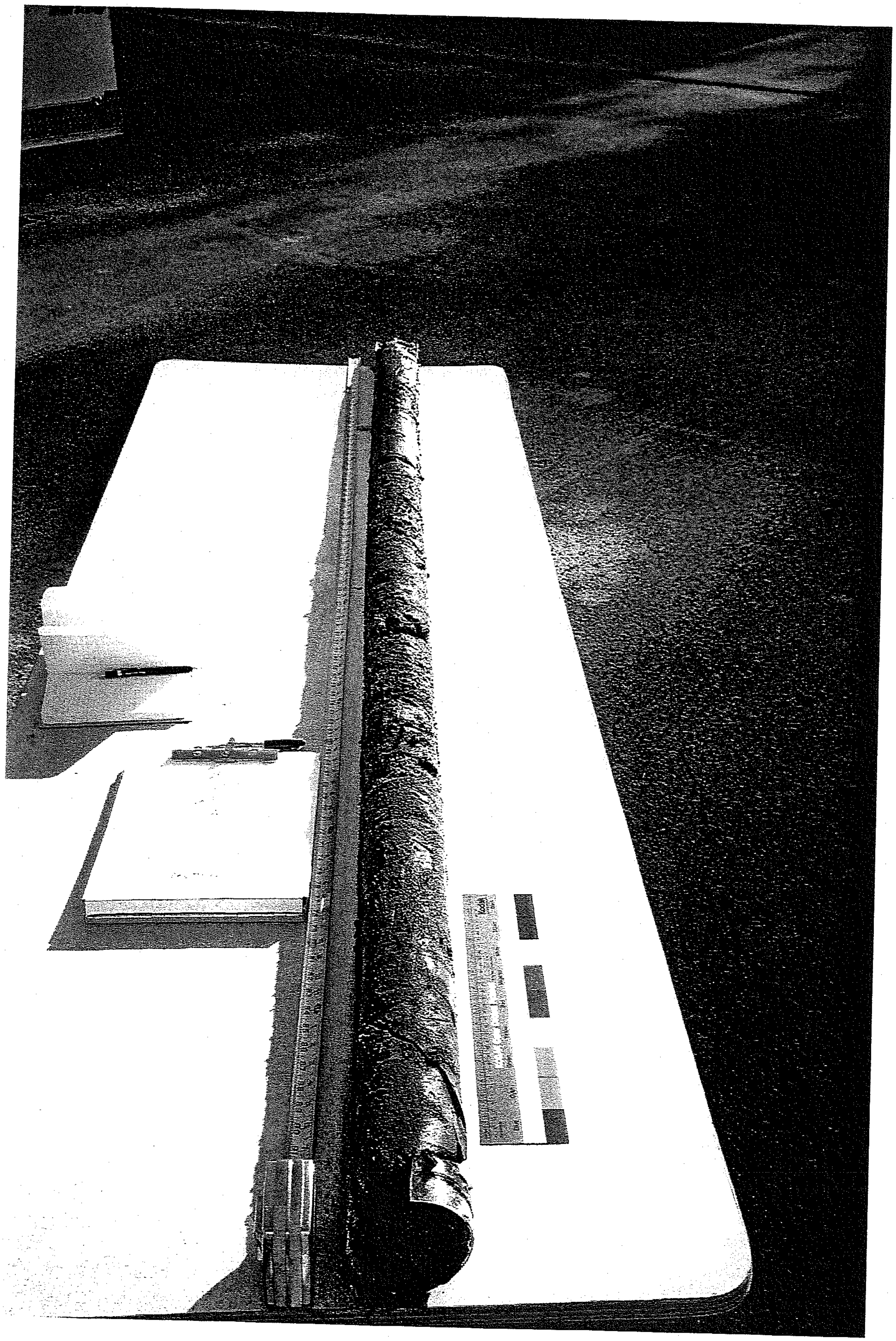
ROLL1DX-08A.JPG 4A Top



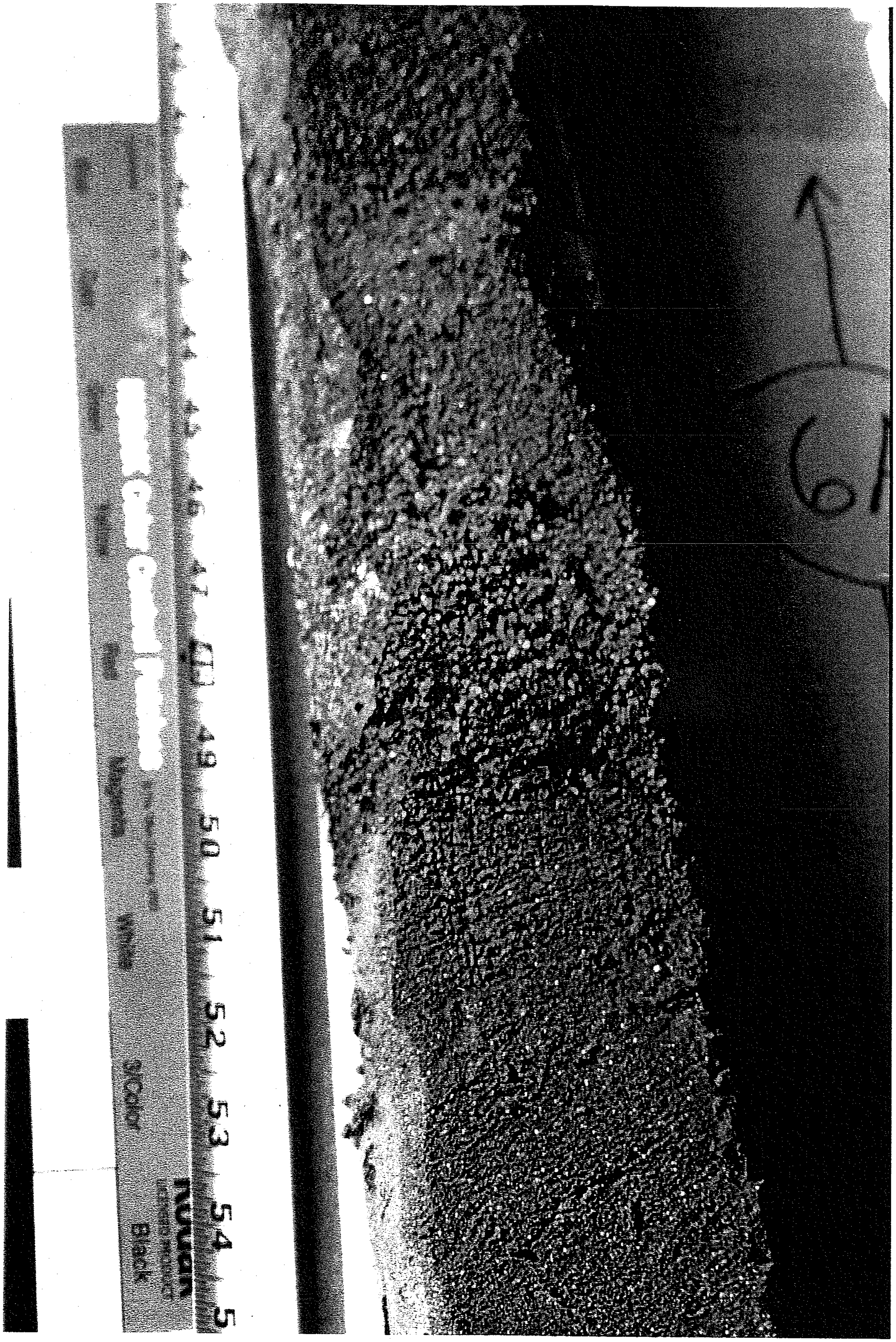
ROLL1DX-09A.JPG 4A Top detail



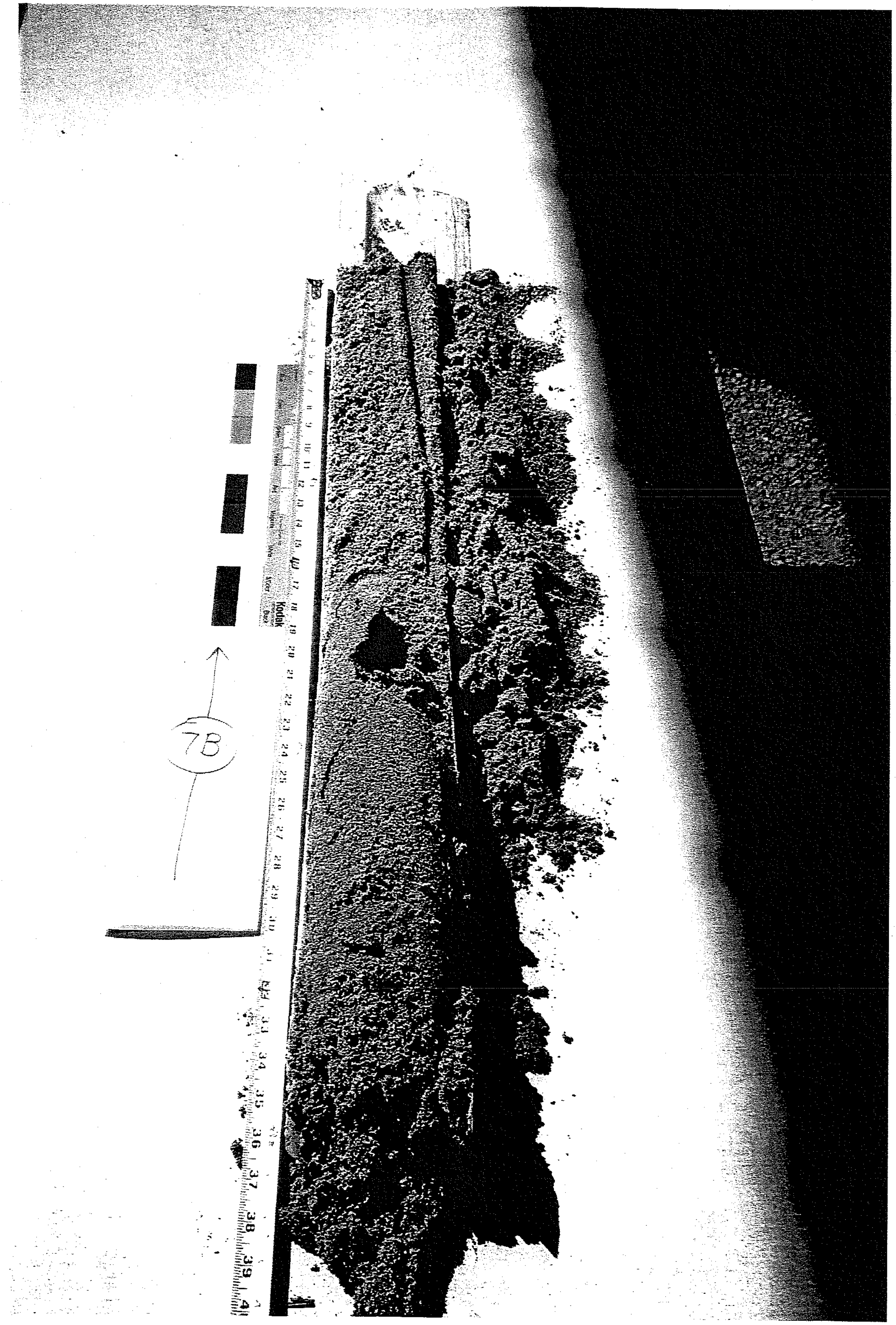
ROLL1DX-10A.JPG 4A Root mass



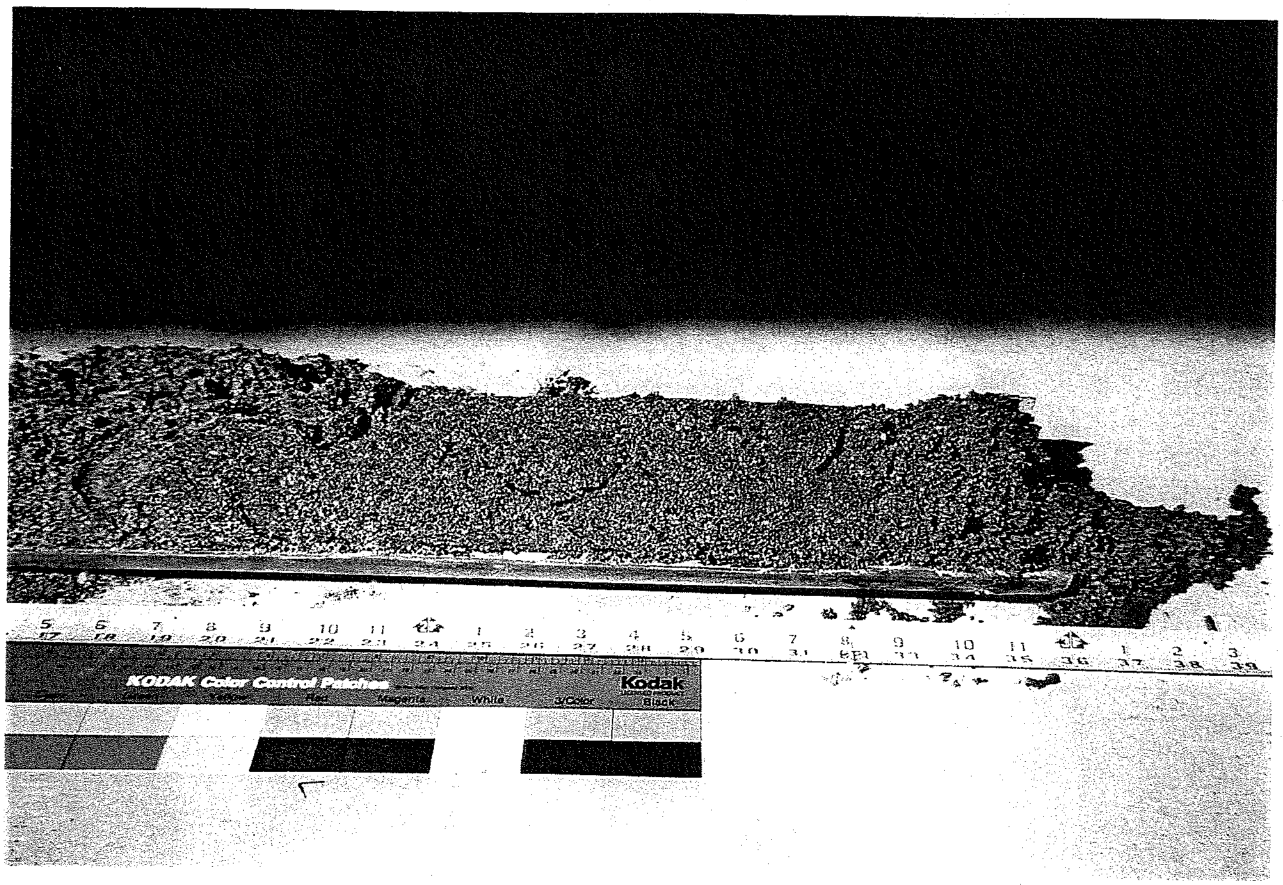
ROLL3DX-16A.JPG 5A Entire core



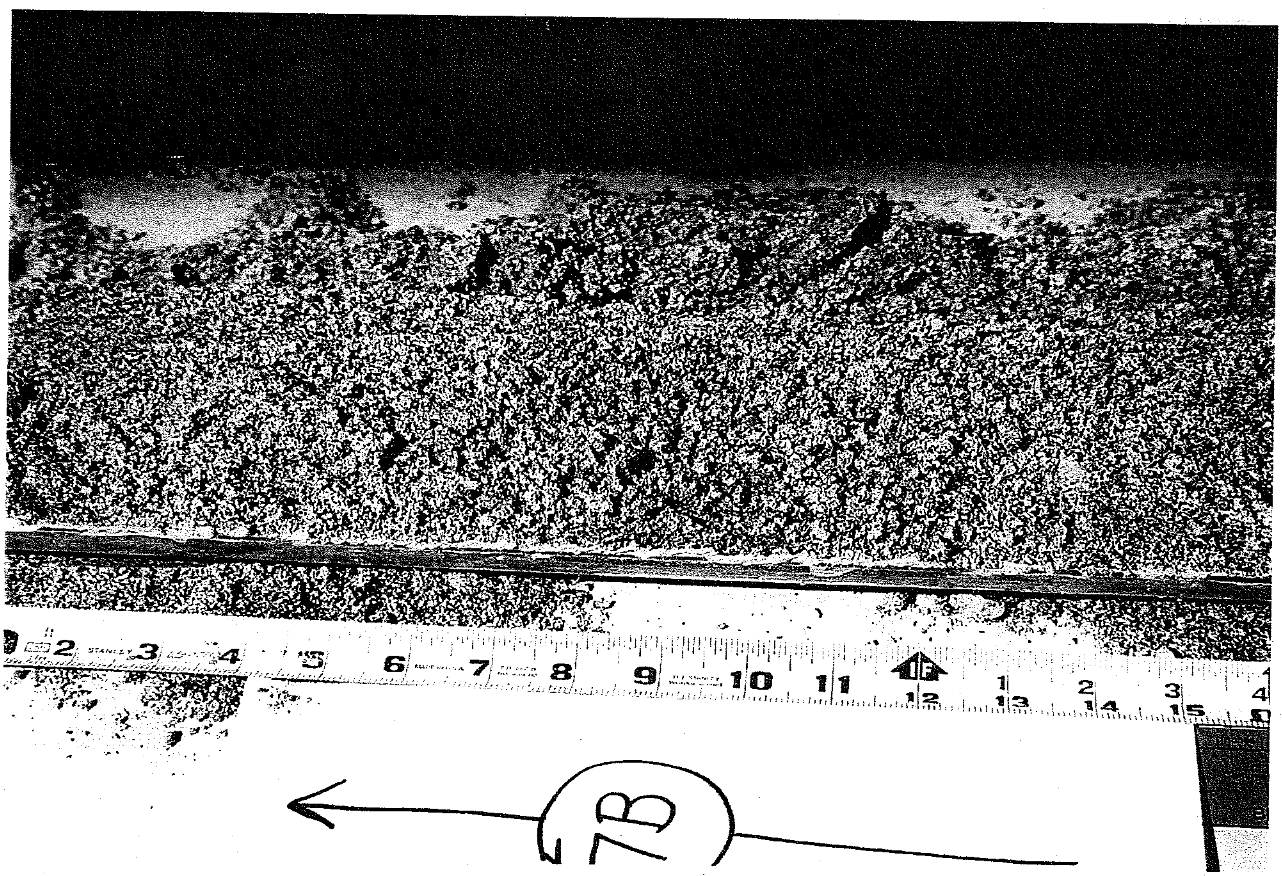
ROLL4DX-12A.JPG 6A Layering within bottom segment



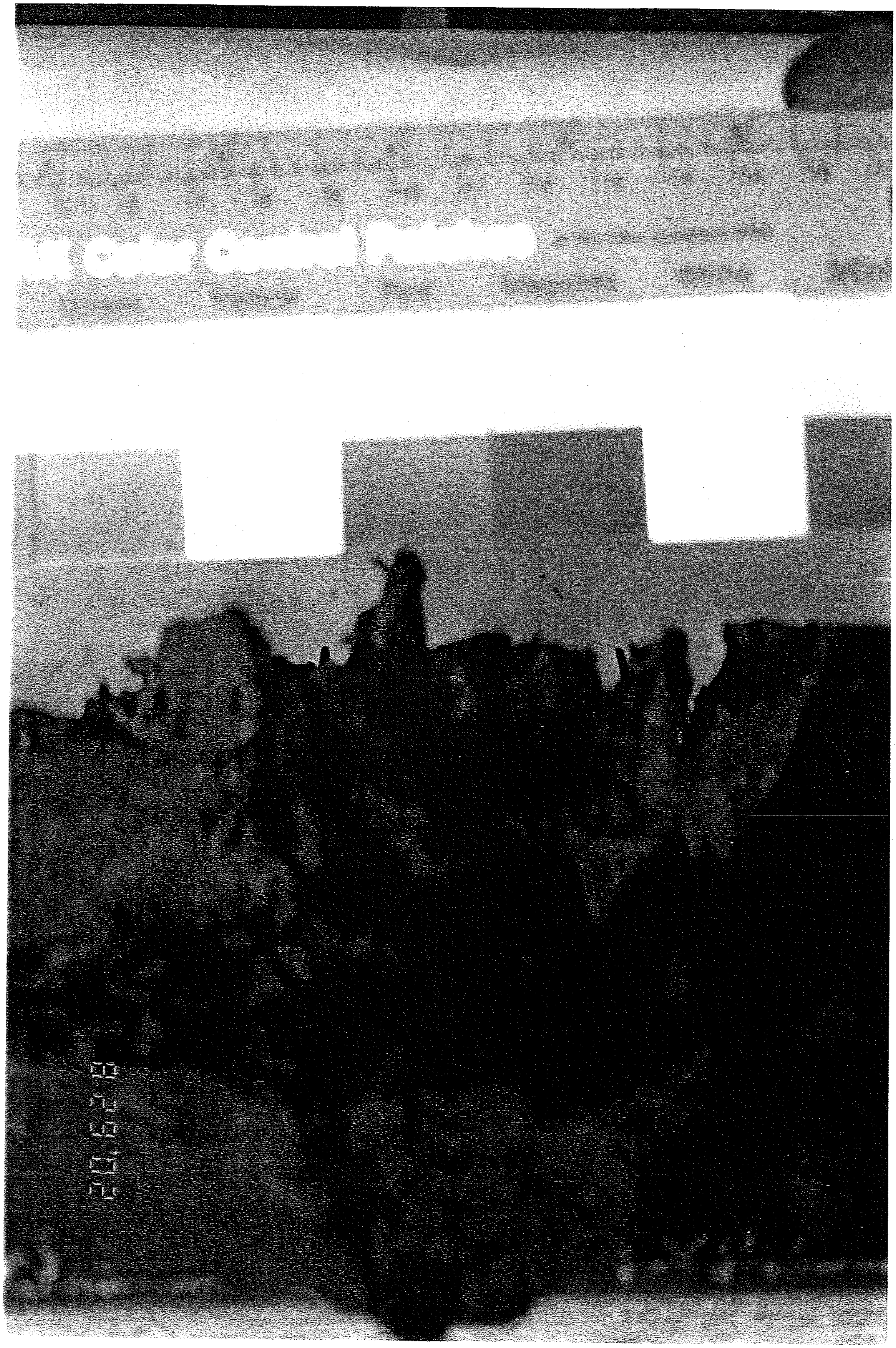
ROLL4DX-17A.JPG 7B Entire



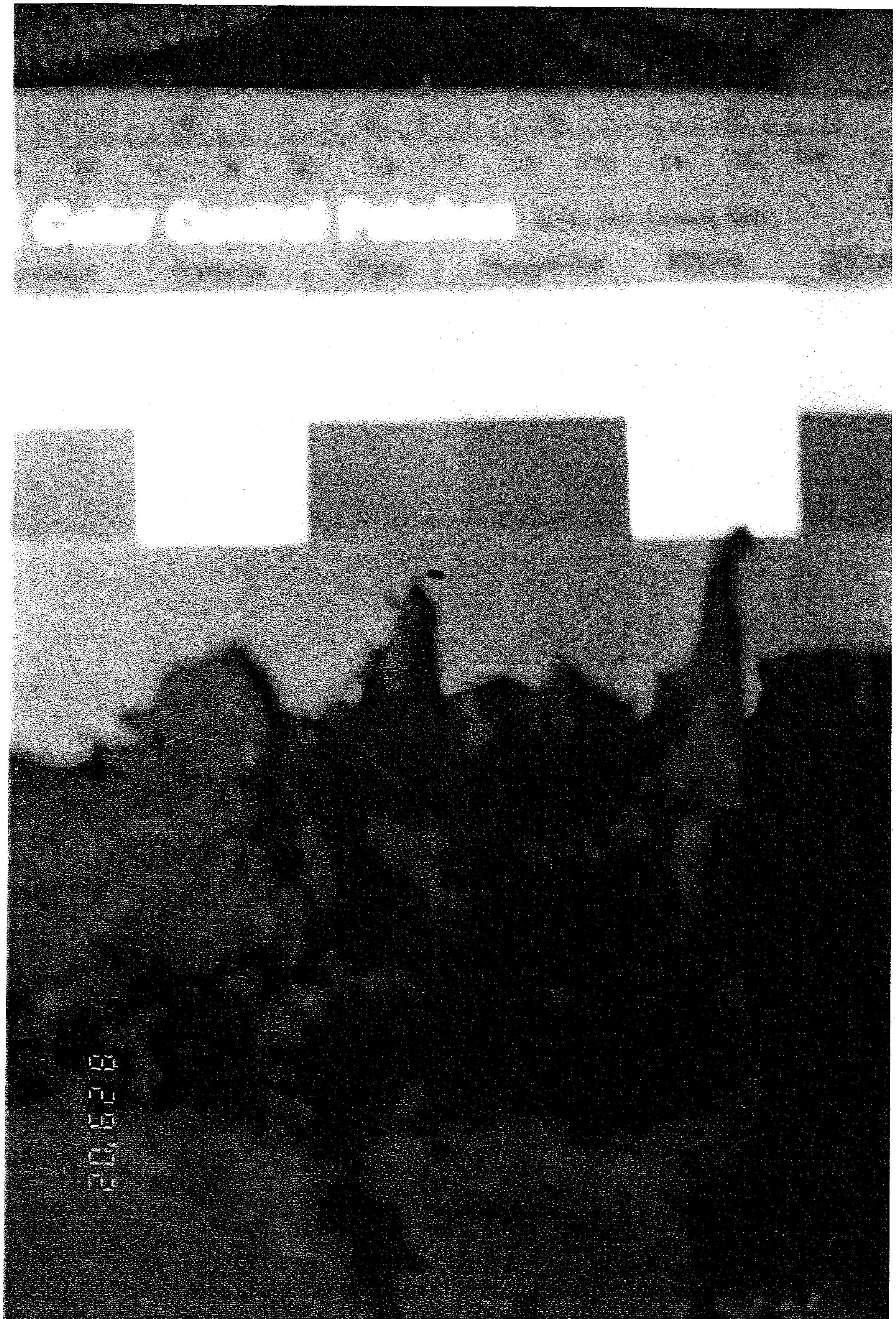
ROLL4DX-18A.JPG 7B Lower segment @ color break



ROLL4DX-19A.JPG 7B Upper segment

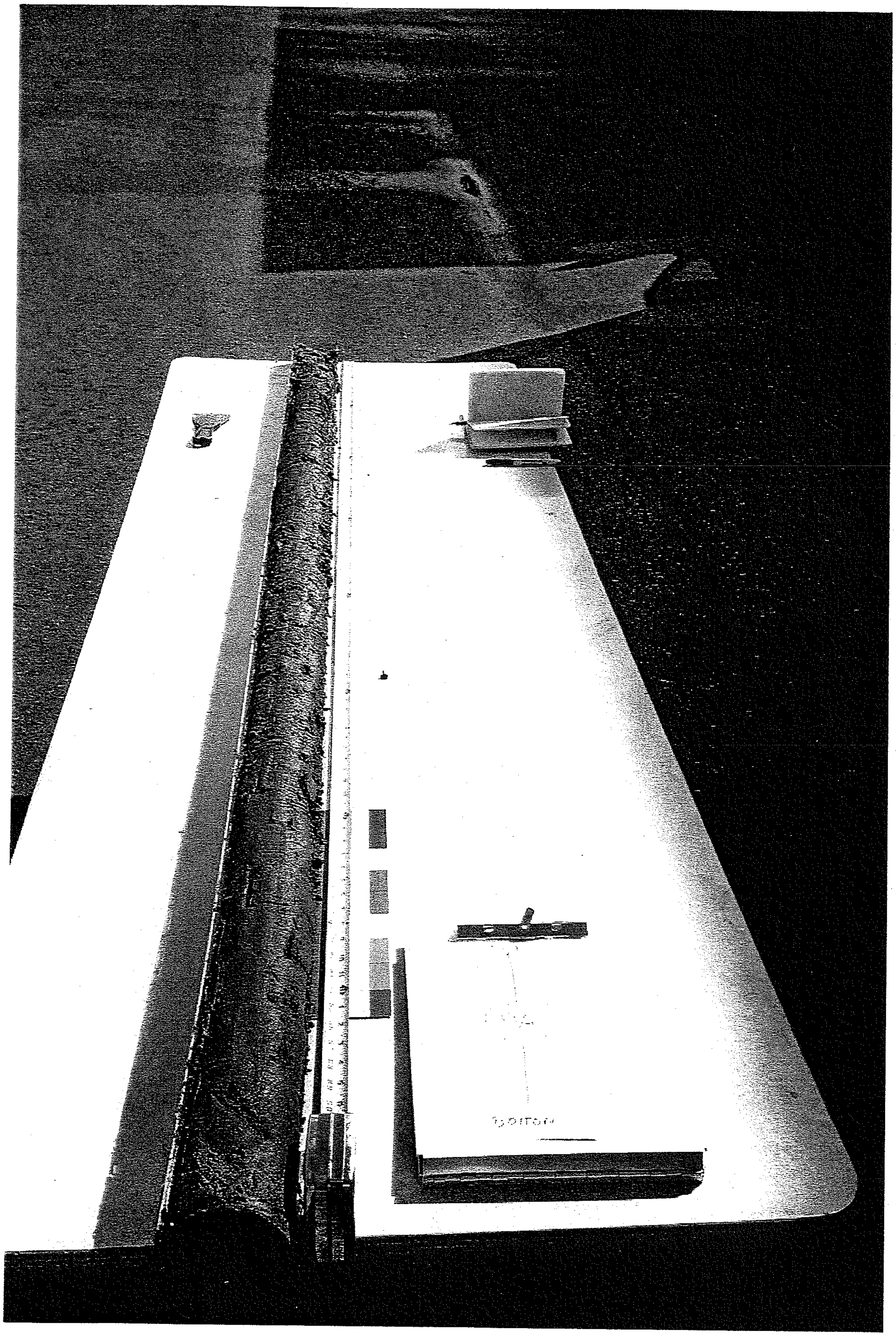


ROLL1DX-22A.JPG 8B Bark Layer (image out of focus)

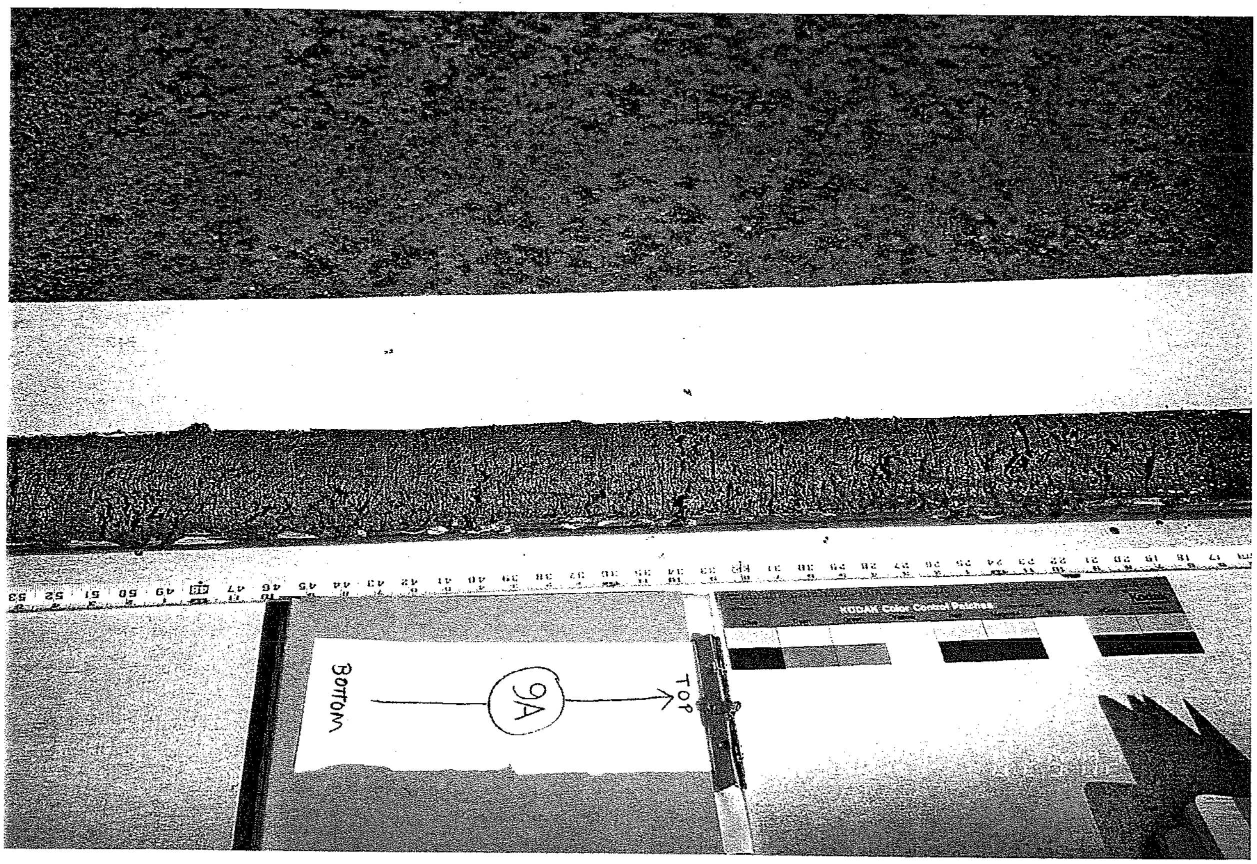


ROLL1DX-23A.JPG 8B Bark layer (image out of focus)

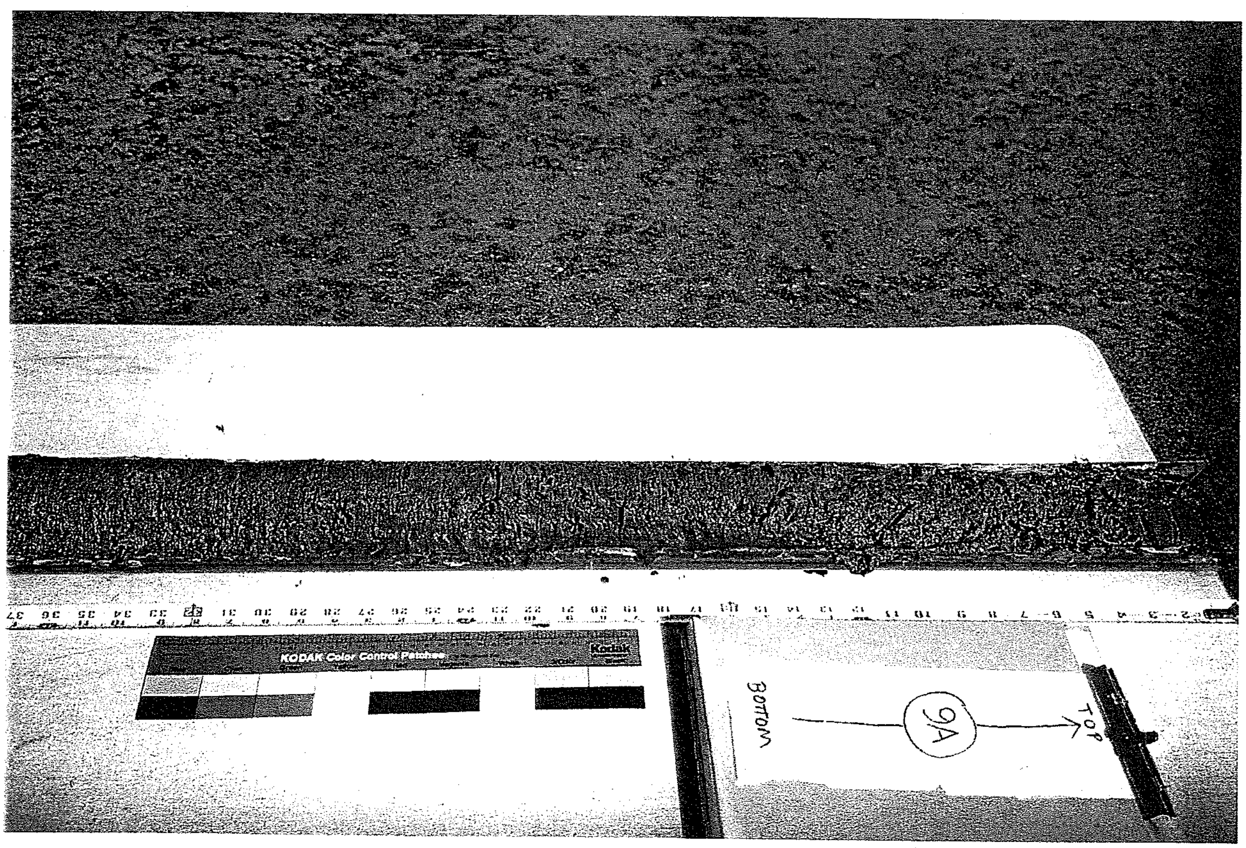
ROLL1DX-24A.JPG 8B Bark layer (image out of focus)



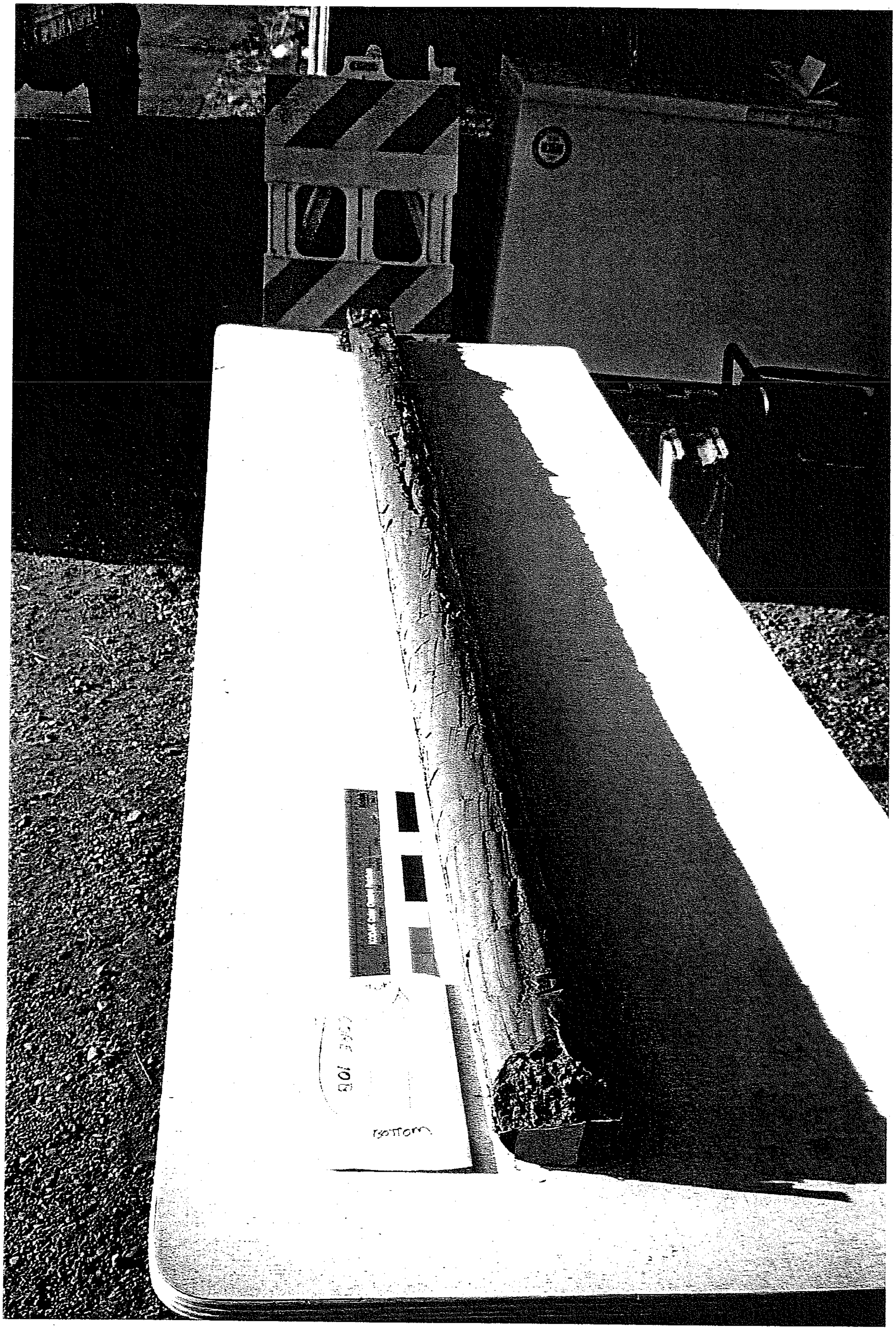
ROLL3DX-11A.JPG 9A Entire core



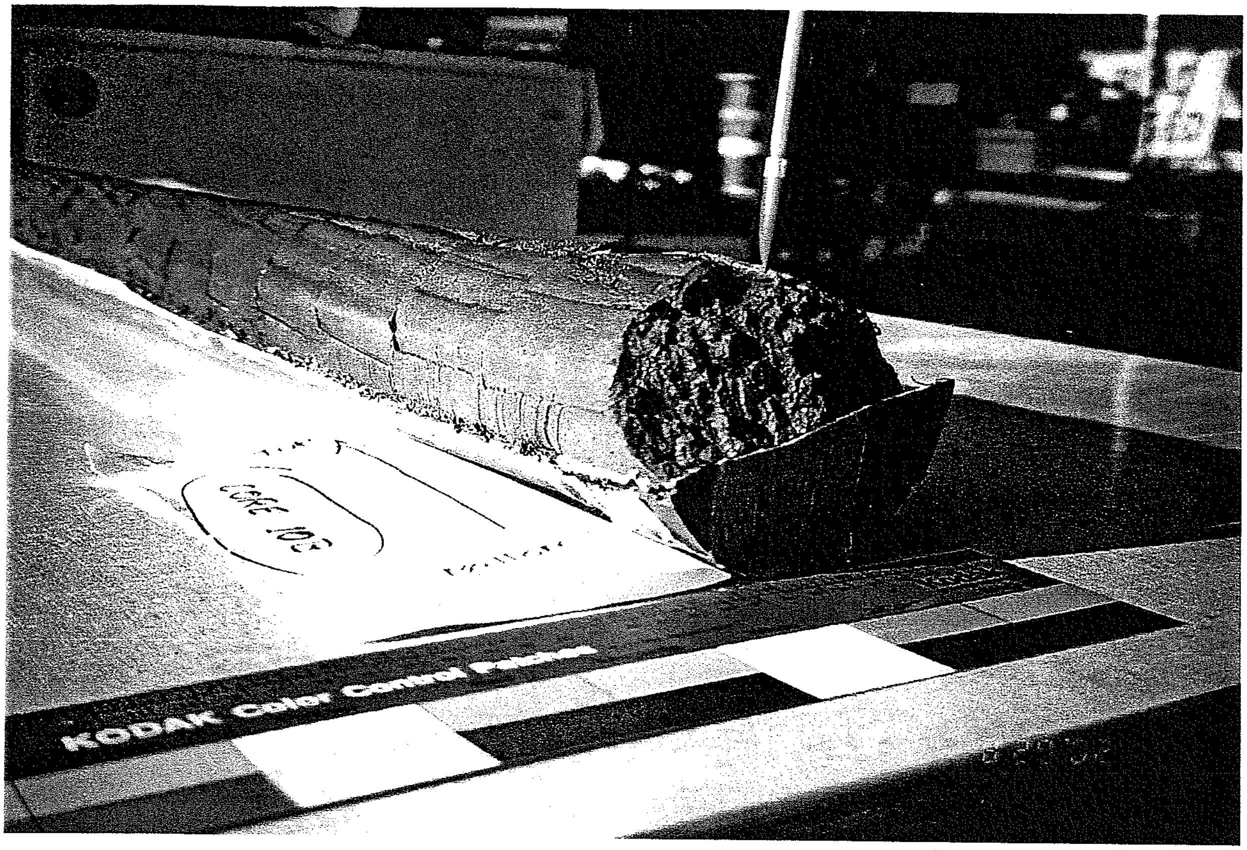
ROLL3DX-14A.JPG 9A Mid



ROLL3DX-15A.JPG 9A Top

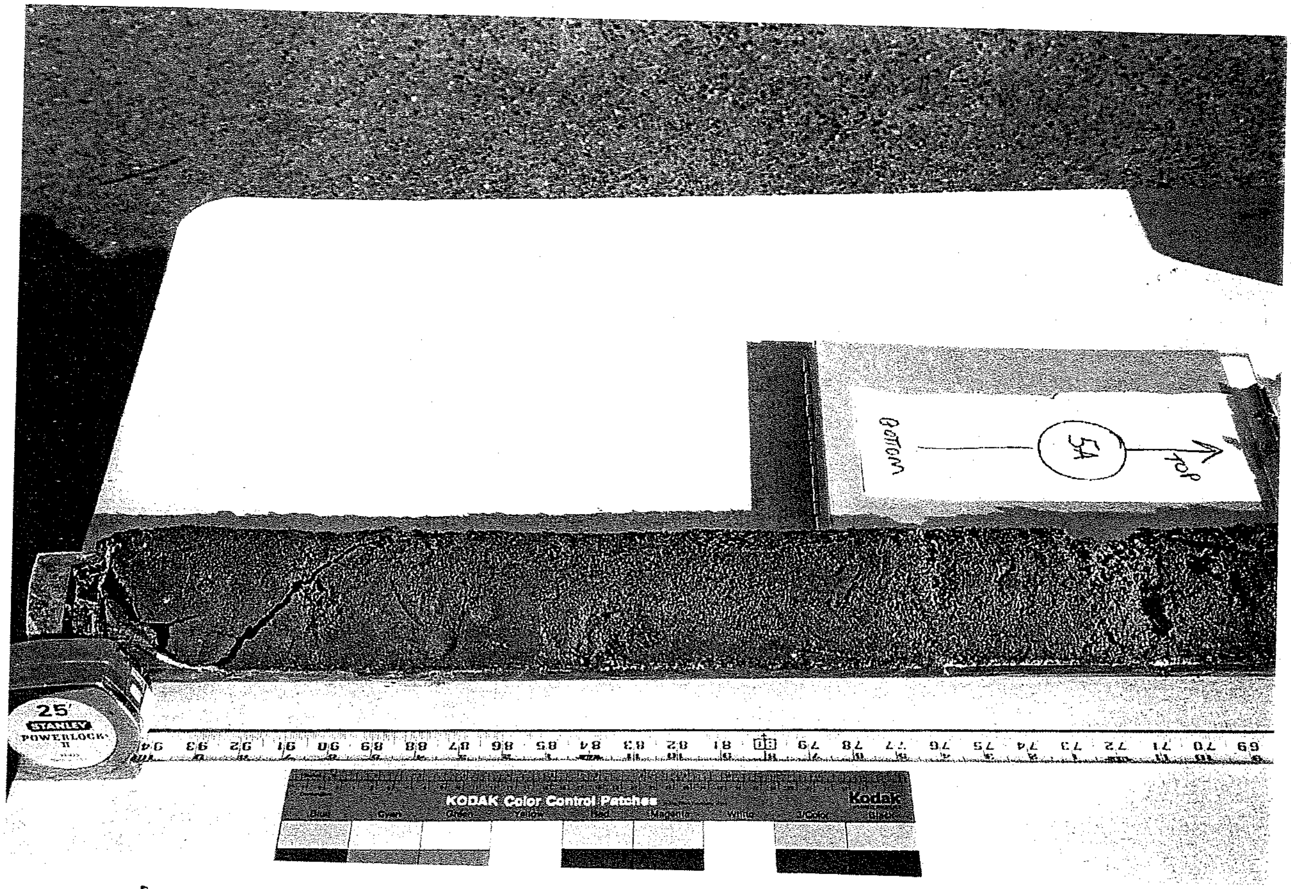


ROLL1DX-13A.JPG 10B Entire core

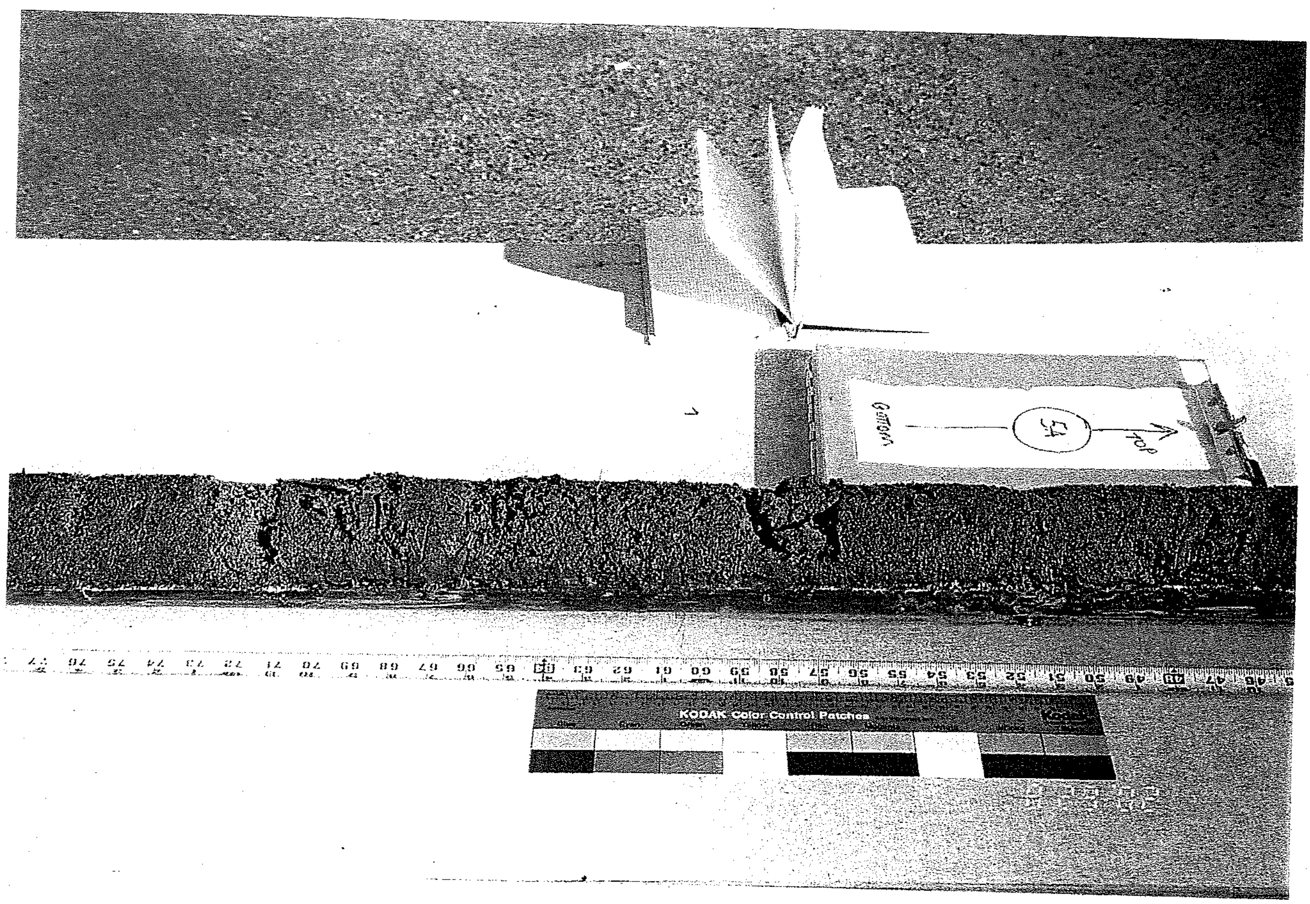


ROLL1DX-14A.JPG 10B Very bottom

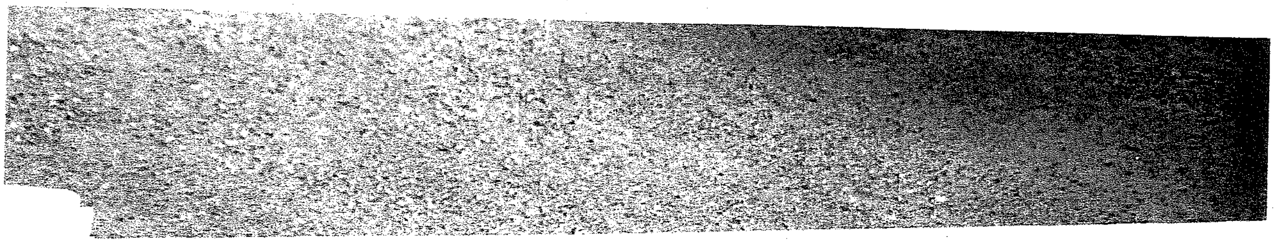
ROLL1DX-15A.JPG 10B Very bottom

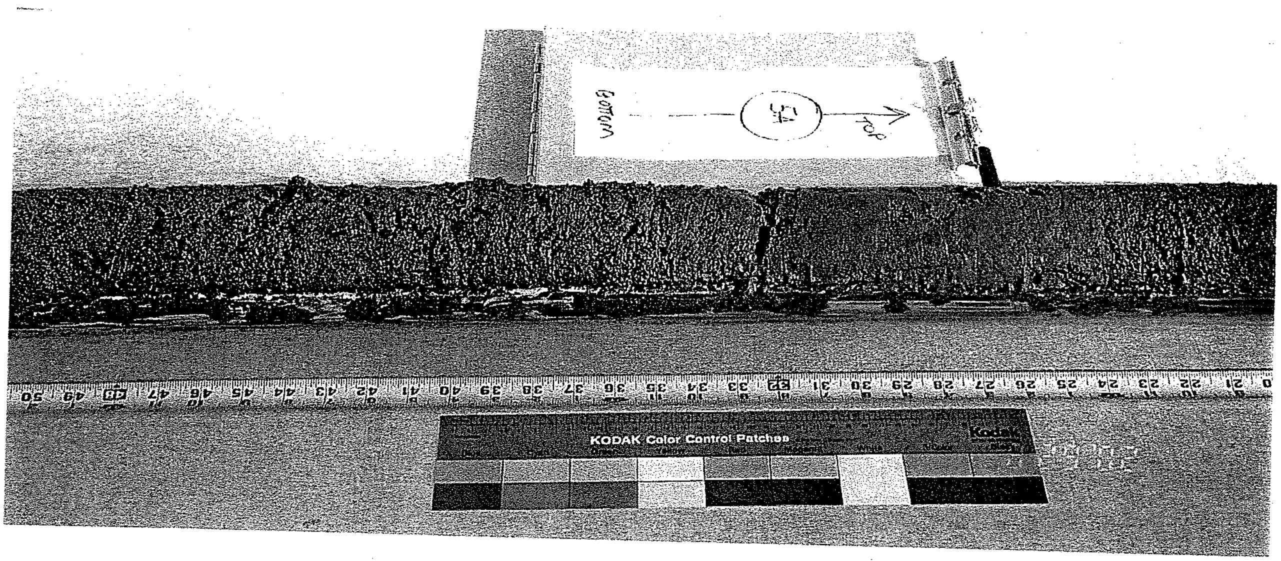


ROLL3DX-17A.JPG 5A Bottom

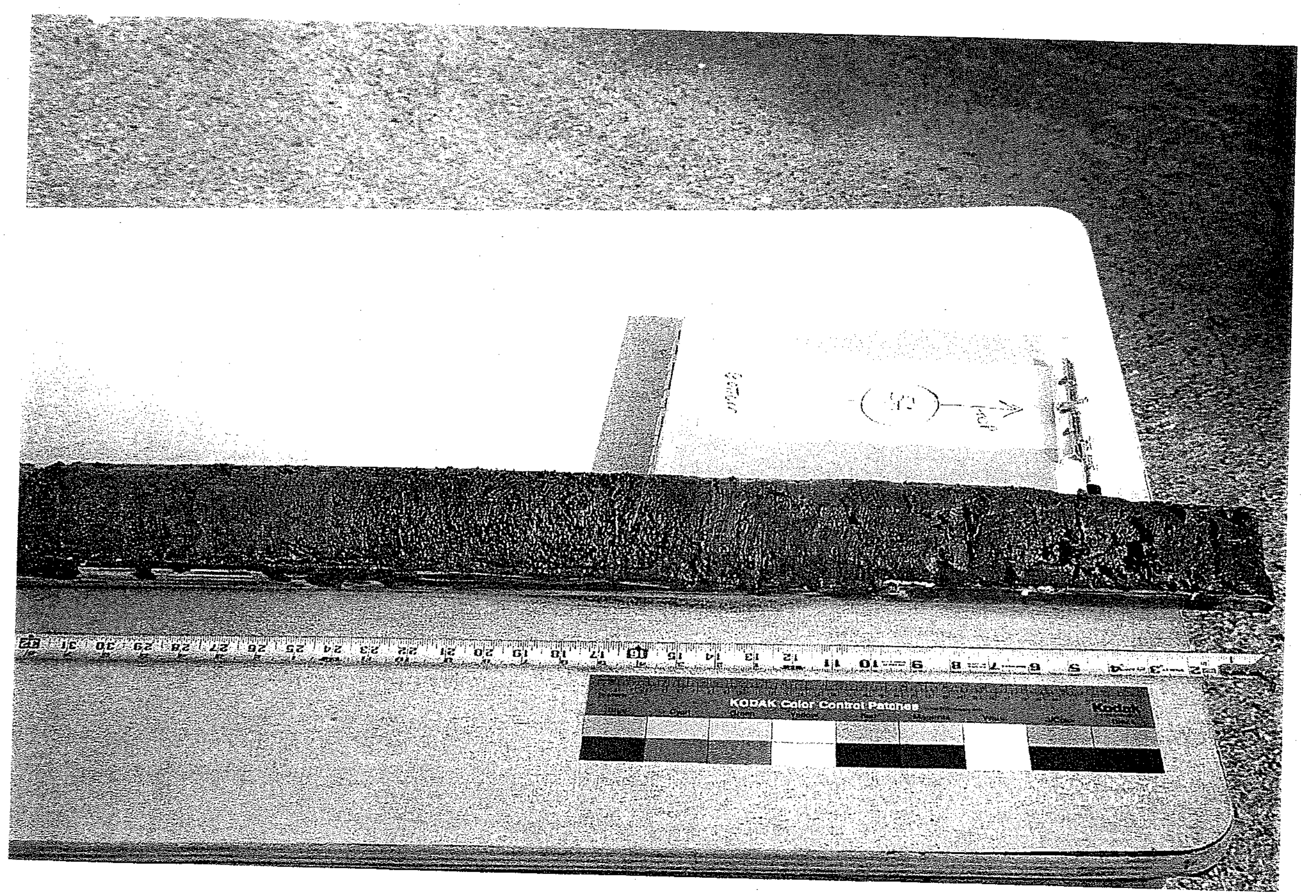


ROLL3DX-18A.JPG 5A Lower mid

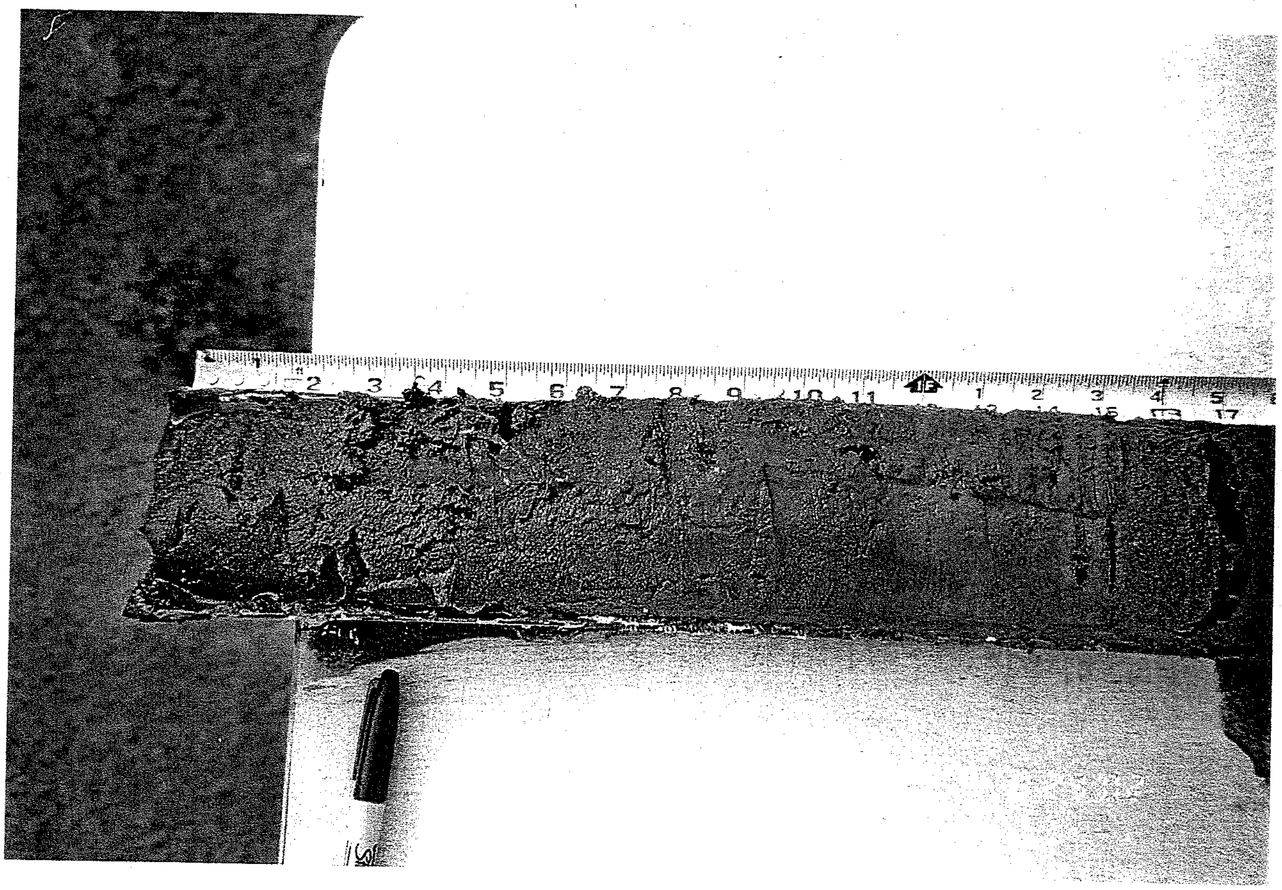




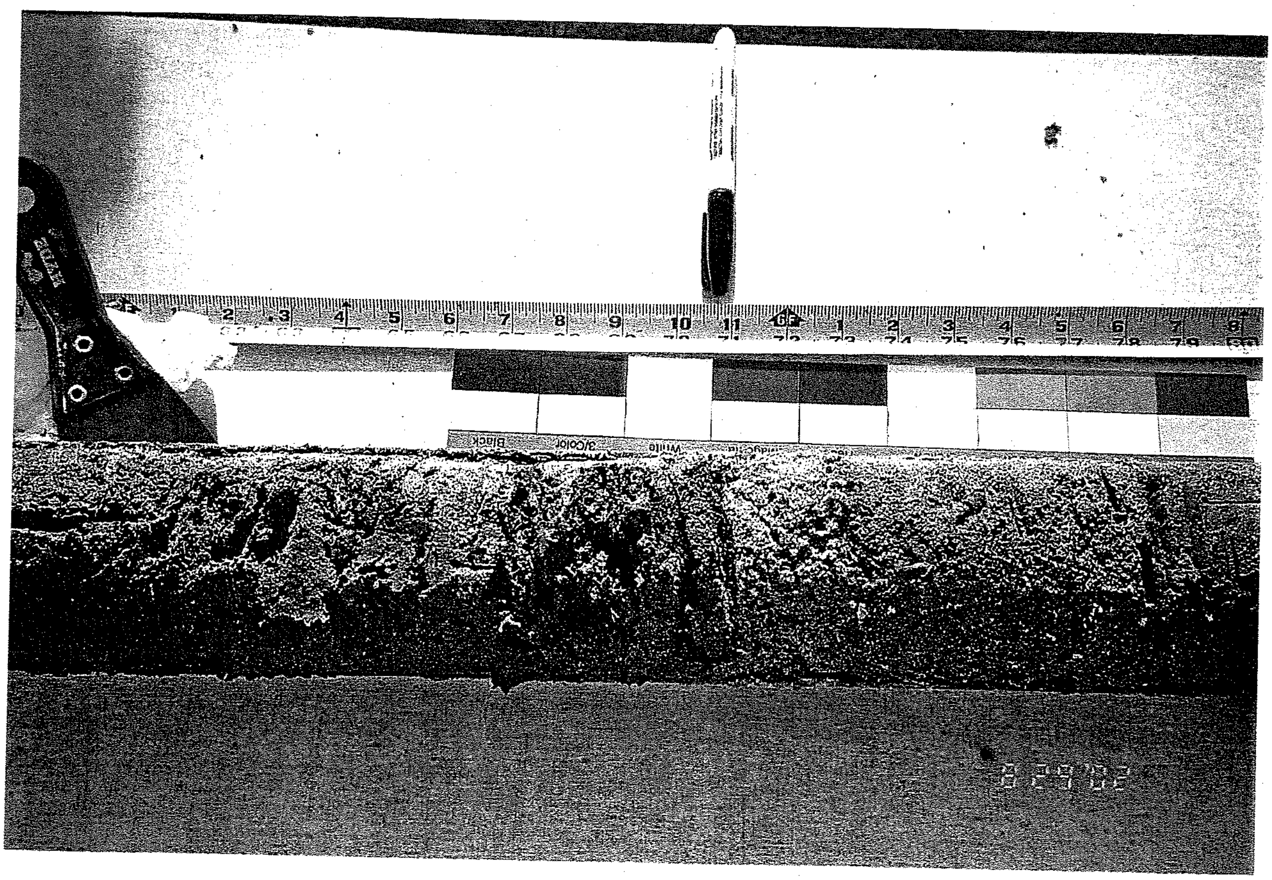
ROLL3DX-19A.JPG 5A Upper mid



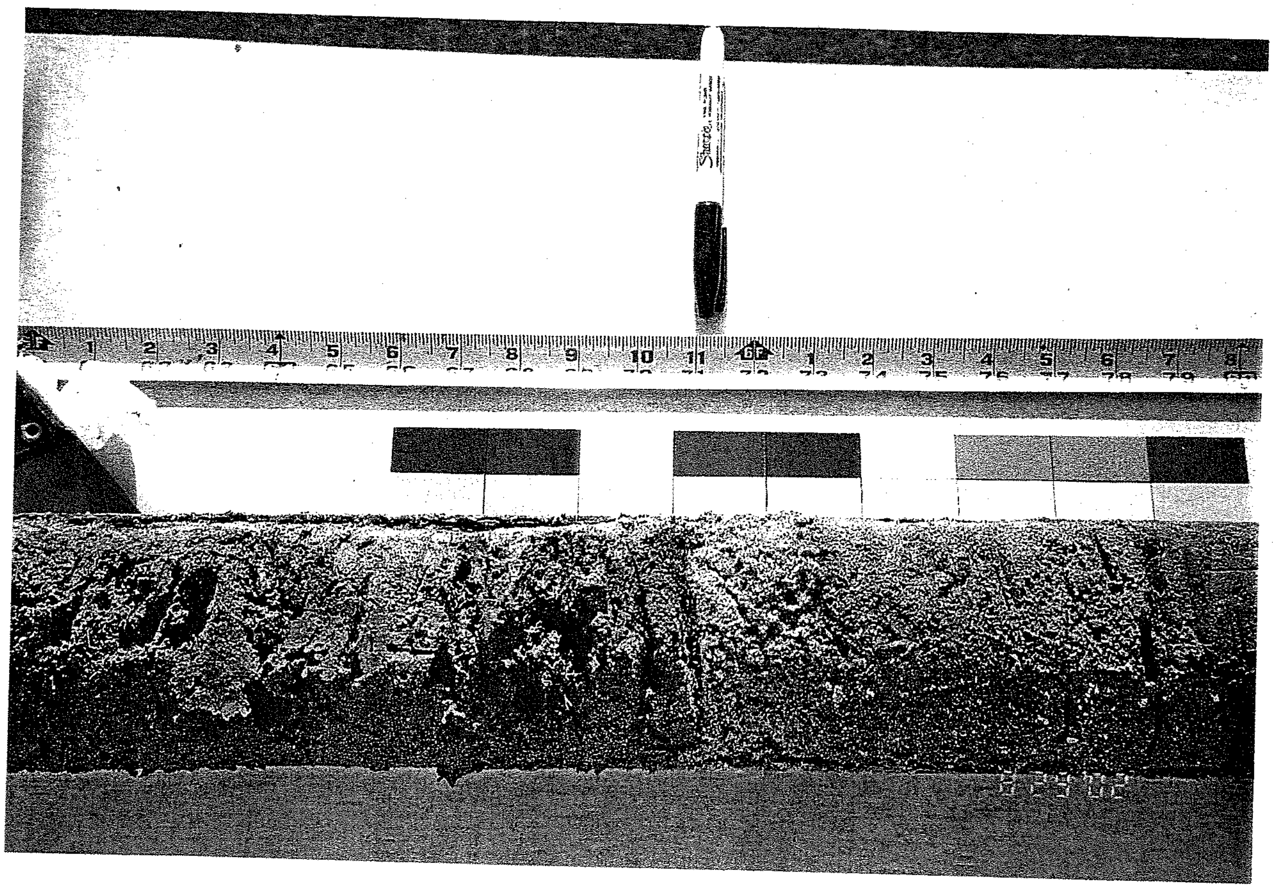
ROLL3DX-20A.JPG 5A Top



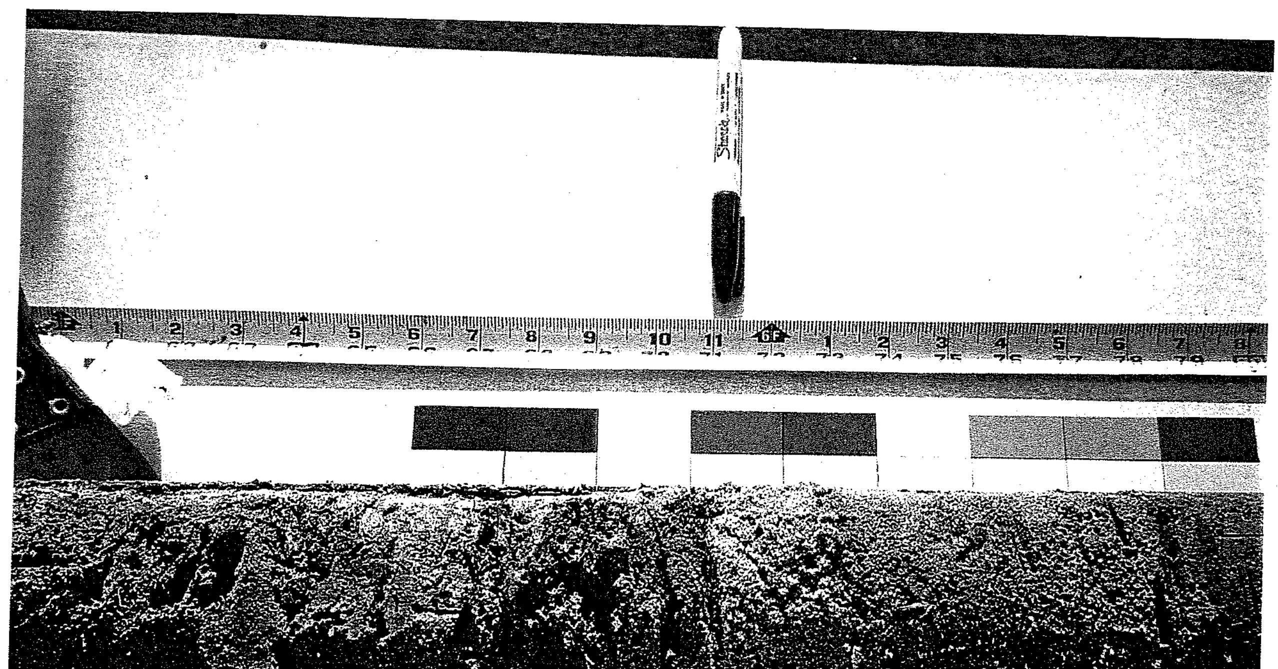
ROLL3DX-21A.JPG 5A Top



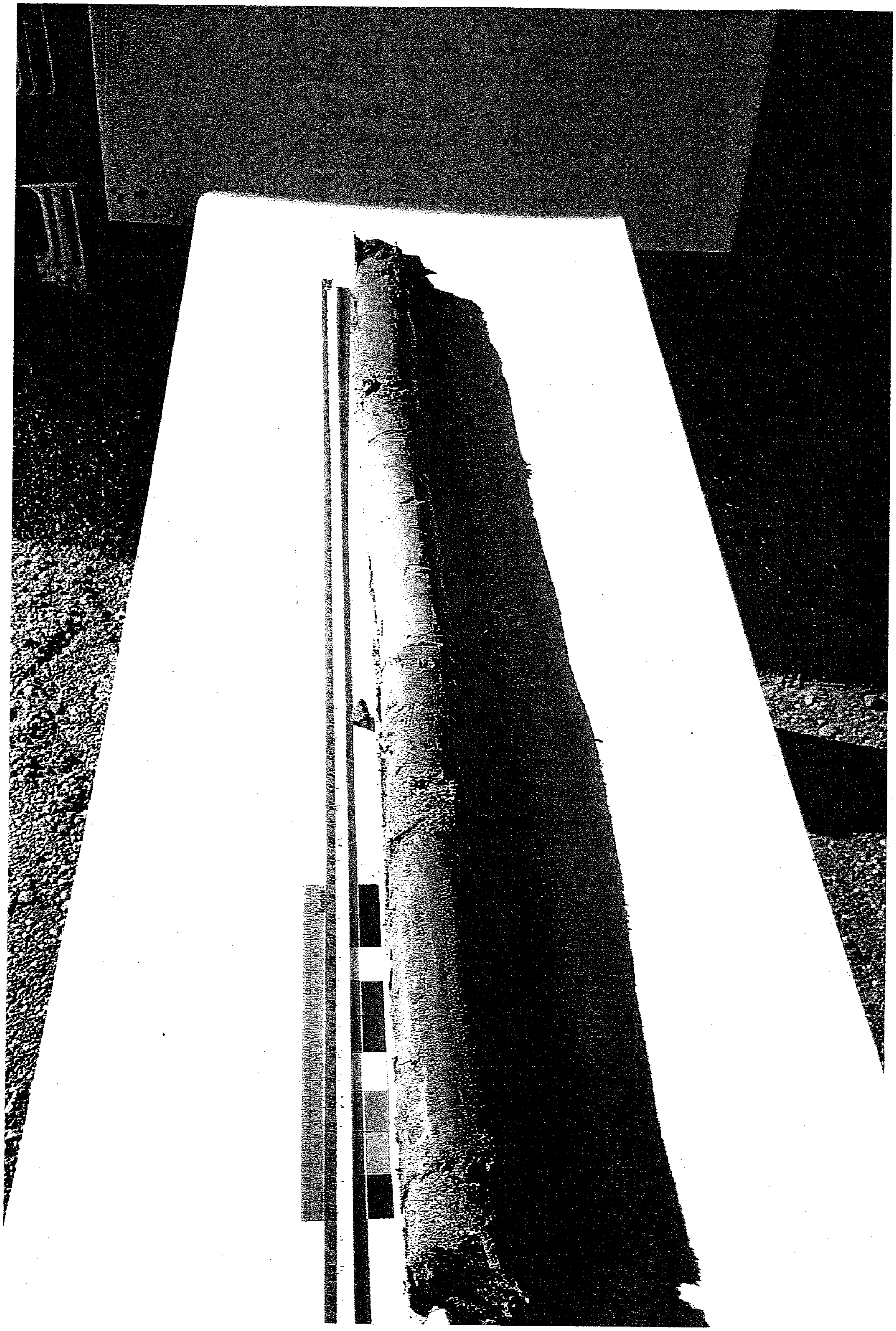
ROLL3DX-22A.JPG 5A Breakpoint at 71 inches



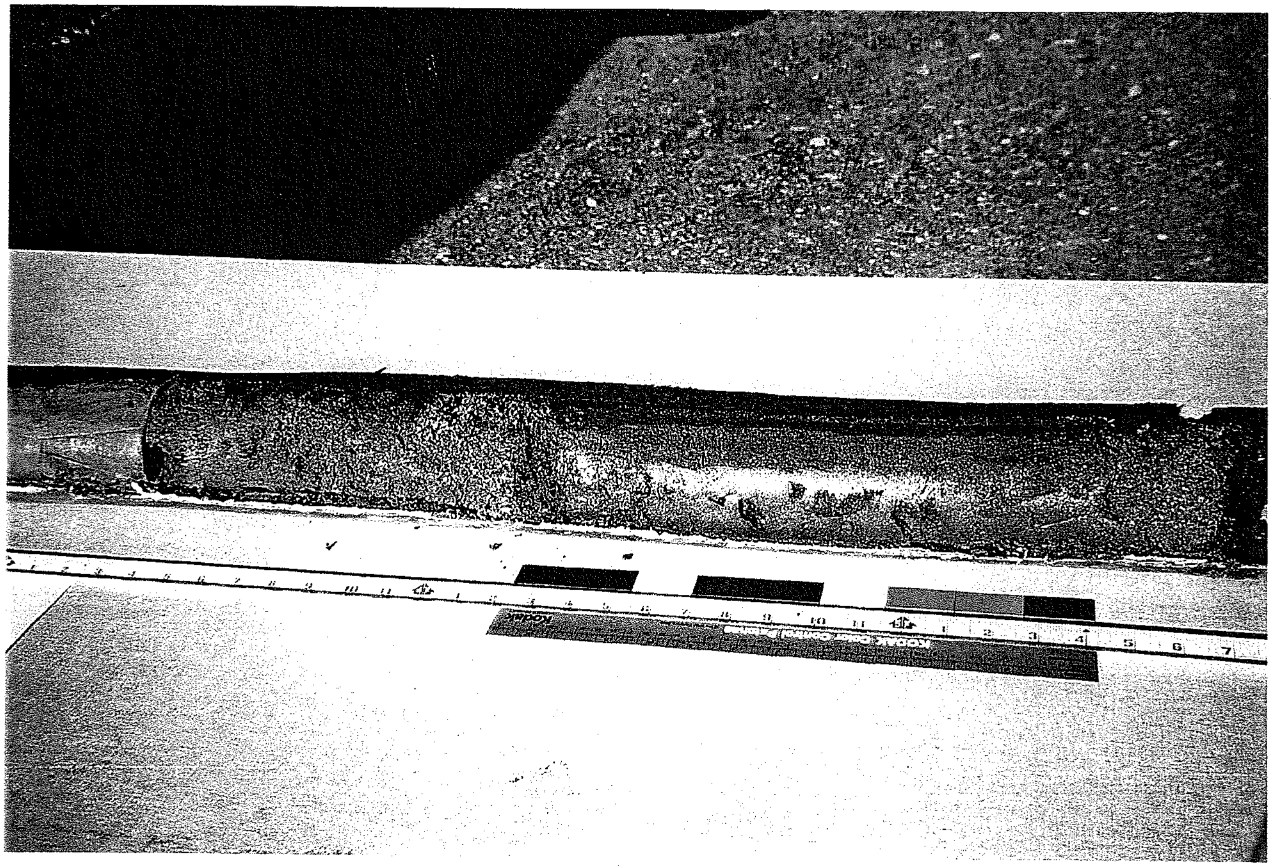
ROLL3DX-23A.JPG 5A Breakpoint at 71 inches



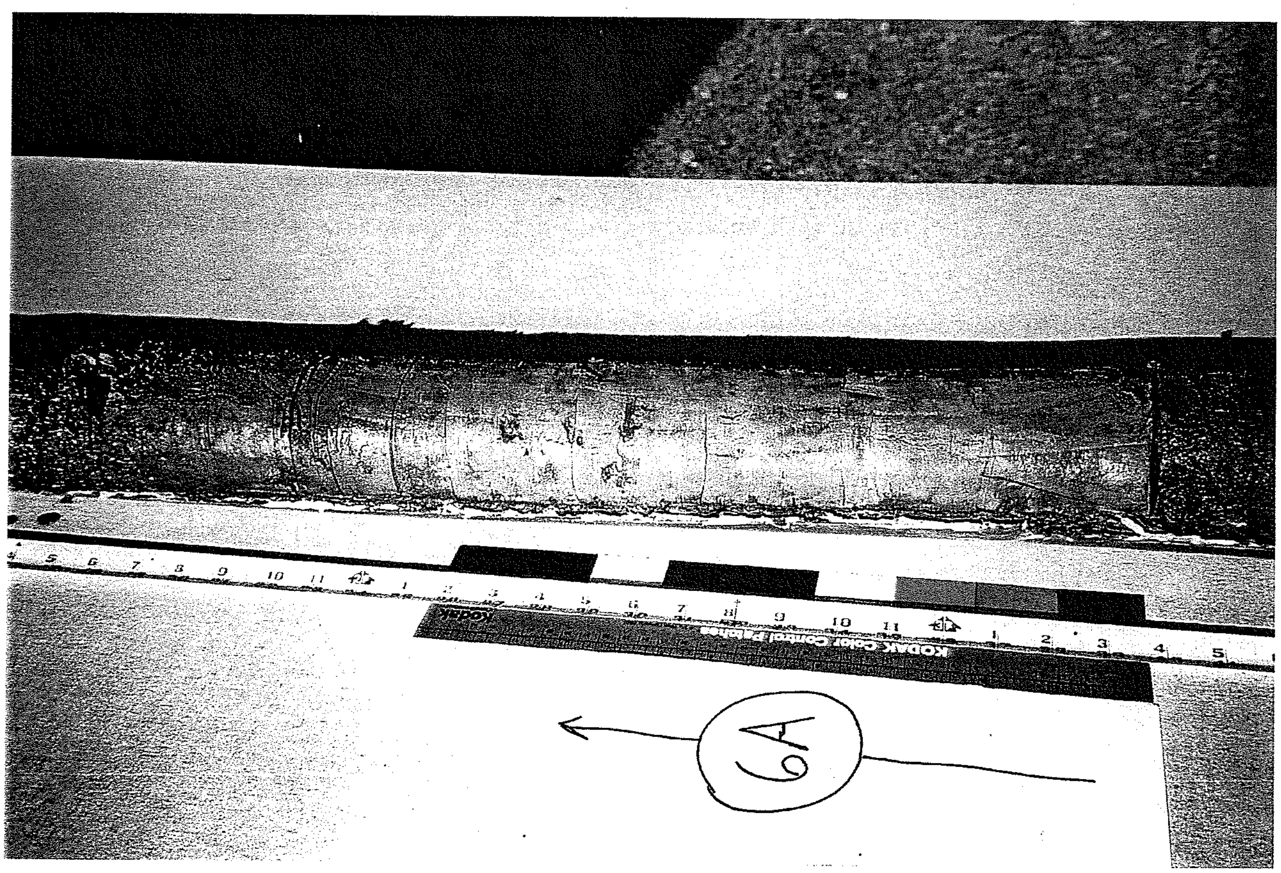
ROLL3DX-24A.JPG 5A Breakpoint at 71 inches



ROLL4DX-04A.JPG 6A Entire core

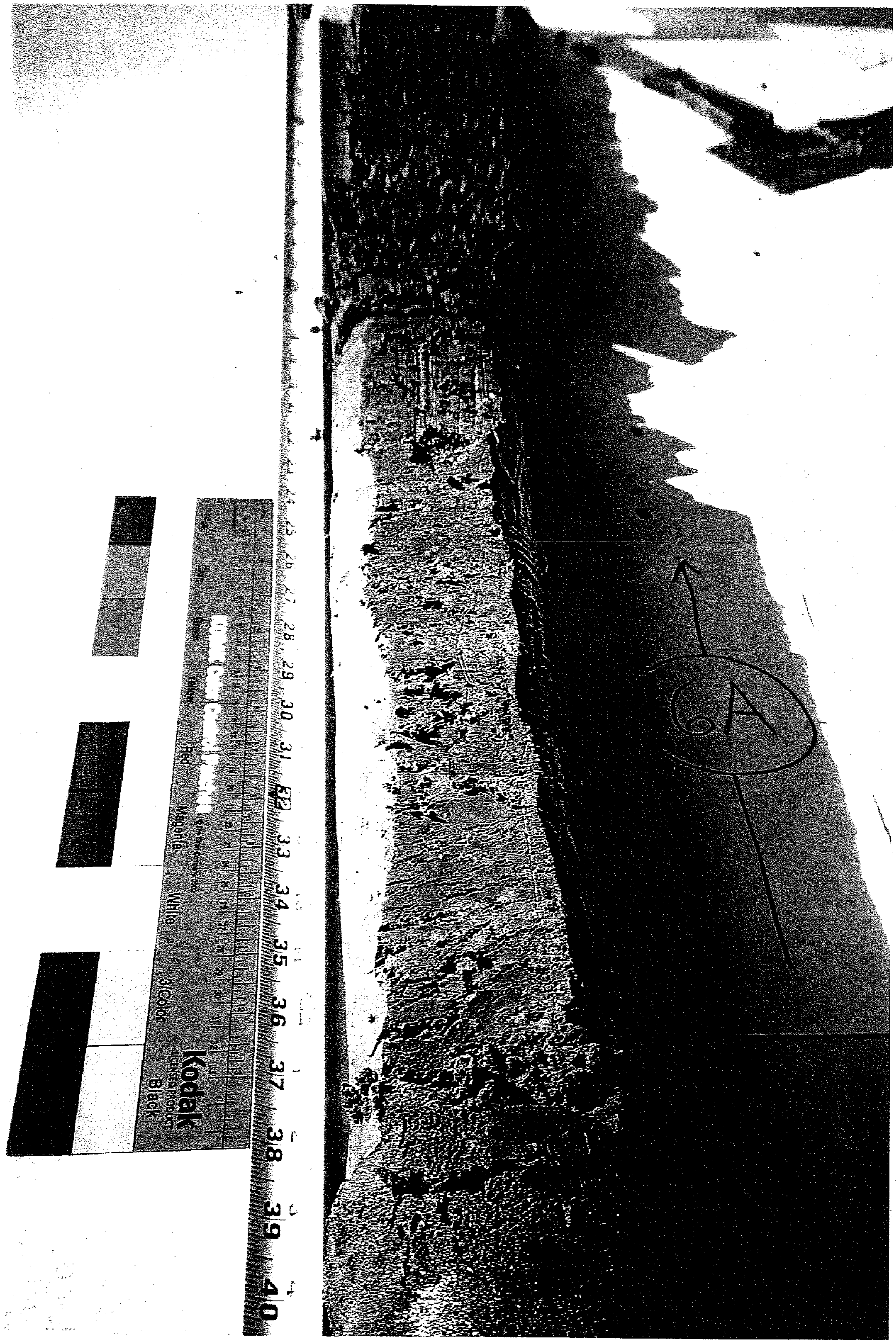


ROLL4DX-05A.JPG 6A Bottom



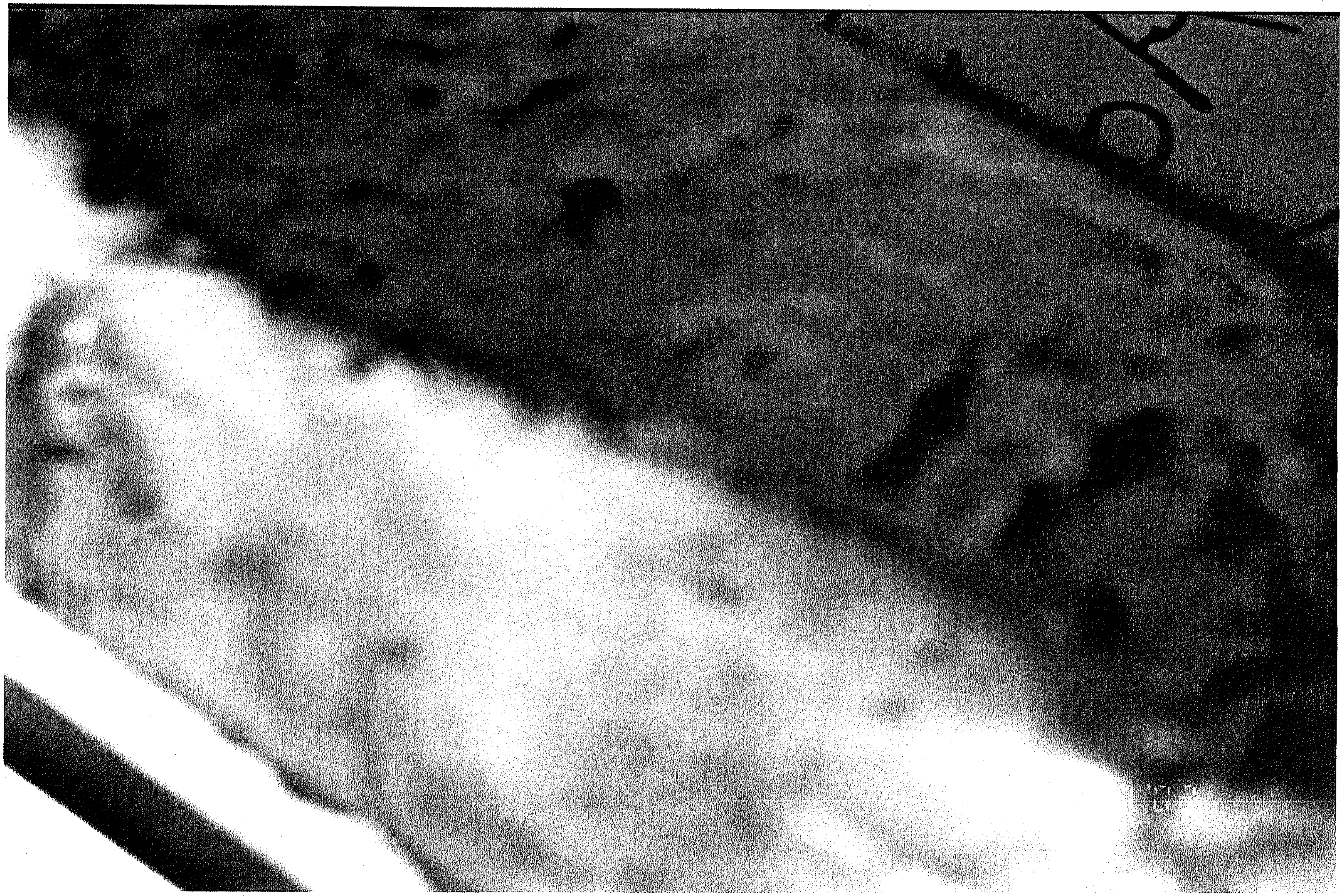
ROLL4DX-06A.JPG 6A Mid

ROLL4DX-07A.JPG 6A Top

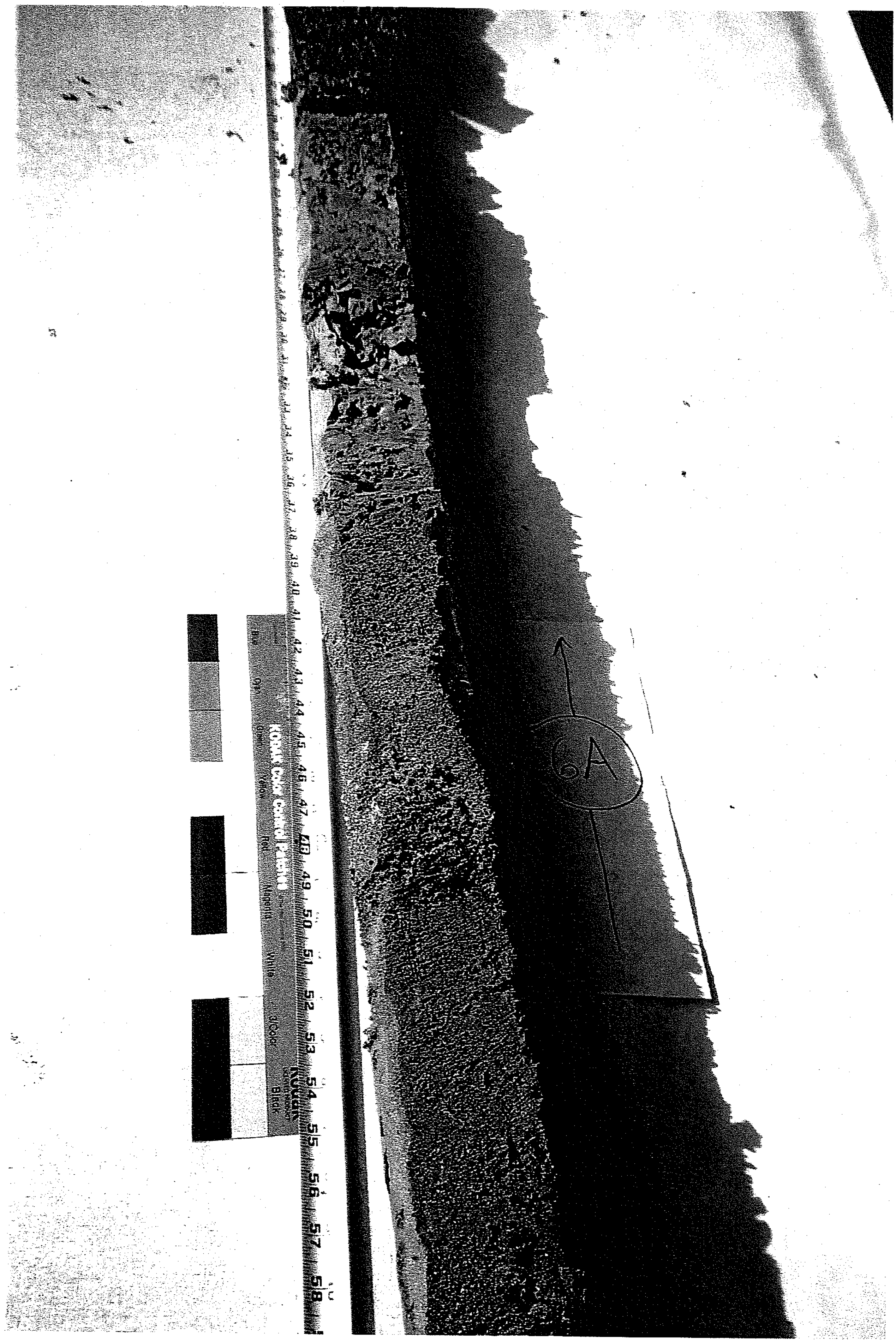


ROLL4DX-08A.JPG 6A 22 to 39.5 inches

ROLL4DX-09A.JPG 6A 22 to 39.5 inches



ROLL4DX-10A.JPG 6A 22 to 39.5 inches



ROLL4DX-11A.JPG 6A Layering within bottom segment

Specific Gravity and Grain Size

ALS Chemex

ALS USA Inc.
Analytical Chemists * Geochemists * Registered Assayers
994 Glendale Ave., Unit 3, Sparks
Nevada, U.S.A. 89431
PHONE: 775-356-5395 FAX: 775-355-0179

To: CH2M HILL

700 CLEARWATER LANE
BOISE, IDAHO
83712

Project : PSD
Comments: Attn: Steve Miller

Certificate Date: 10-FEB-2003
Invoice No. : I0310356
P.O. Number : 173986.A1.20
Account : QRV

CERTIFICATE OF ANALYSIS A0310356

SAMPLE	PREP CODE		Weight grams
05 -35+60	--	--	1.370
05 -60+120	--	--	12.310
05 -120+230	--	--	17.740
05 -230	--	--	123.50
05 Total Weight	--	--	159.50
06 +5	266	--	4.430
06 -5+10	--	--	0.080
06 -10+18	--	--	0.090
06 -18+35	--	--	0.150
06 -35+60	--	--	0.180
06 -60+120	--	--	1.440
06 -120+230	--	--	9.900
06 -230	--	--	244.3
06 Total Weight	--	--	260.6
07 +5	266	--	< 0.001
07 -5+10	--	--	0.050
07 -10+18	--	--	0.090
07 -18+35	--	--	0.110
07 -35+60	--	--	0.180
97 -60+120	--	--	0.880
07 -120+230	--	--	12.770
07 -230	--	--	155.35
07 Total Weight	--	--	169.45
08 +5	266	--	0.020
08 -5+10	--	--	0.160
08 -10+18	--	--	0.240
08 -18+35	--	--	0.890
08 -35+60	--	--	1.200
08 -60+120	--	--	8.590
08 -120+230	--	--	10.760
08 -230	--	--	176.85
08 Total Weight	--	--	198.70
09 +5	266	--	< 0.001
09 -5+10	--	--	0.160
09 -10+18	--	--	0.400
09 -18+35	--	--	0.740
09 -35+60	--	--	1.620
09 -60+120	--	--	1.150
09 -120+230	--	--	5.600
09 -230	--	--	224.3

CERTIFICATION:

ALS Chemex
ALS USA Inc.
Analytical Chemists * Geochemists * Registered Assayers
994 Glendale Ave., Unit 3, Sparks
Nevada, U.S.A. 89431
PHONE: 775-356-5395 FAX: 775-355-0179

To: CH2M HILL

700 CLEARWATER LANE
BOISE, IDAHO
83712

Project : PSD
Comments: Attn: Steve Miller

Certificate Date: 10-FEB-2003
Invoice No. : I0310356
P.O. Number : 173986.A1.20
Account : QRV

CERTIFICATE OF ANALYSIS A0310356

SAMPLE	PREP CODE		Weight grams									
14 -18+35	--	--	0.210									
14 -35+60	--	--	0.440									
14 -60+120	--	--	0.780									
14 -120+230	--	--	2.660									
14 -230	--	--	102.90									
14 Total Weight	--	--	107.30									
15 +5	266	--	0.850									
15 -5+10	--	--	0.570									
15 -10+18	--	--	1.070									
15 -18+35	--	--	1.400									
15 -35+60	--	--	0.680									
15 -60+120	--	--	1.780									
15 -120+230	--	--	0.350									
15 -230	--	--	36.91									
15 Total Weight	--	--	43.61									
16 +5	266	--	0.130									
16 -5+10	--	--	0.100									
16 -10+18	--	--	0.350									
16 -18+35	--	--	2.160									
16 -35+60	--	--	8.380									
16 -60+120	--	--	8.390									
16 -120+230	--	--	5.200									
16 -230	--	--	90.39									
16 Total Weight	--	--	115.10									
17 +5	266	--	2.080									
17 -5+10	--	--	4.290									
17 -10+18	--	--	0.980									
17 -18+35	--	--	10.510									
17 -35+60	--	--	97.99									
17 -60+120	--	--	55.13									
17 -120+230	--	--	16.000									
17 -230	--	--	64.37									
17 Total Weight	--	--	251.3									
18 +5	266	--	< 0.001									
18 -5+10	--	--	1.470									
18 -10+18	--	--	9.560									
18 -18+35	--	--	37.20									
18 -35+60	--	--	28.15									
18 -60+120	--	--	21.28									
18 -120+230	--	--	11.030									

CERTIFICATION: ____________

ALS Chemex

ALS USA Inc.
Analytical Chemists * Geochemists * Registered Assayers
994 Glendale Ave., Unit 3, Sparks
Nevada, U.S.A. 89431
PHONE: 775-356-5395 FAX: 775-355-0179

To: CH2M HILL

700 CLEARWATER LANE
BOISE, IDAHO
83712

Project : PSD
Comments: Attn: Steve Miller

Certificate Date: 10-FEB-2003
Invoice No. : I0310356
P.O. Number : 173986.A1.20
Account : QRV

CERTIFICATE OF ANALYSIS A0310356

SAMPLE	PREP CODE		Weight grams									
23 -10+18	--	--	141.40									
23 -18+35	--	--	164.95									
23 -35+60	--	--	111.00									
23 -60+120	--	--	25.53									
23 -120+230	--	--	3.150									
23 -230	--	--	6.200									
23 Total Weight	--	--	556.0									
24 +5	266	--	8.690									
24 -5+10	--	--	38.01									
24 -10+18	--	--	100.25									
24 -18+35	--	--	175.25									
24 -35+60	--	--	172.75									
24 -60+120	--	--	27.21									
24 -120+230	--	--	10.520									
24 -230	--	--	28.20									
24 Total Weight	--	--	560.9									
25 +5	266	--	1.720									
25 -5+10	--	--	0.430									
25 -10+18	--	--	0.520									
25 -18+35	--	--	0.390									
25 -35+60	--	--	3.840									
25 -60+120	--	--	21.89									
25 -120+230	--	--	17.780									
25 -230	--	--	125.85									
25 Total Weight	--	--	172.40									
26 +5	266	--	6.090									
26 -5+10	--	--	2.460									
26 -10+18	--	--	1.110									
26 -18+35	--	--	0.810									
26 -35+60	--	--	1.240									
26 -60+120	--	--	2.430									
26 -120+230	--	--	2.070									
26 -230	--	--	222.3									
26 Total Weight	--	--	238.5									
27 +5	266	--	0.380									
27 -5+10	--	--	0.840									
27 -10+18	--	--	0.150									
27 -18+35	--	--	0.130									
27 -35+60	--	--	0.110									
27 -60+120	--	--	0.180									

CERTIFICATION: ____________

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To: CH2M HILL
700 CLEARWATER LANE
BOISE, IDAHO
83712

Project : PSD
Comments: Attn: Steve Miller

Certificate Date: 10-FEB-2003
Invoice No. : I0310356
P.O. Number : 173986.A1.20
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CERTIFICATE OF ANALYSIS A0310356

SAMPLE	PREP CODE		Weight grams									
32 -5+10	--	--	0.020									
32 -10+18	--	--	0.050									
32 -18+35	--	--	0.080									
32 -35+60	--	--	0.060									
32 -60+120	--	--	0.090									
32 -120+230	--	--	0.310									
32 -230	--	--	83.17									
32 Total Weight	--	--	83.78									

CERTIFICATION: ________

ALS Chemex
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Sparks Nevada 89431-5730 USA
Phone: 775 356 5395 Fax: 775 355 0179

): CH2M HILL
700 CLEARWATER LANE
BOISE ID 83712-7708

Date : 26-Sep-2003
Account: QRV

Project : Mica Bay - PSD

CERTIFICATE OF ANALYSIS RE03028052

Sample Description	Method Analyte Units LOR	CLA-GRA01 Clay % 0.01	CLA-GRA01 Silt % 0.01
01 -230		30.0	69.6
02 -230		22.5	76.6
03 -230		55.2	44.5
04 -230		71.6	27.9
05 -230		26.5	73.2
06 -230		28.5	71.4
07 -230		36.1	63.8
08 -230		50.5	49.4
09 -230		68.8	30.9
10 -230		30.4	69.0
11 -230		44.5	55.2
12 -230		55.8	43.9
13 -230		73.7	26.2
14 -230		34.2	65.5
15 -230		51.2	48.3
16 -230		33.0	63.9
17 -230		30.3	64.2
18 -230		29.3	68.2
19 -230		24.4	65.0
20 -230		26.6	66.9
21 -230		58.5	40.8
22 -230		23.4	61.2
23 -230		NSS	NSS
24 -230		19.70	68.1
25 -230		25.6	66.4
26 -230		64.2	34.9
27 -230		61.3	38.3
28 -230		57.2	41.5
29 -230		36.8	58.2
30 -230		54.0	45.3
31 -230		51.9	47.8
32 -230		51.8	47.8

Comments: NSS is non-sufficient sample.

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Sparks Nevada 89431-5730 USA
Phone: 775 356 5395 Fax: 775 355 0179

): CH2M HILL
700 CLEARWATER LANE
BOISE ID 83712-7708

Date : 7-Apr-2003
Account: QRV

Project : Mica Bay Watershed

CERTIFICATE OF ANALYSIS RE03005631

Sample Description	Method / Analyte / Units / LOR	WEI-21 Recvd Wt kg 0.02	SCR-51 WT.+4mm g 0.1	SCR-51 WT.+2mm g 0.1	SCR-51 WT.+1mm g 0.1	SCR-51 WT.+500u g 0.1	SCR-51 WT.+250u g 0.1	SCR-51 WT.+125u g 0.1	SCR-51 WT.+63um g 0.1	SCR-51 WT.-63um g 0.1	SCR-51 WT. All g 0.1
L1			3.9	28.5	53.6	61.9	67.9	169.6	150.9	419.8	956.1
L2			47.1	100.7	84.1	79.2	87.7	77.3	70.1	301.5	847.7
A1			31.7	89.6	64.5	48.4	36.0	38.1	46.9	129.7	484.9
A2			10.1	9.5	23.0	25.0	32.4	37.6	61.5	231.3	430.4
P1			16.5	29.4	43.8	61.5	70.3	79.0	115.3	447.3	863.1
P2			46.0	66.9	111.7	110.8	86.8	56.8	71.1	294.0	844.1
SU1			14.0	16.3	114.6	47.6	29.7	8.6	3.5	2.9	237.2
SU2			19.6	7.8	15.5	204.4	61.8	15.2	5.9	3.0	333.2
SP1			<0.1	8.1	275.7	125.8	45.8	7.7	2.4	3.2	468.7
SP2			28.8	170.5	64.0	56.4	31.6	19.8	9.4	8.9	389.4
SP3			73.2	192.1	170.6	93.3	40.4	9.3	3.3	2.6	584.8
SP4			77.7	187.9	204.3	80.8	50.5	10.5	3.2	3.6	618.5
N1			<0.1	<0.1	3.7	139.1	107.6	14.8	5.7	5.1	276.0
N2			65.5	19.3	510.4	137.5	51.1	6.6	2.5	2.6	795.5
M1			242.4	27.0	31.0	28.6	12.6	2.3	0.8	1.9	346.6
M2			14.0	52.1	118.1	94.4	22.4	3.7	0.9	1.8	307.4

Inorganic Elements

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PHONE: 775-356-5395 FAX: 775-355-0179

To: CH2M HILL

700 CLEARWATER LANE
BOISE, IDAHO
83712

Comments: ATTN: STEVE MILLER

CERTIFICATE A0310044

(QRV) - CH2M HILL

Project:
P.O. # : 173986.A1.20

Samples submitted to our lab in Vancouver, BC
This report was printed on 17-JAN-2003.

SAMPLE PREPARATION

METHOD CODE	NUMBER SAMPLES	DESCRIPTION
PREP-41	32	Dry, sieve to -80 mesh
202	32	save reject
DRY-21	32	Drying charge (0-3 Kg)

ANALYTICAL PROCEDURES 1 of 2

METHOD CODE	NUMBER SAMPLES	DESCRIPTION	METHOD	DETECTION LIMIT	UPPER LIMIT
Al-XRF06	32	Al2O3 %: XRF	XRF	0.01	100.00
Ba-XRF06	32	BaO %: XRF	XRF	0.01	100.00
Ca-XRF06	32	CaO %: XRF	XRF	0.01	100.00
Cr-XRF06	32	Cr2O3 %: XRF	XRF	0.01	100.00
Fe-XRF06	32	Fe2O3 %: XRF	XRF	0.01	100.00
K-XRF06	32	K2O %: XRF	XRF	0.01	100.00
Mg-XRF06	32	MgO %: XRF	XRF	0.01	100.00
Mn-XRF06	32	MnO %: XRF	XRF	0.01	100.00
Na-XRF06	32	Na2O %: XRF	XRF	0.01	100.00
P-XRF06	32	P2O5 %: XRF	XRF	0.01	100.00
Si-XRF06	32	SiO2 %: XRF	XRF	0.01	100.00
Sr-XRF06	32	SrO %: XRF	XRF	0.01	100.00
Ti-XRF06	32	TiO2 %: XRF	XRF	0.01	100.00
OA-XRF06	32	LOI %: XRF	XRF	0.01	100.00
OA-XRF06	32	Total %	CALCULATION	0.01	105.00
Ag-MS61	32	Ag ppm: ICP + ICP-MS package	ICP-MS/ICP	0.02	100.0
Al-MS61	32	Al %: ICP + ICP-MS package	ICP	0.01	25.0
As-MS61	32	As ppm: ICP + ICP-MS package	ICP-MS/ICP	0.2	10000
Ba-MS61	32	Ba ppm: ICP + ICP-MS package	ICP	0.5	10000
Be-MS61	32	Be ppm: ICP + ICP-MS package	ICP-MS/ICP	0.05	1000
Bi-MS61	32	Bi ppm: ICP + ICP-MS package	ICP-MS/ICP	0.01	10000
Ca-MS61	32	Ca %: ICP + ICP-MS package	ICP	0.01	25.0
Cd-MS61	32	Cd ppm: ICP + ICP-MS package	ICP-MS/ICP	0.02	500
Ce-MS61	32	Ce ppm: ICP + ICP-MS package	ICP-MS	0.01	500
Co-MS61	32	Co ppm: ICP + ICP-MS package	ICP-MS/ICP	0.1	10000
Cr-MS61	32	Cr ppm: ICP + ICP-MS package	ICP	1	10000
Cs-MS61	32	Cs ppm: ICP + ICP-MS package	ICP-MS	0.05	500
Cu-MS61	32	Cu ppm: ICP + ICP-MS package	ICP	0.2	10000
Fe-MS61	32	Fe %: ICP + ICP-MS package	ICP	0.01	25.0
Ga-MS61	32	Ga ppm: ICP + ICP-MS package	ICP-MS	0.05	500.0
Ge-MS61	32	Ge ppm: ICP + ICP-MS package	ICP-MS	0.05	500.0
Hf-MS61	32	Hf ppm: ICP + ICP-MS package	ICP-MS/ICP	0.1	500
In-MS61	32	In ppm: ICP + ICP-MS package	ICP-MS/ICP	0.005	500
K-MS61	32	K %: ICP + ICP-MS package	ICP	0.01	10.00
La-MS61	32	La ppm: ICP + ICP-MS package	ICP-MS	0.5	500
Li-MS61	32	Li ppm: ICP + ICP-MS package	ICP-MS	0.2	500
Mg-MS61	32	Mg %: ICP + ICP-MS package	ICP	0.01	15.00

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To: CH2M HILL

700 CLEARWATER LANE
BOISE, IDAHO
83712

Project :
Comments: ATTN: STEVE MILLER

Page Number : 1-A
Total Pages : 1
Certificate Date: 17-JAN-2003
Invoice No. : I0310044
P.O. Number : 173986.A1.20
Account : QRV

CERTIFICATE OF ANALYSIS A0310044

SAMPLE	PREP CODE		Al2O3 % XRF	BaO % XRF	CaO % XRF	Cr2O3 % XRF	Fe2O3 % XRF	K2O % XRF	MgO % XRF	MnO % XRF	Na2O % XRF	P2O5 % XRF	SiO2 % XRF	SrO % XRF	TiO2 % XRF	LOI % XRF
1B 0-10	201	202	13.83	0.08	2.08	< 0.01	5.03	2.12	1.53	0.06	2.11	0.17	63.14	0.03	0.81	8.82
1B 10-18	201	202	14.39	0.08	3.38	0.03	5.02	2.36	1.79	0.07	2.86	0.15	64.98	0.03	0.76	3.70
1B 18-58.5	201	202	12.66	0.04	0.81	< 0.01	4.19	1.29	0.84	0.02	0.98	0.13	67.05	< 0.01	0.68	11.10
1B 58.5-BOTTOM	201	202	16.27	0.10	3.76	< 0.01	5.43	2.77	2.10	0.07	2.85	0.10	61.81	0.03	0.67	4.00
2A 0-12.5	201	202	14.46	0.08	1.65	< 0.01	5.15	2.22	1.49	0.06	1.99	0.16	62.40	0.03	0.87	9.22
2A 12.5-33.5	201	202	13.98	0.06	1.12	< 0.01	4.87	1.88	1.30	0.04	1.64	0.11	66.17	0.03	0.88	7.57
2A 33.5-56	201	202	13.99	0.07	1.35	< 0.01	4.65	2.03	1.38	0.04	1.93	0.09	67.23	0.03	0.87	6.30
3 REDO B 0-16	201	202	14.28	0.06	1.23	< 0.01	4.77	1.64	1.21	0.04	1.42	0.13	64.05	0.02	0.82	10.10
3 REDO B 16-34	201	202	12.43	0.06	0.79	< 0.01	4.25	0.85	0.75	0.01	0.62	0.14	67.02	0.03	0.62	12.31
3 REDO B 34-75	201	202	14.27	0.08	2.62	< 0.01	4.72	2.13	1.74	0.05	2.38	0.12	63.44	0.06	0.89	6.36
4A TOP	201	202	13.89	0.07	1.39	< 0.01	4.97	2.20	1.41	0.06	1.86	0.12	62.56	0.02	0.86	9.75
4A MID SECT	201	202	8.98	0.03	0.56	< 0.01	2.50	0.69	0.41	< 0.01	0.47	0.22	46.96	< 0.01	0.43	38.69
4A BOTTOM	201	202	7.80	0.04	0.51	< 0.01	2.70	0.72	0.56	0.01	0.37	0.08	67.78	0.01	0.38	19.02
5A 0-16	201	202	14.18	0.08	1.34	< 0.01	4.67	2.10	1.35	0.05	1.87	0.11	63.40	0.03	0.85	9.82
5A 16-23	201	202	10.38	0.05	0.69	< 0.01	2.94	0.84	0.50	0.07	0.52	0.37	45.30	0.02	0.51	37.38
5A 23-34.5	201	202	14.73	0.07	1.30	< 0.01	3.88	1.70	1.15	0.04	1.61	0.18	62.20	0.05	0.86	12.08
5A 34.5-71	201	202	14.22	0.08	2.97	< 0.01	4.92	2.02	1.91	0.06	2.35	0.11	62.65	0.05	0.97	7.67
5A 71-77	201	202	14.67	0.08	2.90	< 0.01	5.01	2.05	1.88	0.06	2.50	0.12	63.50	0.03	0.89	6.15
5A 77-BOTTOM	201	202	13.89	0.08	2.88	< 0.01	4.69	2.12	1.88	0.06	2.48	0.11	65.70	0.06	0.91	4.88
6A 0-22	201	202	13.77	0.08	1.92	< 0.01	4.72	2.09	1.45	0.06	2.05	0.15	63.51	0.05	0.85	8.97
6A 22-39.5	201	202	12.23	0.03	0.57	< 0.01	3.66	0.98	0.63	0.01	0.69	0.13	68.25	0.01	0.61	12.04
6A 39.5-67.5	201	202	14.01	0.07	3.29	< 0.01	5.00	2.03	2.06	0.07	2.58	0.12	64.01	0.04	0.93	5.63
7B 0-29	201	202	14.19	0.09	4.15	0.01	5.76	2.63	2.19	0.09	2.96	0.19	64.51	0.05	0.92	2.10
7B 29-35	201	202	14.48	0.10	3.15	< 0.01	5.02	2.63	1.65	0.06	2.77	0.15	65.05	0.05	0.71	4.00
8B TOP 11	201	202	14.11	0.07	2.10	< 0.01	4.94	2.18	1.61	0.06	2.24	0.14	63.52	0.06	0.89	7.35
8B 13-65	201	202	9.39	0.03	0.69	0.01	3.25	0.89	0.66	0.02	0.49	0.12	66.29	0.05	0.48	17.44
8B 65-BOTTOM	201	202	10.50	0.04	0.76	< 0.01	3.83	1.00	0.79	0.02	0.52	0.12	65.18	0.03	0.53	16.48
9A 0-71.5	201	202	9.90	0.04	0.82	< 0.01	3.13	1.07	0.78	0.02	0.76	0.09	67.08	0.03	0.51	15.71
9A 71.5-BOT	201	202	12.54	0.06	1.56	< 0.01	4.19	1.64	1.29	0.04	1.53	0.10	64.26	0.04	0.74	11.64
10B 0-30	201	202	13.43	0.06	0.98	< 0.01	5.49	1.48	1.09	0.13	0.92	0.18	61.52	0.05	0.66	13.83
10B 30-60	201	202	13.65	0.05	0.87	< 0.01	5.82	1.52	1.11	0.06	0.74	0.16	61.75	0.01	0.62	13.52
10B 60-85	201	202	13.31	0.05	0.97	< 0.01	5.80	1.67	1.16	0.05	0.87	0.12	63.03	0.01	0.62	12.10

CERTIFICATION: ____________

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To: CH2M HILL
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Project :
Comments: ATTN: STEVE MILLER

Certificate Date: 17-JAN-2003
Invoice No. : I0310044
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Account : QRV

CERTIFICATE OF ANALYSIS A0310044

SAMPLE	PREP CODE		Fe % (ICP)	Ga ppm (ICP)	Ge ppm (ICP)	Hf ppm	In ppm	K % (ICP)	La ppm (ICP)	Li ppm (ICP)	Mg % (ICP)	Mn ppm (ICP)	Mo ppm (ICP)	Na % (ICP)	Nb ppm (ICP)	Ni ppm (ICP)
1B 0-10	201	202	3.24	17.00	0.35	0.7	0.055	1.61	47.5	26.2	0.86	450	0.65	1.57	7.8	19.0
1B 10-18	201	202	3.20	17.95	0.45	1.2	0.055	1.88	63.0	16.6	1.06	550	0.30	2.15	0.9	19.0
1B 18-58.5	201	202	2.72	17.10	0.35	2.1	0.055	0.98	39.0	31.0	0.50	185	0.80	0.69	8.0	24.0
1B 58.5-BOTTOM	201	202	3.57	20.60	0.35	1.3	0.070	2.20	55.0	17.4	1.20	570	0.55	2.13	6.5	26.4
2A 0-12.5	201	202	3.42	19.20	0.40	2.4	0.060	1.76	50.0	33.4	0.87	485	0.45	1.50	2.8	22.2
2A 12.5-33.5	201	202	3.23	18.70	0.45	2.0	0.060	1.49	49.5	35.8	0.76	310	0.20	1.24	0.5	20.4
2A 33.5-56	201	202	2.93	17.95	0.45	2.4	0.055	1.53	50.5	32.6	0.77	310	0.40	1.32	1.6	19.2
3 REDO B 0-16	201	202	3.05	18.85	0.40	2.3	0.055	1.23	48.0	34.8	0.70	295	0.45	1.02	1.2	22.0
3 REDO B 16-34	201	202	2.75	15.90	0.35	0.6	0.050	0.64	30.5	29.4	0.42	115	0.50	0.42	5.5	21.0
3 REDO B 34-75	201	202	3.27	19.20	0.50	1.7	0.060	1.70	61.5	25.4	1.05	450	0.20	1.82	0.5	22.6
4A TOP	201	202	3.29	18.40	0.45	2.6	0.080	1.73	52.5	34.0	0.80	425	1.00	1.20	13.9	24.8
4A MID SECT	201	202	1.70	11.50	0.30	0.3	0.035	0.49	24.0	19.8	0.26	115	0.85	0.34	4.6	16.4
4A BOTTOM	201	202	1.89	10.50	0.25	1.5	0.035	0.54	25.5	21.2	0.37	145	0.75	0.30	6.2	16.0
5A 0-16	201	202	3.02	18.40	0.45	2.7	0.070	1.61	43.0	34.2	0.75	395	0.65	1.29	11.1	23.0
5A 16-23	201	202	1.98	13.55	0.30	0.4	0.040	0.60	23.5	21.6	0.31	395	1.30	0.40	5.9	17.8
5A 23-34.5	201	202	2.50	19.05	0.45	2.4	0.060	1.25	44.0	35.2	0.64	300	0.60	1.14	6.3	21.0
5A 34.5-71	201	202	3.17	18.20	0.60	1.7	0.060	1.50	94.5	22.0	1.09	510	0.25	1.70	1.9	23.0
5A 71-77	201	202	3.26	18.35	0.55	1.7	0.060	1.61	72.0	22.4	1.07	500	0.25	1.82	2.0	22.8
5A 77-BOTTOM	201	202	3.16	17.85	0.50	1.6	0.060	1.68	69.5	21.0	1.06	490	0.15	1.92	0.9	21.2
6A 0-22	201	202	3.13	17.95	0.50	2.2	0.060	1.63	48.0	26.8	0.85	460	0.50	1.50	4.5	21.4
6A 22-39.5	201	202	2.31	14.95	0.40	2.2	0.050	0.70	30.0	25.2	0.36	125	0.55	0.47	7.2	17.4
6A 39.5-67.5	201	202	3.24	17.70	0.60	1.6	0.055	1.62	71.0	18.8	1.18	515	0.45	1.93	10.3	23.2
7B 0-29	201	202	3.67	17.50	0.70	0.9	0.060	2.04	89.5	8.4	1.24	725	0.30	2.25	3.8	20.6
7B 29-35	201	202	3.21	17.45	0.65	1.3	0.050	2.04	44.5	15.6	0.93	515	0.45	2.05	9.8	19.6
8B TOP 11	201	202	3.35	18.30	0.55	2.2	0.070	1.73	58.5	26.2	0.92	535	0.60	1.63	10.3	22.0
8B 13-65	201	202	2.16	11.45	0.40	2.0	0.040	0.65	22.0	23.2	0.41	180	0.65	0.34	5.6	18.2
8B 65-BOTTOM	201	202	2.48	12.50	0.40	2.4	0.040	0.71	25.0	25.0	0.45	195	0.65	0.37	6.8	19.6
9A 0-71.5	201	202	2.04	11.95	0.40	1.9	0.040	0.78	26.0	21.6	0.46	185	0.65	0.53	7.1	17.8
9A 71.5-BOT	201	202	2.76	16.15	0.55	2.3	0.050	1.26	46.5	26.6	0.74	315	0.60	1.13	8.5	21.4
10B 0-30	201	202	3.60	16.80	0.50	3.2	0.065	1.08	33.5	34.0	0.60	785	0.95	0.60	9.4	24.8
10B 30-60	201	202	3.75	16.70	0.45	2.7	0.060	1.13	33.5	33.0	0.62	390	0.85	0.55	7.5	24.2
10B 60-85	201	202	3.87	17.60	0.50	3.1	0.060	1.30	35.0	37.4	0.69	395	1.15	0.68	8.4	26.0

CERTIFICATION: ____________

ALS Chemex

ALS USA Inc.
Analytical Chemists * Geochemists * Registered Assayers
994 Glendale Ave., Unit 3, Sparks
Nevada, U.S.A. 89431
PHONE: 775-356-5395 FAX: 775-355-0179

o: CH2M HILL

700 CLEARWATER LANE
BOISE, IDAHO
83712

Project :
Comments: ATTN: STEVE MILLER

Certificate Date: 17-JAN-2003
Invoice No. : I0310044
P.O. Number : 173986.A1.20
Account : QRV

CERTIFICATE OF ANALYSIS A0310044

SAMPLE	PREP CODE		U ppm (ICP)	V ppm (ICP)	W ppm (ICP)	Y ppm (ICP)	Zn ppm (ICP)	Zr ppm
1B 0-10	201	202	2.6	82	0.8	18.9	338	24.5
1B 10-18	201	202	2.3	77	0.1	22.7	98	35.5
1B 18-58.5	201	202	3.7	74	1.2	19.0	170	70.0
1B 58.5-BOTTOM	201	202	2.4	103	0.3	20.9	82	39.0
2A 0-12.5	201	202	2.8	81	0.1	19.3	478	80.5
2A 12.5-33.5	201	202	3.2	73	< 0.1	20.5	72	64.0
2A 33.5-56	201	202	2.8	73	0.1	20.2	66	81.0
3 REDO B 0-16	201	202	3.6	78	0.1	21.9	82	77.0
3 REDO B 16-34	201	202	3.9	75	0.9	17.0	52	24.5
3 REDO B 34-75	201	202	2.9	63	< 0.1	21.9	78	56.0
4A TOP	201	202	3.4	83	1.4	20.7	4050	88.0
4A MID SECT	201	202	2.5	47	0.9	14.3	116	12.5
4A BOTTOM	201	202	2.2	42	0.8	16.1	58	46.5
5A 0-16	201	202	2.9	77	1.1	18.2	2570	84.0
5A 16-23	201	202	2.4	54	1.1	13.4	188	16.0
5A 23-34.5	201	202	3.0	74	0.4	17.8	68	75.0
5A 34.5-71	201	202	2.9	75	0.1	28.1	80	46.0
5A 71-77	201	202	2.9	73	0.1	25.2	76	48.5
5A 77-BOTTOM	201	202	2.8	68	< 0.1	23.5	74	44.0
6A 0-22	201	202	2.8	77	0.3	19.3	920	67.0
6A 22-39.5	201	202	3.6	66	0.8	17.6	52	66.0
6A 39.5-67.5	201	202	2.9	86	0.3	26.2	76	43.5
7B 0-29	201	202	2.4	87	0.1	27.7	84	19.5
7B 29-35	201	202	1.9	79	1.0	20.1	190	33.0
8B TOP 11	201	202	3.0	82	0.7	21.6	1180	65.5
8B 13-65	201	202	2.9	48	0.8	18.8	114	64.0
8B 65-BOTTOM	201	202	3.4	52	0.9	19.4	78	73.5
9A 0-71.5	201	202	2.7	47	0.8	16.5	102	64.5
9A 71.5-BOT	201	202	3.3	67	0.6	20.8	82	78.0
10B 0-30	201	202	4.4	71	1.3	23.7	648	111.5
10B 30-60	201	202	4.5	73	1.1	22.3	108	97.5
10B 60-85	201	202	4.8	80	0.9	21.4	98	107.0

CERTIFICATION:

ALS Chemex

Chemex Labs, Inc.
Analytical Chemists * Geochemists * Registered Assayers
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PHONE: 775-356-5395 FAX: 775-355-0179

o: CH2M HILL

700 CLEARWATER LANE
BOISE, IDAHO
83712

Comments: ATTN: STEVE MILLER

CERTIFICATE A0225623

(QRV) - CH2M HILL

Project:
P.O. # :

Samples submitted to our lab in Vancouver, BC
This report was printed on 11-OCT-2002.

SAMPLE PREPARATION

METHOD CODE	NUMBER SAMPLES	DESCRIPTION
244	4	Pulp; prev. prepared at Chemex

ANALYTICAL PROCEDURES 2 of 2

METHOD CODE	NUMBER SAMPLES	DESCRIPTION	METHOD	DETECTION LIMIT	UPPER LIMIT
Ti-MS61	4	Ti %: ICP + ICP-MS package	ICP	0.01	10.00
Tl-MS61	4	Tl ppm: ICP + ICP-MS package	ICP-MS	0.02	500
U-MS61	4	U ppm: ICP + ICP-MS package	ICP-MS	0.1	500
V-MS61	4	V ppm: ICP + ICP-MS package	ICP	1	10000
W-MS61	4	W ppm: ICP + ICP-MS package	ICP-MS/ICP	0.1	10000
Y-MS61	4	Y ppm: ICP + ICP-MS package	ICP-MS	0.1	500
Zn-MS61	4	Zn ppm: ICP + ICP-MS package	ICP	2	10000
Zr-MS61	4	Zr ppm: ICP + ICP-MS package	ICP-MS/ICP	0.5	500
Al-XRF06	4	Al2O3 %: XRF	XRF	0.01	100.00
Ba-XRF06	4	BaO %: XRF	XRF	0.01	100.00
Ca-XRF06	4	CaO %: XRF	XRF	0.01	100.00
Cr-XRF06	4	Cr2O3 %: XRF	XRF	0.01	100.00
Fe-XRF06	4	Fe2O3 %: XRF	XRF	0.01	100.00
K-XRF06	4	K2O %: XRF	XRF	0.01	100.00
Mg-XRF06	4	MgO %: XRF	XRF	0.01	100.00
Mn-XRF06	4	MnO %: XRF	XRF	0.01	100.00
Na-XRF06	4	Na2O %: XRF	XRF	0.01	100.00
P-XRF06	4	P2O5 %: XRF	XRF	0.01	100.00
Si-XRF06	4	SiO2 %: XRF	XRF	0.01	100.00
Sr-XRF06	4	SrO %: XRF	XRF	0.01	100.00
Ti-XRF06	4	TiO2 %: XRF	XRF	0.01	100.00
OA-XRF06	4	LOI %: XRF	XRF	0.01	100.00
OA-XRF06	4	Total %	CALCULATION	0.01	105.00

ALS Chemex
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J: CH2M HILL

700 CLEARWATER LANE
BOISE, IDAHO
83712

Project :
Comments: ATTN: STEVE MILLER

Certificate Date: 11-OCT-2002
Invoice No. : I0225623
P.O. Number :
Account : QRV

CERTIFICATE OF ANALYSIS A0225623

SAMPLE	PREP CODE		Ga ppm (ICP)	Ge ppm (ICP)	Hf ppm	In ppm	K % (ICP)	La ppm (ICP)	Li ppm (ICP)	Mg % (ICP)	Mn ppm (ICP)	Mo ppm (ICP)	Na % (ICP)	Nb ppm (ICP)	Ni ppm (ICP)	P ppm (ICP)
ASH 1B	244	--	19.20	0.30	2.0	0.100	0.78	36.0	29.4	0.41	135	1.35	0.48	9.3	30.0	490
ASH 2A	244	--	17.95	0.35	2.0	0.055	1.40	48.0	30.6	0.68	275	0.70	1.13	8.6	21.8	830
ASH 3REDOB	244	--	17.45	0.30	2.0	0.055	0.58	31.5	29.6	0.47	125	0.65	0.45	8.5	26.6	680
ASH 6A	244	--	17.10	0.30	2.0	0.050	0.74	35.5	27.6	0.41	125	0.60	0.45	9.1	23.4	480

CERTIFICATION: [signature]

RERUNS from A0224349

ALS Chemex
EXCELLENCE IN ANALYTICAL CHEMISTRY
ALS USA Inc.
994 Glendale Avenue, Unit 3
Sparks Nevada 89431-5730 USA
Phone: 775 356 5395 Fax: 775 355 0179

To: CH2M HILL
700 CLEARWATER LANE
BOISE ID 83712-7708

Date : 25-Jun-2003
Account: QRV

CERTIFICATE VA03017511

Project : Mica Bay Watershed
P.O. No: 173986.A1.20
This report is for 16 SEDIMENT samples submitted to our lab in North Vancouver, BC, Canada on 22-May-2003.
The following have access to data associated with this certificate:

DICK GLANZMAN	STEVE MILLER	

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
LOG-22	Sample login - Rcd w/o BarCode
SCR-41	Screen to -180um and save both

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	INSTRUMENT
ME-XRF06	Whole Rock Package - XRF	XRF
OA-GRA06	LOI for ME-XRF06	WST-SIM
ME-MS61	47 element four acid ICP-MS	

To: **CH2M HILL**
ATTN: STEVE MILLER
700 CLEARWATER LANE
BOISE ID 83712-7708

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

Signature:

ALS Chemex
EXCELLENCE IN ANALYTICAL CHEMISTRY
ALS USA Inc.
994 Glendale Avenue, Unit 3
Sparks Nevada 89431-5730 USA
Phone: 775 356 5395 Fax: 775 355 0179

o: CH2M HILL
700 CLEARWATER LANE
BOISE ID 83712-7708

Date : 25-Jun-2003
Account: QRV

Project : Mica Bay Watershed

CERTIFICATE OF ANALYSIS VA03017511

Sample Description	Method / Analyte / Units / LOR	ME-XRF06 Total % 0.01	ME-MS61 Ag ppm 0.01	ME-MS61 Al % 0.01	ME-MS61 As ppm 0.2	ME-MS61 Ba ppm 10	ME-MS61 Be ppm 0.05	ME-MS61 Bi ppm 0.01	ME-MS61 Ca % 0.01	ME-MS61 Cd ppm 0.02	ME-MS61 Ce ppm 0.01	ME-MS61 Co ppm 0.1	ME-MS61 Cr ppm 1	ME-MS61 Cs ppm 0.05	ME-MS61 Cu ppm 0.2	ME-MS61 Fe % 0.01
1-L1-INORG		99.85	0.05	6.92	5.3	630	2.02	0.31	0.92	0.09	89.5	10.4	21	5.68	15.2	2.85
2-L2-INORG		99.97	0.06	7.66	7.9	630	2.13	0.50	0.95	0.06	103.0	14.2	25	6.56	21.2	3.45
3-A1-INORG		99.96	0.22	7.83	4.5	690	1.69	0.27	1.60	0.27	71.8	17.1	29	3.67	31.5	3.90
4-A2-INORG		99.91	0.21	8.20	4.5	700	1.73	0.22	1.59	0.25	87.8	20.6	43	3.57	41.2	4.60
5-P1-INORG		99.88	0.06	7.33	6.2	580	1.86	0.35	1.70	0.08	97.2	20.1	45	6.05	27.7	4.06
6-P2-INORG		99.84	0.08	7.09	3.8	590	1.86	0.23	1.40	0.18	94.5	13.4	33	3.33	22.1	3.20
7-SU1-INORG		99.85	0.07	7.14	4.2	500	1.77	0.17	3.35	0.17	181.0	25.9	58	1.97	22.1	5.14
8-SU2-INORG		98.28	0.04	6.84	1.5	520	1.36	0.10	3.02	0.11	310	17.8	40	1.39	11.9	4.48
9-SP1-INORG		99.78	0.07	7.38	1.4	590	1.62	0.11	3.17	0.12	170.5	20.5	41	1.58	13.6	4.53
10-SP2-INORG		100.10	0.03	7.11	1.8	470	1.44	0.11	3.20	0.12	308	21.1	36	1.23	10.0	4.88
11-SP3-INORG		99.76	0.05	6.93	2.9	550	1.58	0.16	2.62	0.10	157.0	18.2	37	2.28	18.5	4.17
12-SP4-INORG		98.22	0.05	7.14	3.0	580	1.58	0.16	2.38	0.11	137.0	18.6	37	2.49	19.8	4.03
13-N1-INORG		98.29	0.05	5.82	0.8	530	1.50	0.13	2.38	0.12	>500	18.5	38	1.44	10.4	5.62
14-N2-INORG		99.79	0.05	6.40	2.4	570	1.64	0.13	2.49	0.11	259	17.0	36	1.68	10.6	4.05
15-M1-INORG		100.10	0.05	6.15	1.9	560	1.49	0.12	2.74	0.10	158.5	17.8	41	1.25	8.6	4.13
16-M2-INORG		99.81	0.04	6.66	2.0	610	1.48	0.12	2.92	0.12	307	17.6	39	1.45	10.4	4.56

Comments: REE's may not be totally soluble in MS61 method.

ALS Chemex
EXCELLENCE IN ANALYTICAL CHEMISTRY
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Sparks Nevada 89431-5730 USA
Phone: 775 356 5395 Fax: 775 355 0179

To: CH2M HILL
700 CLEARWATER LANE
BOISE ID 83712-7708

Date : 25-Jun-2003
Account: QRV

Project : Mica Bay Watershed

CERTIFICATE OF ANALYSIS VA03017511

Sample Description	Method / Analyte / Units / LOR	ME-MS61 Rb ppm 0.1	ME-MS61 Re ppm 0.002	ME-MS61 S % 0.01	ME-MS61 Sb ppm 0.05	ME-MS61 Se ppm 1	ME-MS61 Sn ppm 0.2	ME-MS61 Sr ppm 0.2	ME-MS61 Ta ppm 0.05	ME-MS61 Te ppm 0.05	ME-MS61 Th ppm 0.2	ME-MS61 Ti % 0.01	ME-MS61 Tl ppm 0.02	ME-MS61 U ppm 0.1	ME-MS61 V ppm 1	ME-MS61 W ppm 0.1
1-L1-INORG		105.0	<0.002	0.01	0.10	2	1.9	188.5	0.08	<0.05	15.3	0.41	0.57	2.4	73	0.1
2-L2-INORG		121.5	<0.002	0.01	0.16	2	2.1	194.0	0.08	<0.05	17.4	0.41	0.66	2.8	80	0.1
3-A1-INORG		69.2	<0.002	0.02	0.35	2	2.2	242	0.25	<0.05	12.2	0.50	0.43	2.3	101	0.9
4-A2-INORG		67.5	<0.002	0.02	1.68	2	1.9	226	0.19	<0.05	15.0	0.55	0.43	2.5	112	1.1
5-P1-INORG		104.5	<0.002	0.01	0.31	2	2.7	198.5	0.20	<0.05	14.4	0.49	0.55	2.4	116	0.9
6-P2-INORG		80.4	0.002	0.02	0.28	2	2.0	218	0.11	<0.05	14.3	0.43	0.47	2.9	80	0.9
7-SU1-INORG		56.5	<0.002	0.01	0.33	2	11.8	265	0.73	<0.05	25.0	0.65	0.32	3.6	145	0.9
8-SU2-INORG		41.8	<0.002	0.01	<0.05	3	1.1	299	0.08	<0.05	51.3	0.62	0.24	4.9	86	0.1
9-SP1-INORG		48.4	0.002	0.01	0.14	3	3.1	319	0.17	<0.05	25.5	0.65	0.29	2.9	122	0.3
10-SP2-INORG		46.2	<0.002	0.01	0.07	4	2.2	264	0.14	<0.05	46.8	0.80	0.24	4.9	120	0.1
11-SP3-INORG		65.2	<0.002	0.01	0.33	2	2.4	271	0.64	<0.05	20.3	0.57	0.38	3.7	108	0.8
12-SP4-INORG		68.8	<0.002	0.01	0.27	2	2.3	268	0.28	<0.05	18.9	0.55	0.40	3.5	103	0.6
13-N1-INORG		49.4	0.003	0.01	<0.05	11	1.7	236	0.12	<0.05	364	0.89	0.26	25.4	60	0.2
14-N2-INORG		54.8	0.002	0.01	0.08	3	3.6	248	0.21	<0.05	36.7	0.66	0.30	4.0	98	0.3
15-M1-INORG		44.3	<0.002	0.01	0.09	2	2.6	230	0.13	<0.05	21.4	0.54	0.24	2.7	108	0.2
16-M2-INORG		49.6	<0.002	0.01	<0.05	4	2.4	247	0.10	<0.05	42.9	0.72	0.27	4.1	110	0.1

Comments: REE's may not be totally soluble in MS61 method.

ALS Chemex
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CH2M HILL
700 CLEARWATER LANE
BOISE ID 83712-7708

Date : 6-Aug-2003
Account: QRV

CERTIFICATE VA03028060

Project :
P.O. No: 173986.A1.20
This report is for 29 SOIL samples submitted to our lab in North Vancouver, BC, Canada on 30-Jul-2003.
The following have access to data associated with this certificate:
STEVE MILLER

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
SCR-44	Screen to -63um
FND-02	Find Sample for Addn Analysis

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	
ME-MS61	47 element four acid ICP-MS	
ME-XRF06	Whole Rock Package - XRF	XRF
OA-GRA06	LOI for ME-XRF06	WST-SIM

To: **CH2M HILL**
ATTN: STEVE MILLER
700 CLEARWATER LANE
BOISE ID 83712-7708

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

Signature:

ALS Chemex
EXCELLENCE IN ANALYTICAL CHEMISTRY
ALS USA Inc.
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CH2M HILL
700 CLEARWATER LANE
BOISE ID 83712-7708

Date : 6-Aug-2003
Account: QRV

CERTIFICATE OF ANALYSIS VA03028060

Sample Description / Method / Analyte / Units / LOR	ME-MS61 Ge ppm 0.05	ME-MS61 Hf ppm 0.1	ME-MS61 In ppm 0.005	ME-MS61 K % 0.01	ME-MS61 La ppm 0.5	ME-MS61 Li ppm 0.2	ME-MS61 Mg % 0.01	ME-MS61 Mn ppm 5	ME-MS61 Mo ppm 0.05	ME-MS61 Na % 0.01	ME-MS61 Nb ppm 0.1	ME-MS61 Ni ppm 0.2	ME-MS61 P ppm 10	ME-MS61 Pb ppm 0.5	ME-MS61 Rb ppm 0.1
3 REDO B 0 16 (-230 fraction)	0.16	0.5	0.050	1.26	51.6	28.3	0.63	267	0.61	0.93	6.1	25.0	510	18.2	69.3
3 REDO B 16 34 (-230 fraction)	0.12	0.6	0.040	0.61	28.1	24.2	0.38	104	0.40	0.37	5.0	23.1	560	13.9	34.8
3 REDO B 34 75 (-230 fraction)	0.20	2.5	0.047	1.64	69.3	23.1	0.78	342	0.52	1.48	7.1	22.7	420	14.7	73.2
6A 0 22 (-230 fraction)	0.17	0.8	0.052	1.63	56.6	24.0	0.72	404	0.52	1.40	7.7	22.3	580	98.3	78.6
6A 22 39.5 (-230 fraction)	0.12	0.7	0.037	0.73	32.2	24.5	0.36	121	0.39	0.42	6.3	21.5	480	18.9	39.9
6A 39.5 67.5 (-230 fraction)	0.23	3.2	0.054	1.53	83.8	18.8	0.79	352	0.46	1.42	6.1	23.6	460	14.7	67.1
7B 0 29 (-230 fraction)	0.24	1.7	0.047	2.36	97.7	10.8	0.90	525	0.34	2.29	6.2	21.9	820	23.7	64.2
7B 29 35 (-230 fraction)	0.19	2.8	0.044	2.12	67.1	15.9	0.78	494	0.56	1.88	5.5	23.1	820	38.5	72.4
8B TOP 11 (-230 fraction)	0.19	3.4	0.063	1.66	58.6	22.6	0.74	462	0.46	1.36	7.9	22.1	560	332	77.4
8B 13 65 (-230 fraction)	0.12	0.4	0.033	0.66	22.0	19.9	0.41	182	0.47	0.35	3.9	20.6	470	28.0	44.0
8B 65 BOTTOM (-230 fraction)	0.11	0.5	0.036	0.71	24.7	21.3	0.44	194	0.50	0.36	4.7	21.2	470	14.2	48.4
9A 0 71.5 (-230 fraction)	0.09	1.5	0.026	0.75	26.3	17.4	0.40	162	0.49	0.49	5.3	18.4	300	23.3	45.5
9A 71.5 BOTTOM (-230 fraction)	0.17	1.6	0.037	1.17	43.5	21.1	0.60	262	0.49	0.91	4.5	21.7	410	13.6	60.3
L1 (-230 fraction)	0.15	2.5	0.051	2.01	44.0	24.1	0.74	584	0.46	1.24	6.2	18.7	320	30.0	109.0
L2 (-230 fraction)	0.19	1.5	0.064	2.14	45.4	34.6	1.05	701	0.28	1.16	1.5	26.7	740	18.7	127.5
A1 (-230 fraction)	0.14	0.3	0.045	1.44	32.1	31.6	0.90	793	0.83	1.47	6.0	29.9	1300	21.3	66.7
A2 (-230 fraction)	0.16	5.6	0.050	1.52	37.3	24.5	1.12	956	0.76	1.51	8.5	41.9	1780	16.8	63.5
P1 (-230 fraction)	0.18	2.4	0.051	2.22	40.7	21.8	1.13	674	<0.05	1.24	0.5	30.6	540	14.7	90.2
P2 (-230 fraction)	0.17	1.2	0.040	1.56	45.6	17.2	0.77	530	0.49	1.37	4.3	20.2	660	14.8	71.1
SU1 (-230 fraction)	0.27	0.4	0.054	1.65	98.3	17.0	1.14	918	0.59	1.53	8.2	28.4	1060	30.0	66.4
SU2 (-230 fraction)	0.18	0.8	0.044	1.43	63.5	15.2	0.89	577	0.41	1.42	7.2	22.5	790	14.6	55.7
SP1 (-230 fraction)	0.19	0.4	0.041	1.46	65.1	17.1	0.95	650	0.43	1.54	6.3	23.0	840	21.5	51.8
SP2 (-230 fraction)	0.22	0.3	0.045	1.66	76.4	19.2	0.88	1090	0.53	1.60	7.9	21.2	1080	23.4	61.9
SP3 (-230 fraction)	0.22	0.7	0.047	1.61	71.8	20.3	0.97	989	0.48	1.46	7.4	23.7	1090	19.6	65.0
SP4 (-230 fraction)	0.23	0.4	0.048	1.67	82.4	18.0	1.01	977	0.43	1.58	6.8	22.0	990	18.8	61.8
N1 (-230 fraction)	0.23	0.4	0.051	1.62	84.3	22.9	0.83	771	0.62	1.38	8.1	23.3	950	26.9	71.7
N2 (-230 fraction)	0.25	0.4	0.047	1.59	87.5	21.0	0.82	763	0.67	1.38	8.3	20.2	960	22.0	67.7
M1 (-230 fraction)	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS
M2 (-230 fraction)	0.24	0.6	0.052	1.68	81.7	19.8	0.88	687	0.62	1.59	7.3	21.9	840	28.0	64.3

Comments: REE's may not be totally soluble in MS61 method. NSS is non-sufficient sample.

ALS Chemex

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994 Glendale Ave., Unit 3, Sparks
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PHONE: 775-356-5395 FAX: 775-355-0179

To: CH2M HILL

700 CLEARWATER LANE
BOISE, IDAHO
83712

Project : PSD
Comments: Attn: Steve Miller

Certificate Date: 10-FEB-2003
Invoice No. : I0310356
P.O. Number : 173986.A1.20
Account : QRV

CERTIFICATE OF ANALYSIS A0310356

SAMPLE	PREP CODE		Weight grams
01 +5	266	--	4.430
01 -5+10	--	--	2.490
01 -10+18	--	--	2.870
01 -18+35	--	--	5.450
01 -35+60	--	--	13.880
01 -60+120	--	--	20.58
01 -120+230	--	--	19.090
01 -230	--	--	67.02
01 Total Weight	--	--	135.80
02 +5	266	--	4.250
02 -5+10	--	--	24.12
02 -10+18	--	--	68.21
02 -18+35	--	--	119.10
02 -35+60	--	--	63.16
02 -60+120	--	--	32.09
02 -120+230	--	--	15.120
02 -230	--	--	13.860
02 Total Weight	--	--	339.9
03 +5	266	--	1.250
03 -5+10	--	--	3.840
03 -10+18	--	--	7.130
03 -18+35	--	--	9.730
03 -35+60	--	--	8.450
03 -60+120	--	--	7.210
03 -120+230	--	--	5.890
03 -230	--	--	362.9
03 Total Weight	--	--	406.4
04 +5	266	--	6.750
04 -5+10	--	--	82.64
04 -10+18	--	--	164.20
04 -18+35	--	--	233.2
04 -35+60	--	--	102.10
04 -60+120	--	--	20.65
04 -120+230	--	--	4.350
04 -230	--	--	20.03
04 Total Weight	--	--	634.0
05 +5	266	--	0.230
05 -5+10	--	--	0.760
05 -10+18	--	--	2.480
05 -18+35	--	--	1.130

CERTIFICATION:

ALS Chemex
EXCELLENCE IN ANALYTICAL CHEMISTRY
ALS USA Inc.
994 Glendale Avenue, Unit 3
Sparks Nevada 89431-5730 USA
Phone: 775 356 5395 Fax: 775 355 0179

: CH2M HILL
700 CLEARWATER LANE
BOISE ID 83712-7708

Date : 25-Jun-2003
Account: QRV

Project : Mica Bay Watershed

CERTIFICATE OF ANALYSIS VA03017510

Sample Description	Method Analyte Units LOR	WEI-21 Recvd Wt kg 0.02	OA-GRA08b S.G. Unity 0.01
1-L1-SG		1.16	2.60
2-L2-SG		1.08	2.60
3-A1-SG		0.80	2.42
4-A2-SG		0.74	2.45
5-P1-SG		1.00	2.60
6-P2-SG		1.02	2.44
7-SU1-SG		0.46	2.63
8-SU2-SG		0.38	2.73
9-SP1-SG		0.52	2.70
10-SP2-SG		0.40	2.67
11-SP3-SG		0.36	2.60
12-SP4-SG		0.36	2.62
13-N1-SG		0.52	2.68
14-N2-SG		0.50	2.63
15-M1-SG		0.40	2.61
16-M2-SG		0.38	2.56

ALS Chemex
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Analytical Chemists * Geochemists * Registered Assayers
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PHONE: 775-356-5395 FAX: 775-355-0179

To: CH2M HILL

700 CLEARWATER LANE
BOISE, IDAHO
83712

Project :
Comments: ATTN: STEVE MILLER

Certificate Date: 15-JAN-
Invoice No. : I031004
P.O. Number : 173896.
Account : QRV

CERTIFICATE OF ANALYSIS A0310043

SAMPLE	PREP CODE		Spec Gr S.G.
1B 0-10	217	222	2.34
1B 10-18	217	222	2.61
1B 18-58.5	217	222	2.23
1B 58.5-BOTTOM	217	222	2.65
2A 0-12.5	217	222	2.41
2A 12.5-33.5	217	222	2.47
2A 33.5-56	217	222	2.51
3 REDO B 0-16	217	222	2.32
3 REDO B 16-34	217	222	2.21
3 REDO B 34-75	217	222	2.51
4A TOP	217	222	2.50
4A MID SECT	217	222	1.90
4A BOTTOM	217	222	2.00
5A 0-16	217	222	2.36
5A 16-23	217	222	2.03
5A 23-34.5	217	222	2.26
5A 34.5-71	217	222	2.52
5A 71-77	217	222	2.59
5A 77-BOTTOM	217	222	2.54
6A 0-22	217	222	2.45
6A 22-39.5	217	222	2.17
6A 39.5-67.5	217	222	2.64
7B 0-29	217	222	2.61
7B 29-35	217	222	2.58
8B TOP 11	217	222	2.51
8B 13-65	217	222	1.97
8B 65-BOTTOM	217	222	2.09
9A 0-71.5	217	222	2.08
9A 71.5-BOT	217	222	2.35
10B 0-30	217	222	2.28
10B 30-60	217	222	2.29
10B 60-85	217	222	2.23

CERTIFICATION:

Appendix G

Core 7 Analysis

Geochemical Analysis and Description of Core 7

1.0 Introduction

This section of the response to comments from the Idaho Department of Environmental Quality, related to the Mica Bay Sediment Impact Assessment report dated November 11, 2003, focuses on Core 7. This section presents further clarification of information previously presented, and presents the findings of additional analyses related to Core 7.

Based on media reports in late 2001 and early 2002, it was anticipated that most if not all of the cores would show a discrete blanket of visually identifiable project-related sediments in the upper to uppermost depth intervals that would represent sediments deposited from the project within Mica Bay. Based on both physical and chemical data, this was not observed. Discrete depth intervals in cores from each location were segmented based on changes in color, grain-size, sorting or other visual differences. With the exception of ash layers in several cores, it was evident that there are no depth intervals across a common elevation or layering sequence that could be identified to correlate from one core to another core in any of the 10 core locations. For some chemical or physical parameters, there are some similarities in various core layers from location to location, but they are not consistent across the delta. In other words, there is very limited or no lateral continuity or stratum in the cores. Therefore, the depth intervals are not strata that represent a single depositional sequence that extends between core locations. Even the ash-dominant depth intervals have considerably variable thicknesses between core locations. Therefore, the sediment layers in Mica Bay indicate a highly diverse and complex depositional history.

2.0 Key Findings

After thorough review of the physical and chemical relationships from the 10 cores collected from Mica Bay compared with physical and chemical characteristics of samples collected to represent watershed sources, and specifically roadway- (project) related materials, there are no sediment layers in Mica Bay, including Core 7 sediments, that clearly correspond to project-related sediment in the watershed samples. This does not mean that there are no project-related sediment particles incorporated within the uppermost sediment layers of some part of Mica Bay. It means that the clearly definable sediment layers in Mica Bay represent a mixture of watershed sources, lacustrine sources, and Mount Saint Helens ash, but there is an insufficient amount of project-related sediments accumulated within these sediment layers to quantify project-related particles as a source within the mixture. Therefore, based on the core data, it was not possible to estimate a quantity of sediment contribution to Mica Bay from the project.

The key findings associated with the focused analysis on Core 7 presented below include the following:

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CH2M HILL
700 CLEARWATER LANE
BOISE ID 83712-7708

Date : 6-Aug-2003
Account: QRV

CERTIFICATE OF ANALYSIS VA03028060

Sample Description	Method / Analyte / Units / LOR	ME-MS61 Zn ppm 2	ME-MS61 Zr ppm 0.5	ME-XRF06 SiO2 % 0.01	ME-XRF06 Al2O3 % 0.01	ME-XRF06 Fe2O3 % 0.01	ME-XRF06 CaO % 0.01	ME-XRF06 MgO % 0.01	ME-XRF06 Na2O % 0.01	ME-XRF06 K2O % 0.01	ME-XRF06 Cr2O3 % 0.01	ME-XRF06 TiO2 % 0.01	ME-XRF06 MnO % 0.01	ME-XRF06 P2O5 % 0.01	ME-XRF06 SrO % 0.01	ME-XRF06 BaO % 0.01
3 REDO B 0 16 (-230 fraction)		72	11.2	65.12	13.87	4.05	1.04	1.09	1.37	1.54	0.01	0.84	0.04	0.13	0.02	0.07
3 REDO B 16 34 (-230 fraction)		45	8.2	66.68	11.47	3.21	0.67	1.60	0.54	0.80	0.01	0.57	0.01	0.13	0.01	0.05
3 REDO B 34 75 (-230 fraction)		64	51.6	64.21	13.59	4.06	1.81	1.47	1.99	1.94	0.01	0.96	0.05	0.10	0.03	0.08
6A 0 22 (-230 fraction)		866	15.2	65.03	13.51	4.13	1.62	1.27	1.96	1.96	0.01	0.89	0.06	0.14	0.03	0.07
6A 22 39.5 (-230 fraction)		59	16.3	68.02	11.83	3.27	0.48	0.60	0.59	0.89	0.01	0.62	0.02	0.12	0.01	0.05
6A 39.5 67.5 (-230 fraction)		65	51.2	63.75	12.81	3.94	1.94	3.28	1.87	1.74	0.01	0.99	0.05	0.10	0.03	0.07
7B 0 29 (-230 fraction)		85	25.1	63.44	15.35	4.65	3.18	1.66	3.09	2.73	0.01	0.80	0.07	0.19	0.04	0.11
7B 29 35 (-230 fraction)		258	49.4	63.70	14.42	4.66	2.32	1.43	2.50	2.39	0.01	0.81	0.07	0.18	0.03	0.09
8B TOP 11 (-230 fraction)		1225	61.7	64.71	13.63	4.44	1.65	1.38	1.99	2.02	0.01	0.91	0.07	0.13	0.03	0.08
8B 13 65 (-230 fraction)		108	12.8	66.81	9.07	3.06	0.69	0.74	0.45	0.80	<0.01	0.41	0.03	0.11	0.01	0.04
8B 65 BOTTOM (-230 fraction)		73	11.6	65.78	9.52	3.43	0.71	1.04	0.49	0.87	<0.01	0.46	0.03	0.11	0.01	0.05
9A 0 71.5 (-230 fraction)		84	26.5	68.31	9.16	2.70	0.74	0.69	0.69	0.96	<0.01	0.46	0.02	0.08	0.01	0.05
9A 71.5 BOTTOM (-230 fraction)		72	34.1	65.37	11.84	3.58	1.18	1.00	1.28	1.44	<0.01	0.71	0.04	0.10	0.02	0.06
L1 (-230 fraction)		66	49.2	67.94	13.61	4.24	1.27	1.31	1.79	2.46	0.01	0.96	0.08	0.08	0.02	0.08
L2 (-230 fraction)		93	31.6	62.80	15.27	5.24	1.28	1.76	1.59	2.53	0.01	0.97	0.10	0.17	0.02	0.08
A1 (-230 fraction)		108	6.5	57.61	14.95	5.48	2.02	1.53	2.10	1.78	0.01	0.98	0.11	0.30	0.03	0.09
A2 (-230 fraction)		118	106.0	56.74	15.81	6.44	1.96	1.96	2.08	1.82	0.01	1.01	0.13	0.39	0.03	0.09
P1 (-230 fraction)		85	39.3	64.47	14.15	5.31	1.69	1.85	1.64	2.55	0.01	1.03	0.09	0.13	0.02	0.08
P2 (-230 fraction)		72	22.5	63.37	13.93	4.44	1.74	1.33	1.97	1.94	0.01	0.91	0.08	0.16	0.03	0.08
SU1 (-230 fraction)		80	5.9	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS
SU2 (-230 fraction)		70	10.1	62.42	13.10	4.99	2.39	1.63	2.07	1.83	0.01	1.02	0.08	0.19	0.03	0.07
SP1 (-230 fraction)		70	7.7	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS
SP2 (-230 fraction)		95	6.5	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS
SP3 (-230 fraction)		99	11.2	64.53	13.08	5.34	2.42	1.62	2.08	1.93	0.01	1.02	0.13	0.24	0.03	0.07
SP4 (-230 fraction)		92	7.1	65.95	12.73	5.02	2.42	1.71	2.11	1.93	0.01	1.12	0.13	0.22	0.03	0.07
N1 (-230 fraction)		85	6.8	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS
N2 (-230 fraction)		78	6.0	63.30	13.00	5.55	2.13	1.44	2.03	1.97	0.01	1.06	0.11	0.23	0.03	0.08
M1 (-230 fraction)		NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS
M2 (-230 fraction)		77	9.9	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS

Comments: REE's may not be totally soluble in MS61 method. NSS is non-sufficient sample.

Nutrients and Total Organic Carbon

ALS Environmental

CHEMICAL ANALYSIS REPORT

Date:	January 23, 2003
ALS File No.	S3895
Report On:	CH2M Hill Soil Analysis
Report To:	**ALS Chemex** 994 Glendale Avenue Unit 7 Sparks, NV, USA 89431-5730
Attention:	**Mr. Howard Shafer**
Received:	December 31, 2002

ALS ENVIRONMENTAL
per:

Joanne Patrick, B.Sc. - Project Chemist
Frederick Chen, B.Sc. - Special Projects Manager

File No. S3895

RESULTS OF ANALYSIS - Sediment/Soil

Sample ID		2A 12.5"-33.5"	2A 33.5-56"	3RedoB 0"-16"	3RedoB 16"-34"	3RedoB 34"-75"
Sample Date		02 08 30	02 08 30	02 08 30	02 08 30	02 08 30
ALS ID		*6*	*7*	*8*	*9*	*10*
Nutrients						
Ammonia Nitrogen	N	53	7	64	91	52
Available Phosphorus	P	17	29	10	9	7
Nitrate Nitrogen	N	1.0	3.0	1.0	1.0	0.5
Total Nitrogen	N	0.09	0.04	0.25	0.18	0.14
Organic Parameters						
Total Organic Carbon	C [1]	0.84	0.27	2.35	1.20	2.12

Ammonia (ppm), Nitrate (ppm), Total Nitrogen (%), and Available Phosphorus (ppm) analyses were subcontracted to Pacific Soil Analysis Inc. in Richmond, BC.
< = Less than the detection limit indicated.
[1]Total Organic Carbon results are expressed as percent, dry weight basis.

File No. S3895

RESULTS OF ANALYSIS - Sediment/Soil

Sample ID		5A 23"- 34.5"	5A 34.5"- 71"	5A 71"- 77"	5A 77"- Bottom	6A 0"- 22"
Sample Date		02 08 29	02 08 29	02 08 29	02 08 29	02 08 30
ALS ID		*16*	*17*	*18*	*19*	*20*
Nutrients						
Ammonia Nitrogen	N	268	64	24	26	52
Available Phosphorus	P	34	7	8	3	12
Nitrate Nitrogen	N	0.8	0.4	0.4	1.2	0.8
Total Nitrogen	N	0.30	0.17	0.08	0.10	0.23
Organic Parameters						
Total Organic Carbon	C[1]	2.71	3.20	1.19	1.23	5.26

Ammonia (ppm), Nitrate (ppm), Total Nitrogen (%), and Available Phosphorus (ppm) analyses were subcontracted to Pacific Soil Analysis Inc. in Richmond, BC.
< = Less than the detection limit indicated.
[1]Total Organic Carbon results are expressed as percent, dry weight basis.

File No. S3895

RESULTS OF ANALYSIS - Sediment/Soil

Sample ID		8B 13"-65"	8B 65"-Bottom	9A 0"-71.5"	9A 71.5"-Bottom	10B 0"-30"
Sample Date		02 08 29	02 08 29	02 08 29	02 08 29	02 08 29
ALS ID		*26*	*27*	*28*	*29*	*30*
Nutrients						
Ammonia Nitrogen	N	376	432	144	204	132
Available Phosphorus	P	6	5	4	7	3
Nitrate Nitrogen	N	4.6	<0.4	1.5	<0.4	<0.4
Total Nitrogen	N	0.50	0.44	0.45	0.29	0.29
Organic Parameters						
Total Organic Carbon	C[1]	5.49	4.18	5.11	3.45	2.56

Ammonia (ppm), Nitrate (ppm), Total Nitrogen (%), and Available Phosphorus (ppm) analyses were subcontracted to Pacific Soil Analysis Inc. in Richmond, BC.

< = Less than the detection limit indicated.

[1]Total Organic Carbon results are expressed as percent, dry weight basis.

File No. S3895

Appendix 1 - QUALITY CONTROL - Replicates

Sediment/Soil		2A 0"- 12" 02 08 30	2A 0"- 12" QC # 319139	5A 16"- 23" 02 08 29	5A 16"- 23" QC # 319140
Organic Parameters					
Total Organic Carbon	C [1]	3.10	2.86	15.4	15.5

Ammonia (ppm), Nitrate (ppm), Total Nitrogen (%), and Available Phosphorus (ppm) analyses were subcontracted to Pacific Soil Analysis Inc. in Richmond, BC.
< = Less than the detection limit indicated.
[1] Total Organic Carbon results are expressed as percent, dry weight basis.

Appendix 2 - METHODOLOGY

Outlines of the methodologies utilized for the analysis of the samples submitted are as follows

Available Ammonia and Nitrate Nitrogen

These analyses are carried out in accordance with methods described inSoil Science Society of America (1982) and Canadian Society of SoilScience (1978). Ammonia nitrogen and nitrate nitrogen are determined colourimetrically on a potassium sulphate extract.

Note: These analyses are subcontracted.

Total Nitrogen in Sediment/Soil

This analysis is carried out in accordance with methods described inMethods of Soil Analysis Part 2, Soil Science Society of America (1982). Total Nitrogen is determined colourimetrically on a semi-micro Kjeldahl digest.

Note: Total Nitrogen analysis is subcontracted.

Total Carbon, Total Organic Carbon and Inorganic Carbon in Sediment/Soil

This analysis is carried out in accordance with U.S. EPA Method 9060A (Publ.# SW-846 3rd ed., Washington, DC 20460). Total Carbon is determined by hightemperature oxidation of carbon to carbon dioxide which is then measured bymeans of a nondispersive infrared analyzer. Inorganic Carbon is determinedby reaction with phosphoric acid to convert all carbonates to carbon dioxide which is also measured by means of a nondispersive infrared analyzer. Total Organic Carbon is determined as the difference between Total and Inorganic Carbons.

Recommended Holding Time:
Sample: 14 days
Reference: Puget
For more detail see ASL "Collection & Sampling Guide"

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End of Report

File No. S3895

Appendix 1 - QUALITY CONTROL - Replicates

Sediment/Soil		8B Top 11" 02 08 29	8B Top 11" QC # 319141
Organic Parameters			
Total Organic Carbon	C [1]	2.13	2.51

Ammonia (ppm), Nitrate (ppm), Total Nitrogen (%), and Available Phosphorus (ppm) analyses were subcontracted to Pacific Soil Analysis Inc. in Richmond, BC.
< = Less than the detection limit indicated.
[1] Total Organic Carbon results are expressed as percent, dry weight basis.

File No. S3895

RESULTS OF ANALYSIS - Sediment/Soil

Sample ID		10B 30"-60"	10B 60"-85"
Sample Date		02 08 29	02 08 29
ALS ID		*31*	*32*
Nutrients			
Ammonia Nitrogen	N	170	180
Available Phosphorus	P	3	1
Nitrate Nitrogen	N	1.0	0.8
Total Nitrogen	N	0.23	0.20
Organic Parameters			
Total Organic Carbon	C [1]	2.24	1.78

Ammonia (ppm), Nitrate (ppm), Total Nitrogen (%), and Available Phosphorus (ppm) analyses were subcontracted to Pacific Soil Analysis Inc. in Richmond, BC.

< = Less than the detection limit indicated.

[1]Total Organic Carbon results are expressed as percent, dry weight basis.

File No. S3895

RESULTS OF ANALYSIS - Sediment/Soil

Sample ID		6A 22"- 39.5"	6A 39.5"- 67.5"	7B 0"- 29"	7B 29"- 35"	8B Top 11"
Sample Date		02 08 30	02 08 30	02 08 30	02 08 30	02 08 29
ALS ID		*21*	*22*	*23*	*24*	*25*
Nutrients						
Ammonia Nitrogen	N	140	25	5	8	90
Available Phosphorus	P	5	6	22	26	8
Nitrate Nitrogen	N	<0.4	<0.4	<0.4	<0.4	0.8
Total Nitrogen	N	0.17	0.07	0.02	0.02	0.16
Organic Parameters						
Total Organic Carbon	C [1]	1.94	1.30	<0.05	0.07	2.13

Ammonia (ppm), Nitrate (ppm), Total Nitrogen (%), and Available Phosphorus (ppm) analyses were subcontracted to Pacific Soil Analysis Inc. in Richmond, BC.
< = Less than the detection limit indicated.
[1]Total Organic Carbon results are expressed as percent, dry weight basis.

File No. S3895

RESULTS OF ANALYSIS - Sediment/Soil

Sample ID		4A Top	4A Mid Section	4A Bottom	5A 0"- 16"	5A 16"- 23"
Sample Date		02 08 28	02 08 28	02 08 28	02 08 29	02 08 29
ALS ID		*11*	*12*	*13*	*14*	*15*
Nutrients						
Ammonia Nitrogen	N	56	244	213	116	292
Available Phosphorus	P	5	27	4	7	26
Nitrate Nitrogen	N	0.4	4.6	3.8	<0.4	<0.4
Total Nitrogen	N	0.28	1.05	0.58	0.14	1.17
Organic Parameters						
Total Organic Carbon	C [1]	3.62	14.7	6.02	2.91	15.4

Ammonia (ppm), Nitrate (ppm), Total Nitrogen (%), and Available Phosphorus (ppm) analyses were subcontracted to Pacific Soil Analysis Inc. in Richmond, BC.
< = Less than the detection limit indicated.
[1]Total Organic Carbon results are expressed as percent, dry weight basis.

File No. S3895

RESULTS OF ANALYSIS - Sediment/Soil

Sample ID		1B 0"- 10"	1B 10"- 18"	1B 18"- 58.5"	1B 58.5"- Bottom	2A 0"- 12"
Sample Date		02 08 29	02 08 29	02 08 29	02 08 29	02 08 30
ALS ID		*1*	*2*	*3*	*4*	*5*
Nutrients						
Ammonia Nitrogen	N	12	7	79	8	16
Available Phosphorus	P	10	22	8	5	8
Nitrate Nitrogen	N	3.1	1.2	2.0	0.4	<0.4
Total Nitrogen	N	0.14	0.03	0.13	0.02	0.23
Organic Parameters						
Total Organic Carbon	C[1]	5.01	0.14	2.72	<0.05	3.10

Ammonia (ppm), Nitrate (ppm), Total Nitrogen (%), and Available Phosphorus (ppm) analyses were subcontracted to Pacific Soil Analysis Inc. in Richmond, BC.
< = Less than the detection limit indicated.
[1]Total Organic Carbon results are expressed as percent, dry weight basis.

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:CH2M HILL
700 CLEARWATER LANE
BOISE ID 83712-7708

Date : 6-Aug-2003
Account: QRV

CERTIFICATE OF ANALYSIS VA03028060

Sample Description	Method / Analyte / Units / LOR	ME-XRF06 LOI % 0.01	ME-XRF06 Total % 0.01
3 REDO B 0 16 (-230 fraction)		10.65	99.82
3 REDO B 16 34 (-230 fraction)		13.60	99.33
3 REDO B 34 75 (-230 fraction)		8.42	98.69
6A 0 22 (-230 fraction)		8.85	99.52
6A 22 39.5 (-230 fraction)		13.20	99.69
6A 39.5 67.5 (-230 fraction)		9.44	100.05
7B 0 29 (-230 fraction)		4.54	99.85
7B 29 35 (-230 fraction)		6.32	98.93
8B TOP 11 (-230 fraction)		7.91	98.95
8B 13 65 (-230 fraction)		17.15	99.36
8B 65 BOTTOM (-230 fraction)		16.45	98.94
9A 0 71.5 (-230 fraction)		15.25	99.12
9A 71.5 BOTTOM (-230 fraction)		12.80	99.40
L1 (-230 fraction)		6.03	99.88
L2 (-230 fraction)		7.30	99.11
A1 (-230 fraction)		12.75	99.71
A2 (-230 fraction)		11.25	99.71
P1 (-230 fraction)		6.03	99.05
P2 (-230 fraction)		9.19	99.17
SU1 (-230 fraction)		NSS	NSS
SU2 (-230 fraction)		9.05	98.89
SP1 (-230 fraction)		NSS	NSS
SP2 (-230 fraction)		NSS	NSS
SP3 (-230 fraction)		7.32	99.83
SP4 (-230 fraction)		6.12	99.56
N1 (-230 fraction)		NSS	NSS
N2 (-230 fraction)		8.99	99.92
M1 (-230 fraction)		NSS	NSS
M2 (-230 fraction)		NSS	NSS

Comments: REE's may not be totally soluble in MS61 method. NSS is non-sufficient sample.

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To: CH2M HILL

700 CLEARWATER LANE
BOISE, IDAHO
83712

Comments: ATTN: STEVE MILLER

CERTIFICATE A0310043

(QRV) - CH2M HILL

Project:
P.O. # : 173896.A1.20

Samples submitted to our lab in Vancouver, BC
This report was printed on 15-JAN-2003.

SAMPLE PREPARATION

METHOD CODE	NUMBER SAMPLES	DESCRIPTION
PUL-31	32	Geochem ring entire sample
DRY-21	32	Drying charge (0-3 Kg)

ANALYTICAL PROCEDURES

METHOD CODE	NUMBER SAMPLES	DESCRIPTION	METHOD	DETECTION LIMIT	UPPER LIMIT
OA-GRA08b	32	Spec. grav. SG: pulv. material	PYCNOMETER	0.01	20.0

The results of this assay were based solely upon the content of the sample submitted. Any decision to invest should be made only after the potential investment value of the claim or deposit has been determined based on the results of assays of multiple samples of geologic materials collected by the prospective investor or by a qualified person selected by him/her and based on an evaluation of all engineering data which is available concerning any proposed project Statement required by Nevada State Law NRS 519

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: CH2M HILL
700 CLEARWATER LANE
BOISE ID 83712-7708

Date : 25-Jun-2003
Account: QRV

CERTIFICATE VA03017510

Project : Mica Bay Watershed
P.O. No: 173986.A1.20
This report is for 16 SEDIMENT samples submitted to our lab in North Vancouver, BC, Canada on 30-May-2003.
The following have access to data associated with this certificate:

DICK GLANZMAN	STEVE MILLER	

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
LOG-22	Sample login - Rcd w/o BarCode
SCR-41	Screen to -180um and save both

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	INSTRUMENT
OA-GRA08b	Specific Gravity for Pulps	WST-SIM

To: **CH2M HILL**
ATTN: STEVE MILLER
700 CLEARWATER LANE
BOISE ID 83712-7708

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

Signature:

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ALS USA Inc.
Analytical Chemists * Geochemists * Registered Assayers
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PHONE: 775-356-5395 FAX: 775-355-0179

To: CH2M HILL
700 CLEARWATER LANE
BOISE, IDAHO
83712

A0310356

Comments: Attn: Steve Miller

CERTIFICATE A0310356

(QRV) - CH2M HILL
Project: PSD
P.O. # : 173986.A1.20

Samples submitted to our lab in Sparks, NV
This report was printed on 10-FEB-2003.

SAMPLE PREPARATION

METHOD CODE	NUMBER SAMPLES	DESCRIPTION
266	32	Special prep procedure

ANALYTICAL PROCEDURES

METHOD CODE	NUMBER SAMPLES	DESCRIPTION	METHOD	DETECTION LIMIT	UPPER LIMIT
445	288	Weight g	BALANCE	0.001	1000.0

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700 CLEARWATER LANE
BOISE ID 83712-7708

Date : 6-Aug-2003
Account: QRV

CERTIFICATE OF ANALYSIS VA03028060

Sample Description	Method / Analyte / Units / LOR	ME-MS61 Re ppm 0.002	ME-MS61 S % 0.01	ME-MS61 Sb ppm 0.05	ME-MS61 Se ppm 1	ME-MS61 Sn ppm 0.2	ME-MS61 Sr ppm 0.2	ME-MS61 Ta ppm 0.05	ME-MS61 Te ppm 0.05	ME-MS61 Th ppm 0.2	ME-MS61 Ti % 0.01	ME-MS61 Tl ppm 0.02	ME-MS61 U ppm 0.1	ME-MS61 V ppm 1	ME-MS61 W ppm 0.1	ME-MS61 Y ppm 0.1
3 REDO B 0 16 (-230 fraction)		0.002	0.03	0.28	<1	2.0	154.0	0.05	<0.05	14.5	0.45	0.43	4.0	81	0.9	24.1
3 REDO B 16 34 (-230 fraction)		<0.002	0.02	0.34	<1	2.1	76.8	0.05	<0.05	10.0	0.31	0.24	3.8	70	1.0	17.2
3 REDO B 34 75 (-230 fraction)		<0.002	0.04	0.26	<1	1.9	241	0.11	<0.05	19.8	0.49	0.36	3.7	84	0.8	22.5
6A 0 22 (-230 fraction)		<0.002	0.07	1.66	<1	2.1	223	0.06	<0.05	15.6	0.46	0.54	3.2	78	1.1	20.5
6A 22 39.5 (-230 fraction)		<0.002	0.03	0.43	1	2.1	73.0	<0.05	<0.05	11.4	0.34	0.31	3.8	69	1.0	19.8
6A 39.5 67.5 (-230 fraction)		<0.002	0.12	0.14	1	1.9	232	0.20	<0.05	25.1	0.54	0.35	4.5	89	0.4	27.2
7B 0 29 (-230 fraction)		<0.002	0.01	0.17	<1	2.4	329	0.19	<0.05	26.7	0.44	0.29	3.3	90	0.4	25.9
7B 29 35 (-230 fraction)		<0.002	0.02	0.37	<1	2.0	287	0.14	<0.05	19.6	0.44	0.39	3.0	87	0.4	21.1
8B TOP 11 (-230 fraction)		<0.002	0.08	4.51	<1	2.3	217	0.29	<0.05	16.2	0.46	0.48	3.2	80	0.7	20.0
8B 13 65 (-230 fraction)		<0.002	0.14	0.61	<1	1.2	61.1	<0.05	<0.05	9.0	0.24	0.24	2.9	50	0.6	17.7
8B 65 BOTTOM (-230 fraction)		<0.002	0.15	0.51	<1	1.3	66.1	<0.05	<0.05	9.9	0.26	0.28	3.3	53	0.8	19.4
9A 0 71.5 (-230 fraction)		<0.002	0.11	0.45	<1	1.7	81.6	<0.05	<0.05	9.8	0.25	0.23	2.7	45	0.7	16.0
9A 71.5 BOTTOM (-230 fraction)		<0.002	0.08	0.28	<1	1.5	142.5	<0.05	0.24	14.5	0.38	0.34	3.8	66	0.9	20.5
L1 (-230 fraction)		<0.002	0.01	0.22	<1	2.4	196.5	0.09	<0.05	14.8	0.47	0.54	2.4	85	0.7	13.4
L2 (-230 fraction)		<0.002	0.01	0.14	<1	2.4	201	<0.05	<0.05	15.6	0.49	0.65	2.9	94	0.1	14.4
A1 (-230 fraction)		<0.002	0.02	0.24	<1	2.1	243	0.10	0.10	11.8	0.53	0.38	2.2	103	0.6	13.1
A2 (-230 fraction)		<0.002	0.02	1.57	<1	1.9	244	0.34	0.11	12.8	0.57	0.39	2.4	116	0.9	15.4
P1 (-230 fraction)		<0.002	0.01	<0.05	<1	1.7	205	<0.05	0.06	13.0	0.47	0.51	2.3	104	<0.1	13.7
P2 (-230 fraction)		<0.002	0.02	0.17	<1	1.7	226	0.06	<0.05	13.9	0.45	0.38	2.9	82	0.5	17.5
SU1 (-230 fraction)		<0.002	0.01	0.36	<1	5.2	257	0.14	0.06	25.9	0.54	0.35	4.3	114	1.2	28.5
SU2 (-230 fraction)		<0.002	0.03	0.19	<1	2.0	252	0.10	<0.05	20.2	0.51	0.32	3.2	89	0.7	18.9
SP1 (-230 fraction)		<0.002	0.02	0.20	<1	3.2	279	0.08	<0.05	19.5	0.51	0.28	2.9	92	0.5	18.8
SP2 (-230 fraction)		<0.002	0.02	0.87	<1	3.1	257	0.21	<0.05	25.3	0.50	0.34	3.7	98	1.3	22.6
SP3 (-230 fraction)		<0.002	0.02	0.36	<1	2.4	249	0.14	<0.05	20.7	0.55	0.39	3.8	102	0.9	23.5
SP4 (-230 fraction)		<0.002	0.02	0.21	1	2.3	268	0.13	0.06	24.7	0.60	0.38	4.2	106	0.7	24.4
N1 (-230 fraction)		<0.002	0.02	0.38	<1	2.6	231	0.13	<0.05	25.2	0.56	0.44	4.2	101	2.7	25.8
N2 (-230 fraction)		<0.002	0.03	0.24	3	2.8	243	0.13	0.18	25.9	0.56	0.38	4.3	98	1.2	25.2
M1 (-230 fraction)		NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS
M2 (-230 fraction)		<0.002	0.02	0.27	1	3.4	253	0.13	<0.05	24.5	0.51	0.36	3.7	95	1.3	24.5

Comments: REE's may not be totally soluble in MS61 method. NSS is non-sufficient sample.

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: CH2M HILL
700 CLEARWATER LANE
BOISE ID 83712-7708

Date : 6-Aug-2003
Account: QRV

CERTIFICATE OF ANALYSIS VA03028060

Sample Description	Method / Analyte / Units / LOR	ME-MS61 Ag ppm 0.01	ME-MS61 Al % 0.01	ME-MS61 As ppm 0.2	ME-MS61 Ba ppm 10	ME-MS61 Be ppm 0.05	ME-MS61 Bi ppm 0.01	ME-MS61 Ca % 0.01	ME-MS61 Cd ppm 0.02	ME-MS61 Ce ppm 0.01	ME-MS61 Co ppm 0.1	ME-MS61 Cr ppm 1	ME-MS61 Cs ppm 0.05	ME-MS61 Cu ppm 0.2	ME-MS61 Fe % 0.01	ME-MS61 Ga ppm 0.05
3 REDO B 0 16 (-230 fraction)		0.12	7.40	2.7	550	1.84	0.30	0.72	0.05	103.0	9.7	32	4.95	19.2	2.75	19.65
3 REDO B 16 34 (-230 fraction)		0.10	5.88	5.1	360	1.54	0.29	0.42	0.03	59.6	6.2	30	3.85	18.4	2.42	15.75
3 REDO B 34 75 (-230 fraction)		0.06	7.70	2.0	630	1.66	0.21	1.31	0.10	139.0	10.2	36	3.69	18.2	2.80	18.10
6A 0 22 (-230 fraction)		0.28	7.36	4.2	600	1.93	0.23	1.19	11.95	111.0	11.2	30	4.25	21.0	2.81	18.55
6A 22 39.5 (-230 fraction)		0.08	6.05	3.6	340	1.55	0.28	0.33	0.30	69.3	6.1	25	3.85	15.8	2.28	16.80
6A 39.5 67.5 (-230 fraction)		0.11	7.33	2.3	630	1.66	0.18	1.40	0.16	166.0	10.8	30	3.39	16.0	2.84	18.40
7B 0 29 (-230 fraction)		0.06	8.73	2.1	950	1.62	0.08	2.48	0.42	192.0	12.3	28	1.76	10.7	3.24	18.95
7B 29 35 (-230 fraction)		0.12	8.49	4.7	830	1.64	0.15	1.76	2.07	134.0	12.5	32	2.94	16.1	3.34	18.60
8B TOP 11 (-230 fraction)		0.92	7.42	6.0	630	1.69	0.27	1.16	14.35	116.0	10.6	29	4.35	25.3	2.98	17.65
8B 13 65 (-230 fraction)		0.15	4.73	4.5	310	1.34	0.28	0.48	0.64	52.8	6.6	19	3.68	17.8	2.11	12.10
8B 65 BOTTOM (-230 fraction)		0.14	5.05	5.1	330	1.44	0.31	0.50	0.22	59.3	7.4	20	4.00	19.5	2.38	12.90
9A 0 71.5 (-230 fraction)		0.12	4.64	3.2	330	1.21	0.23	0.51	0.46	58.8	6.3	21	3.35	15.6	1.80	11.90
9A 71.5 BOTTOM (-230 fraction)		0.08	6.28	2.0	490	1.34	0.23	0.86	0.13	90.1	7.8	31	3.59	17.6	2.50	15.20
L1 (-230 fraction)		0.06	7.38	5.0	690	1.72	0.31	0.91	0.10	90.6	9.8	28	6.71	13.6	2.91	17.95
L2 (-230 fraction)		0.09	8.60	8.1	720	2.01	0.60	0.94	0.06	98.9	14.5	31	8.28	21.3	3.71	21.4
A1 (-230 fraction)		0.22	8.10	4.2	780	1.34	0.23	1.46	0.24	71.2	14.2	31	3.92	27.7	3.79	19.70
A2 (-230 fraction)		0.20	9.13	3.6	820	1.12	0.21	1.45	0.24	82.7	16.5	44	3.91	34.9	4.42	20.2
P1 (-230 fraction)		0.07	8.21	3.4	690	1.30	0.35	1.31	0.06	87.1	14.9	44	6.82	24.0	3.81	18.00
P2 (-230 fraction)		0.09	7.35	2.5	630	1.32	0.20	1.26	0.16	88.9	10.6	28	3.39	17.2	2.98	16.05
SU1 (-230 fraction)		0.08	7.29	4.1	610	1.49	0.20	2.09	0.11	202	19.2	47	3.26	24.2	3.94	17.60
SU2 (-230 fraction)		0.06	6.82	2.3	610	1.28	0.14	1.67	0.10	129.0	11.8	37	2.57	13.0	3.24	15.30
SP1 (-230 fraction)		0.07	6.96	2.6	660	1.80	<0.01	2.01	0.09	133.0	12.4	31	2.15	16.1	3.31	15.15
SP2 (-230 fraction)		0.06	7.77	5.6	650	1.78	0.02	1.85	0.14	156.5	15.6	30	2.79	20.0	3.99	17.40
SP3 (-230 fraction)		0.08	7.06	4.4	640	1.92	0.01	1.86	0.12	146.5	16.0	33	3.14	22.6	3.78	17.20
SP4 (-230 fraction)		0.05	7.40	3.1	670	1.59	0.04	2.01	0.11	172.0	15.0	37	2.82	19.0	3.74	16.55
N1 (-230 fraction)		0.09	7.36	5.1	680	2.03	0.03	1.54	0.16	173.5	17.3	30	3.39	23.1	4.02	18.20
N2 (-230 fraction)		0.03	7.02	6.5	660	1.51	0.04	1.60	0.12	183.0	15.2	32	3.15	18.5	3.97	17.45
M1 (-230 fraction)		NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS	NSS
M2 (-230 fraction)		0.06	7.42	4.9	690	1.68	0.03	1.91	0.11	167.5	13.2	29	2.81	20.3	3.74	17.60

Comments: REE's may not be totally soluble in MS61 method. NSS is non-sufficient sample.

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To: CH2M HILL
700 CLEARWATER LANE
BOISE ID 83712-7708

Date : 25-Jun-2003
Account: QRV

Project : Mica Bay Watershed

CERTIFICATE OF ANALYSIS VA03017511

Sample Description	Method / Analyte / Units / LOR	ME-MS61 Y ppm 0.1	ME-MS61 Zn ppm 2	ME-MS61 Zr ppm 0.5
1-L1-INORG		13.4	63	61.7
2-L2-INORG		15.3	81	73.2
3-A1-INORG		15.4	107	17.5
4-A2-INORG		18.6	112	7.1
5-P1-INORG		18.0	80	62.4
6-P2-INORG		21.1	74	28.2
7-SU1-INORG		39.5	94	47.6
8-SU2-INORG		40.1	79	14.0
9-SP1-INORG		32.0	82	30.7
10-SP2-INORG		46.3	87	22.2
11-SP3-INORG		33.3	91	48.1
12-SP4-INORG		29.3	91	50.8
13-N1-INORG		141.5	88	2.4
14-N2-INORG		40.7	74	32.6
15-M1-INORG		34.6	72	35.2
16-M2-INORG		50.0	81	30.5

Comments: REE's may not be totally soluble in MS61 method.

ALS Chemex

EXCELLENCE IN ANALYTICAL CHEMISTRY

ALS USA Inc.
994 Glendale Avenue, Unit 3
Sparks Nevada 89431-5730 USA
Phone: 775 356 5395 Fax: 775 355 0179

To: CH2M HILL
700 CLEARWATER LANE
BOISE ID 83712-7708

Date: 25-Jun-2003
Account: QRV

Project : Mica Bay Watershed

CERTIFICATE OF ANALYSIS VA03017511

Sample Description	Method / Analyte / Units / LOR	ME-MS61 Ga ppm 0.05	ME-MS61 Ge ppm 0.05	ME-MS61 Hf ppm 0.1	ME-MS61 In ppm 0.005	ME-MS61 K % 0.01	ME-MS61 La ppm 0.5	ME-MS61 Li ppm 0.2	ME-MS61 Mg % 0.01	ME-MS61 Mn ppm 5	ME-MS61 Mo ppm 0.05	ME-MS61 Na % 0.01	ME-MS61 Nb ppm 0.1	ME-MS61 Ni ppm 0.2	ME-MS61 P ppm 10	ME-MS61 Pb ppm 0.5
1-L1-INORG		16.85	0.24	2.1	0.052	1.98	48.4	23.7	0.71	595	0.29	1.34	1.5	17.6	320	19.4
2-L2-INORG		20.2	0.27	2.2	0.059	2.09	55.7	33.5	1.04	627	0.33	1.24	1.3	24.0	690	18.4
3-A1-INORG		20.5	0.25	0.4	0.055	1.36	37.5	38.8	1.00	811	1.02	1.64	7.8	33.2	1260	25.3
4-A2-INORG		21.4	0.34	0.3	0.061	1.40	45.5	30.1	1.28	944	0.90	1.62	9.2	49.8	1670	19.1
5-P1-INORG		19.10	0.33	2.2	0.065	1.97	50.9	26.8	1.33	701	0.46	1.32	8.8	36.1	620	16.9
6-P2-INORG		18.25	0.35	1.0	0.049	1.52	54.4	24.8	0.88	556	0.70	1.48	8.3	23.7	680	17.6
7-SU1-INORG		20.4	0.40	1.8	0.075	1.52	98.8	15.2	1.92	1030	0.77	1.91	15.4	38.2	2120	21.0
8-SU2-INORG		18.05	0.46	0.8	0.058	1.29	166.0	11.8	1.56	906	0.06	1.90	0.4	28.7	750	12.8
9-SP1-INORG		19.35	0.41	1.4	0.066	1.40	92.6	14.2	1.60	882	0.63	2.00	7.3	33.8	840	33.7
10-SP2-INORG		20.1	0.49	1.2	0.063	1.40	176.5	12.3	1.62	1140	0.35	2.03	2.6	27.9	1170	13.6
11-SP3-INORG		18.70	0.34	1.8	0.063	1.62	85.7	17.1	1.35	909	0.65	1.85	16.6	27.3	1890	14.7
12-SP4-INORG		18.75	0.31	1.8	0.053	1.66	74.4	18.1	1.32	892	0.62	1.86	9.0	28.1	1380	16.1
13-N1-INORG		24.7	1.63	0.7	0.071	1.42	>500	11.5	1.12	1345	0.07	1.56	0.3	23.2	1130	17.7
14-N2-INORG		17.95	0.45	1.3	0.069	1.56	145.5	12.6	1.16	843	0.72	1.73	13.0	22.8	990	16.2
15-M1-INORG		17.00	0.37	1.4	0.068	1.50	95.5	10.8	1.36	775	0.57	1.68	5.9	26.3	790	19.6
16-M2-INORG		18.35	0.53	1.4	0.070	1.66	169.5	11.8	1.40	919	0.64	1.80	3.1	24.6	860	19.1

Comments: REE's may not be totally soluble in MS61 method.

ALS Chemex

EXCELLENCE IN ANALYTICAL CHEMISTRY

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To: CH2M HILL
700 CLEARWATER LANE
BOISE ID 83712-7708

Date : 25-Jun-2003
Account: QRV

Project : Mica Bay Watershed

CERTIFICATE OF ANALYSIS VA03017511

Sample Description	Method / Analyte / Units / LOR	WEI-21 Recvd Wt kg 0.02	ME-XRF06 SiO2 % 0.01	ME-XRF06 Al2O3 % 0.01	ME-XRF06 Fe2O3 % 0.01	ME-XRF06 CaO % 0.01	ME-XRF06 MgO % 0.01	ME-XRF06 Na2O % 0.01	ME-XRF06 K2O % 0.01	ME-XRF06 Cr2O3 % 0.01	ME-XRF06 TiO2 % 0.01	ME-XRF06 MnO % 0.01	ME-XRF06 P2O5 % 0.01	ME-XRF06 SrO % 0.01	ME-XRF06 BaO % 0.01	ME-XRF06 LOI % 0.01
1-L1-INORG		1.02	68.29	13.18	4.24	1.38	1.29	1.80	2.45	<0.01	0.91	0.08	0.08	0.02	0.09	6.05
2-L2-INORG		0.94	63.95	15.04	5.32	1.50	2.03	1.73	2.65	<0.01	0.88	0.09	0.17	0.02	0.08	6.51
3-A1-INORG		0.78	55.20	15.32	6.10	2.39	1.91	2.25	1.72	<0.01	0.98	0.11	0.30	0.03	0.10	13.55
4-A2-INORG		0.76	55.45	15.85	7.23	2.37	2.47	2.30	1.76	<0.01	1.09	0.14	0.42	0.02	0.10	10.70
5-P1-INORG		1.18	63.03	14.26	6.21	2.41	2.35	1.78	2.48	0.01	1.00	0.10	0.13	0.02	0.08	6.01
6-P2-INORG		1.00	61.24	14.27	5.07	2.11	1.65	2.07	2.00	<0.01	0.94	0.08	0.17	0.02	0.08	10.15
7-SU1-INORG		0.32	59.01	13.89	8.39	4.91	3.62	2.54	1.86	0.01	1.27	0.14	0.47	0.02	0.06	3.66
8-SU2-INORG		0.56	57.90	13.44	7.61	4.67	3.21	2.60	1.65	0.01	1.84	0.13	0.20	0.03	0.07	4.91
9-SP1-INORG		0.64	59.75	14.14	6.56	4.35	2.80	2.54	1.73	0.01	1.09	0.11	0.19	0.03	0.08	6.39
10-SP2-INORG		0.34	59.96	13.86	7.87	4.59	3.25	2.61	1.75	0.01	1.56	0.16	0.31	0.02	0.06	4.09
11-SP3-INORG		0.70	62.31	13.59	6.46	3.78	2.46	2.46	2.01	0.01	1.10	0.12	0.44	0.03	0.06	4.93
12-SP4-INORG		0.54	60.88	13.69	6.39	3.44	2.39	2.41	2.06	0.01	1.09	0.13	0.31	0.03	0.08	5.33
13-N1-INORG		0.54	59.60	12.55	8.96	3.57	2.10	2.23	1.91	0.01	2.80	0.18	0.35	0.02	0.07	3.95
14-N2-INORG		0.72	62.51	13.33	6.90	3.87	2.29	2.38	2.07	0.01	1.47	0.13	0.23	0.02	0.08	4.49
15-M1-INORG		0.44	67.35	13.07	5.48	3.95	2.15	2.61	2.18	0.01	0.73	0.08	0.13	0.03	0.09	2.22
16-M2-INORG		0.42	63.12	13.41	6.90	4.19	2.52	2.45	2.16	0.01	1.27	0.12	0.21	0.03	0.09	3.33

Comments: REE's may not be totally soluble in MS61 method.

ALS Chemex

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J: CH2M HILL

700 CLEARWATER LANE
BOISE, IDAHO
83712

Project :
Comments: ATTN: STEVE MILLER

Certificate Date: 11-OCT-200
Invoice No. : I0225623
P.O. Number :
Account : QRV

CERTIFICATE OF ANALYSIS A0225623

SAMPLE	PREP CODE		P2O5 % XRF	SiO2 % XRF	SrO % XRF	TiO2 % XRF	LOI % XRF	TOTAL %								
ASH 1B	244	--	0.11	62.75	< 0.01	0.65	15.14	99.71								
ASH 2A	244	--	0.19	67.39	0.02	0.85	7.62	99.76								
ASH 3REDOB	244	--	0.16	62.74	< 0.01	0.60	14.69	99.97								
ASH 6A	244	--	0.11	67.11	< 0.01	0.59	13.12	99.85								

CERTIFICATION:

RERUNS from A0224349

ALS Chemex
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To: CH2M HILL

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BOISE, IDAHO
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Certificate Date: 11-OCT-200
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CERTIFICATE OF ANALYSIS A0225623

SAMPLE	PREP CODE		Ag ppm (ICP)	Al % (ICP)	As ppm	Ba ppm (ICP)	Be ppm (ICP)	Bi ppm (ICP)	Ca % (ICP)	Cd ppm (ICP)	Ce ppm (ICP)	Co ppm (ICP)	Cr ppm (ICP)	Cs ppm (ICP)	Cu ppm (ICP)	Fe % (ICP)
ASH 1B	244	--	0.10	6.84	4.6	437.5	1.60	0.43	0.37	0.08	68.9	7.7	164	4.50	24.2	2.80
ASH 2A	244	--	0.12	6.46	5.0	652.0	1.80	0.24	0.73	0.02	90.6	10.4	39	4.80	24.4	3.09
ASH 3REDOB	244	--	0.08	6.55	10.0	500.1	1.70	0.33	0.66	0.02	64.2	8.0	34	3.80	26.6	3.65
ASH 6A	244	--	0.10	6.23	4.4	424.5	1.45	0.32	0.38	0.20	74.0	6.8	27	4.40	22.6	2.69

CERTIFICATION:

RERUNS from A0224349

ALS Chemex

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BOISE, IDAHO
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Comments: ATTN: STEVE MILLER

CERTIFICATE A0225623

(QRV) - CH2M HILL

Project:
P.O. # :

Samples submitted to our lab in Vancouver, BC
This report was printed on 11-OCT-2002.

SAMPLE PREPARATION

METHOD CODE	NUMBER SAMPLES	DESCRIPTION
244	4	Pulp; prev. prepared at Chemex

ANALYTICAL PROCEDURES 1 of 2

METHOD CODE	NUMBER SAMPLES	DESCRIPTION	METHOD	DETECTION LIMIT	UPPER LIMIT
Ag-MS61	4	Ag ppm: ICP + ICP-MS package	ICP-MS/ICP	0.02	100.0
Al-MS61	4	Al %: ICP + ICP-MS package	ICP	0.01	25.0
As-MS61	4	As ppm: ICP + ICP-MS package	ICP-MS/ICP	0.2	10000
Ba-MS61	4	Ba ppm: ICP + ICP-MS package	ICP	0.5	10000
Be-MS61	4	Be ppm: ICP + ICP-MS package	ICP-MS/ICP	0.05	1000
Bi-MS61	4	Bi ppm: ICP + ICP-MS package	ICP-MS/ICP	0.01	10000
Ca-MS61	4	Ca %: ICP + ICP-MS package	ICP	0.01	25.0
Cd-MS61	4	Cd ppm: ICP + ICP-MS package	ICP-MS/ICP	0.02	500
Ce-MS61	4	Ce ppm: ICP + ICP-MS package	ICP-MS	0.01	500
Co-MS61	4	Co ppm: ICP + ICP-MS package	ICP-MS/ICP	0.1	10000
Cr-MS61	4	Cr ppm: ICP + ICP-MS package	ICP	1	10000
Cs-MS61	4	Cs ppm: ICP + ICP-MS package	ICP-MS	0.05	500
Cu-MS61	4	Cu ppm: ICP + ICP-MS package	ICP	0.2	10000
Fe-MS61	4	Fe %: ICP + ICP-MS package	ICP	0.01	25.0
Ga-MS61	4	Ga ppm: ICP + ICP-MS package	ICP-MS	0.05	500.0
Ge-MS61	4	Ge ppm: ICP + ICP-MS package	ICP-MS	0.05	500.0
Hf-MS61	4	Hf ppm: ICP + ICP-MS package	ICP-MS/ICP	0.1	500
In-MS61	4	In ppm: ICP + ICP-MS package	ICP-MS/ICP	0.005	500
K-MS61	4	K %: ICP + ICP-MS package	ICP	0.01	10.00
La-MS61	4	La ppm: ICP + ICP-MS package	ICP-MS	0.5	500
Li-MS61	4	Li ppm: ICP + ICP-MS package	ICP-MS	0.2	500
Mg-MS61	4	Mg %: ICP + ICP-MS package	ICP	0.01	15.00
Mn-MS61	4	Mn ppm: ICP + ICP-MS package	ICP	5	10000
Mo-MS61	4	Mo ppm: ICP + ICP-MS package	ICP	0.05	10000
Na-MS61	4	Na %: ICP + ICP-MS package	ICP	0.01	10.00
Nb-MS61	4	Nb ppm: ICP + ICP-MS package	ICP-MS	0.1	500
Ni-MS61	4	Ni ppm: ICP + ICP-MS package	ICP-MS/ICP	0.2	10000
P-MS61	4	P ppm: ICP + ICP-MS package	ICP	10	10000
Pb-MS61	4	Pb ppm: ICP + ICP-MS package	ICP-MS/ICP	0.5	10000
Rb-MS61	4	Rb ppm: ICP + ICP-MS package	ICP-MS	0.1	500
Re-MS61	4	Re ppm: ICP + ICP-MS package	ICP-MS/ICP	0.002	50.0
S-MS61	4	S %: ICP + ICP-MS package	ICP-MS/ICP	0.01	10.00
Sb-MS61	4	Sb ppm: ICP + ICP-MS package	ICP-MS	0.05	1000.0
Se-MS61	4	Se ppm: ICP + ICP-MS package	ICP-MS/ICP	1	1000
Sn-MS61	4	Sn ppm: ICP + ICP-MS package	ICP-MS/ICP	0.2	500
Sr-MS61	4	Sr ppm: ICP + ICP-MS package	ICP-MS/ICP	0.2	10000
Ta-MS61	4	Ta ppm: ICP + ICP-MS package	ICP-MS	0.05	100.0
Te-MS61	4	Te ppm: ICP + ICP-MS package	ICP-MS	0.05	500
Th-MS61	4	Th ppm: ICP + ICP-MS package	ICP-MS	0.2	500

ALS Chemex

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To: CH2M HILL

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BOISE, IDAHO
83712

Project :
Comments: ATTN: STEVE MILLER

Certificate Date: 17-JAN-2003
Invoice No. : I0310044
P.O. Number : 173986.A1.20
Account : QRV

CERTIFICATE OF ANALYSIS A0310044

SAMPLE	PREP CODE		P ppm (ICP)	Pb ppm (ICP)	Rb ppm (ICP)	Re ppm	S %	Sb ppm (ICP)	Se ppm	Sn ppm	Sr ppm (ICP)	Ta ppm (ICP)	Te ppm (ICP)	Th ppm (ICP)	Ti % (ICP)	Tl ppm (ICP)
1B 0-10	201	202	660	40.0	73.5	< 0.002	0.07	0.65	< 1	1.8	231	0.15	< 0.05	11.8	0.45	0.44
1B 10-18	201	202	610	20.0	63.4	< 0.002	0.04	0.05	1	1.4	326	< 0.05	< 0.05	14.2	0.39	0.32
1B 18-58.5	201	202	550	66.5	52.2	< 0.002	0.05	0.90	1	1.8	107.5	0.25	< 0.05	11.8	0.38	0.44
1B 58.5-BOTTOM	201	202	420	18.5	54.6	0.002	0.09	0.15	1	1.6	287	0.05	< 0.05	13.4	0.41	0.32
2A 0-12.5	201	202	720	125.5	89.7	< 0.002	0.04	1.00	1	1.8	224	< 0.05	< 0.05	13.4	0.45	0.52
2A 12.5-33.5	201	202	480	18.5	77.9	< 0.002	0.02	0.05	1	1.4	174.5	< 0.05	< 0.05	13.6	0.40	0.52
2A 33.5-56	201	202	350	16.0	81.3	< 0.002	0.01	0.10	1	1.8	185.0	< 0.05	< 0.05	12.8	0.43	0.52
3 REDO B 0-16	201	202	560	18.5	66.8	< 0.002	0.04	0.10	1	1.6	152.5	< 0.05	< 0.05	13.2	0.41	0.46
3 REDO B 16-34	201	202	640	14.0	35.1	< 0.002	0.03	0.45	1	1.4	74.6	0.05	< 0.05	10.2	0.33	0.28
3 REDO B 34-75	201	202	490	14.5	73.8	< 0.002	0.05	0.10	1	1.0	284	< 0.05	< 0.05	15.4	0.32	0.40
4A TOP	201	202	540	440	92.5	< 0.002	0.29	9.50	2	2.4	167.5	0.70	< 0.05	14.6	0.47	0.78
4A MID SECT	201	202	840	21.5	26.5	< 0.002	0.22	0.55	1	1.2	55.5	0.05	< 0.05	7.2	0.22	0.18
4A BOTTOM	201	202	390	10.0	37.5	< 0.002	0.21	0.40	1	1.0	46.2	0.20	< 0.05	7.2	0.21	0.24
5A 0-16	201	202	460	271	85.2	< 0.002	0.18	5.00	2	2.0	181.0	0.55	< 0.05	12.4	0.46	0.80
5A 16-23	201	202	1410	98.0	34.2	< 0.002	0.23	0.90	1	1.2	70.1	0.15	< 0.05	7.6	0.26	0.40
5A 23-34.5	201	202	720	16.0	58.7	< 0.002	0.05	0.30	1	1.8	168.0	0.10	< 0.05	12.4	0.44	0.44
5A 34.5-71	201	202	500	14.5	60.3	< 0.002	0.06	0.15	2	1.2	263	< 0.05	< 0.05	20.4	0.41	0.36
5A 71-77	201	202	440	15.0	64.6	< 0.002	0.05	0.10	2	1.2	276	< 0.05	< 0.05	18.8	0.42	0.36
5A 77-BOTTOM	201	202	490	14.0	68.1	< 0.002	0.04	0.05	1	1.2	293	< 0.05	< 0.05	17.0	0.39	0.36
6A 0-22	201	202	660	102.5	78.4	< 0.002	0.09	1.05	2	1.8	227	0.05	< 0.05	12.2	0.45	0.56
6A 22-39.5	201	202	540	16.5	36.1	< 0.002	0.03	0.45	1	1.6	66.0	0.25	< 0.05	9.8	0.33	0.28
6A 39.5-67.5	201	202	540	13.5	61.1	< 0.002	0.08	0.20	2	1.6	301	0.15	< 0.05	18.4	0.50	0.34
7B 0-29	201	202	740	19.0	51.4	< 0.002	0.03	0.10	2	1.2	311	< 0.05	< 0.05	21.0	0.47	0.24
7B 29-35	201	202	690	29.0	63.9	< 0.002	0.03	0.35	1	1.4	294	0.25	< 0.05	11.6	0.38	0.34
8B TOP 11	201	202	630	305	80.2	< 0.002	0.09	3.70	1	2.2	244	0.20	< 0.05	15.8	0.48	0.50
8B 13-65	201	202	520	28.0	44.4	< 0.002	0.15	0.70	1	1.2	50.6	0.20	< 0.05	8.6	0.23	0.26
8B 65-BOTTOM	201	202	520	15.0	48.7	< 0.002	0.15	0.60	1	1.2	56.3	0.35	< 0.05	9.8	0.26	0.30
9A 0-71.5	201	202	360	26.0	47.8	< 0.002	0.13	0.55	1	1.2	75.2	0.25	< 0.05	8.8	0.26	0.28
9A 71.5-BOT	201	202	470	15.0	67.0	< 0.002	0.09	0.35	1	1.6	166.0	0.30	< 0.05	13.2	0.39	0.38
10B 0-30	201	202	730	712	68.3	< 0.002	0.10	5.30	2	1.8	87.6	0.45	0.05	12.8	0.34	0.44
10B 30-60	201	202	710	30.5	71.9	0.002	0.08	0.85	2	1.8	78.4	0.25	< 0.05	13.2	0.32	0.46
10B 60-85	201	202	540	22.5	79.8	< 0.002	0.08	0.70	1	1.8	95.1	0.30	0.05	13.6	0.33	0.48

CERTIFICATION: [signature]

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700 CLEARWATER LANE
BOISE, IDAHO
83712

Project :
Comments: ATTN: STEVE MILLER

Certificate Date: 17-JAN-2003
Invoice No. : I0310044
P.O. Number : 173986.A1.20
Account : QRV

CERTIFICATE OF ANALYSIS A0310044

SAMPLE	PREP CODE		TOTAL %	Ag ppm (ICP)	Al % (ICP)	As ppm	Ba ppm (ICP)	Be ppm (ICP)	Bi ppm (ICP)	Ca % (ICP)	Cd ppm (ICP)	Ce ppm (ICP)	Co ppm (ICP)	Cr ppm (ICP)	Cs ppm (ICP)	Cu ppm (ICP)
1B 0-10	201	202	99.81	0.22	7.48	4.0	626.9	1.60	0.20	1.40	2.28	85.1	12.5	28	3.40	28.2
1B 10-18	201	202	99.60	0.06	8.21	1.4	813.6	1.75	0.12	2.30	0.30	128.0	13.3	31	2.00	20.4
1B 18-58.5	201	202	99.79	0.28	6.90	9.2	438.0	1.65	0.30	0.55	1.92	74.3	8.8	27	4.10	27.8
1B 58.5-BOTTOM	201	202	99.96	0.12	9.04	2.0	895.2	1.85	0.16	2.60	0.14	98.2	16.0	32	1.65	23.4
2A 0-12.5	201	202	99.78	0.30	8.15	3.6	671.8	1.90	0.26	1.15	3.80	97.0	12.7	31	4.40	33.6
2A 12.5-33.5	201	202	99.65	0.12	7.88	1.6	587.3	1.85	0.25	0.79	0.04	91.9	11.0	29	4.60	27.0
2A 33.5-56	201	202	99.96	0.12	7.39	2.0	589.0	1.85	0.23	0.88	0.06	93.3	11.6	31	4.25	28.6
3 REDO B 0-16	201	202	99.77	0.16	7.84	2.6	559.2	1.95	0.29	0.82	0.06	94.0	10.9	28	4.60	29.0
3 REDO B 16-34	201	202	99.88	0.16	6.79	6.8	382.0	1.50	0.30	0.49	0.04	57.3	6.8	22	3.75	26.0
3 REDO B 34-75	201	202	98.86	0.08	8.24	0.6	665.6	1.75	0.16	1.85	0.10	122.0	13.1	31	3.15	25.2
4A TOP	201	202	99.16	1.26	7.67	14.4	614.2	1.95	0.39	0.94	52.8	99.0	14.9	30	5.45	48.9
4A MID SECT	201	202	99.94	0.16	4.75	1.8	268.0	1.10	0.22	0.39	1.08	44.4	4.9	12	2.25	27.4
4A BOTTOM	201	202	99.98	0.14	4.45	2.8	296.0	1.15	0.21	0.37	0.16	47.6	6.9	13	2.70	23.0
5A 0-16	201	202	99.85	0.78	7.73	6.6	823.2	1.80	0.30	0.90	29.8	77.4	12.1	28	4.70	40.6
5A 16-23	201	202	99.57	0.34	5.38	1.6	346.0	1.25	0.21	0.49	1.90	43.2	6.4	15	2.95	25.6
5A 23-34.5	201	202	99.85	0.16	7.90	1.8	570.0	1.80	0.24	0.88	0.20	78.6	8.9	26	3.90	28.8
5A 34.5-71	201	202	99.98	0.10	7.75	< 0.2	631.8	1.75	0.16	2.00	0.14	176.0	14.0	33	2.60	24.4
5A 71-77	201	202	99.84	0.10	8.04	0.8	683.0	1.75	0.16	2.00	0.10	144.5	13.9	31	2.70	22.8
5A 77-BOTTOM	201	202	99.74	0.06	7.87	< 0.2	646.9	1.70	0.14	2.00	0.08	139.5	12.9	29	2.65	21.0
6A 0-22	201	202	99.67	0.34	7.65	2.8	615.1	1.65	0.23	1.35	12.15	94.2	12.6	27	3.75	32.2
6A 22-39.5	201	202	99.84	0.18	6.40	2.6	327.5	1.40	0.27	0.37	0.20	58.5	6.0	20	3.40	21.6
6A 39.5-67.5	201	202	99.84	0.18	7.86	0.2	644.8	1.70	0.12	2.30	0.14	140.5	13.6	35	2.30	23.6
7B 0-29	201	202	99.84	0.08	7.76	< 0.2	887.2	1.55	0.08	2.90	0.22	177.5	15.0	33	1.05	17.0
7B 29-35	201	202	99.82	0.18	7.89	1.2	888.0	1.65	0.12	2.10	1.20	82.8	13.6	27	1.90	19.4
8B TOP 11	201	202	99.27	0.90	7.96	4.0	652.8	1.75	0.24	1.50	14.15	115.0	12.9	31	3.95	37.6
8B 13-65	201	202	99.81	0.20	5.00	3.8	300.5	1.35	0.28	0.47	0.60	48.6	7.0	15	3.60	24.0
8B 65-BOTTOM	201	202	99.80	0.20	5.44	4.2	327.0	1.45	0.33	0.49	0.24	55.6	8.0	16	3.90	26.4
9A 0-71.5	201	202	99.94	0.20	5.23	2.4	336.0	1.70	0.25	0.56	0.54	53.5	7.2	15	3.35	23.2
9A 71.5-BOT	201	202	99.63	0.20	6.89	1.4	516.0	2.10	0.23	1.10	0.16	87.2	10.3	25	3.65	29.4
10B 0-30	201	202	99.82	1.46	7.16	13.6	457.5	2.30	0.45	0.65	4.14	73.4	13.3	23	5.45	41.4
10B 30-60	201	202	99.88	0.30	7.33	12.2	443.0	2.35	0.45	0.58	0.36	76.4	13.0	22	5.50	34.8
10B 60-85	201	202	99.76	0.30	7.46	14.0	481.5	2.35	0.46	0.68	0.22	79.4	17.0	25	6.00	37.4

CERTIFICATION: [signature]

ALS Chemex
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994 Glendale Ave., Unit 3, Sparks
Nevada, U.S.A. 89431
PHONE: 775-356-5395 FAX: 775-355-0179

To: CH2M HILL

700 CLEARWATER LANE
BOISE, IDAHO
83712

Comments: ATTN: STEVE MILLER

CERTIFICATE A0310044

(QRV) - CH2M HILL

Project:
P.O. # : 173986.A1.20

Samples submitted to our lab in Vancouver, BC
This report was printed on 17-JAN-2003.

SAMPLE PREPARATION

METHOD CODE	NUMBER SAMPLES	DESCRIPTION
PREP-41	32	Dry, sieve to -80 mesh
202	32	save reject
DRY-21	32	Drying charge (0-3 Kg)

ANALYTICAL PROCEDURES 2 of 2

METHOD CODE	NUMBER SAMPLES	DESCRIPTION	METHOD	DETECTION LIMIT	UPPER LIMIT
Mn-MS61	32	Mn ppm: ICP + ICP-MS package	ICP	5	10000
Mo-MS61	32	Mo ppm: ICP + ICP-MS package	ICP	0.05	10000
Na-MS61	32	Na %: ICP + ICP-MS package	ICP	0.01	10.00
Nb-MS61	32	Nb ppm: ICP + ICP-MS package	ICP-MS	0.1	500
Ni-MS61	32	Ni ppm: ICP + ICP-MS package	ICP-MS/ICP	0.2	10000
P-MS61	32	P ppm: ICP + ICP-MS package	ICP	10	10000
Pb-MS61	32	Pb ppm: ICP + ICP-MS package	ICP-MS/ICP	0.5	10000
Rb-MS61	32	Rb ppm: ICP + ICP-MS package	ICP-MS	0.1	500
Re-MS61	32	Re ppm: ICP + ICP-MS package	ICP-MS/ICP	0.002	50.0
S-MS61	32	S %: ICP + ICP-MS package	ICP-MS/ICP	0.01	10.00
Sb-MS61	32	Sb ppm: ICP + ICP-MS package	ICP-MS	0.05	1000.0
Se-MS61	32	Se ppm: ICP + ICP-MS package	ICP-MS/ICP	1	1000
Sn-MS61	32	Sn ppm: ICP + ICP-MS package	ICP-MS/ICP	0.2	500
Sr-MS61	32	Sr ppm: ICP + ICP-MS package	ICP-MS/ICP	0.2	10000
Ta-MS61	32	Ta ppm: ICP + ICP-MS package	ICP-MS	0.05	100.0
Te-MS61	32	Te ppm: ICP + ICP-MS package	ICP-MS	0.05	500
Th-MS61	32	Th ppm: ICP + ICP-MS package	ICP-MS	0.2	500
Ti-MS61	32	Ti %: ICP + ICP-MS package	ICP	0.01	10.00
Tl-MS61	32	Tl ppm: ICP + ICP-MS package	ICP-MS	0.02	500
U-MS61	32	U ppm: ICP + ICP-MS package	ICP-MS	0.1	500
V-MS61	32	V ppm: ICP + ICP-MS package	ICP	1	10000
W-MS61	32	W ppm: ICP + ICP-MS package	ICP-MS/ICP	0.1	10000
Y-MS61	32	Y ppm: ICP + ICP-MS package	ICP-MS	0.1	500
Zn-MS61	32	Zn ppm: ICP + ICP-MS package	ICP	2	10000
Zr-MS61	32	Zr ppm: ICP + ICP-MS package	ICP-MS/ICP	0.5	500

ALS Chemex
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994 Glendale Avenue, Unit 3
Sparks Nevada 89431-5730 USA
Phone: 775 356 5395   Fax: 775 355 0179

): CH2M HILL
700 CLEARWATER LANE
BOISE ID 83712-7708

CERTIFICATE RE03005631

Project : Mica Bay Watershed
P.O. No:
This report is for 16 SEDIMENT samples submitted to our lab in Sparks, Nevada, USA on 5-Mar-2003.
The following have access to data associated with this certificate:
STEVE MILLER

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI-21	Received Sample Weight
LOG-22	Sample login - Rcd w/o BarCode
SCR-51	Screening

To: **CH2M HILL**
ATTN: STEVE MILLER
700 CLEARWATER LANE
BOISE ID 83712-7708

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

Signature:

ALS Chemex
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Phone: 775 356 5395 Fax: 775 355 0179

:CH2M HILL
700 CLEARWATER LANE
BOISE ID 83712-7708

Date : 26-Sep-2003
Account: QRV

CERTIFICATE RE03028052

Project : Mica Bay - PSD
P.O. No: 173986.A1.20
This report is for 32 SEDIMENT samples submitted to our lab in Sparks, Nevada, USA on 30-Jul-2003.
The following have access to data associated with this certificate:
STEVE MILLER

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
FND-02	Find Sample for Addn Analysis

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION
CLA-GRA01	Clay and Silt in Sediment

The results of this assay were based solely upon the content of the sample submitted. Any decision to invest should be made only after the potential investment value of the claim or deposit has been determined based on the results of assays of multiple samples of geological materials collected by the prospective investor or by a qualified person selected by him/her and based on an evaluation of all engineering data which is available concerning any proposed project. Statement required by Nevada State Law NRS 519.

To: CH2M HILL
ATTN: STEVE MILLER
700 CLEARWATER LANE
BOISE ID 83712-7708

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

Signature:

ALS Chemex

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PHONE: 775-356-5395 FAX: 775-355-0179

To: CH2M HILL
700 CLEARWATER LANE
BOISE, IDAHO
83712

Project : PSD
Comments: Attn: Steve Miller

Certificate Date: 10-FEB-2003
Invoice No. : I0310356
P.O. Number : 173986.A1.20
Account : QRV

CERTIFICATE OF ANALYSIS A0310356

SAMPLE	PREP CODE		Weight grams									
27 -120+230	--	--	0.530									
27 -230	--	--	84.08									
27 Total Weight	--	--	86.40									
28 +5	266	--	2.840									
28 -5+10	--	--	1.480									
28 -10+18	--	--	0.530									
28 -18+35	--	--	0.560									
28 -35+60	--	--	0.180									
28 -60+120	--	--	0.540									
28 -120+230	--	--	1.750									
28 -230	--	--	138.70									
28 Total Weight	--	--	146.55									
29 +5	266	--	0.090									
29 -5+10	--	--	0.520									
29 -10+18	--	--	0.530									
29 -18+35	--	--	0.570									
29 -35+60	--	--	0.960									
29 -60+120	--	--	6.830									
29 -120+230	--	--	13.010									
29 -230	--	--	131.20									
29 Total Weight	--	--	153.70									
30 +5	266	--	< 0.001									
30 -5+10	--	--	< 0.001									
30 -10+18	--	--	0.010									
30 -18+35	--	--	0.060									
30 -35+60	--	--	0.020									
30 -60+120	--	--	0.040									
30 -120+230	--	--	0.300									
30 -230	--	--	76.78									
30 Total Weight	--	--	77.21									
31 +5	266	--	0.080									
31 -5+10	--	--	0.070									
31 -10+18	--	--	0.070									
31 -18+35	--	--	0.070									
31 -35+60	--	--	0.040									
31 -60+120	--	--	0.020									
31 -120+230	--	--	0.280									
31 -230	--	--	73.98									
31 Total Weight	--	--	74.61									
31 +5	266	--	< 0.001									

CERTIFICATION: [signature]

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Certificate Date: 10-FEB-2003
Invoice No. : I0310356
P.O. Number : 173986.A1.20
Account : QRV

CERTIFICATE OF ANALYSIS A0310356

SAMPLE		PREP CODE		Weight grams
18	-230	--	--	23.84
18	Total Weight	--	--	132.55
19	+5	266	--	0.110
19	-5+10	--	--	0.400
19	-10+18	--	--	1.930
19	-18+35	--	--	9.740
19	-35+60	--	--	51.10
19	-60+120	--	--	101.60
19	-120+230	--	--	53.62
19	-230	--	--	171.85
19	Total Weight	--	--	390.3
20	+5	266	--	0.550
20	-5+10	--	--	0.970
20	-10+18	--	--	1.620
20	-18+35	--	--	2.930
20	-35+60	--	--	15.180
20	-60+120	--	--	34.05
20	-120+230	--	--	18.400
20	-230	--	--	157.35
20	Total Weight	--	--	231.0
21	+5	266	--	0.010
21	-5+10	--	--	0.010
21	-10+18	--	--	0.060
21	-18+35	--	--	0.150
21	-35+60	--	--	0.570
21	-60+120	--	--	0.960
21	-120+230	--	--	1.480
21	-230	--	--	85.33
21	Total Weight	--	--	88.57
22	+5	266	--	2.210
22	-5+10	--	--	8.070
22	-10+18	--	--	26.28
22	-18+35	--	--	51.63
22	-35+60	--	--	123.35
22	-60+120	--	--	104.40
22	-120+230	--	--	31.71
22	-230	--	--	102.25
22	Total Weight	--	--	449.9
23	+5	266	--	31.61
23	-5+10	--	--	72.19

CERTIFICATION:

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To: CH2M HILL

700 CLEARWATER LANE
BOISE, IDAHO
83712

Project : PSD
Comments: Attn: Steve Miller

Certificate Date: 10-FEB-2003
Invoice No. : I0310356
P.O. Number : 173986.A1.20
Account : QRV

CERTIFICATE OF ANALYSIS A0310356

SAMPLE	PREP CODE		Weight grams									
09 Total Weight	--	--	234.0									
10 +5	266	--	0.440									
10 -5+10	--	--	1.080									
10 -10+18	--	--	1.040									
10 -18+35	--	--	1.640									
10 -35+60	--	--	13.640									
10 -60+120	--	--	82.68									
10 -120+230	--	--	52.17									
10 -230	--	--	164.35									
10 Total Weight	--	--	317.0									
11 +5	266	--	14.200									
11 -5+10	--	--	33.75									
11 -10+18	--	--	36.01									
11 -18+35	--	--	31.55									
11 -35+60	--	--	22.68									
11 -60+120	--	--	21.42									
11 -120+230	--	--	19.170									
11 -230	--	--	175.30									
11 Total Weight	--	--	354.0									
12 +5	266	--	16.090									
12 -5+10	--	--	1.360									
12 -10+18	--	--	3.030									
12 -18+35	--	--	6.010									
12 -35+60	--	--	6.890									
12 -60+120	--	--	5.490									
12 -120+230	--	--	4.520									
12 -230	--	--	118.85									
12 Total Weight	--	--	162.25									
13 +5	266	--	0.650									
13 -5+10	--	--	1.630									
13 -10+18	--	--	0.710									
13 -18+35	--	--	0.640									
13 -35+60	--	--	0.420									
13 -60+120	--	--	0.390									
13 -120+230	--	--	10.580									
13 -230	--	--	76.62									
13 Total Weight	--	--	91.64									
14 +5	266	--	< 0.001									
14 -5+10	--	--	0.090									
14 -10+18	--	--	0.250									

CERTIFICATION: [signature]

Report

U.S.95, Bellgrove to Mica
Project No. DHP-NH-CM-5110(119)

Mica Bay Hydrographic Survey Report

Prepared for

Idaho Transportation Department and Idaho Department of Environmental Quality

September 2002

PROFESSIONAL LAND SURVEYOR
REGISTERED
8024
9-16-02
STATE OF IDAHO
JOHN C. SLONAKER

John C. Slonaker, P.L.S.

CH2MHILL

Purpose

The purpose of this report is to document the hydrographic surveying methods used to develop the attached bathymetric map of Mica Bay as outlined in the June 26, 2002, *Methodology for Impact Assessment of South Fork Mica Creek, Mica Creek and Mica Bay in Relation to the U.S. 95 Bellgrove to Mica Project*. This methodology was approved by the Idaho Department of Environmental Quality on July 9, 2002.

Methods

Overview

Mica Bay was surveyed from July 8, 2002 through July 19, 2002, during Coeur d' Alene Lake summertime full-pool conditions. Two different surveying techniques were used to generate the bathymetric map of Mica Bay. A Global Positioning System (GPS) survey using a Lieca SR530 GPS system and Geodetic Real Time Kinematic (RTK) methods recorded rod positions during the manual survey of the bottom of the bay in water depths up to 9.6 meters (31.5 feet). Depth-sounding surveys of the bottom of the bay were performed using a Reson Seabat 8101 multibeam sonar. The depth sounding work was conducted in water depths of approximately 1 meter (3.3 feet) to 28.6 meters (93.9 feet). Therefore, overlapping portions of the study area were surveyed using both techniques.

Depth sounding survey personnel incorporated a Trimble-based GPS system to track vessel locations during the depth sounding surveys in deep water. The system consisted of a Trimble 4000SSE Surveyor base station set up on existing Mica Bay control monuments and a Trimble 4000SSE GPS rover collecting RTK positional data in the vessel. Survey personnel chose the Trimble system in order to gain efficiency by using equipment compatible with the experience of the depth sounding crew.

The manual survey equipment consisted of the Leica GPS SR 530 Real Time Kinematic (RTK) System base station and remote rover unit with a GPS antenna attached to a fabricated survey rod consisting of interchangeable lengths of 2.5-centimeter (1 inch) diameter electrical conduit mounted on a 10 centimeter (4-inch) diameter foot. A 6.7-meter (22-foot) pontoon boat was used as the manual survey vessel because it was able to access water depths less than 0.3 meters (1 foot). Conventional surveys, used to supplement the GPS system coverage, were conducted with a Leica TCA1101 Theodolite and Lieca NA-2 engineer's level.

Except for equipment modifications described above, a detailed description of the proposed depth sounding equipment and associated survey methodology, is found in Appendix A in the June 26, 2002, *Methodology for Impact Assessment of South Fork Mica Creek, Mica Creek and Mica Bay in Relation to the U.S. 95 Bellgrove to Mica Project*.

Survey Control and Water Surface Elevation

The original Bellgrove to Mica Project (DHP-NH-CM-5110(119); Key No. 2815 horizontal survey control system is based on the NAD83 State Plane Coordinate System 1992 – West Zone (SPC) referenced to the High Accuracy Reference Network (HARN) point IDTD 1 COEU GPS. The horizontal survey control uses a combined scale factor (CSF) of 0.999910512 to project a project specific ground control datum. The basis of vertical control is NGS monument CL 2. CL-2 is a First Order Horizontal Control Station with an adjusted VERTCON elevation of 764.9m (2510 feet). The calculated VERTCON elevation was revised by a subsequent ITD conventional vertical control survey. Using the National Vertical Geodetic Datum of 1929 (NVGD29), ITD established an elevation of 764.783m (2509.126 feet) on CL-2 which became the basis of vertical control for both the Bellgrove to Mica U.S. 95 Project and the Mica Bay surveys.

The horizontal and vertical control systems used for the Mica Bay surveys are an extension of the U. S. 95; Bellgrove to Mica Project survey control used for the design and construction of U. S. 95. Five additional survey control monuments were set at inter-visible points around Mica Bay. The additional Mica Bay survey control monuments were used to control both the manual and depth sounding surveys. An order A horizontal GPS station "STMA GPS" was used to correlate and check the horizontal control system.

Further checks on the vertical control included a conventional, closed level run from an existing U.S. 95 project survey control monument to four of the five monuments set for the Mica Bay survey. The Mica Bay survey control points are summarized in the Mica Bay Control Survey table on Page 5.

Daily water levels were monitored from one to three times per day using a single staff gage consisting of two sections of a fiberglass level rod attached to the southern most corner of the Kootenai County Pier. Conventional level techniques were used to set the gage at a true elevation corresponding to the graduated marks on the rod. This method provided a direct reading of the elevation of the water surface without additional calculation. The centrally located staff gage position on the Kootenai County Pier was visible during a major portion of the manual and depth sounding surveys.

Due to the central location of the staff gage and the density and visibility of the Mica Bay survey control, no additional staff gages were set. However, when the gage was not visible, water surface elevations were measured from different locations using conventional survey techniques. A summary of the water surface elevations is given in the table labeled "Water Surface Elevations" on Page 6.

Water surface elevations measured both during the pre-survey mobilization period and during the time of the actual Mica Bay survey, show a steady increase in elevation during the course of the project. The elevations ranged from 647.472m (2124.25') to 647.595m (2124.65') over a period of 21 days from June 28 to July 18, 2002. These elevations correlate to the WWP elevations used at the Post Falls gauging station as 2127.25' to 2127.65' (description of WWP elevation datum on page 6).

The Mica Bay surveys were overlaid on a digital copy of an aerial photograph taken on April 19, 1999. The surface elevation on this date, was 2126.23 feet in WWP datum or 2123.23 feet in the NVGD29 Mica Bay elevation datum.

Map Generation

Survey point data obtained from the depth sounding surveys and the manual surveys were loaded into the Bentley MicroStation-based "SelectCAD" and "SelectSurvey" computer software for processing into a combined digital terrain model (DTM). The process for combining the two surveys is summarized in the following steps:

- A conversion of the depth sounding data from SPC Grid elevations to SPC project datum was accomplished by applying the CSF conversion factor 0.999910512 to the ASCII formatted coordinate point file (Mica_SPC_xyz.pts) using Microsoft Excel.
- The manual surveys were processed using Leica Ski-Pro Version 2.1 for the GPS data and Leica Survey Office Version 2.0 with output files directly compatible for import into Bentley's "SelectSurvey" and "SelectCAD" software (MICABAY2.dtm).
- The ASCII points, from the depth sounding surveys, were then imported into a digital terrain model (DTM) along with the manual survey points as random points, and re-triangulated to form a DTM of the entire project (MB_Combined.dtm).

In order to check the contours generated from the MB_Combined.dtm, they were overlaid on the original contour maps generated from both the manual surveys and depth sounding surveys for visual comparison. In two sections of the mapping, anomalies appeared between the two surveys, which warranted further checks.

An Isopach surface was created showing the difference between the depth sounding surveys and the manual surveys that indicated a difference in elevation ranging from 0.013m (0.04 feet) to 0.340m (1.10 feet). This documents the good correlation between the data collected from the two survey methods. However, a cluster of points in the northeast corner of the survey and another in the southeast corner, near the break to deep water, indicated differences of up to 2 meters (6.56 feet). Further investigation indicated that the manual topographic shots taken in deep water were spaced too far apart to accurately catch the toe of slope into deeper water. In this case, the depth sounding surveys complemented the manual surveys and resolved the issue of differences between the surveys.

A contour map showing ½- meter (1.64 foot) intervals, created from MB_Combined.dtm, was combined with planimetrics from the manual surveys and overlaid on a scanned digital image of Mica Bay taken from an uncontrolled aerial photograph dated April 19, 1999.

The process utilized the Intergraph "IRAS\C" raster imaging software incorporated into MicroStation. Using IRAS\C, the aerial photograph was referenced to photo identifiable control points on the ground (edge of boat ramps, bridge abutment walls, culverts, etc.). The image reference process allowed the contours and survey planimetrics to be overlaid on the aerial photograph for a visual reference for locating the extent of the surveys.

It is important to note that the digital aerial photographic image is used for visual reference only. Since the aerial photograph is uncontrolled and has not been rectified to actual ground elevations, distortion is present in the aerial image that intensifies from the center of the photograph to the outer edges. In this regard, the actual manual surveys and depth sounding surveys cannot exactly overlay the topographic features shown in the aerial photograph.

Results

Bathymetric Map

The combined bathymetric map covers an area of 112 hectares (277 acres). The combined total is based on 38 hectares (94 acres) mapped during the manual survey, and 94 hectares (232 acres) mapped during the depth sounding survey (approximately 20 hectares or 49 acres overlap between the two surveys. The combined bathymetric map is based on 153,300 survey points, 6,500 using manual techniques and 146,800 using depth sounding sounding.

Using the U.S. National Map Accuracy Standards for a 0.5-meter (1.64-foot) contour map, (no more than 10% of the elevations tested should be in error more than one-half the contour interval), a comparative analysis was performed on 82 point elevations within the area of overlap between the manual surveys and combined DTM. Comparative testing indicates that 14% of the points fall outside the 0.250-meter specification. However, the same comparative analysis of the combined DTM and depth sounding data demonstrates that only 1% of the elevations fall outside the map accuracy specification. In accordance with the Standard, spacing of the manual shots is a consideration when determining the apparent vertical error. In this regard, the depth sounding survey enhanced the manual survey and produced a combined DTM (MB_Combined.dtm) that meets or exceeds National Map Accuracy Standards.

Field Observations

An attempt was made to locate water intake structures in the study area during the field survey from the boat. Although water clarity was good, with visibility estimated at approximately 3.0 to 3.7 meters (10 to 12 feet) (variable depending upon aquatic plant density), the survey personnel were unable to visibly identify the location of any water intake structures. In some areas near boat docks adjacent to the county boat ramp, segments of small diameter plastic pipes extending from the shoreline were visible in the shallow areas, but in all cases they extended into deep water where they were no longer visible from the surface. Therefore, the exact location of any intake structures could not be confirmed achieved during the survey.

A significant finding of the field survey was the water depth and accessibility of the Mica Creek channel into the bay. Survey personnel were able to navigate the 6.7 meter (22 foot) pontoon boat used for the manual survey all the way to Loff's Bay Road in both Mica Creek and the channel to the south that flows through a 1.5 meter (5-foot) by 1.2 meter (4-foot) oval culvert. Measured water depths in the Mica Creek channel, from the Loff's Bay Road Bridge to the County boat ramp parking area, ranged from 1.238 meters (4.06 feet) to 1.73 meters (5.70 feet).

MICA BAY CONTROL SURVEY
JULY, 2002

State Plane Conversion
Idaho Transportation Department
CH2M HILL Project No. 173986.A1.01
GPS Geodetic Control Survey (Static & RTK)
Horizontal Datum: NAD83 (1992) SPC Idaho West Zone
Vertical Datum: NVGD29 DATUM ADJUSTED BY ITD
Average C.S.F. = 0.999910512 PER ITD BELLGROVE TO MICA PROJECT

Name	Position	Grid Northing	Grid Easting	Project Northing	Project Easting	Elev. (meters)
CL 2	Published	649805.798	710578.980	N/A	N/A	
IDTD COEU	Published	675750.332	721535.392	N/A	N/A	
STMA GPS	Published	627942.484	738854.021	N/A	N/A	
530 *	Static	659865.194	714592.555	659924.249	714656.508	657.712
531 **	Static	660283.011	715707.487	660342.104	715771.540	649.571**
MB1	RTK/Diff Lev	659807.593	716505.408	659866.643	716569.533	649.495
MB2	RTK/Trig Lev	659336.514	716750.453	659395.522	716814.600	648.673
MB3	RTK/Diff Lev	659649.141	716101.921	659708.177	716166.009	648.709
MB4	RTK/Diff Lev	659930.132	716105.709	659989.193	716169.797	649.801
MB5	RTK/Diff Lev	659844.956	716434.313	659904.009	716498.431	650.385

* = Original highway project control (Bellgrove to Mica)

** = Held as vertical control bench mark for level loop

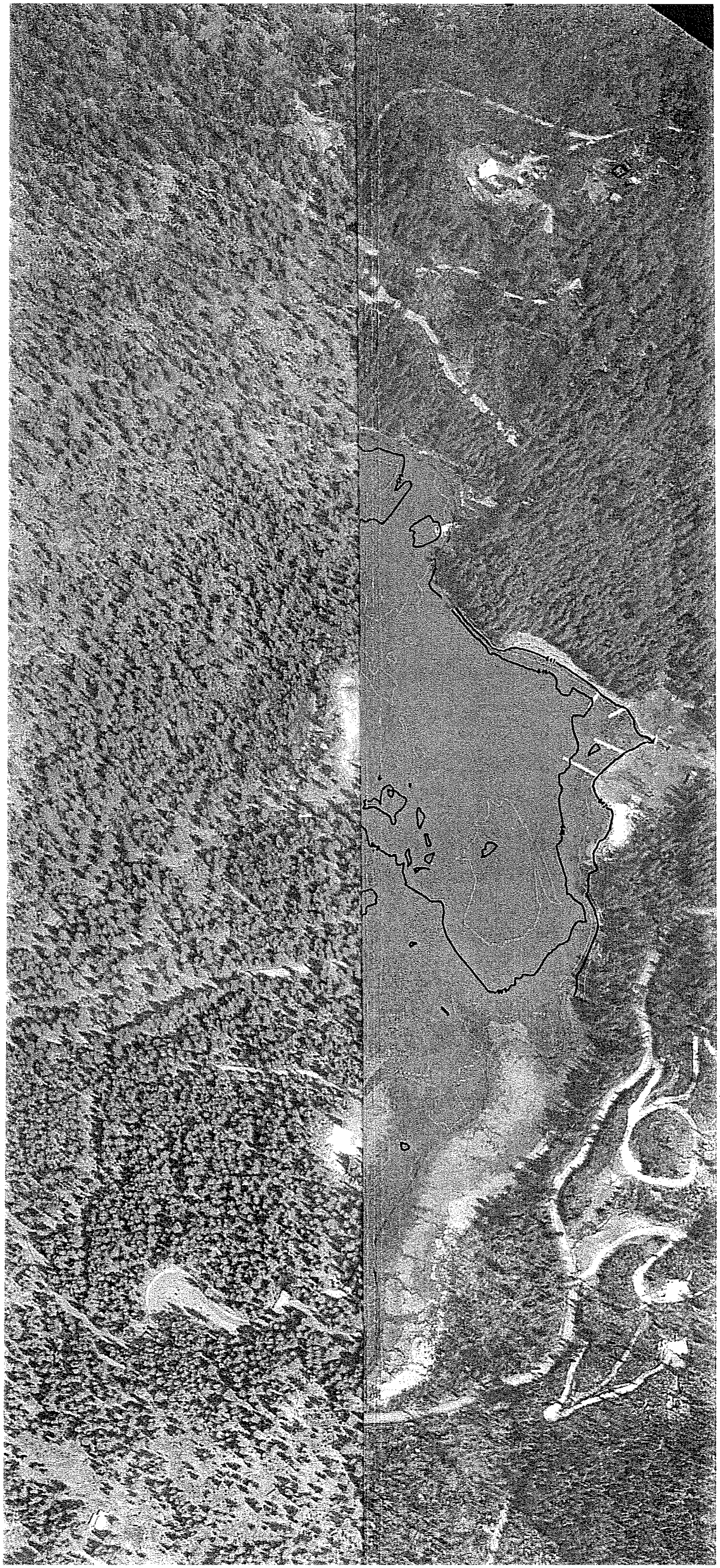
Mica Bay Daily Water Surface Elevations

		Elevation (NVGD29)		
Date	**Time**	**Meters**	**Feet ****	**Method**
06/28/2002	9:25 AM	647.472	2124.25	Trig
06/28/2002	10:00 AM	647.463	2124.22	Trig
07/10/2002	3:55 PM	647.503	2124.35	Gage
07/10/2002	5:03 PM	647.503	2124.35	Gage
07/11/2002	2:49 PM	647.518	2124.40	Gage
07/12/2002	7:39 AM	647.534	2124.45	Gage
07/12/2002	11:28 AM	647.534	2124.45	Gage
07/12/2002	2:01 PM	647.579	2124.60	Gage
07/15/2002	5:46 PM	647.579	2124.60	Gage
07/16/2002	10:14 AM	647.579	2124.60	Gage
07/17/2002	9:02 AM	647.595	2124.65	Gage
07/18/2002	8:13 AM	647.595	2124.65	Gage
	Average	**647.538**	**2124.46**	

** Lake Coeur d' Alene water surface elevations measured at the staff gage at the Post Falls outfall are measured in Washington Water Power (WWP) vertical datum. The WWP datum is 3.00 feet higher than the ITD project adjusted datum used for the survey of U.S. 95 and Mica Bay. Therefore, 3.00 feet must be added to the daily elevations to correlate with the Post Falls staff gage. In other words;

2124.46′ (NVGD29) + 3.00′= 2127.46′ (WWP Datum)

The Post Falls gage elevation and the WWP elevation datum is based on the USGS benchmark "2157", PID SV0418 located at the southeast corner of the Idaho State Bank Building. The accepted elevation of the U.S. Geological Survey benchmark "2127" at the time of the placement of the Post Falls staff gage was 2,157.40 feet. The NVGD29 (Mica Bay survey) published elevation on benchmark "2157" is 2154.41 or 3.01 feet lower than the WWP elevations. The 3.00-foot correction has been accepted throughout the community and can be referenced in Case No. 91-85186 Kootenai County District Court.



Appendix C

Mica Bay Interim Core Sampling Report

Report

U.S.95, Bellgrove to Mica
Project No. DHP-NH-CM-5110(119)

Mica Bay
Interim Core Sampling Report

Prepared for

Idaho Transportation Department and
Idaho Department of Environmental Quality

November 2002

CH2MHILL

Purpose

The purpose of this report is to:

1. Describe the sediment core sampling effort in Mica Bay
2. Provide an initial description of the sediment cores
3. Present an initial assessment of the presence or absence of Mt. St. Helen's ash in the cores
4. Provide a description ensuing steps

Methodology and Field Data

Core samples were collected in Mica Bay on August 27 and 28, 2002, during a week-long effort to collect the cores, describe their physical attributes, and process them. A pair of cores were collected at the 10 locations shown in Figure 1. Positioning the sampling vessel was done using GPS equipment.

Each core was collected using an electric vibracorer fitted with a 4-inch (outside diameter) core barrel that housed a transparent, rigid CAB (cellulose acetate butyrate) core liner tube (inside diameter = 3.6 inch). Sampling was done from a 20-foot pontoon barge. Each core was collected, extracted from the vibracorer, capped, and transported in the core liners for either processing or archiving.

Due to the length of the cores, the cores contained within the liner tubes were extracted from the vibracorer in a horizontal position (a process that required approximately 5 minutes). The tubes with cores were then transported to shore in an upright position.

Cores were transported in a 16-foot long, closed-trailer truck from Mica Bay to the Idaho Transportation Department supply yard for processing. During transport, the core tubes were kept vertical if less than 7-feet long (some tubes with shallow recovery were cut in the field), or on an angle as close to vertical as possible.

Table 1 lists the core samples collected, vibracorer penetration depth, sample recovery depth, and whether the core was processed or archived.

TABLE 1
Mica Bay Core Sample Inventory and Field-Collection Data

Core Number	Penetration Depth (ft)	Recovery Depth (ft)	Processed	Archived
1A	10	5.8		Yes
1B	10	7.4	Yes	
2A	6	4.7	Yes	
2B	7	4.1		Yes

TABLE 1
Mica Bay Core Sample Inventory and Field-Collection Data

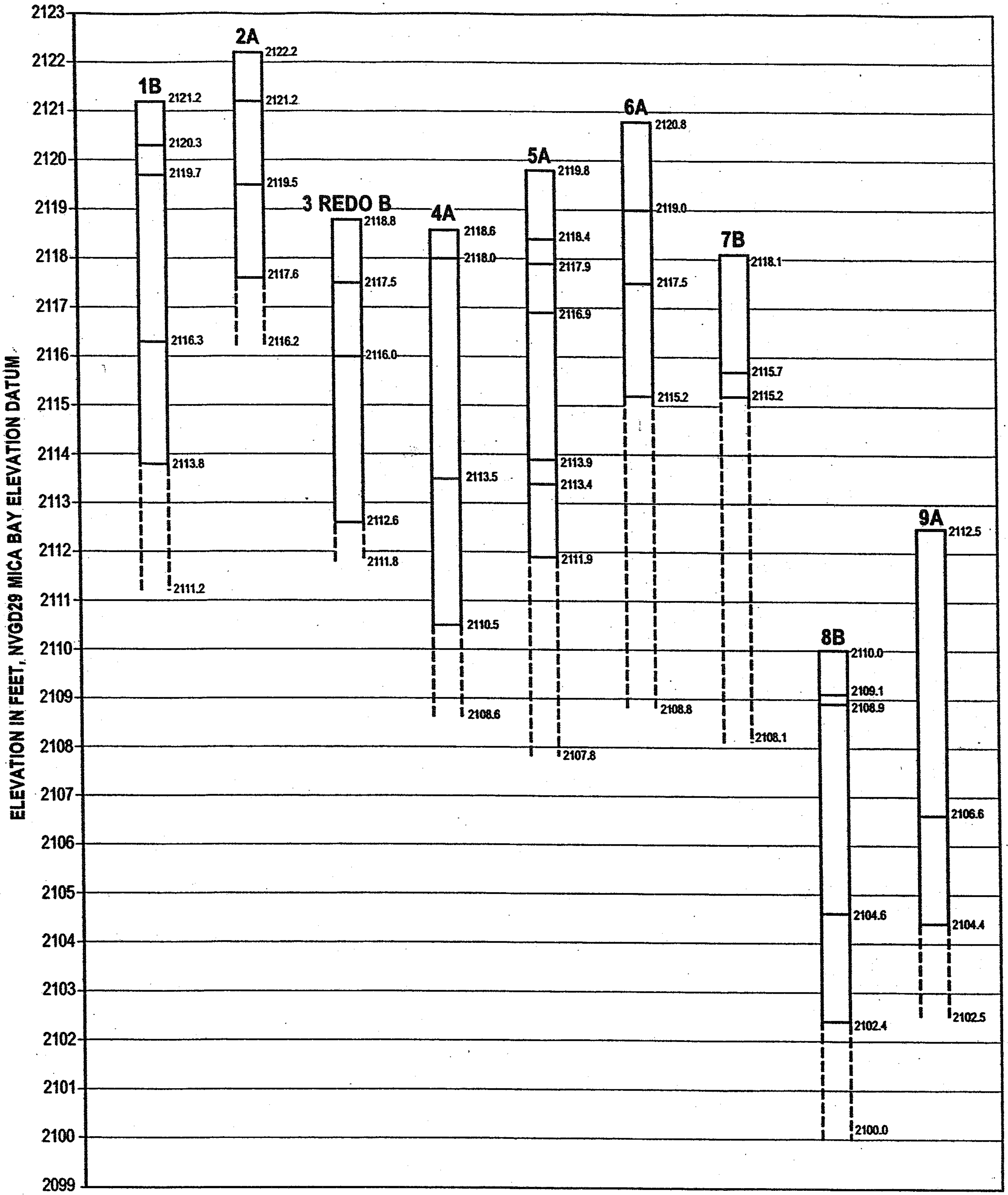
Core Number	Penetration Depth (ft)	Recovery Depth (ft)	Processed	Archived
3B extra*	10	3.2		Yes
3 redo A	8	5.9		Yes
3 redo B	7	6.3	Yes	
4A	10	8.1	Yes	
4B	10	8.6		Yes
5A	10	7.9	Yes	
5B	12	7.0		Yes
6A	12	5.6	Yes	
6B	10	5.7		Yes
7A	10	2.1		Yes
7B	10	2.9	Yes	
8A	10	7.4		Yes
8B	10	7.6	Yes	
9A	10	8.1	Yes	
9B	10	7.2		Yes
10A	10	4.3		Yes
10B	10	7.2	Yes	
10 redo A**	10	7.3		Yes

*Significant boat drift occurred from wind and wave action during the first attempt to core this location; resulting in coring outside of the proposed location (and outside the targeted submerged channel). The first core outside the proposed location was discarded due to lack of recovery; however, the second (3B extra) was archived. The proposed location was resampled (denoted as "3 redo A" and "3 redo B") after conditions improved.

**10 redo A was collected in an attempt to attain a recovery depth more similar to 10B (as compared to 10A).

Core processing consisted of removing one-half (lengthwise) of the core liner and then scraping away the very thin layer of sediment that was in contact with the liner. Then, visual descriptions of sediment color, grain size, composition, and layering (if apparent) were noted. If odor was detected, it was also noted. A tape measure was used to record the core length and associated depths (from the top of the core) of individual layers or special features. Photographs were taken of each core.


CORE 1
CORE 2
CORE 3
CORE
CORE 5
CORE 6
CORE 7
CORE 8
CORE 9
CORE 10



NOTES:

1. Solid lines represent visible changes identified in recovered core sedments.
2. Dashed lines indicate penetration depth.
3. Core 10B not shown due to scale. Top Elevation = 2079.2; Bottom Recovery = 2072.0; Penetration = 2069.2.

FIGURE 2
SCHEMATIC OF MICA BAY CORES PROCESSED AUGUST 28-30, 2002

173986.A1.20

Appendix A

Mica Bay Cores:
Schematics and Descriptions

Layer	Elevation (top)	COLOR	DESCRIPTION
1	2121.2	OLIVE BLACK (5 Y 2/1)	0" TO 10": ORGANIC; SILT/CLAY/FINE SAND (FINING UPWARD); ORGANIC DEBRIS OF GRASSES, TWIGS, BARKS; CHAOTIC DISTRIBUTION OF ORGANICS.
2	2120.3	LIGHT OLIVE GRAY (5 Y 6/1) IN A DARK GREENISH GRAY, FINER-GRAINED MATRIX (5 Y 4/1)	10" TO 18": COARSENING OF GRAINS WITH DEPTH; COARSE SAND AT BASE, FINE SAND AT TOP; SAND IS < 1 PERCENT MICACEOUS; BASE OF LAYER IS VERY DISTINCT, KNIFE SHARP, ABRUPT; COARSE SANDS TO 3 MM DIAMETER; SANDS ARE SUBROUND; < 1 PERCENT MICA SUBANGULAR; UPPER 18" VERY LIKELY ONE GRADED UNIT FINING UPWARD.
3	2119.7	DARK GREENISH GRAY (5 G 4/1)	18" TO 58 1/2": SILTY CLAY; NO MICA; VERY DENSE AND HARD; IRREGULAR BROWNISH-BLACK, ORGANIC-RICH NODULES IN UPPER 6" OF THIS SEGMENT, THEN ALL VERY FINE-GRAINED BELOW; WITHIN CLAYS ARE IRREGULAR REDDISH-BROWN/YELLOW MOTTLING, VERY SMALL SCALE TO A FEW MILLIMETERS APART AT LARGEST; ABUNDANT ROOTS TOWARD BASE (53" TO 58 1/2"). 32" TO 49" - LIGHT COLORED, DRY, DENSE, CONCOIDAL BREAKING, PALE/GREENISH/GRAY TO PALE GREEN. SUBSAMPLED POTENTIAL ASH. DRIES TO A WHITE POWDER/LIGHT GRAY ON FINGERS. 47" TO 53" - 6" LONG ROOT
4	2116.3	COARSE SAND, LIGHT OLIVE GRAY (5 Y 6/1) IN A DARK GREENISH GRAY MATRIX	58 1/2" TO 88 1/2": POORLY GRADED; SUBANGULAR; FINE- TO COARSE-GRAINED SAND; DOES FINE UPWARD SOMEWHAT, BUT POORLY ORDERED; NO LENSING OF GRAINS; COARSER-GRAINED SANDS AT BASE, RANDOM, UP TO 1/2 CM INDIVIDUAL ANGULAR GRAINS; LITTLE BLACK SPECS MAKING UP < 3 PERCENT; ONE BLACK GRAIN AT 79" WAS CARBONIZED WOOD; MICA IS PERVASIVELY DISTRIBUTED AT < 3 PERCENT; QUARTZ/FELDSPATHIC SAND DOMINATES; AT 58 1/2" KNIFE-EDGE SHIFT DOWNWARD FROM CLAY TO SAND; NO VEGETATION IS PRESENT IN SAND, BUT VEGETATION IS PRESENT IN ABOVE CLAY.
Base	2113.8		

CORE 1B

ELEVATIONS BASED ON THE NVGD29 MICA BAY ELEVATIONS DATUM

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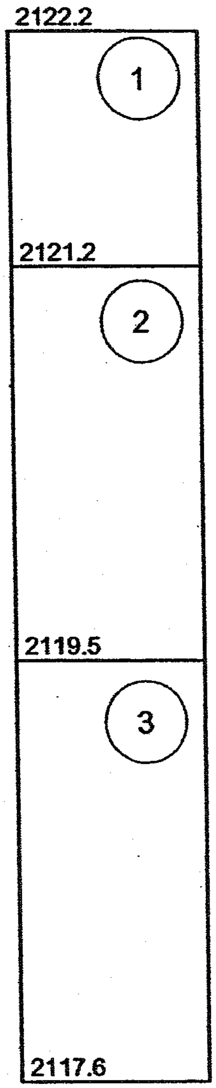
COLOR



OLIVE BLACK (5 Y 2/1)

BETWEEN DARK GREENISH GRAY (5 GY 4/1) AND (5 G 4/1)

MOTTLING RANGING FROM DARK GREENISH GRAY (5 GY 4/1) TO DARK YELLOWISH BROWN (10 Y 4/2)

DESCRIPTION

1. 0" TO 12 1/2": CLAYEY SILT; LOTS OF ROOTS; NO BLADES; VEGETATION IS NOT MATTED; NO LAYERING; POORLY MICACEOUS; VERY-FINE GRAINED MICA. VERY TOP HAS SOME VEGETATION GROWTH. FINE PIECES OF WOODY DEBRIS, SOME OCCASIONAL BLADED GRASS. BROWNER TOWARD THE BASE. CONTACT TO NEXT SEGMENT IS ≤ 1", JUST ABOVE NEXT CLAY SEGMENT IS MOTTLED REDDISH-BROWN SEDIMENT.

2. 12 1/2" TO 33 1/2": WET; SILTY CLAY; NO MICA; VERY UNIFORM, NO LAYERING, ONE LARGE MASS (LOOKS LIKE ASH POSSIBLE). ONLY OCCASIONAL WOODY FRAGMENT. UPPER END HAS HIGHER MOISTURE CONTENT, MUDDY; LOWER END IS MUCH DRYER AND CONCHOIDAL FRACTURING. TRANSITION TO NEXT LOWER SEGMENT VERY GRADUAL > 2".

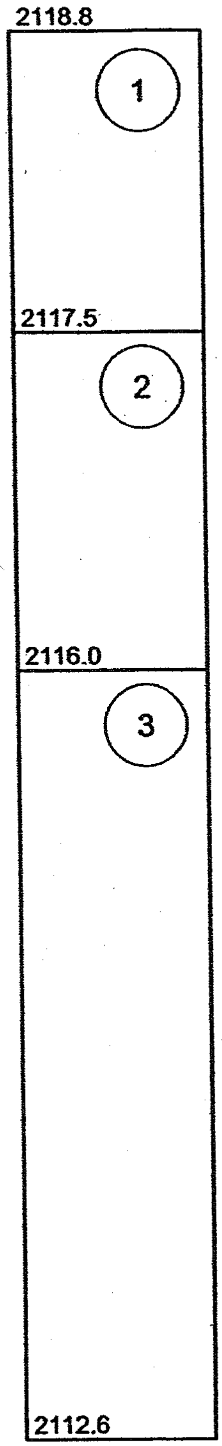
3. 33 1/2" TO 56": VERY DRY; HIGH DEGREE OF MOTTLING; SILTY CLAY TO CLAYEY SILT; MICACEOUS, MICA IS VERY-FINE GRAINED; MOTTLING OF RUSTY TO GRAY WITH OVERALL BROWN DOMINATING GRAY. LONG TRANSITION FROM ~33 1/2" TO 41". MOTTLING IS MAJOR DIFFERENCE BETWEEN THIS SEGMENT AND LOWER PART OF 12 1/2" TO 33 1/2".

CORE 2A

ELEVATIONS BASED ON THE NVGD29 MICA BAY ELEVATIONS DATUM

COLOR

DESCRIPTION



1. OLIVE BLACK (5 Y 2/1)

   0" TO 16": SILTY; SLIGHTLY MICACEOUS; SILT-DOMINATED TRANSITION FROM BLUE GRAY TO BROWNISH; ONLY UPPER 4" SEEM TO CONTAIN VEGETATION. VERY TOP IS WOODY DEBRIS AND TWIGS. BOTTOM ~3" TO 4" TRANSITIONS TO CLAY BELOW.

2. GREENISH BLACK (5 GY 2/1)

   16" TO 34": DRY CLAY, WELL COMPACTED, CONCHOIDALLY FRACTURING; NO AQUATIC/GRASSY VEGETATION OR MICA. THIN, HAIR-LIKE ROOTS ONLY.

3. DUSKY YELLOWISH BROWN (10 YR 2/2)

   34" TO 75": UPPER-END TRANSITION ZONE INTO CLAY IS ~4" THICK, NOT SUDDEN TRANSITION. HIGHLY MICACEOUS; NO SORTING OR LAYERING; SCATTERED ORGANIC DEBRIS OF GRASS/ROOTS. DEBRIS UP TO 1 CM ACROSS. DEBRIS, NOT IN-PLACE GROWTH. VARIABLE INCREASES/DECREASES IN MICA, BUT NO SORTING.

CORE 3 REDO B

ELEVATIONS BASED ON THE NVGD29 MICA BAY ELEVATIONS DATUM

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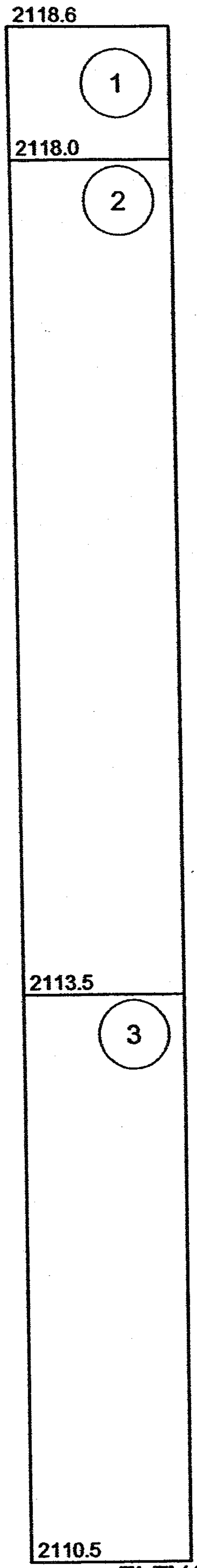


COLOR	DESCRIPTION
DUSKY YELLOWISH BROWN (10 YR 2/2)	(1) 0" TO 8": COARSE MIXED FRACTION; MICA IS 5 TO 10 PERCENT AND QUITE VISIBLE. INDIVIDUAL ROCK FRAGMENTS ARE ANGULAR (SOME SUBANGULAR BUT MAJORITY ANGULAR. UP TO 3 MM IN DIAMETER IN LONGEST DIMENSION.
DUSKY YELLOWISH BROWN (10 YR 2/2)	(2) 8" TO 61": HIGHLY ORGANIC RICH; PARTIALLY CARBONIZED AT ITS BASE; TRANSITIONS TO LIGHT BROWN, LIKE DRY VEGETATION. BOTTOM 12" TO 18" OF THIS SEGMENT IS CARBONIZED, ~ 60-70 PERCENT VEGETATION; ABOVE THAT IS 40-50 PERCENT VEGETATION. UNIFORMLY DISTRIBUTED ORGANIC MATTER IN BOTH ROOTS AND LEAVES / STEM THROUGHOUT. IN LOWER SECTION THE CARBONIZED ZONE SEEMS MORE DENSELY DOMINATED BY ROOT MASS RATHER THAN GRASS.
DARK YELLOWISH BROWN (10 YR 4/2)	(3) 61" TO 97": ORGANIC DEBRIS < 10 PERCENT; APPROXIMATELY < 1 PERCENT MICA.

CORE 4A

ELEVATIONS BASED ON THE NVGD29 MICA BAY ELEVATIONS DATUM

CH2MHILL

ALS Environmental

CHEMICAL ANALYSIS REPORT

Date:	October 23, 2002
ALS File No.	P9350
Report On:	Ash Analysis
Report To:	**CH2M Hill Inc.** 700 Clearwater Lane Boise, ID USA 83712
Attention:	**Mr. Steve Miller**
Received:	September 18, 2002

ALS ENVIRONMENTAL
per:

Can Dang, B.Sc. - Project Chemist
Frederick Chen, B.Sc. - Special Projects Manager

File No. P9350

RESULTS OF ANALYSIS - Sediment/Soil

Sample ID		Ash? 1B	Ash? 2A	Ash? 3 Redo B	Ash? 6A
ALS ID		*1*	*2*	*3*	*4*
Physical Tests					
Moisture	%	43.7	43.9	47.0	53.2
Nutrients					
Ammonia Nitrogen	N	13.2	2.67	7.26	17.2
Available Phosphorus	P	-	5	32	6
Total Kjeldahl Nitrogen	N	-	0.05	0.13	0.14
Nitrate Nitrogen	N	2.4	1.3	1.4	1.2
Organic Parameters					
Total Organic Carbon	C	1.3	0.36	1.34	1.12

Remarks regarding the analyses appear at the beginning of this report.
Total Organic Carbon results are expressed as percent, dry weight basis.
Results are expressed as milligrams per dry kilogram except where noted.
Total Kjeldahl Nitrogen results are expressed as percent.
< = Less than the detection limit indicated.

ALS Environmental

CHEMICAL ANALYSIS REPORT

Date: June 16, 2003

ALS File No. S8651

Report On: 173986.A1.20 Soil Analysis

Report To: **CH2M Hill Inc.**
700 Clearwater Lane
Boise, ID, USA
83712

Attention: **Mr. Steve Miller**

Received: May 27, 2003

ALS ENVIRONMENTAL
per:

Frederick Chen, B.Sc. - Special Projects Manager
Can Dang, B.Sc. - Project Chemist

ALS CANADA LTD.
1988 Triumph Street, Vancouver, BC Canada V5L 1K5
Phone: 604-253-4188 Fax: 604-253-6700 Website: www.alsenviro.com

File No. S8651

RESULTS OF ANALYSIS - Sediment/Soil

Sample ID		6 P2	7 SU1	8 SU2	9 SP1	10 SP2
ALS ID		*6*	*7*	*8*	*9*	*10*
Physical Tests						
Moisture %		9.1	5.4	3.0	3.0	2.5
Nutrients						
Available Phosphorus	P	287	16	20	12	13
Total Kjeldahl Nitrogen	N	4.7	5.5	1.8	2.1	2.4
Leachable Nutrients						
Ammonia Nitrogen	N	0.3	1.7	0.7	0.3	0.9
Nitrate Nitrogen	N	4.29	0.41	0.33	0.26	0.40
Total Phosphate	P	11.0	0.61	0.23	0.39	0.56
Organic Parameters						
Total Organic Carbon	C	1.18	0.28	0.21	<0.05	<0.05

Results are expressed as milligrams per dry kilogram except where noted.
Total Organic Carbon results are expressed as percent, dry weight basis.
< = Less than the detection limit indicated.

File No. S8651

RESULTS OF ANALYSIS - Sediment/Soil

Sample ID		16 M2
ALS ID		*16*
Physical Tests		
Moisture %		11.7
Nutrients		
Available Phosphorus	P	12
Total Kjeldahl Nitrogen	N	1.7
Leachable Nutrients		
Ammonia Nitrogen	N	0.4
Nitrate Nitrogen	N	0.28
Total Phosphate	P	0.62
Organic Parameters		
Total Organic Carbon	C	0.28

Results are expressed as milligrams per dry kilogram except where noted.
Total Organic Carbon results are expressed as percent, dry weight basis.
< = Less than the detection limit indicated.

Appendix 2 - METHODOLOGY

Outlines of the methodologies utilized for the analysis of the samples submitted are as follows

Moisture in Sediment/Soil

This analysis is carried out gravimetrically by drying the sample at 103 C for a minimum of six hours.

Recommended Holding Time:
Sample: 14 days
Reference: Puget
For more detail see ALS Environmental "Collection & Sampling Guide"

Conventional Parameters in Sediment/Soil

These analyses are carried out on a leachable basis. The procedure involves mixing the sample with reagent grade water in a one to ten ratio and leaching for several hours. The leachate is filtered and analyzed in accordance with procedures described in "Methods for Chemical Analysis of Water and Wastes" (USEPA), "Manual for the Chemical Analysis of Water, Wastewaters, Sediments and Biological Tissues" (BCMOE), and/or "Standard Methods for the Examination of Water and Wastewater" (APHA). Further details are available on request.

Total Carbon, Total Organic Carbon and Inorganic Carbon in
Sediment/Soil

This analysis is carried out in accordance with U.S. EPA Method 9060A (Publ. # SW-846 3rd ed., Washington, DC 20460). Total Carbon is determined by high temperature oxidation of carbon to carbon dioxide which is then measured by means of a nondispersive infrared analyzer. Inorganic Carbon is determined by reaction with phosphoric acid to convert all carbonates to carbon dioxide which is also measured by means of a nondispersive infrared analyzer. Total Organic Carbon is determined as the difference between Total and Inorganic Carbons.

Recommended Holding Time:
Sample: 14 days
Reference: Puget
For more detail see ASL "Collection & Sampling Guide"

End of Report

USGS Surface Sediment Inorganic Data

Sample	Depth	SA	TOC	Ag	Cu	Pb	Zn	Ni	Co	Cd	Cr	Hg	As	Sb	Se	Fe	Mn	Al	Ti
	meters	m /g	wt. %	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	wt. %	wt. %	wt. %	wt. %
Couer d'Alene # 1	26.5	27.2	5.6	8	121	2960	6500	27	22	141	52	2.7	100	42	0.4	4.4	0.18	7.7	0.35
Couer d'Alene # 2	8.5	28.1	7.4	10	123	4790	6100	26	22	103	48	2.8	23	39	0.3	4.0	0.13	7.4	0.32
Couer d'Alene # 3	10.6	14.0	10.0	2	53	940	4400	17	9	83	34	0.62	20	8.0	0.3	2.4	0.05	5.5	0.28
Couer d'Alene # 4	1.8	14.8	10.4	3	63	1390	9100	24	10	148	33	0.74.	17	11	0.3	2.1	0.04	5.6	0.27
Couer d'Alene # 5	5.0	23.1	7.8	<1	26	140	570	18	10	13	32	0.12	16	2.0	0.3	2.0	0.07	5.1	0.21
Couer d'Alene # 6	15.8	47.5	4.6	11	131	3340	7100	31	36	133	56	4.9	94	59	0.6	4.9	0.30	8.1	0.33
Couer d'Alene # 7	36.7	52.3	3.6	5	76	2130	5900	24	29	96	41	1.9	110	21	0.4	5.1	0.92	7.3	0.31
Couer d'Alene # 8	39.0	38.7	4.2	7	109	2770	6100	23	18	131	49	2.8	65	30	0.4	4.4	0.18	7.9	0.33
Couer d'Alene # 10	35.0	20.9	5.7	4	75	1370	7200	24	17	133	43	1.5	69	22	0.3	3.3	0.08	7.5	0.37
Couer d'Alene # 11	38.1	41.2	4.1	7	108	2650	5800	28	30	112	49	2.6	120	41	0.4	5.2	0.42	7.9	0.33
Couer d'Alene # 12	35.6	53.9	3.2	5	77	1830	4900	25	29	87	41	1.9	110	24	0.3	5.4	1.08	7.3	0.30
Couer d'Alene # 13	38.5	45.6	2.5	12	150	3810	6400	32	38	96	52	3.9	180	67	0.4	5.7	0.44	8.3	0.31
Couer d'Alene # 14	35.1	50.2	2.6	7	96	2650	4900	27	29	78	41	2.2	100	32	0.3	5.5	0.48	7.9	0.30
Couer d'Alene # 15	37.3	47.7	2.4	11	150	4170	6500	33	34	88	48	3.3	120	58	0.4	5.5	0.32	8.7	0.32
Couer d'Alene # 16	33.3	45.6	2.7	6	91	1850	5800	28	31	100	47	2.9	110	40	0.4	5.0	0.72	8.1	0.38
Couer d'Alene # 17	34.6	47.3	2.5	9	132	3070	6200	36	38	89	55	3.1	160	54	0.4	5.2	0.44	8.7	0.33
Couer d'Alene # 18	6.0	44.3	2.4	7	106	2490	5400	28	27	9.0	51	2.7	81	35	0.4	5.1	0.41	8.4	0.33
Couer d'Alene # 19	34.5	34.3	2.0	3	73	1290	4500	26	22	85	47	1.7	44	21	0.3	4.4	0.32	8.4	0.34
Couer d'Alene # 20	24.8	30.2	2.2	3	70	1230	4300	27	22	76	53	1.4	66	20	0.3	4.2	0.29	8.7	0.35
Couer d'Alene # 21	11.8	26.1	2.4	1	42	540	2800	24	15	46	47	0.47	33	6.0	0.2	3.8	0.24	8.5	0.35
Couer d'Alene # 22A	2.3	3.6	1.1	<1	9	50	420	14	7	6.0	28	0.32	9.0	1.0	<0.1	1.9	0.05	5.1	0.37
Couer d'Alene # 22B	11.0	16.5	1.8	<1	35	280	2400	26	15	43	50	0.28	38	6.0	0.1	3.3	0.01	9.0	0.39
Couer d'Alene # 23	10.0	12.0	2.3	<1	27	190	1600	20	10	24	41	0.15	21	2.0	0.2	2.7	0.07	7.9	0.36
Couer d'Alene # 24	24.0	24.1	2.1	2	51	700	3300	28	17	57	42	0.96	52	12	0.2	3.7	0.23	8.5	0.35
Couer d'Alene # 25	26.9	35.0	2.8	2	60	1030	3700	29	20	56	39	1.03	73	12	0.3	5.0	0.35	8.2	0.34
Couer d'Alene # 26	21.0	28.3	3.3	2	61	980	3100	31	15	47	48	0.82	59	11	0.4	4.6	0.19	8.2	0.34

Sample	Depth	SA	TOC	Ag	Cu	Pb	Zn	Ni	Co	Cd	Cr	Hg	As	Sb	Se	Fe	Mn	Al	Ti
	meters	m /g	wt. %	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	wt. %	wt. %	wt. %	wt. %
Couer d'Alene # 27	2.5	15.5	5.6	4	81	2170	7200	28	14	157	36	1.4	28	15	0.3	3.1	0.06	8.0	0.36
Couer d'Alene # 28	17.2	19.9	6.6	5	86	1840	6100	26	15	157	38	2.2	57	22	0.4	3.2	0.11	7.9	0.35
Couer d'Alene # 29	34.5	52.4	2.7	7	97	2310	6200	28	35	113	40	3.2	85	44	0.5	5.9	0.83	7.8	0.29
Couer d'Alene # 30	42.7	49.7	2.7	8	112	2540	6400	30	30	120	45	3.4	150	45	0.5	5.1	0.33	8.0	0.32
Couer d'Alene # 31	43.0	45.9	3.1	7	100	2290	6800	23	25	128	45	2.6	104	32	0.5	4.9	0.24	7.8	0.31
Couer d'Alene # 32	41.3	47.5	2.6	8	112	2670	6300	25	30	126	50	2.9	126	39	0.4	5.1	0.28	8.3	0.34
Couer d'Alene # 33	37.2	51.7	2.2	3	64	940	4300	19	26	77	32	1.2	182	16	0.4	4.4	1.60	7.4	0.30
Couer d'Alene # 34	42.3	59.3	2.3	5	79	1370	5800	23	33	114	41	2.5	140	27	0.4	4.8	1.78	7.5	0.31
Couer d'Alene # 35	48.3	50.5	2.5	6	90	2320	5400	23	30	114	42	2.5	75	26	0.4	5.3	0.58	7.1	0.32
Couer d'Alene # 36	44.8	53.7	2.7	10	122	3080	7000	26	38	132	53	3.8	182	54	0.5	5.9	0.49	8.4	0.34
Couer d'Alene # 37	9.7	28.4	3.5	4	69	1870	4100	20	16	74	44	1.4	24	16	0.3	3.7	0.12	8.0	0.41
Couer d'Alene # 38	15.8	49.1	3.2	8	108	2860	6200	24	25	131	49	3.9	90	50	0.6	5.0	0.47	8.3	0.34
Couer d'Alene # 39	31.0	56.7	2.9	11	131	3060	7500	34	43	127	52	4.8	196	65	0.6	5.9	0.75	8.3	0.33
Couer d'Alene # 40	26.6	54.2	2.5	8	100	3200	4200	27	38	78	46	2.5	122	37	0.4	5.8	1.54	8.2	0.34
Couer d'Alene # 41	51.1	46.3	2.2	7	95	2370	5700	25	32	126	44	3.0	94	27	0.4	5.0	0.73	7.9	0.32
Couer d'Alene # 42	39.1	47.6	2.2	5	83	2160	5300	25	31	102	40	2.5	58	25	0.4	5.2	0.69	8.3	0.33
Couer d'Alene # 43	53.8	59.3	2.5	7	99	2740	6600	28	36	130	47	3.5	96	34	0.4	5.6	1.02	8.2	0.33
Couer d'Alene # 44	13.1	45.3	2.5	6	80	2400	6100	26	32	89	43	3.2	156	31	0.4	5.3	0.98	8.0	0.37
Couer d'Alene # 45	44.1	60.1	2.2	5	79	2060	5300	25	36	103	39	2.5	156	26	0.4	5.1	1.96	7.7	0.32
Couer d'Alene # 46	44.6	43.0	1.7	3	68	1590	3900	21	30	79	31	1.4	50	13	0.2	4.6	0.91	7.9	0.32
Couer d'Alene # 47	39.1	47.9	1.6	21	215	6830	4600	24	35	46	52	3.5	92	76	0.4	7.3	0.84	8.5	0.27
Couer d'Alene # 48	21.3	42.4	1.7	4	67	1720	3700	21	39	69	34	2.0	112	22	0.3	5.0	1.72	7.9	0.36
Couer d'Alene # 49	27.9	54.6	2.5	8	103	3000	7100	30	38	129	57	4.8	116	45	0.6	6.0	0.99	8.2	0.36
Couer d'Alene # 50	14.7	41.6	2.4	5	71	1800	5500	29	31	80	50	2.5	96	27	0.4	5.3	0.62	8.3	0.40
Couer d'Alene # 51	8.1	15.6	2.6	1	33	370	2200	22	14	27	54	0.36	24	4.0	0.1	3.8	0.11	8.0	0.48
Couer d'Alene # 52	40.5	42.8	2.0	9	110	2700	6000	26	33	112	46	3.8	144	42	0.5	5.4	0.49	8.3	0.32

→ SHALLOW (SURFACE) SEDIMENTS IN AND NEAR MICA BAY

Sample	Depth	SA	TOC	Ag	Cu	Pb	Zn	Ni	Co	Cd	Cr	Hg	As	Sb	Se	Fe	Mn	Al	Ti
	meters	m /g	wt. %	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	wt. %	wt. %	wt. %	wt. %
Couer d'Alene # 53	43.0	46.8	2.2	9	116	2760	6100	27	33	116	47	4.5	142	49	0.5	5.5	0.52	8.2	0.33
Couer d'Alene # 54	39.6	39.3	1.7	3	63	1460	3900	21	27	81	31	1.3	178	15	0.2	4.1	1.41	7.5	0.32
Couer d'Alene # 55	43.3	40.5	2.0	7	99	2480	5500	25	30	110	44	3.6	115	35	0.5	5.2	0.50	8.7	0.35
Couer d'Alene # 56	48.2	41.6	2.0	4	72	1820	4200	21	26	81	39	1.7	60	17	0.4	4.6	0.68	8.1	0.32
Couer d'Alene # 57	55.5	49.2	2.4	6	87	2400	4800	26	31	95	46	2.0	70	25	0.5	5.1	0.49	8.3	0.33
Couer d'Alene # 58	35.1	40.2	2.0	4	65	1640	3400	21	39	58	32	1.3	240	15	0.2	4.7	0.92	8.2	0.34
Couer d'Alene # 59	50.1	41.5	1.9	9	107	2570	4900	24	36	90	48	4.6	200	45	0.5	5.4	0.92	8.6	0.33
Couer d'Alene # 60	52.9	42.5	2.1	9	106	2550	4900	24	32	92	46	2.3	82	40	0.4	5.4	0.52	8.5	0.32
Couer d'Alene # 61	38.6	38.2	1.8	4	68	1610	4500	19	32	93	36	2.1	190	18	0.2	4.5	0.86	8.2	0.35
Couer d'Alene # 62	33.1	32.9	1.6	3	60	1290	3200	16	26	61	31	1.1	210	12	0.2	4.3	0.73	8.1	0.35
Couer d'Alene # 63	54.7	37.4	1.9	7	99	2400	5100	22	32	108	46	2.7	120	35	0.2	5.0	0.38	8.4	0.35
Couer d'Alene # 64	48.5	39.7	1.8	5	74	1930	4400	21	34	88	40	2.4	230	23	0.3	4.7	1.25	8.1	0.35
Couer d'Alene # 65	29.8	32.3	1.6	3	59	1320	3100	17	29	62	32	1.8	190	13	0.2	4.3	0.74	8.4	0.37
Couer d'Alene # 66	14.0	36.7	2.3	8	97	2610	4800	21	35	92	50	3.3	160	46	0.3	5.7	0.82	8.2	0.41
Couer d'Alene # 67	39.2	43.0	2.0	4	64	1720	3500	18	30	66	40	1.1	240	14	0.2	4.7	1.28	8.0	0.33
Couer d'Alene # 68	33.1	43.5	1.7	3	60	1540	2600	31	31	59	0	1.1	60	12	0.2	4.4	2.10	7.8	0.34
Couer d'Alene # 69	37.7	39.9	2.1	5	72	2020	4000	22	29	72	43	1.6	110	20	0.3	5.0	0.71	8.4	0.35
Couer d'Alene # 70	15.0	22.9	1.8	1	36	710	2300	19	20	30	45	0.68	150	7.0	0.2	4.0	0.68	7.9	0.48
Couer d'Alene # 71	39.5	32.3	1.6	5	79	2100	4800	24	37	85	42	2.6	350	27	0.2	4.7	0.76	8.3	0.35
Couer d'Alene # 72	41.8	42.4	1.7	5	77	2020	5200	25	38	101	42	2.7	320	27	0.3	4.7	1.16	8.0	0.34
Couer d'Alene # 73	16.3	32.2	1.6	3	58	1490	2900	18	31	49	30	1.1	80	14	0.2	4.4	2.46	7.9	0.35
Couer d'Alene # 73 A	16.3		0.2	<1	35	176	1340	10	29	20	8	0.2	46	3.1	<0.1	3.1	2.59	7.7	0.32
Couer d'Alene # 74	23.0	27.3	1.3	3	55	1210	2400	16	27	46	27	1.2	120	11	0.2	4.3	0.94	8.2	0.36
Couer d'Alene # 75	37.5	31.5	1.5	4	69	1710	3700	20	32	69	34	1.8	230	19	0.2	4.6	0.83	8.4	0.35
Couer d'Alene # 76	38.3	32.7	1.6	3	62	1540	3200	19	26	59	35	1.00	130	13	0.2	4.4	0.69	8.2	0.33
Couer d'Alene # 77	39.7	31.0	1.5	3	61	1380	3500	19	29	62	33	1.2	190	13	0.2	4.3	0.64	8.3	0.35

SHALLOW (SURFACE) SEDIMENT IN MICA BAY

Sample	Depth	SA	TOC	Ag	Cu	Pb	Zn	Ni	Co	Cd	Cr	Hg	As	Sb	Se	Fe	Mn	Al	Ti
	meters	m /g	wt. %	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	wt. %	wt. %	wt. %	wt. %
Couer d'Alene # 78	20.7	46.6	2.1	3	59	1620	2900	21	30	49	37	1.01	80	13	0.2	4.7	2.00	7.9	0.35
Couer d'Alene # 79	39.5	26.8	1.4	3	62	1400	2800	18	26	52	25	0.96	170	14	0.2	4.4	0.71	8.3	0.35
Couer d'Alene # 80	39.9	30.9	1.4	5	71	1720	3200	21	31	65	36	2.7	270	22	0.3	4.6	0.84	8.4	0.35
Couer d'Alene # 81	29.7	31.3	1.4	3	62	1420	3500	21	31	64	28	1.2	250	15	0.2	4.3	0.80	8.2	0.34
Couer d'Alene # 82	19.5	31.4	1.6	3	56	1350	2900	18	29	47	35	1.5	240	13	0.2	4.5	1.07	8.2	0.38
Couer d'Alene # 83	42.7	31.9	1.7	5	78	2100	4500	23	37	82	42	2.4	310	25	0.3	4.7	0.61	8.4	0.34
Couer d'Alene # 84	42.0	29.9	1.4	3	62	1400	3100	18	30	59	29	1.2	190	14	0.2	4.4	0.71	8.4	0.35
Couer d'Alene # 85	32.9	49.2	2.4	5	65	2060	3200	25	31	45	40	1.2	430	16	0.3	5.4	1.90	7.8	0.34
Couer d'Alene # 86	34.8	32.6	1.7	4	65	1620	3200	19	30	54	38	1.3	220	15	0.2	4.7	0.74	8.4	0.36
Couer d'Alene # 87	40.0	28.5	1.4	6	83	2150	3800	21	36	65	37	3.1	270	30	0.3	5.0	0.70	8.5	0.35
Couer d'Alene # 88	43.1	33.4	1.4	4	70	1690	4000	19	34	75	36	2.3	300	20	0.2	4.5	0.82	8.4	0.34
Couer d'Alene # 89	42.5	31.2	1.5	5	71	1750	3600	21	34	63	34	1.8	290	19	0.2	4.7	0.89	8.4	0.35
Couer d'Alene # 90	15.4	27.3	1.8	3	44	1140	2400	19	23	32	43	1.4	170	12	0.2	4.6	0.56	7.6	0.60
Couer d'Alene # 91	27.7	44.1	2.5	5	68	2090	3200	23	32	46	48	1.3	520	18	0.4	5.3	1.66	8.0	0.38
Couer d'Alene # 92	35.0	28.6	1.4	4	65	1490	2700	18	32	51	35	1.3	210	16	0.2	4.5	0.87	8.4	0.34
Couer d'Alene # 93	41.0	31.1	1.8	9	104	2620	4800	27	39	87	54	4.8	400	43	0.5	5.7	0.65	8.4	0.34
Couer d'Alene # 94	39.6	30.6	1.6	4	65	1570	3300	21	35	56	40	1.5	230	17	0.3	4.8	0.53	8.9	0.37
Couer d'Alene # 95	20.6	44.0	2.2	5	69	1980	3200	23	32	50	41	1.3	275	17	0.3	4.9	1.40	8.2	0.38
Couer d'Alene # 96	11.0	11.9	1.6	<1	21	130	530	17	15	3.3	50	0.08	8.4	1.4	<0.1	3.4	0.09	7.5	0.54
Couer d'Alene # 97	16.0	28.8	1.9	2	47	970	2400	23	24	34	56	1.3	100	12	0.1	4.5	0.45	8.5	0.50
Couer d'Alene # 98	32.1	41.5	2.0	5	77	1980	3600	22	36	67	48	2.9	230	29	0.2	5.3	0.81	8.3	0.38
Couer d'Alene # 99	34.0	32.8	1.8	4	68	1730	2800	23	29	44	49	1.4	110	15	0.1	5.0	0.70	8.6	0.39
Couer d'Alene # 100	11.4	11.2	1.5	<1	18	45	230	14	12	1.3	42	0.04	2.4	2.2	0.1	3.1	0.07	7.1	0.64
Couer d'Alene # 101	17.3	23.7	1.9	1	32	390	1300	20	17	14	53	0.33	40	4.0	<0.1	4.2	0.33	8.3	0.56
Couer d'Alene # 102	19.5	37.1	2.4	2	46	880	2400	24	25	33	56	0.86	160	8.0	0.1	4.9	1.12	8.3	0.53
Couer d'Alene # 103	26.5	28.2	2.4	2	43	870	2300	23	24	28	54	0.53	160	7.0	0.1	4.7	1.23	8.2	0.52

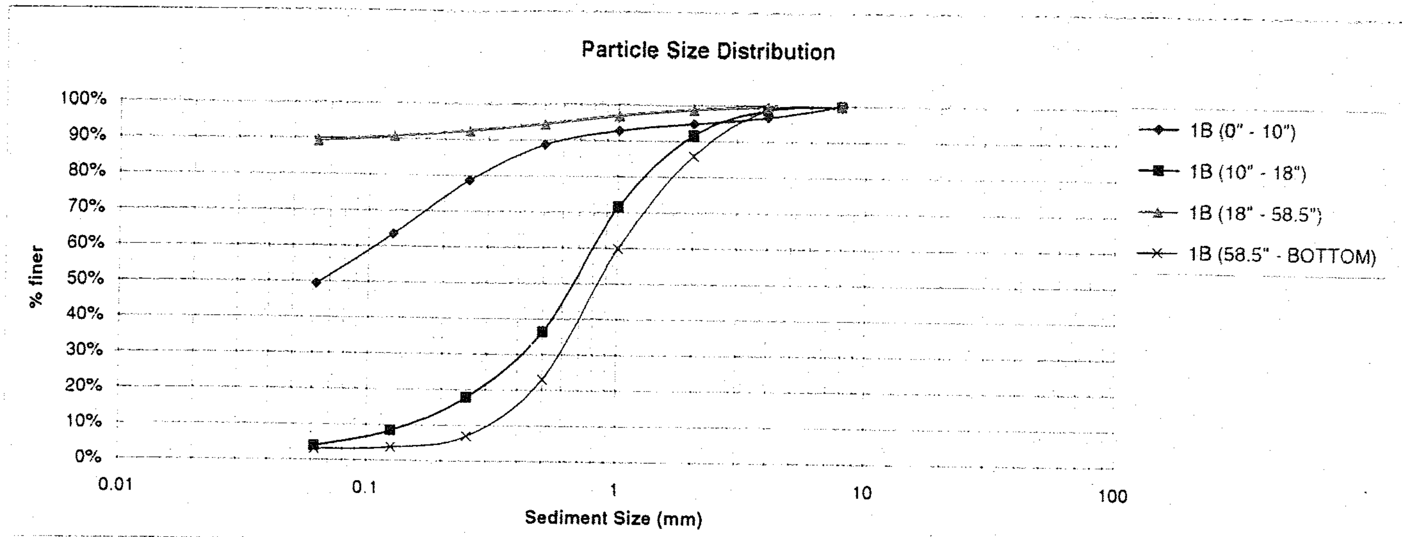
Sample	Depth	SA	TOC	Ag	Cu	Pb	Zn	Ni	Co	Cd	Cr	Hg	As	Sb	Se	Fe	Mn	Al	Ti
	meters	m /g	wt. %	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	wt. %	wt. %	wt. %	wt. %
Couer d'Alene # 104	31.7	17.9	1.8	4	72	1400	3600	24	34	70	54	2.6	170	22	0.2	4.7	0.42	8.8	0.47
Couer d'Alene # 105	29.7	21.8	1.3	3	65	1220	2300	17	27	43	32	1.7	100	15	0.2	4.4	0.38	8.4	0.38
Couer d'Alene # 106	32.7	24.9	1.6	3	56	960	2000	21	24	38	44	0.86	40	10	0.2	4.5	0.30	8.7	0.44
Couer d'Alene # 107	24.1	42.5	2.6	4	62	1700	2900	24	30	43	48	1.0	580	14	0.2	5.3	1.74	7.8	0.37
Couer d'Alene # 108	35.8	26.9	1.9	6	85	2090	3700	28	35	70	63	3.8	270	28	0.2	5.5	0.90	8.9	0.45
Couer d'Alene # 109	37.4	37.8	2.1	6	77	2010	3500	24	32	61	49	1.7	200	19	0.2	5.3	0.63	8.4	0.35
Couer d'Alene # 110	37.3	42.6	2.4	6	71	2050	3300	22	30	52	47	1.3	310	18	0.3	5.4	1.17	7.8	0.34
Couer d'Alene # 111	33.1	41.4	2.3	6	71	2190	3100	22	26	44	48	1.3	410	19	0.2	5.4	1.32	7.6	0.34
Couer d'Alene # 112	33.7	34.5	2.1	8	83	2380	3100	24	26	48	52	1.6	220	22	0.3	5.7	0.85	8.4	0.36
Couer d'Alene # 113	34.3	39.0	2.6	7	72	2180	2900	22	25	38	45	1.4	540	20	0.3	5.9	2.04	7.3	0.31
Couer d'Alene # 114	23.8	14.1	0.8	4	60	1050	1600	12	20	21	26	1.2	130	11	0.1	3.9	0.49	8.3	0.31
Couer d'Alene # 115	20.6	20.9	1.9	5	57	1540	2100	20	20	27	47	1.0	260	14	0.2	4.7	0.87	7.8	0.42
Couer d'Alene # 116	21.8	19.8	1.5	7	78	2320	2600	17	22	33	36	2.0	470	20	0.2	5.4	0.89	8.0	0.32
Couer d'Alene # 116A	21.8		0.5	2	51	732	1380	10	17	23	17	1.3	80	8	<0.1	3.8	0.31	8.3	0.30
Couer d'Alene # 117	21.2	25.5	2.2	10	91	3200	3200	20	22	34	43	2.2	500	27	0.2	6.9	1.15	7.2	0.29
Couer d'Alene # 118	17.1	16.1	2.2	10	90	3290	3000	15	19	28	37	2.4	500	27	0.2	6.9	0.74	7.0	0.31
Couer d'Alene # 119	18.8	23.9	1.9	8	85	2930	2900	19	23	33	41	2.1	660	25	0.2	6.5	1.00	7.6	0.32
Couer d'Alene # 119A	18.8		0.4	1	51	640	1340	11	16	24	16	1.2	61	7	<0.1	3.4	0.25	8.3	0.32
Couer d'Alene # 120	18.4	18.2	2.1	11	98	3620	3100	18	18	31	38	2.6	460	32	0.3	7.6	0.80	6.7	0.26
Couer d'Alene # 121	17.4	19.0	1.6	7	65	2220	2600	16	21	24	45	1.5	150	17	0.1	5.3	0.61	7.2	0.39
Couer d'Alene # 122	19.6	19.7	2.1	11	95	3860	3400	14	20	31	41	2.5	270	32	0.1	7.4	0.83	6.5	0.27
Couer d'Alene # 123	16.7	9.2	2.2	14	112	4790	3800	12	15	31	36	3.0	200	34	0.2	8.5	0.70	5.6	0.22
Couer d'Alene # 124	2.7	7.5	7.4	18	164	7680	9000	19	20	92	39	3.4	170	54	0.2	5.0	0.39	7.0	0.24
Couer d'Alene # 125	1.6	10.7	1.8	18	148	3740	3500	15	20	31	33	4.3	160	96	0.3	12.4	1.11	4.6	0.15
Couer d'Alene # 126	1.6	11.7	2.8	11	109	3300	6000	13	18	84	37	3.4	170	31	0.1	6.7	0.48	6.7	0.27
Couer d'Alene # 127	14.1	12.8	0.3	13	110	4400	4200	10	14	34	30	3.2	180	37	0.1	9.1	0.77	4.8	0.20

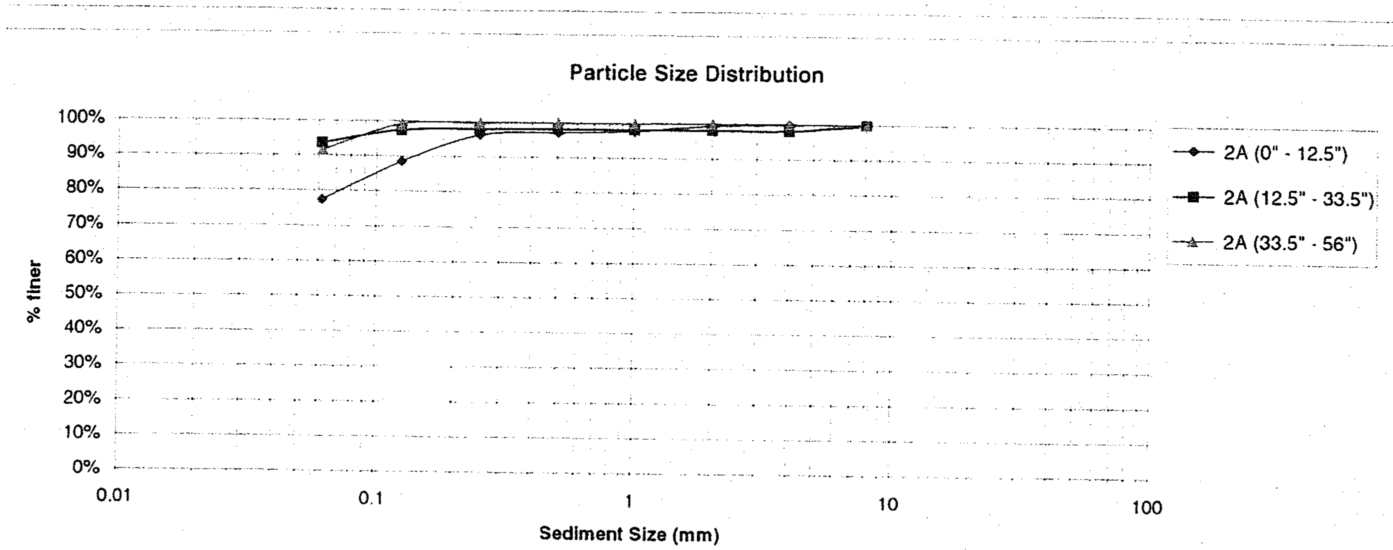
Sample	Depth	SA	TOC	Ag	Cu	Pb	Zn	Ni	Co	Cd	Cr	Hg	As	Sb	Se	Fe	Mn	Al	Ti
	meters	m /g	wt. %	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	wt. %	wt. %	wt. %	wt. %
Couer d'Alene #128	9.9	18.2	1.9	11	97	3910	3200	13	18	27	35	3.6	480	31	0.1	8.7	0.80	5.8	0.25
Couer d'Alene #128A	9.9		2.1	11	99	4010	3190	16	17	28	33	3.7	480	33	0.2	8.6	0.87	5.8	0.23
Couer d'Alene #129	21.2	23.1	2.3	13	97	3850	3600	17	20	32	39	2.5	290	29	0.3	7.4	1.25	6.4	0.27
Couer d'Alene #130	19.7	34.0	2.5	7	73	2410	3400	23	27	37	45	1.7	530	18	0.2	6.2	1.36	7.6	0.33
Couer d'Alene #131	19.0	30.1	2.3	5	65	1750	2800	19	25	33	43	1.8	160	16	0.3	6.0	0.60	7.3	0.36
Couer d'Alene #132	15.8	28.1	2.0	5	62	1800	2900	21	26	32	46	1.7	250	15	0.2	5.4	0.63	7.9	0.39
Couer d'Alene #133	15.1	35.6	2.4	4	64	1670	3300	23	28	39	47	1.2	230	13	0.3	5.2	0.80	8.3	0.36
Couer d'Alene #134	19.5	21.9	1.9	4	63	1460	2800	19	29	36	43	1.5	90	17	0.2	5.2	0.54	8.3	0.36
Couer d'Alene #135	20.2	24.3	2.5	2	50	820	2300	21	22	31	44	0.91	60	7.8	0.2	5.0	0.33	8.1	0.40
Couer d'Alene #136	18.6	23.1	2.5	2	46	590	1900	20	19	26	48	0.64	45	6.5	0.3	4.9	0.28	8.5	0.41
Couer d'Alene #137	17.5	29.4	2.4	4	53	1150	2600	23	26	30	49	0.88	210	9.0	0.3	5.2	0.88	7.9	0.38
Couer d'Alene #138	17.3	23.8	2.6	3	53	910	2400	22	17	36	51	0.91	60	9.0	0.2	5.3	0.21	8.0	0.41
Couer d'Alene #139	16.2	15.7	2.4	1	38	330	1500	20	15	20	47	0.30	23	4.0	0.2	4.3	0.13	8.0	0.45
Couer d'Alene #140	11.5		1.5	<1	19	73	360	15	12	2.3	41	0.04	5.8	1.1	0.1	3.0	0.10	6.6	0.55
Couer d'Alene #141	13.0	15.6	2.9	1	33	170	1100	21	14	11	49	0.14	15	2.1	0.3	4.2	0.11	7.7	0.43
Couer d'Alene #142	2.2	9.6	3.9	<1	33	70	1500	19	13	22	36	0.09	9.0	2.1	0.2	3.0	0.04	7.4	0.41
Couer d'Alene #143	5.5	13.1	2.5	<1	30	30	140	19	13	<0.5	41	0.05	8.0	0.8	0.2	4.0	0.09	7.5	0.43
Couer d'Alene #144	6.0	17.0	2.4	<1	30	21	109	20	15	<0.5	42	0.04	9.0	0.7	0.2	4.1	0.12	8.0	0.45
Couer d'Alene #144A	6.0		0.9	<1	35	18	78	12	13	<.5	28	0.05	5.0	0.6	0.1	3.5	0.07	8.1	0.38
Couer d'Alene #145	2.6	7.5	1.5	<1	15	17	88	14	11	<0.5	37	0.04	2.8	0.6	<0.1	2.7	0.05	6.3	0.56
Couer d'Alene #146	11.0	13.0	2.5	<1	31	24	121	22	15	<0.5	49	0.06	6.5	0.8	0.2	4.1	0.08	8.2	0.48
Couer d'Alene #147	5.7	9.5	2.9	<1	27	16	84	19	13	<0.5	40	0.04	5.0	0.6	0.2	3.5	0.07	7.3	0.40
Couer d'Alene #148	2.6	6.6	3.5	<1	26	14	76	19	12	<0.5	41	0.05	4.1	0.7	0.2	3.1	0.04	6.9	0.40
Couer d'Alene #149	1.5	5.3	2.8	<1	25	14	77	16	11	<0.5	40	0.03	2.8	0.6	0.2	2.9	0.03	6.8	0.40
Couer d'Alene #150	1.7	8.0	4.8	<1	31	24	100	19	12	<0.5	38	0.05	3.9	0.8	0.2	2.9	0.04	6.7	0.40
Couer d'Alene #151	7.2	4.6	2.0	<1	19	14	65	13	10	<0.5	39	0.02	3.0	0.5	0.1	2.7	0.04	6.7	0.38

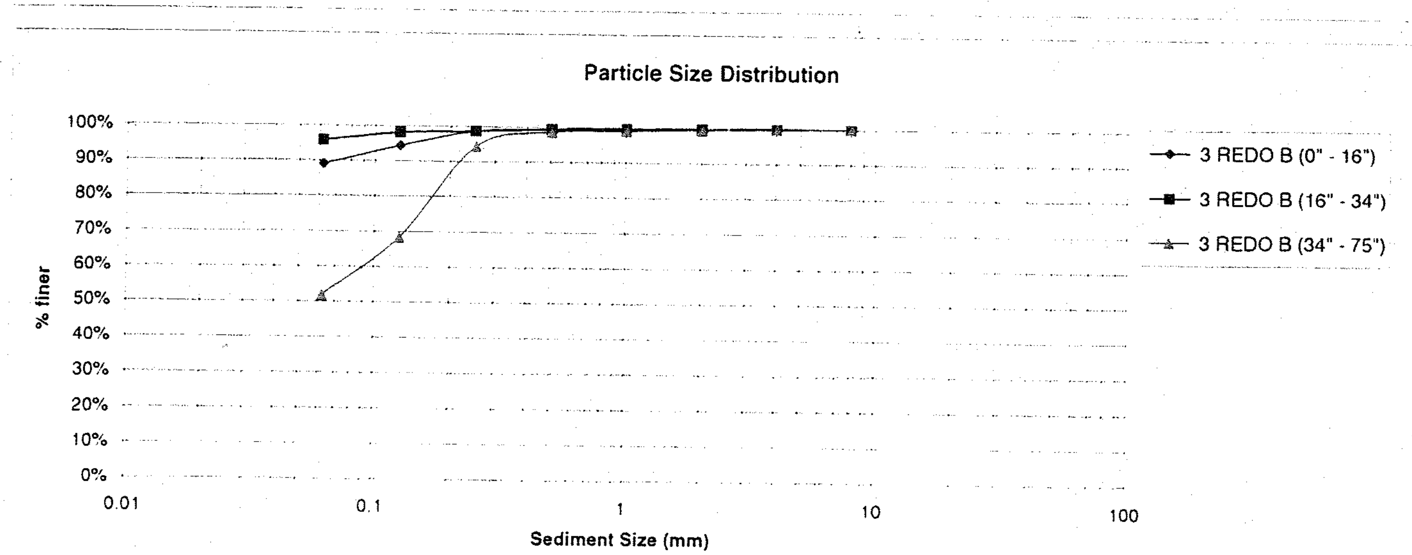
Sample	Depth	SA	TOC	Ag	Cu	Pb	Zn	Ni	Co	Cd	Cr	Hg	As	Sb	Se	Fe	Mn	Al	Ti
	meters	m /g	wt. %	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	wt. %	wt. %	wt. %	wt. %
Couer d'Alene #152	8.4	4.1	1.7	<1	18	14	63	12	10	<0.5	38	0.02	2.9	0.5	<0.1	2.6	0.04	6.2	0.38
Couer d'Alene #153	8.1	5.0	2.6	<1	23	17	76	12	11	<0.5	41	0.05	4.7	0.5	0.1	3.0	0.04	6.7	0.39
Couer d'Alene #154	5.1	11.1	2.9	<1	30	35	354	16	13	1.8	44	0.06	6.3	0.7	0.2	3.6	0.07	7.8	0.40
Couer d'Alene #155	7.4	8.4	3.5	<1	31	28	133	18	13	<0.5	46	0.05	4.0	0.7	0.2	3.4	0.05	7.8	0.39
Couer d'Alene #156	2.6	9.5	15.6	2	57	1480	6200	23	15	87	29	0.53	40	19	0.3	2.9	0.47	4.4	0.21
Couer d'Alene #157	0.9	4.2	2.5	11	91	2650	3500	5	8	19	15	2.9	200	33	<0.1	16.4	1.56	2.9	0.15
Couer d'Alene #158	7.0	2.6	1.6	8	71	2010	3600	4	7	19	21	2.4	90	28	<0.1	9.6	0.92	3.6	0.14
Couer d'Alene #159	7.0	2.9	1.7	10	82	1990	3850	10	7	21	18	2.6	90	32	0.1	9.7	0.97	3.6	0.16
Couer d'Alene #160	6.6	3.9	1.8	9	77	2620	3800	11	8	23	21	2.7	140	28	0.2	9.3	0.84	3.9	0.15
Couer d'Alene #161	7.6	5.5	0.4	2	18	1050	1300	8	5	5.8	22	0.58	40	9	<0.1	4.0	0.23	5.0	0.23
Couer d'Alene #162	8.6	3.4	2.3	13	109	4140	4870	11	8	30	20	3.4	110	40	0.1	10.5	1.03	3.4	0.14
Couer d'Alene #163	9.2	6.6	2.6	12	105	4800	4970	12	10	31	25	3.7	180	50	0.1	11.9	1.12	3.4	0.15
Couer d'Alene #164	12.0	4.7	1.9	12	99	3740	4650	14	10	31	29	3.3	120	42	0.1	10.1	0.92	3.9	0.16
Couer d'Alene #165	6.9	8.6	2.0	11	108	4610	4100	15	13	38	33	3.1	140	39	0.3	7.7	0.68	5.4	0.22
Couer d'Alene #166	11.6	4.2	2.3	12	103	4200	4800	12	8	33	23	3.6	140	37	0.1	10.0	0.98	3.8	0.15
Couer d'Alene #167	11.0	5.0	0.3	1	15	1670	970	10	7	3.1	32	0.37	30	13	<0.1	2.5	0.06	5.4	0.22
Couer d'Alene #168	7.5	6.1	0.8	3	33	2090	1900	9	7	7.9	26	1.1	60	20	<0.1	4.6	0.27	4.8	0.19
Couer d'Alene #169	10.3	3.2	0.9	6	42	1300	2600	8	6	14	21	1.4	40	19	0.1	7.2	0.65	4.4	0.20
Couer d'Alene #170	8.6	8.6	0.4	2	26	3440	1500	10	7	5.6	24	0.60	75	29	0.1	3.7	0.13	5.2	0.22
Couer d'Alene #171	5.0	3.4	0.8	6	56	2330	2700	9	7	13	22	1.5	70	25	0.1	5.4	0.47	4.3	0.17

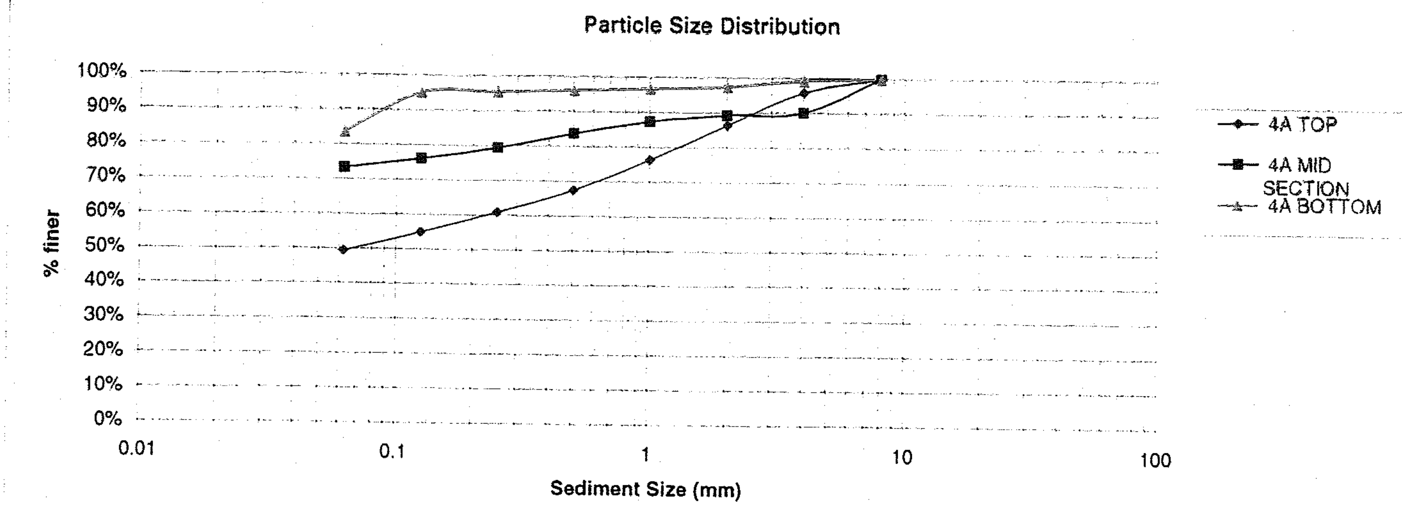
Appendix F

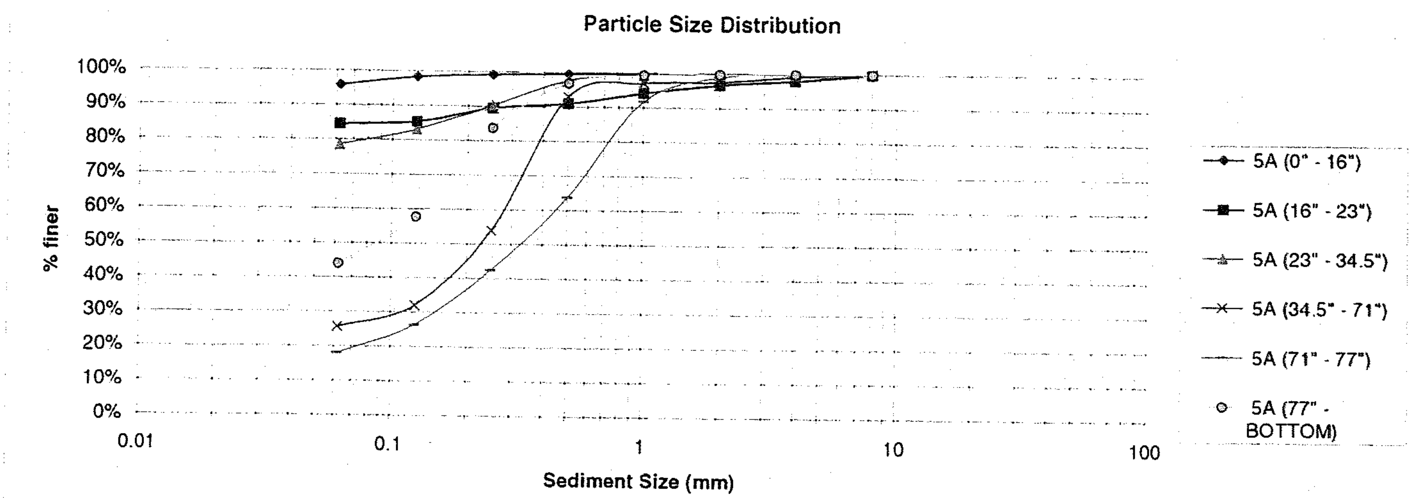
Particle Size Distributions

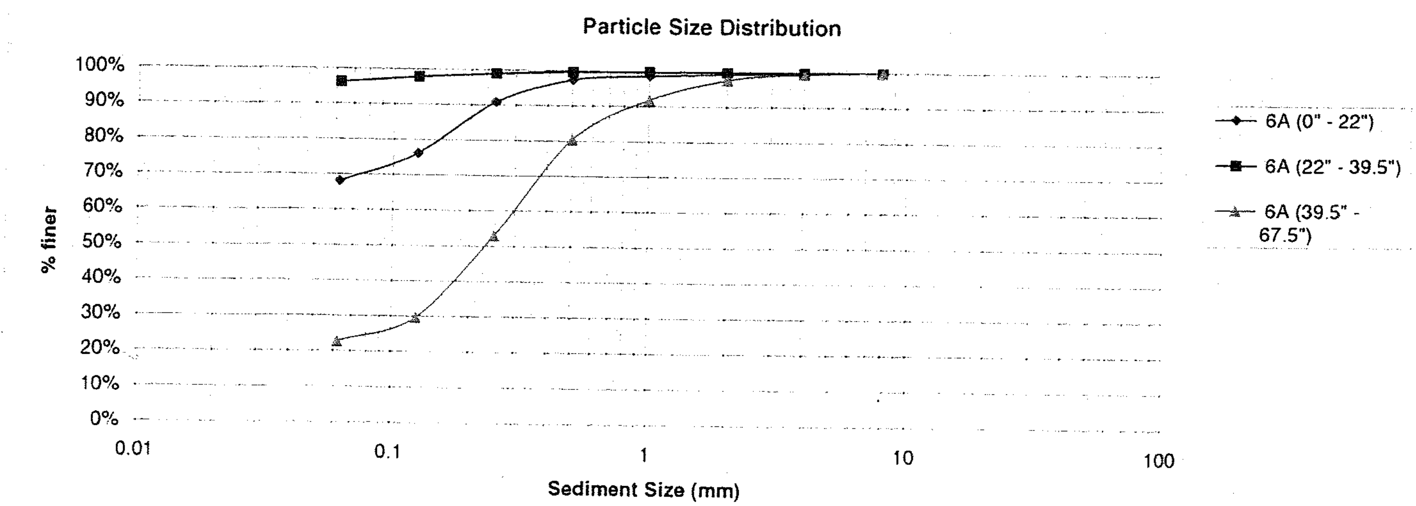

Particle Size Distribution
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
% finer
0.01
0.1
1
10
100
Sediment Size (mm)
1B (0" - 10")
1B (10" - 18")
1B (18" - 58.5")
1B (58.5" - BOTTOM)

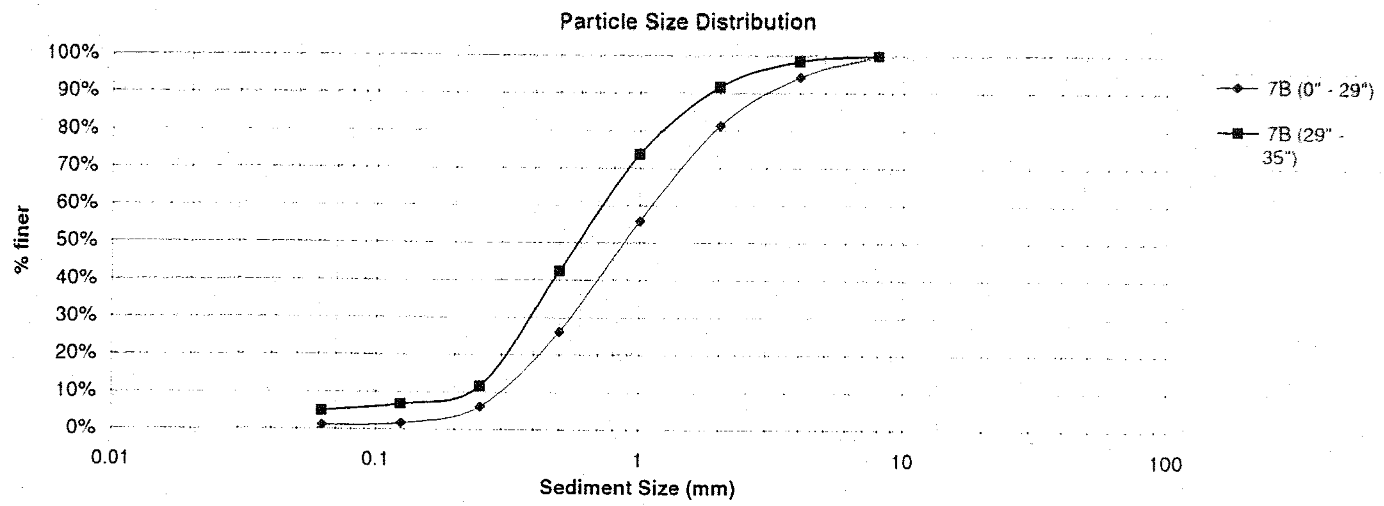

Particle Size Distribution
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
% finer
0.01
0.1
1
10
100
Sediment Size (mm)
2A (0" - 12.5")
2A (12.5" - 33.5")
2A (33.5" - 56")

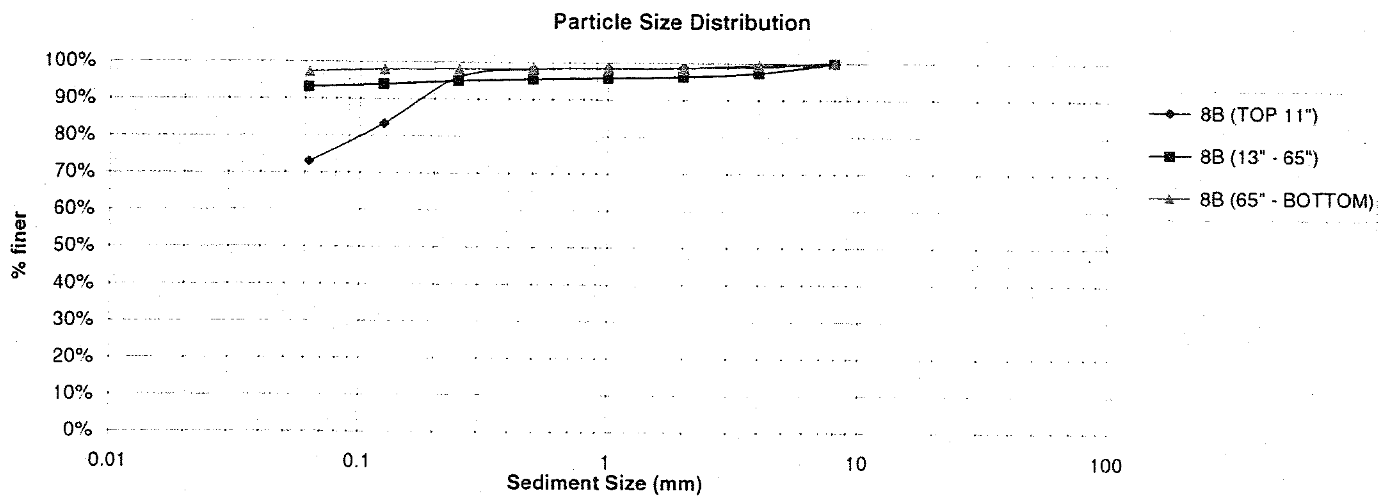

Particle Size Distribution
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
% finer
0.01
0.1
1
10
100
Sediment Size (mm)
3 REDO B (0" - 16")
3 REDO B (16" - 34")
3 REDO B (34" - 75")

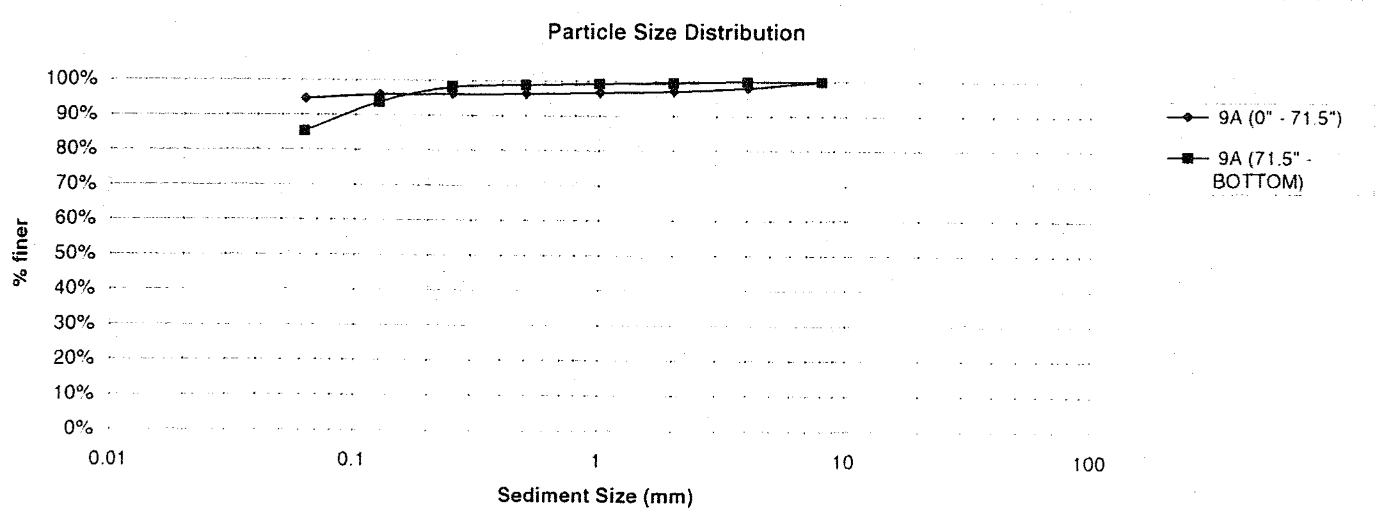

Particle Size Distribution
% finer
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.01
0.1
1
10
100
Sediment Size (mm)
4A TOP
4A MID SECTION
4A BOTTOM

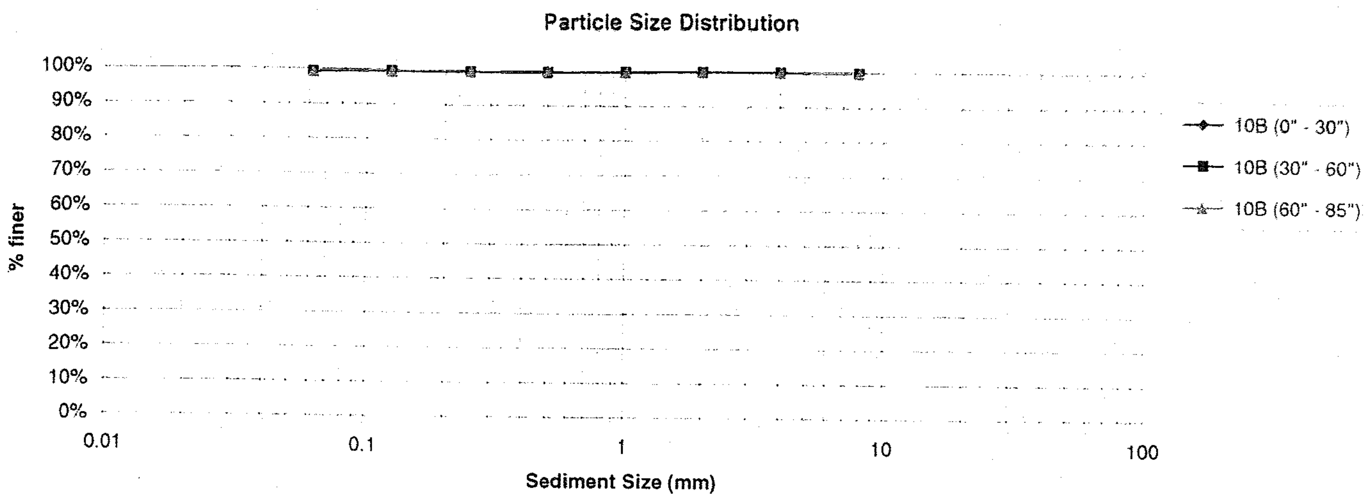

Particle Size Distribution
% finer
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.01
0.1
1
10
100
Sediment Size (mm)
5A (0" - 16")
5A (16" - 23")
5A (23" - 34.5")
5A (34.5" - 71")
5A (71" - 77")
5A (77" - BOTTOM)


Particle Size Distribution
% finer
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.01
0.1
1
10
100
Sediment Size (mm)
6A (0" - 22")
6A (22" - 39.5")
6A (39.5" - 67.5")


Particle Size Distribution
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
% finer
0.01
0.1
1
10
100
Sediment Size (mm)
7B (0" - 29")
7B (29" - 35")

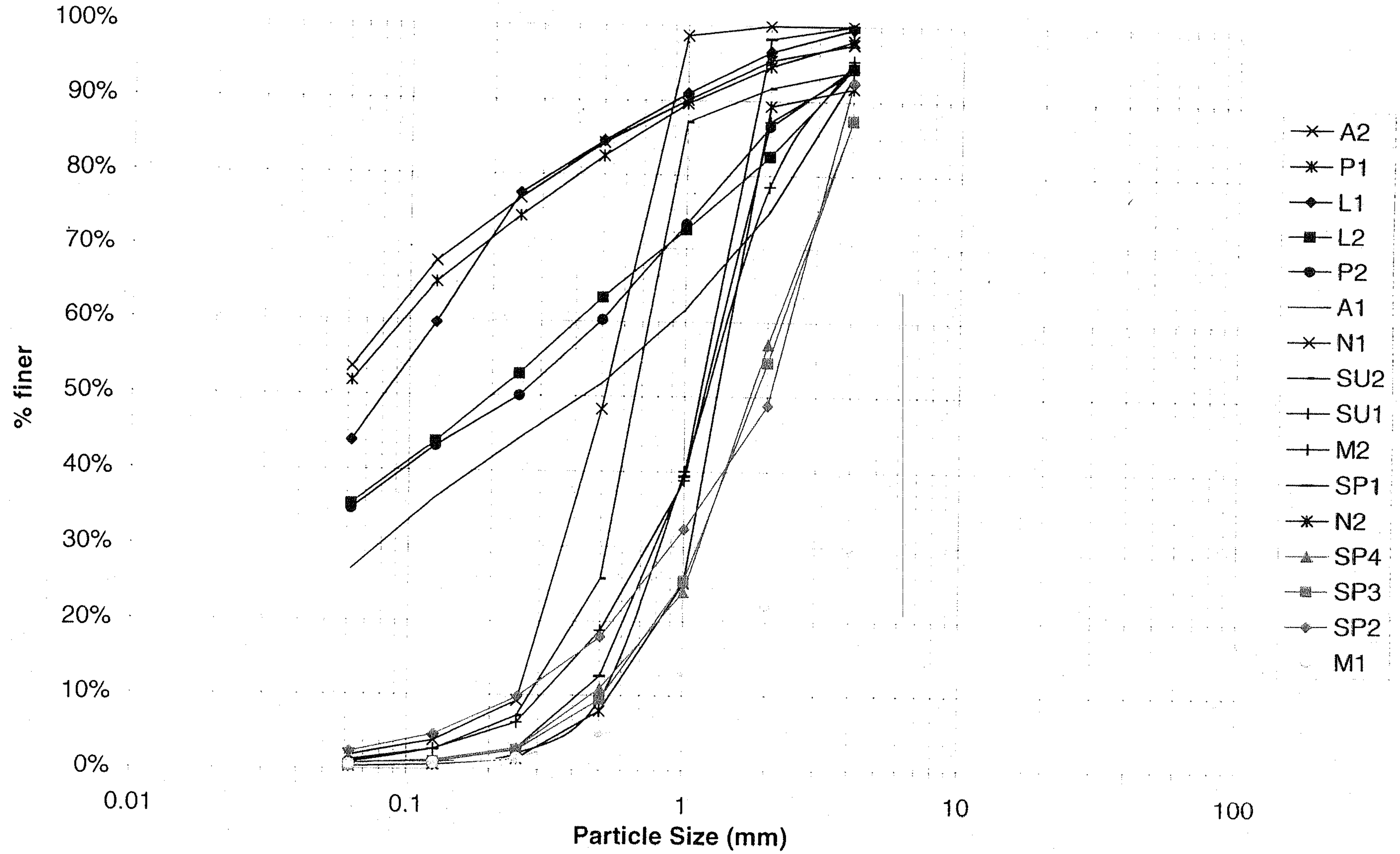

Particle Size Distribution
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
% finer
0.01
0.1
1
10
100
Sediment Size (mm)
8B (TOP 11")
8B (13" - 65")
8B (65" - BOTTOM)


Particle Size Distribution
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
% finer
0.01
0.1
1
10
100
Sediment Size (mm)
9A (0" - 71.5")
9A (71.5" - BOTTOM)



Particle Size Distribution
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
% finer
0.01
0.1
1
10
100
Sediment Size (mm)
10B (0" - 30")
10B (30" - 60")
10B (60" - 85")

Particle Size Distribution - Mica Bay Watershed Samples



p:\Idaho Transportation Department\173986\Task 2 Coring and Assess\Analytical Data\Watershed\Watershed PSD.xls

6.0 Reference

Rieder, M., Cavazzini, G., D'Yakonov, Y.S., Frank-Kamenestskii, V.A., Gottardi, G., Guggenheim, S., Pavel, V.K., Muller, G., Neiva, A.M.R., Radoslovich, E.W., Robert, J.L., Sassi, F.P., Takeda, H., Weiss, Z. and Wones, D.R., 1998, Nomenclature of the Micas: Clays and Clay Minerals, Vol. 46, No. 5, pp. 586-595.

TABLE 1
Color Codes Associated with the Mica Bay Core Layers

Color Code	Frequency of Occurrence	Core and Layer Number
5Y 2/1	8	1-1, 2-1, 3-1, 5-4,5-6, 6-1, 6-3, 10
5Y 6/1	2	1-2, 1-4
5Y 4/1	5	1-2, 5-4, 5-6, 8-3, 9-2
5G 4/1	2	1-3, 2-2
5GY 4/1	4	2-2, 2-3, 6-2, 7-2
10Y 4/2	1	2-3
5GY 2/1	1	3-2
10YR 2/2	3	3-3, 4-1, 4-2
5YR 3/2	1	5-2
Medium Gray	1	5-3
10YR 4/2	5	4-3, 5-1, 5-5, 8-3, 9-1
10YR 6/2	1	7-1
10YR 5/4	1	7-1
Grayish Black to Black	1	8-1

Table 2. Watershed sediment source contribution by end members determined by comparing Core 7 zero to 29 inch depth interval data with each of the watershed sample data.

Core 7 (0-29") Coarse plus Fines versus all watershed sample Coarse plus Fines

Core 7 has the **Lowest Concentration** – As, Bi, Cs, Li, Ta, LOI, NO3,

Ni, only Logging sample L1 is lower

Core 7 has the **Highest Concentration** – Ba, Na, TN, Organic form of Nitrogen

Ge, only N1 higher

K and K2O, only L2 higher

Sr, only SP1 higher

SiO2, only L1 and M1

Grain-size, Minus 35 Plus 60 only N1 higher

Core 7 (0-29") Only Fines versus all watershed sample Fines

Core 7 has the **Lowest Concentration** – As, Cs, Cu, Li, Mn, Tl

Fe, only L1 and P2 are lower, SU2 equals Core 7

Mo, only P1 and L2 are lower

W, only L2 is lower

Core 7 has the **Highest Concentration** – Ba, Ca, Cd, K, K2O, Na, Sr, Th

Al only A1 and A2 are higher

Ce, only SU1 is higher

La, only SU1 is higher

Y, only SU1 is higher, N1 essentially equal to Core 7

Note: Underlined elements are present in both coarse plus fines and fines only.

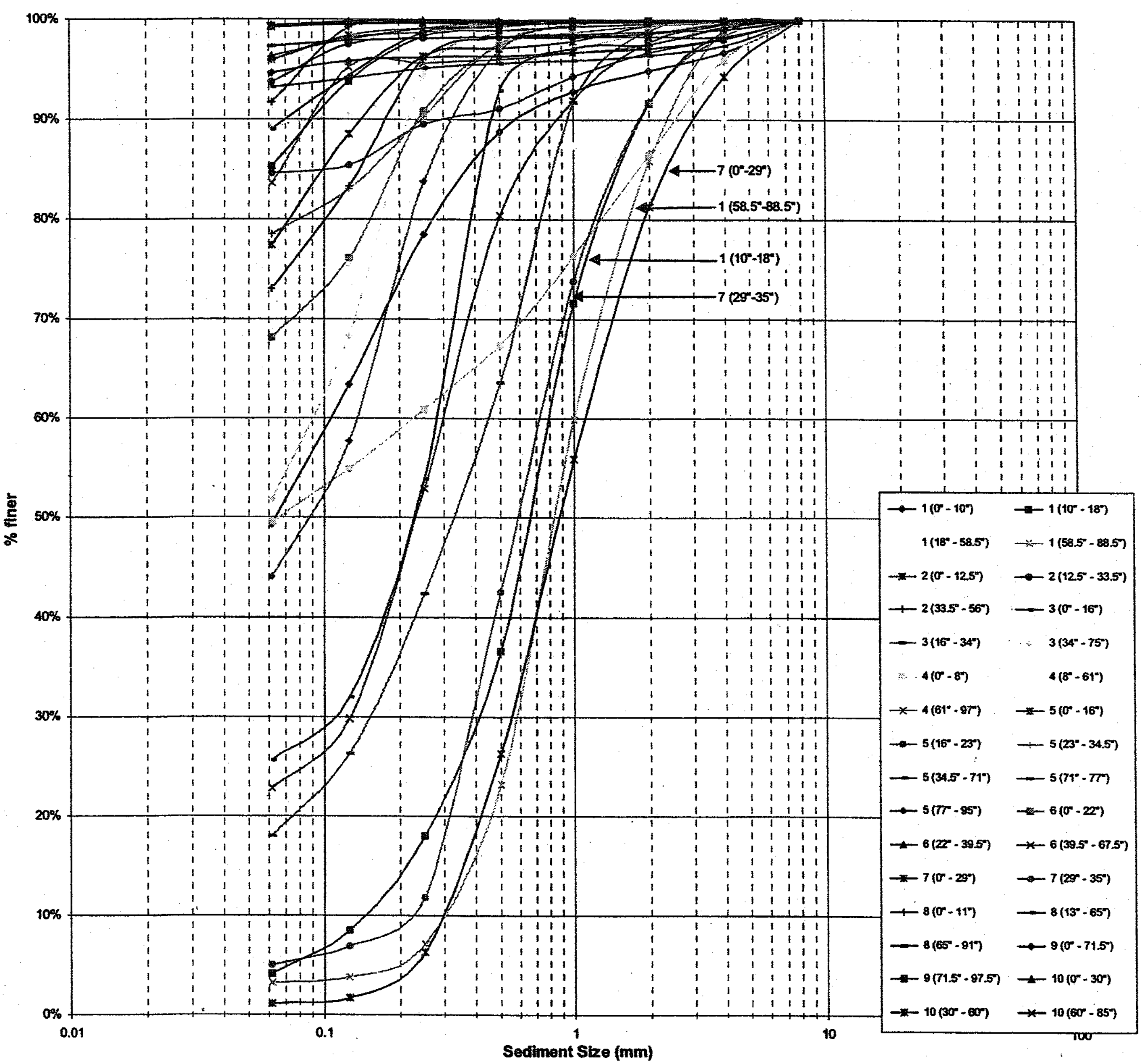


Figure 1. Particle Size Distribution of Mica Bay Core Samples.

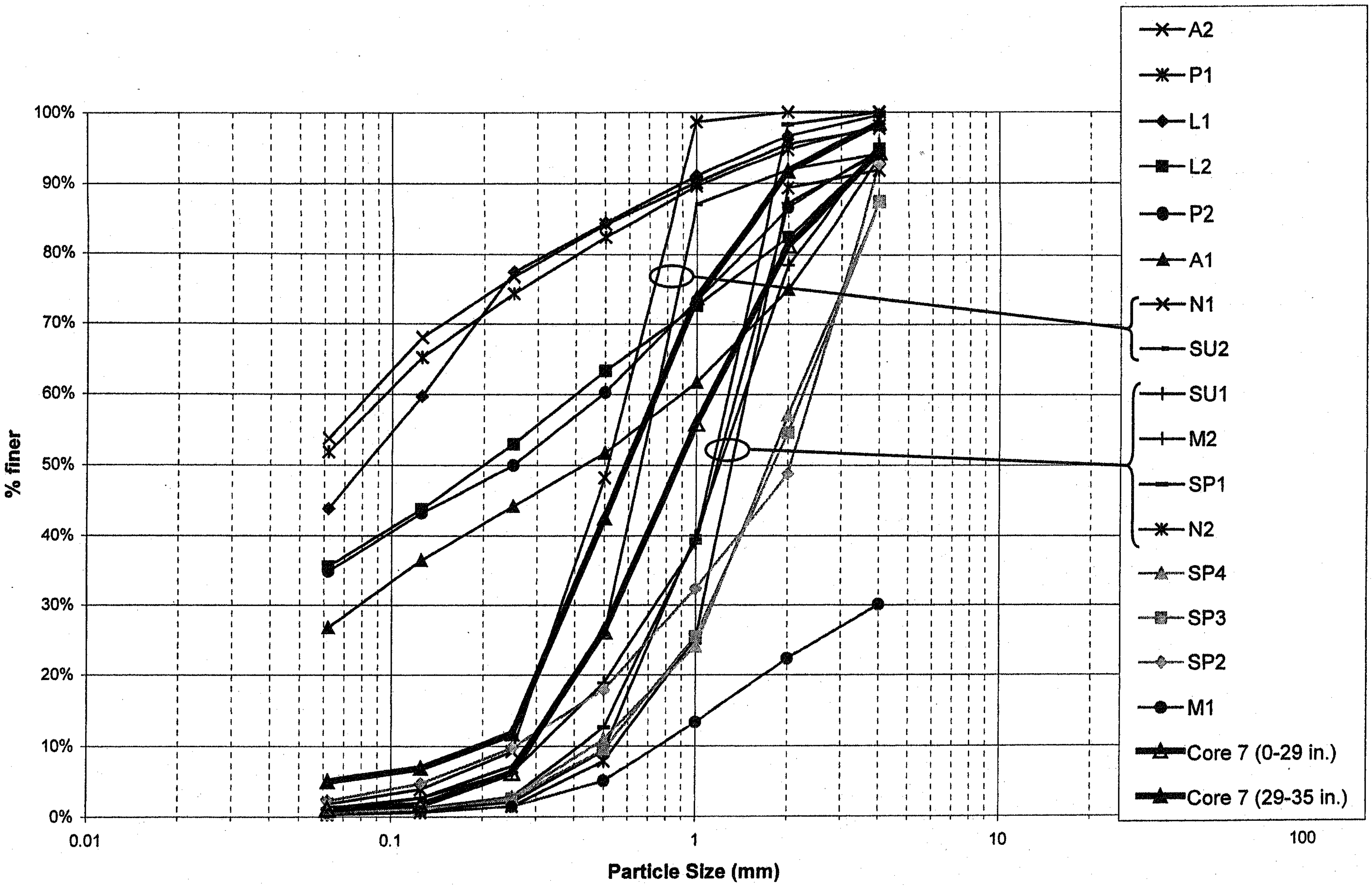


Figure 2. Particle Size Distribution - Mica Bay Watershed and Core 7 Samples.

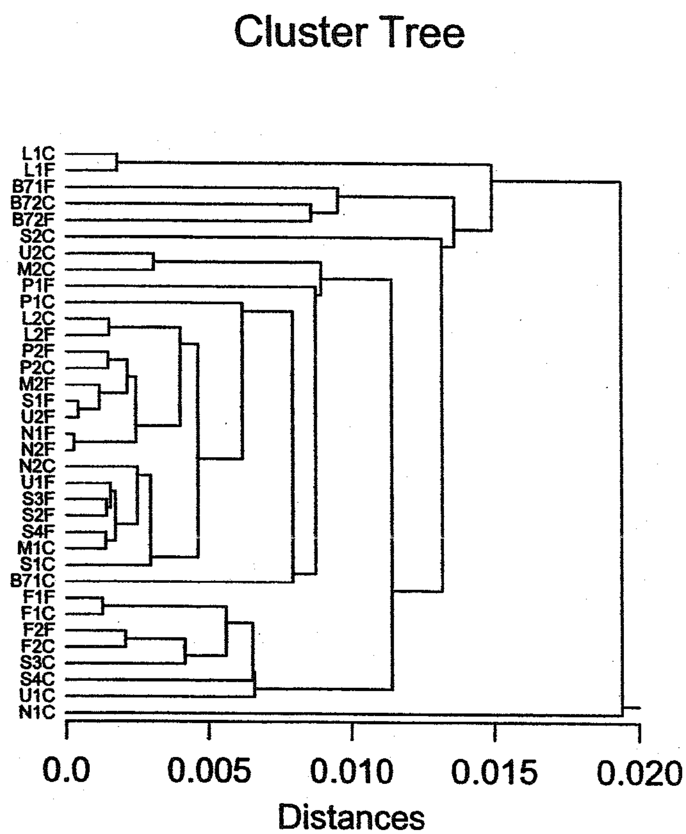


Figure 3. Cluster analysis that includes all the chemistry and grain-size analyses for the watershed samples compared with the Core 7 data.

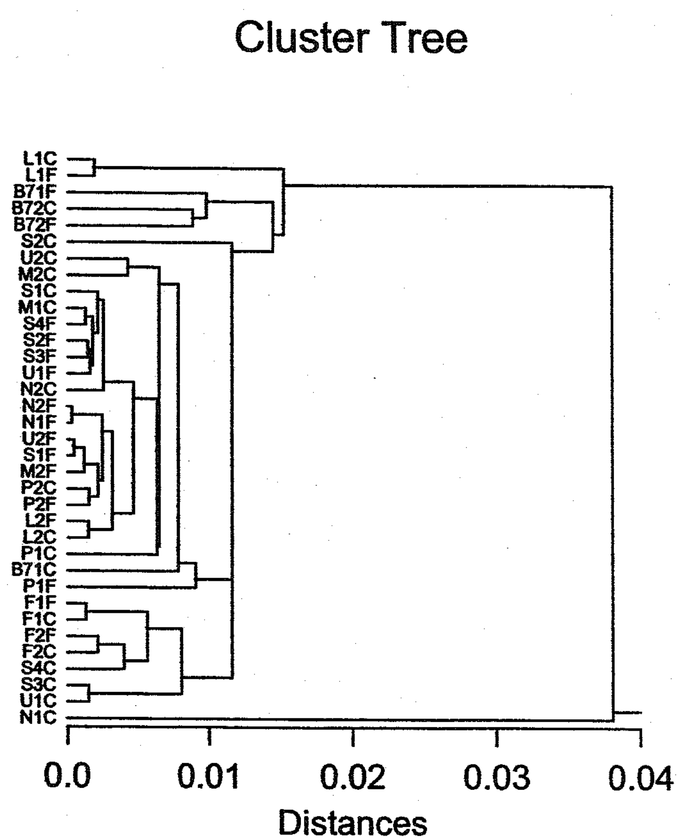


Figure 4. Cluster analysis for all the trace element data from the watershed locations compared with Core 7 samples.

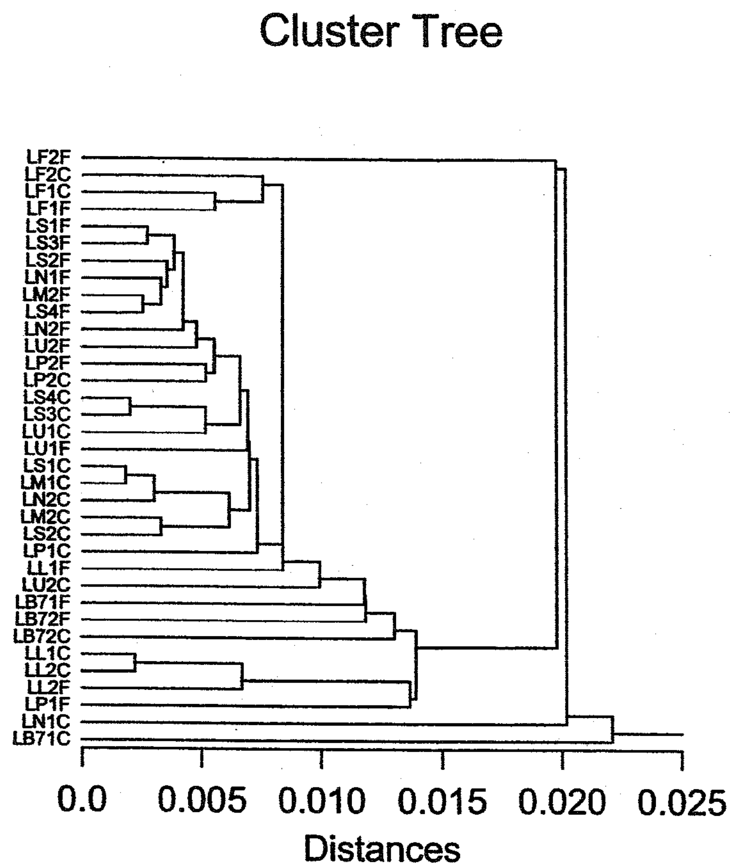


Figure 5. Cluster analysis of the logarithm of trace element concentrations from the watershed samples compared with the Core 7 samples.

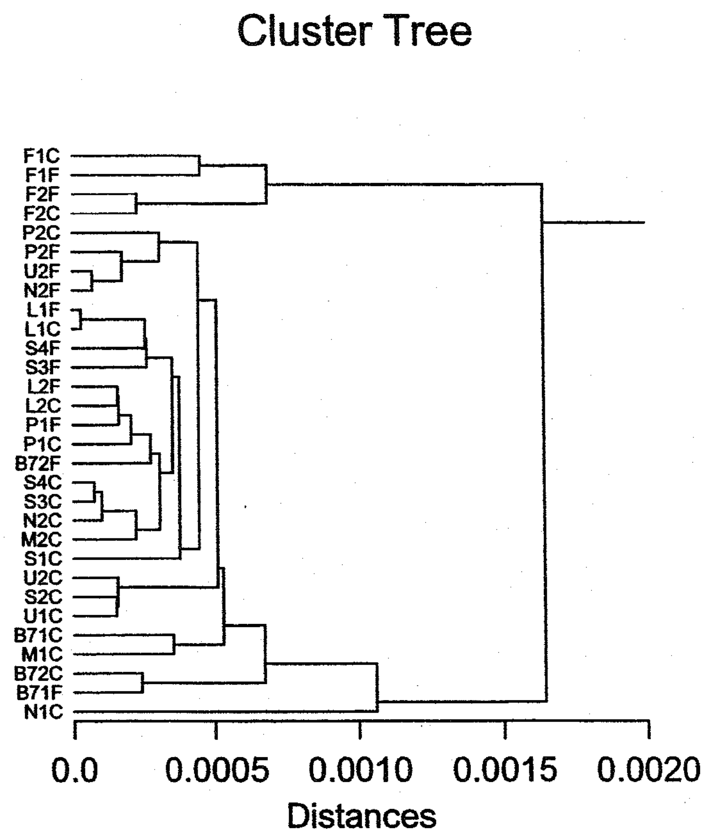


Figure 6. Cluster analysis for major oxide data from the watershed samples compared with Core 7 samples.

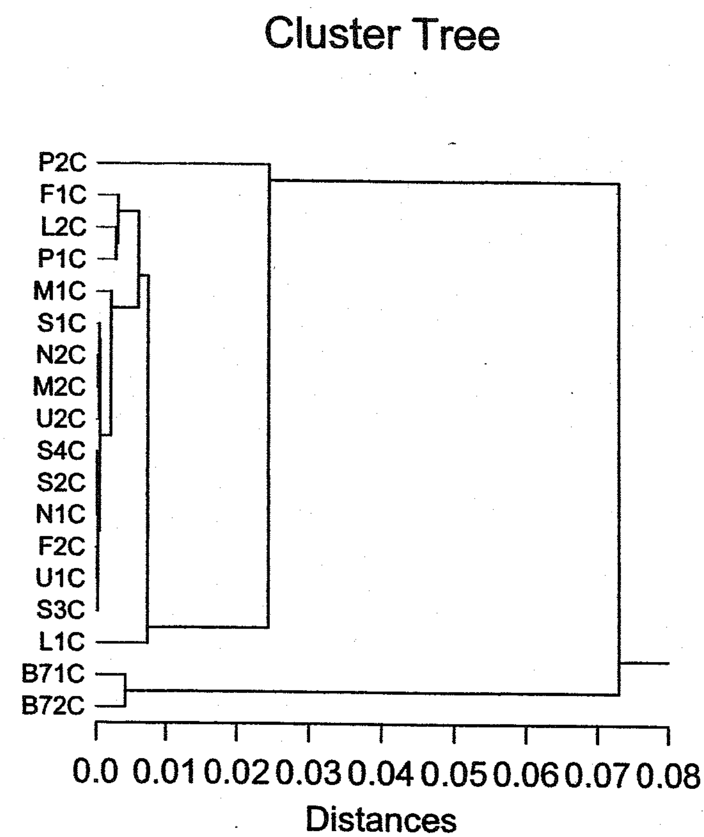


Figure 7. Cluster analysis for the nutrient data from the watershed samples compared with Core 7 samples.

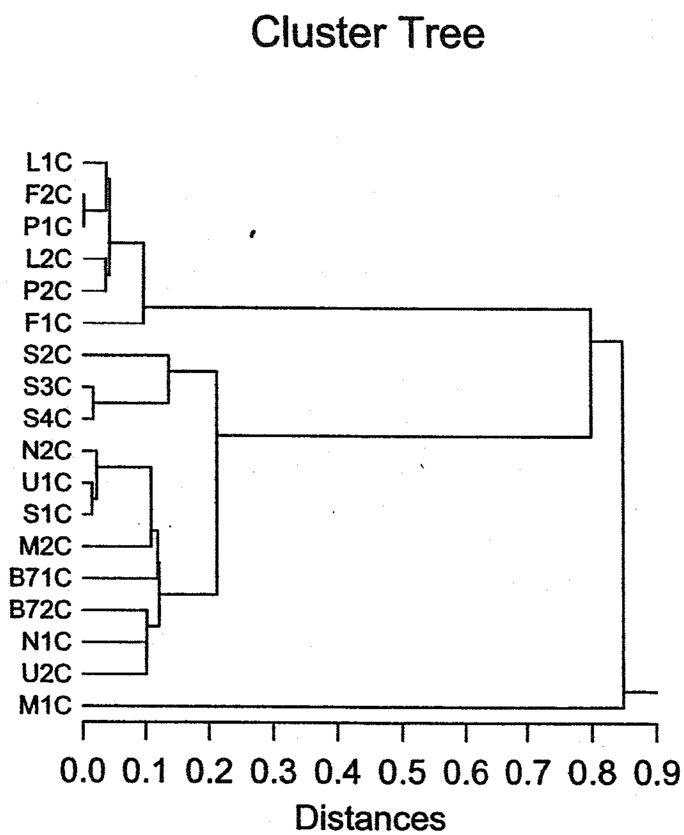


Figure 8. Cluster analysis for grain-size data comparison for the watershed samples and Core 7 samples.

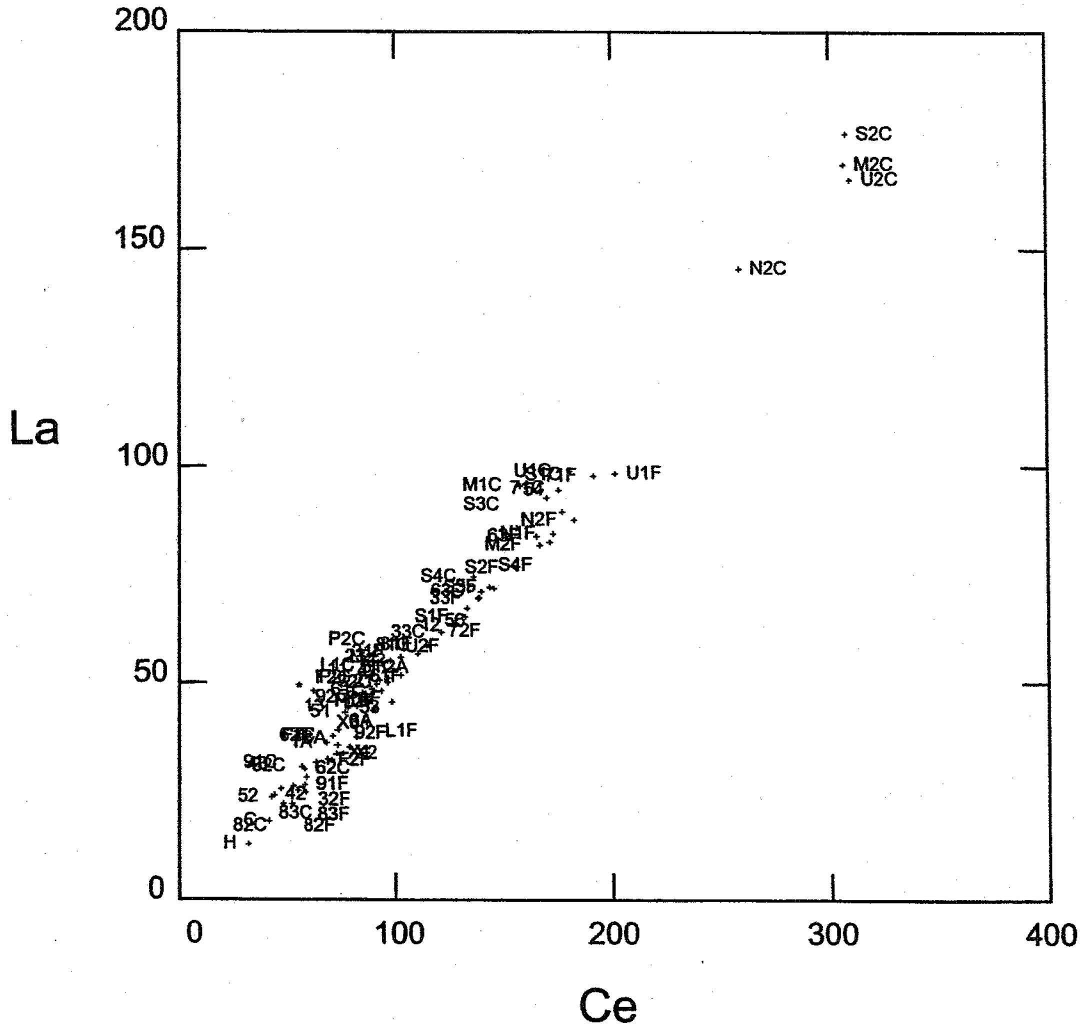


Figure 9. Cerium to lanthanum relationships for all depth intervals and watershed samples. (N1 is not on the scatterplot because the concentrations for both elements is greater than 500 mg/kg)

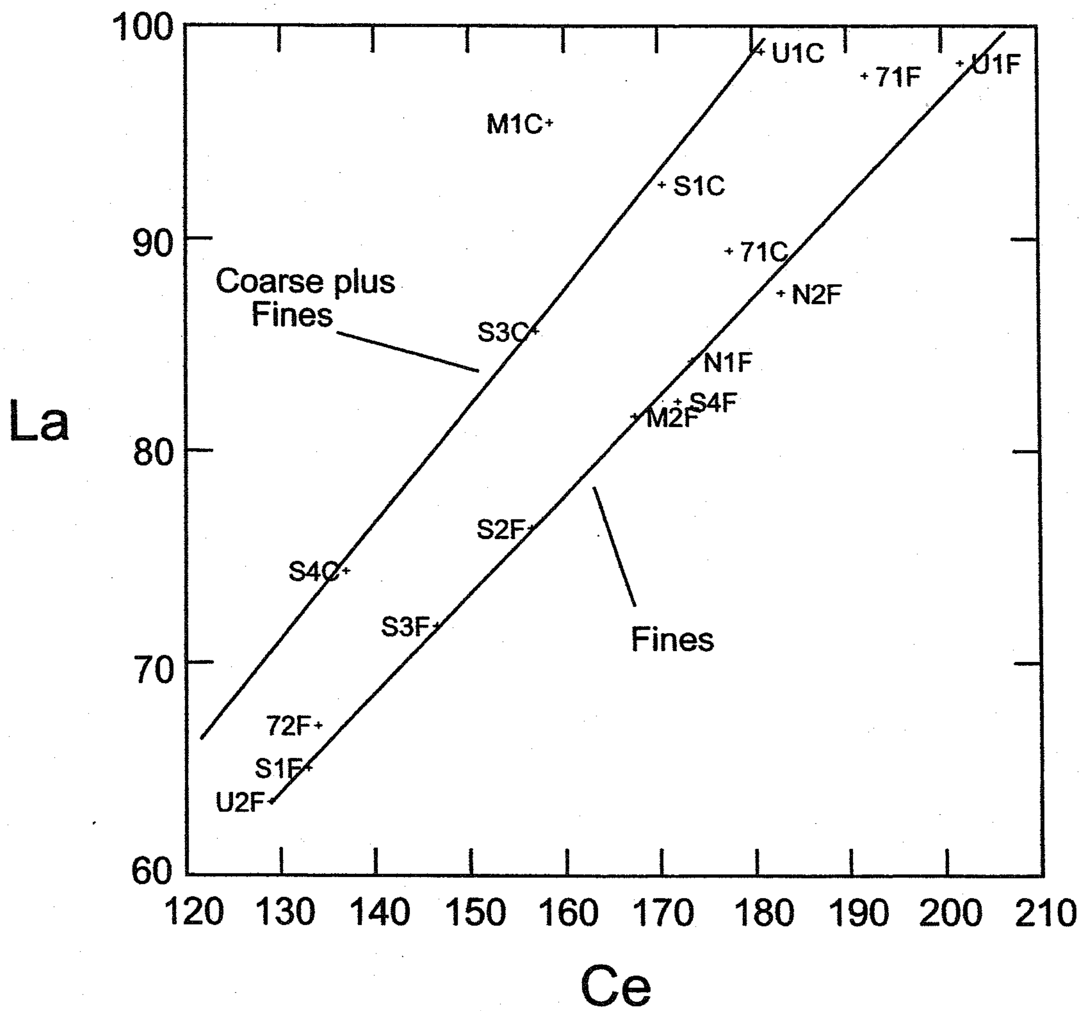


Figure 10. Cerium to lanthanum relationships for upper depth interval samples from Core 7 and watershed samples in the general area of Core 7 samples.

- Based on grain size, Core 7 sediments are not unique to all other core layers within Mica Bay.
- Based on an element to element (end member) comparison of the coarse plus fine grained samples, the North Fork and forest soils are the primary contributors of sediment to the upper (0 to 29 inch) depth interval of Core 7.
- Based on an element to element comparison of the fine-grained sediment only (minus 230 mesh), the 1.1 percent of the fine-grained sediment in the upper depth interval of Core 7 comes from background sources, forest and agricultural soils.
- Based on the cluster analysis, the Core 7 sediments are different than all the watershed sediments. This indicates there is a lacustrine component in Core 7 that makes it different than all the watershed samples.
- Based on the scatter plot analysis, the upper depth interval of Core 7 is most closely associated with the North Fork stream sediment N2 as the most probable source.
- Both the grain size data and scatter plot analysis indicates the upper depth interval of Core 7 sediments have the same depositional conditions and watershed source as those found in the pre-1980 bottom depth interval in Core 1.

3.0 Core 7 Color

Physical descriptions of all cores, including color, are included in the Mica Bay Sediment Impact Assessment report, Appendix C, Volume 2 of 2. The Munsell charts in the Rock Color Chart distributed by the Geological Society of America and used by professional geologists to define the color of rocks and sediments in field studies around the world were used to identify the color of the core sediments during visual inspection. The range of color codes identified in the core layers are listed in Table 1.

The upper depth interval of Core 7 (0 to 29 inches) is a pale yellowish-brown (color code 10YR6/2) to moderate yellowish brown (10YR5/4). As shown in Table 1, there are six individual core layers associated with a color that is not associated with any other layer. Given the broad spectra of colors within the cores and lack of either vertical or lateral continuity of any particular color; color, by itself, is neither a reliable indicator of age, depositional environment nor probable source.

4.0 Core 7 Grain Size

Grain size is described in the Mica Bay Sediment Impact Assessment report (Section 3.3.2) based on laboratory grain size data in Appendix D, and particle size distribution curves in Appendix F. The individual particle size distribution curves for the core depth intervals in Appendix F are combined into one plot and presented here in Figure 1. Figure 1 illustrates that the upper and lower depth intervals of Core 7 have very similar particle size distributions as two depth intervals in Core 1. The curve most similar to the upper layer Core 7 sediments is the bottom depth interval of Core 1 (58.5 to 88.5 inches). The bottom depth interval in Core 5 (71 to 77 inches) is slightly finer, but also similar to the Core 1 and Core 7 curves. Therefore, although the sediments in Core 7 and two depth intervals in

Core 1 are generally coarser than the majority of the other core depth intervals in the bay, they are not unique on the basis of grain size.

Figure 2 illustrates the particle size distribution curves for Core 7 and the watershed samples. This is the same plot included in Appendix F illustrating the particle size distributions for the watershed samples, but the Core 7 data has been added for comparison. Figure 2 shows the particle size distribution curve for the upper layer in Core 7 lies between two groups of curves. The two groups of curves that bracket the Core 7 data are from the following watershed locations: SU1, SU2, SP1, N1, N2, and M2 (refer to Figure 3-1 in the November 11, 2003 report for a map of the watershed sampling locations and designators). These locations are all stream samples from the background South Fork Mica Creek (SU1 and SU2), the uppermost South Fork Mica Creek location adjacent to the project (SP1), the North Fork Mica Creek locations (N1 and N2), and the downstream Mica Creek sample location (M2). The lower depth interval of Core 7 is slightly finer than the upper layer, so its particle size distribution curve more closely aligns with SU1 and N1.

The Core 7 sediments are dominantly composed of subangular grains. This reflects relatively short transport times through the watershed to the point of deposition. Although recently eroded materials transported through the Mica Creek system would be expected to have an angular character, this physical property is not a good differentiator of sediment sources in the basin. This is due to the multiple sources of eroded sediments throughout the basin. For example, the severe bank erosion just upstream of the bay in Mica Creek, as well as the extensive bank erosion in the North Fork Mica Creek are probable sources along with the potential of eroded materials from the project. There are watershed activities throughout the basin and upstream of the roadway project that have the potential to deliver sediment with similar grain angularity as found in Core 7. In addition, the relatively recent and high magnitude flood in 1996 would have created an erosive environment conducive to rapid transport of sediment grains.

5.0 Geochemical Analyses

5.1 Overview of Approach

Based on the information presented in Chapter 3 of the Mica Bay Sediment Impact Assessment report, the physical and chemical characteristics of the cores indicate a mixture of three totally independent major sources reflected in the Mica Bay sediments: a watershed source with a potential project-related subsource, Mount Saint Helens ash source (which also formed a time line) and a lake source (nutrients and mining-related constituents). A database of particle size, trace elements, major oxides and nutrients was put together for watershed samples and core depth interval samples to distinguish between each of these sources. It was important to select chemical elements and physical characteristics that are likely to be minimally changed in the weathering process or the fluvial and lacustrine depositional environments. In addition, the chemical constituents need to exhibit either the highest or lowest concentrations in each environment and have a large overall range in concentrations so that different sources can be identified.

Silica, alumina and potassium oxide were selected because they are sensitive to variable transport conditions by reflecting quartz, clay plus feldspar, and mica, respectively. A scatterplot of silica to alumina ratios versus the silica to potassium ratios indicate the relative importance of these three minerals as sources of sediment to the bay. Barium was significantly higher in the watershed material than in the bay sediments so barium was selected to reflect watershed material. Zinc, although generally a very mobile element, is significantly higher in the lake environment as part of the mining-related metals from mineral deposits along the Coeur d'Alene River. Mount Saint Helens ash is among the lowest concentrations for both barium and zinc. Therefore, a barium to zinc scatterplot compares the potential significance of ash (lowest in both), watershed (high barium, low zinc) and lake (high zinc, low barium) sources on the bay depth intervals. Finally, cerium and lanthanum, light rare earth elements, were selected to differentiate between watershed sources (highest) and Mount Saint Helens ash (lowest), particularly for the post 1980 sediment depth intervals, the focus of this investigation.

Scatter plots for barium-zinc and cerium-lanthanum in Section 3 of the Mica Bay Sediment Impact Assessment report do not include all the data from the data base. For the barium-zinc scatter plot, samples containing more than 150 mg/kg zinc were considered to have too high a lake influence to be able to be useful in estimating the source of watershed sediments to Mica Bay. In other words, Figure 3-9 (in the November 11, 2003 report) excludes core depth intervals with zinc concentrations above 150 mg/kg so that watershed sources could be compared with core depth intervals most likely impacted by watershed sources (minimum lake influence).

Only the minus 230 mesh size fraction data (fines) for the watershed samples were used with both coarse plus fines and fines only core depth intervals for the cerium-lanthanum scatter plot (Figure 3-10) because the core sediments are mostly fine-grained. The coarser particles in the coarse plus fine sample watershed data would tend to dilute the chemical signature of depth intervals in cores from Mica Bay. Core 7 is the focus of this response. Since Core 7 was almost exclusively coarse-grained sediment (greater than 230 mesh) this response includes both the coarse plus fines, and fines only, data from the watershed samples compared to the upper (0 to 29 inch) depth interval of Core 7.

Values or concentrations of any particular depth interval from a core are expected to reflect the potential major source by similarity with values or concentrations. In other words, Mica Bay core depth intervals plotting near a source on a scatterplot comparing two oxides or elements indicates that this watershed source may be the dominant source. This is most probable if the dominant source is the only source, or only one of two sources (a mixture of high- and low-concentration sources). If two or more sources contribute nearly the same amount to the depth interval more scatter is evident. Then it becomes a weight of evidence based on the dominance of a watershed source on a depth interval by several different elements, oxides and grain sizes.

In general, single dominant sources are relatively easy to identify. For example, all the literature-based Mount Saint Helens ash data and Mica Bay depth intervals that are dominantly ash plot very close to each other on scatter plots. However, essentially all of the depth intervals are variable mixtures of sources. In any mixture, sources both higher and lower in concentration then the particular core depth interval can be considered as potential sources. Higher and lower watershed sources bracketing a core depth interval form end members. The closest end members are considered the most probable major contributor of sediment to the core depth interval.

These principles are applied in the following sections which present the geochemical findings associated with Core 7 using three different methods of analysis:

- Method 1: An element to element (end member) comparison between the upper part of Core 7 and each of the watershed samples
- Method 2: Cluster analysis for the same data used in the above comparison that includes trace elements, major element oxides, grain-size and nutrients sub-cluster trees
- Method 3: Scatter plots that focus on Core 7 samples in Figures 3-8, 3-9 and 3-10 in the Mica Bay Sediment Impact Assessment report

5.2 Method 1: Element to Element (End Member) Comparison

One of the simplest methods of documenting a source contributing most of the sediment to a particular core depth interval in Mica Bay is by comparing element and physical characteristics of the depth interval to all potential watershed samples. This end member procedure is very cumbersome and too time consuming to apply to individual depth intervals of all cores except by statistics, but it is applicable for an individual depth interval. In this case, the probable watershed end-member sediment contributors are determined by comparing Core 7 sample data with comparable grain-size sample data representing each of the respective watershed sources. This end member determination focuses only on data from the upper part (0 to 29 inches) of Core 7 and all the watershed samples (no other depth intervals of other core locations are being considered in this analysis). Table 2 lists the results of the comparison of the shallowest depth interval of Core 7 (0 to 29 inches) data with comparable grain-size samples in each of the watershed sources. The coarse plus fine samples are compared first, followed by the fines only samples. Given equal weight to each element or characteristic, the potential source with the largest number elements and characteristics could be considered the most significant source of sediment to the upper part of Core 7. However, as described in the following text, each chemical element and characteristic is not necessarily equal to all others.

5.2.1 Coarse plus Fines Comparison

5.2.1.1 Discussion

Sediment transport and chemical transformations are responsible for the elements and characteristics of Core 7 that have lower or higher concentrations than their potential sources. In other words, for some elements/characteristics there are no watershed sources that would represent an end member for elements and characteristics that is comparably lower or higher than Core 7 sediments. Therefore, in order for elements and characteristics in Core 7 to be lower than all watershed sources, a sufficient amount of the element or characteristic must be lost from the watershed soil or sediment deposited at the Core 7 location. The loss could occur during soil or sediment transport to the bay or occur through chemical reactions within the bay that mobilizes the element or alters the characteristic.

Nitrate is expected to be low because it is very mobile. Nitrate would be expected to be lost from the soils and sediments during both transport and following deposition. Low concentrations of cesium, lithium and loss on ignition (LOI) reflect the very low minus 230 mesh size fraction. This grain size fraction represents only 1.1 percent of the upper part of Core 7 (particularly the clays). Low arsenic probably reflects the low iron concentration in

Core 7. Conversely, the highest barium and sodium concentrations occurring in Core 7 indicate that these are being enhanced over their watershed source concentrations. Barium is generally very insoluble so its enhanced concentration over watershed source concentrations is not unusual, but sodium is generally a very mobile ion enhanced only by ion exchange on minus 230 mesh material. The pair suggest that mica, which is considerably enhanced in Core 7, is probably responsible for their higher concentrations than their potential source concentrations. Barium and sodium are commonly associated with potassium in micas (Rieder, et al., 1998).

The elevated total nitrogen and particularly the organic form of nitrogen suggests that the uppermost depth interval of Core 7 has been significantly affected by the lake environment. The organic form of nitrogen is 195 mg/kg in this upper part of Core 7, essentially the same as the lower part of Core 7 (192 mg/kg). This is in strong contrast to watershed sources concentrations that are all below 7 mg/L. These relationships indicate that either the upper part of the core was deposited within the bay several years ago or that the bacteria colonize the deposited sediments extremely rapidly.

The most important part of the comparison is the list of elements or characteristics that are the only one or two watershed sources that have lower or higher concentrations than the Core 7 sediment. These are the elements or characteristics that are most likely to be end members sources that contribute most of the sediment forming Core 7. From Table 2, nickel in the logged forest land soil L1 is the only element lower than the nickel concentration in Core 7 sediments. Nickel is relatively mobile when iron is low, as it is in Core 7, supporting the low arsenic concentration conclusion described in the above text. Germanium and the minus 35 plus 60 grain size from the background North Fork Mica Creek (N1) is the only source that has a higher concentration than Core 7. Potassium (and therefore potassium oxide) of the logged forest land soil L2 is the only source with a higher potassium than Core 7. Silica concentrations of both the potential forest source L1 and the upper mainstem Mica Creek location M1 are the only locations with a higher silica concentration than Core 7.

Strontium of the South Fork Mica Creek location SP1 (which is most likely to be related to project and or logged forest land due to the proximity of the sediment pond failure) is the only source with a higher strontium than Core 7. Strontium is generally as mobile as calcium and nickel. Therefore strontium is not considered a reliable element for source identification but it is a common impurity in barium-rich minerals. However, if it were substituted in the barium minerals, source location N1 should have a similarly high strontium and the strontium concentration of N1 is similar to the strontium concentration of all the other potential sources than SP1. Furthermore, if strontium was a significant source from SP1, it should also be significant in the downstream South Fork locations, SP2, SP3 and SP4. Since it is not significant in the downstream South Fork locations, strontium is either put into solution during transport; transport has been very localized at this time and strontium has not reached the downstream locations; and/or SP1 is not a significant source of sediment to Core 7.

5.2.1.2 Summary

Given equal weight to each source, the upper North Fork location N1 and forest soil L1 each have two end members and the other forest soil L2 with one end member. These relationships suggest that the upper North Fork and forest soils are the primary sources of sediment to Core 7. The sediments in mainstem Mica Creek at the M1 location would be expected to have also received sediment from these sources as well as being a nearby source of sediment to Core 7. Strontium appears to be localized at and near the SP1 location and, therefore strontium does not indicate a sediment loading from SP1 to either downstream South Fork locations or Core 7.

Of the four elements and one grain size, grain size would be the most important parameter, closely followed by silica and potassium. Germanium is equally important but the concentrations are low and have a limited range. Nickel is considerably more mobile which probably explains its low concentration. These relationships indicate that the upper North Fork N1 and forest soils are the primary contributors of sediment to the upper depth interval of Core 7.

Since essentially 99 percent of the Core 7 sediment have a grain size greater than 230 mesh, these coarse plus fines results provide the primary sources of sediment to the upper part of Core 7. However, the following comparison of fines is presented to estimate the primary sources of sediment providing the remaining one percent of the upper part of Core 7.

5.2.2 Fines Only Comparison

5.2.2.1 Discussion

Similar to coarse plus fines, the arsenic, cesium and lithium concentrations are also lower in the fines of the upper part of Core 7 than all the watershed sources. Copper, manganese and thallium are also lower in Core 7 than all the sources. These elements are commonly higher in silts and particularly clay-sized particles of most sediments so it indicates that the sediment sources contain similarly low concentrations of elements commonly present in fine-grained sediments.

Iron as an oxyhydroxide forms one of the most important adsorbing media for metals and other elements as well as being the primary agent that gives color to the sediments. Iron concentrations are relatively low in the upper part of Core 7 and this is probably one of the major reasons that the upper part of Core 7 is slightly paler yellow brown than several other depth intervals from other cores. Iron of forest soil L1 and project-related soil P2 have a lower iron concentration than Core 7. The iron concentration of background South Fork SU2 is equal to the iron concentration of Core 7. Molybdenum, another element generally adsorbed by iron oxyhydroxide, of project-related P1 and forest soil L2 is lower than Core 7. With low iron oxyhydroxide concentrations, molybdenum is a relatively mobile element. Tungsten of forest soil L2 is the only watershed source lower than the tungsten concentration of Core 7.

Also similar to the coarse plus fines, barium and sodium are also higher in the minus 230 mesh sediment of the upper part of Core 7 than any of the watershed sources and probably for the same reasons. These elements are joined by calcium, cadmium, potassium, strontium and thorium that are all higher in the fines of Core 7. Aluminum concentrations of both agricultural soils are the only watershed locations higher than the upper part of Core 7. This is not surprising because aluminum is a major component of clay minerals as well as feldspars and mica. Cerium, lanthanum and yttrium concentrations of background South Fork SU1 are each higher than their respective concentrations in Core 7. Furthermore, the yttrium concentration of background North Fork N1 has essentially the same concentration as Core 7.

5.2.2.2 Summary

Given equal weight to each of the elements, the total of three background upper South Fork samples plus the single background upper North Fork sample indicates that background sources of the fine-grained (minus 230 mesh) sediment are the most significant sources in the fines of the upper part of Core 7. These sources are followed by two forest soils from L2 and one from L1. Therefore, 8 of the 12 possible end members contributing fine-grained sediment to the 1.1 percent of fine-grained material in the upper part of Core 7 are estimated to be from background and forest soils. The remaining four are equally split between project-related and agricultural soils.

Each of the project-related soils P1 and P2 form end members based on their low molybdenum and iron concentrations, respectively. Project-related P1 is also a forest soil so it could be combined with the above forest soils. Finally, both of the agricultural soils A1 and A2 form end members based on their high aluminum concentrations. Aluminum should be given higher weighting than molybendum and at least equal weighting for iron. Therefore, the 1.1 percent of minus 230 mesh sediment comes from background upper South Fork and North Fork sources (may represent one background population), forest and agricultural soils. Project-related fines may well be in the upper part of Core 7 but this source appears to lag all the other watershed sources contributing minus 230 mesh sediment to the upper part of Core 7.

5.3 Method 2: Cluster Analysis

5.3.1 Discussion

Cluster analysis is a common statistical method of demonstrating linkage between samples and/or variables. The results of cluster analysis are visually portrayed by a cluster tree. Figure 3 is a cluster analysis tree that includes all of Core 7 and the watershed data/locations. The minus 230 mesh (fines) sample of the upper Core 7 depth interval (B71F) is associated with both the coarse plus fines and minus 230 mesh samples of the lower depth interval of Core 7 (B72C and B72F). These three samples are among the last to be associated with the coarse plus fines of the upper depth interval of Core 7 (B71C) and all the watershed sources. B71C is isolated from almost all other samples linking only after most of the potential watershed sources are associated (mixed). In other words, there are no obvious linkages with a single or small group of potential watershed sources.

Use of cluster analysis was extended to specific subpopulations within the database that includes trace elements, major oxides, nutrients and grain size to determine if one or more of these would link Core 7 Mica Bay sediments to a watershed source. Figure 4, the results of the trace element cluster analysis, indicates that trace elements controlled the cluster analysis for all of the data shown on Figure 3. Associations are very similar for all the sample locations and essentially the same for each of the four Core 7 results. Project-related P1 is given more significance in the trace element cluster analysis but still links only with a mixture of B71C with most of the other watershed sources.

To further test the potential for a linkage of trace elements in Core 7 bay sediments with the potential watershed sources, the logarithm of all trace element data values for each of the samples was calculated and subjected to cluster analysis. The results of the logarithm of the trace elements cluster analysis are shown on Figure 5. The same Core 7 group (B71F, B72C and B72F) are still linked to one another and may be linked to the coarse plus fines South Fork background SU2 (LU2C) slightly more strongly than all the other potential watershed sources. However, the coarse plus fines upper depth interval of Core 7 (LB71C) is isolated from all other samples – in other words, a unique sample based on a cluster analysis of logarithm values of trace elements.

As shown in Figure 6, the results of the cluster analysis of the major oxide data suggests a few associations between potential watershed sources and Core 7 depth intervals. Major oxides represent the major rock-forming elements that, for example, include silica, alumina, potassium oxide, etc. The minus 230 mesh fraction of the lower depth interval of Core 7 (B72F) is linked with both project-related coarse plus fines P1C and fines P1F and both forest soils L2C and L2F. Since P1 could be considered a forest land source as well as project-related source, because it was collected from a cleared and grubbed forest site within the project boundary, this cluster analysis suggests that forest soils are a significant contributor to the minus 230 mesh sediments of the lower depth interval of Core 7. The coarse plus fine upper depth interval of Core 7 (B71C) is linked to the mainstem Mica Creek coarse plus fine source (M1C) which would support the end member analysis results. However, the coarse plus fine sample from the lower depth interval of Core 7 (B72C) is linked with the minus 230 mesh sample for the upper depth interval of Core 7 (B71F) and both are isolated; only linking with almost all the other watershed sources after their mixture.

Cluster analysis of the nutrient data includes nitrogen and phosphorus species plus total organic carbon and shown on Figure 7. Nutrients were only analyzed on the coarse plus fine samples because nutrients are primarily added within the lake environment. Both the upper and lower depth intervals of Core 7 are isolated mixing only with the accumulated mixture of all the watershed sources. This was expected since nutrients are primarily lake-related. However in the watershed mixture, the coarse plus fines sample from project-related P2C and forest soil L1C are singled out as having more unique nutrient characteristics than the other potential watershed sources.

Finally, results of the cluster analysis of the grain size data is shown on Figure 8. The coarse plus fine upper depth interval of Core 7 (B71C) is linked with a mixture of background sources and coarse plus fine project-related SP1 (S1C). The grain size cluster analysis suggests that SP1 is mixed first with upper background South Fork SU1 (U1C) then with North Fork N2 (N2C) and finally with mainstem M2 (M2C) prior to mixing with the upper depth interval of Core 7 (B71C). The lower depth interval of Core 7 is mixed with upper background South Fork SU2 (U2C) and upper background North Fork N1. Although at first glance these associations makes some sense, the other potential South Fork samples SP2, SP3 and SP4 that are downstream of SP1 only mix with the B71C and other sources after these have been mixed with the B72C and other sources. These relationships suggest that SP1 and SU1 are similar to N2C but SP1 is not associated with its downstream sediments SP2, SP3 and SP4. In other words, these associations support the end member conclusion that project-related SP1 is a localized South Fork stream sediment site that does not extend downstream to SP2, SP3 and SP4. Therefore, SP1 is unlikely to be a definable source of sediment to Core 7.

5.3.2 Summary

Using all the Core 7 and watershed data, trace elements, logarithm of trace elements and nutrients, cluster analysis indicates that Core 7 data are isolated from all watershed sources. The coarse plus fine sample from the uppermost depth interval of Core 7 is the most isolated. Major oxides associate the coarse plus fine upper depth interval of Core 7 with mainstem Mica Creek M1. The fines-only upper depth interval of Core 7 is associated with the coarse plus fine lower depth interval of Core 7. Grain size associates the coarse plus fine upper depth interval of Core 7 with background North Fork stream sediment N2, upper background stream sediment South Fork SU1 and South Fork stream sediment SP1. The link to SP1 is not supported by stream sediment locations SP2, SP3 or SP4 that are downstream locations between SP1 and both mainstem Mica Creek locations and Core 7. Therefore, the association with SP1 is not credible. The background of South and North Fork are considered to be essentially the same source because the geology and geochemical signatures are very similar to essentially the same.

5.4 Method 3: Scatter Plots

5.4.1 Discussion

Scatter plots presented as Figures 3-8, 3-9 and 3-10 in the Mica Bay Sediment Impact Assessment report Volume 1 of 2 are reappraised to focus on the upper depth interval of Core 7 in the following sections.

5.4.1.1. Figure 3-8 of the Mica Bay Sediment Impact Assessment report (Volume 1 of 2)

Figure 3-8 is a scatter plot that compares the silica/alumina ratio to the silica/potassium oxide ratio. This plot essentially describes the relative transport of quartz (silica) relative to both mica (silica/potassium ratio) and predominantly clays but also feldspars (silica/alumina ratio) . Both coarse plus fines upper and lower Core 7 samples group with the bottom depth interval of Core 1 (58.5 to 88.5 inches) and both the coarse plus fine and fine only samples from forest soil L2 and project-related/forest soil P1 as the most micaceous of all the other core depth intervals and watershed samples. These relationships support the conclusions reached in the end member evaluation. Furthermore, the association of the bottom depth interval from Core 1 (prior to 1980) with the Core 7 depth intervals suggest that environmental conditions of deposition and watershed source for both cores may have been the same.

5.4.1.2. Figure 3-9 of the Mica Bay Sediment Impact Assessment report (Volume 1 of 2)

Figure 3-9 is a scatter plot that compares zinc and barium concentrations of the core depth intervals and watershed samples. Zinc was chosen to represent the high metals concentration within the Coeur d'Alene Lake sediments as described in both the Mica Bay Sediment Impact Assessment report and in several U.S. Geological Survey documents. As much as 4,050 mg/kg zinc (uppermost sample from Core 4) is present in the Mica Bay core depth intervals. In fact, the highest metals concentrations were almost always in the uppermost (shallowest, top) core depth interval at each core location. This relationship itself suggests that the very low zinc concentrations of the watershed that includes the project-related samples, have had essentially no very recent impact on the bay sediments.

All core depth samples with zinc concentrations higher than 150 mg/kg were considered too impacted by the lake environment to be of interest in defining potential primary watershed sources. Except for the slightly higher zinc concentrations in the agricultural soils (less than 130 mg/kg), zinc concentrations in the watershed sources range between about 65 and 100 mg/kg.

The coarse plus fines and minus 230 mesh samples from the lower depth interval of Core 7 has zinc concentrations of 190 and 258 mg/kg, respectively and are off the scale of Figure 3-9. This is in considerable contrast to the zinc concentration of the coarse plus fines and minus 230 mesh samples from the upper depth interval of 84 and 85 mg/kg, respectively. Clearly the upper depth interval of Core 7 is significantly less impacted by the lake than the lower depth interval. This indicates that the upper depth interval of Core 7 is much more recent than the lower depth interval.

Similar to Figure 3-8, the bottom depth interval of Core 1 is grouped with both the coarse plus fines and minus 230 mesh samples from the upper depth interval of Core 7. Barium concentrations isolate these three samples as the penultimate watershed samples within the Mica Bay sediments. Zinc alone is not a credible watershed discriminator amongst watershed samples but barium has more contrast and therefore is a better discriminator of the watershed. Using the barium concentration alone, both coarse plus fines and minus 230 mesh agriculture soil samples A1 and A2 would be considered the major contributor of sediment to the upper depth interval of Core 7.

The barium to zinc relationship supports the above conclusion that environmental conditions and watershed sources that resulted in the deposition of the bottom depth interval of Core 1 and the upper core depth interval of Core 7 were the same. Furthermore, the barium concentration suggests that agricultural soils were a primary contributor of sediment to the upper depth interval of Core 7.

5.4.1.3. Figure 3-10 of the Mica Bay Sediment Impact Assessment report (Volume 1 of 2)
Figure 3-10 is a scatter plot comparing the relationships between cerium and lanthanum in the Mica Bay depth intervals and watershed samples. With one exception, Figure 9 (this document) shows all of the data with reported detected concentrations. The cerium and lanthanum concentrations of the upper background North Fork stream sediment N1 are higher than the upper laboratory quantification limit of 500 mg/kg. Therefore these data points are at unknown offscale positions and not plotted on Figure 9.

Figure 9 of this document shows that there is an excellent linear relationship between cerium and lanthanum (a common geochemical condition). The background coarse plus fine North and South Fork stream sediments (N2C and U2C) along with potentially project-related South Fork stream sediment SP2 (S2C) are major watershed sources of high cerium and lanthanum to the mainstem of Mica Creek (M2C). Therefore, it is likely that these same watershed locations are also the major contributors of elevated cerium and lanthanum to Mica Bay sediments. In fact, M2 was collected downstream downstream of Loffs Bay Road in the channel near the head (upstream) of the delta.

Figure 10 of this document enlarges the area around the upper depth interval of Core 7. A line has been fitted by linear square fit calculations to the coarse plus fine samples (designated with a C) and the minus 230 mesh samples (designated with a F). When the points for Core 7 are not included, both lines have a correlation coefficient greater than 0.99 accounting for 98 plus percent of the variance of the cerium and lanthanum concentrations.

These relationships indicate that for most of the samples the minus 230 mesh size fraction of samples have higher cerium but lower lanthanum than the coarse plus fine samples.

The coarse plus fines upper depth interval of Core 7 sample (71C) and both the upper and lower minus 230 mesh Core 7 samples (71F and 72F, respectively) have a consistent closer relationship to the minus 230 mesh watershed samples than the coarse plus fines watershed samples. From the cerium and lanthanum relationships the coarse plus fines and minus 230 mesh samples of the upper depth interval of Core 7 are closely associated with minus 230 mesh samples from upper North Fork stream sediments N1 and particularly N2 (N1F and N2F) on Figure 10. Even though it is shown to be the case, the reasons for this relationship between the coarse plus fines of the upper depth interval of Core 7 more closely associating with minus 230 mesh watershed sources than coarse plus fines of watershed sources is not known. This is enigmatic because the minus 230 mesh grain size fraction of the upper part of Core 7 is only 1.1 percent.

Without the fitted linear least square fit lines on Figure 10, one might be inclined to associate the coarse plus fine upper depth interval sample of Core 7 as a mixture between the minus 230 mesh North Fork stream sediment (N2F) with the coarse plus fine project and or forest related South Fork sediment sample SP1 (S1C on Figure 10). This would be supported if the coarse plus fine fraction South Fork stream sediments were reversed with the most down gradient stream sediment SP4 in the SP1 position and the other stream sediments in their order falling along the line (as they are doing on the minus 230 mesh line). It is difficult to believe that SP1, the project-related South Fork stream sediment farthest from Mica Bay would be more closely associated with 71C than SP4.

Figure 10 indicates that the upper depth interval from Core 7 receives most of its sediment from the North Fork.

5.4.2 Summary

Figure 3-8 (silica/alumina versus silica/potassium) from the Mica Bay Sediment Impact Assessment report indicates that Core 7 and the pre-1980 bottom depth interval of Core 1 are the most closely associated, most micaceous and group with coarse plus fine forest soil L2 and project-related/forest soil P1. Figure 3-9 (barium versus zinc) from the report supports the association between the pre-1980 bottom depth interval of Core 1 and suggests an association with agricultural soils but not with either L2 or P1. The association between the upper depth interval of Core 7 and the pre-1980 bottom depth interval of Core 1 indicates a common depositional environment and watershed source to both depth intervals.

A new scatterplot centered on Core 7 was prepared to supplement Figure 3-10 (cerium versus lanthanum) from the Mica Bay Sediment Impact Assessment report. Both the upper and lower depth intervals of Core 7 are most closely associated with the minus 230 mesh potential watershed samples and not with the coarse plus fines watershed samples. The upper depth interval of Core 7 is most closely associated with the North Fork stream sediment N2 as the most probable source.

Final Report

Volume 3 of 3, Appendixes H-Q

U.S. 95, Bellgrove to Mica
Project No. DHP-NH-CM-5110(119)

Mica Bay and Mica Creek Final Impact Assessment

Prepared for

Idaho Transportation Department and Idaho Department of Environmental Quality

March 18, 2004

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Final Report

Volume 3 of 3, Appendixes H-Q

U.S. 95, Bellgrove to Mica
Project No. DHP-NH-CM-5110(119)

Mica Bay and Mica Creek Final Impact Assessment

Prepared for

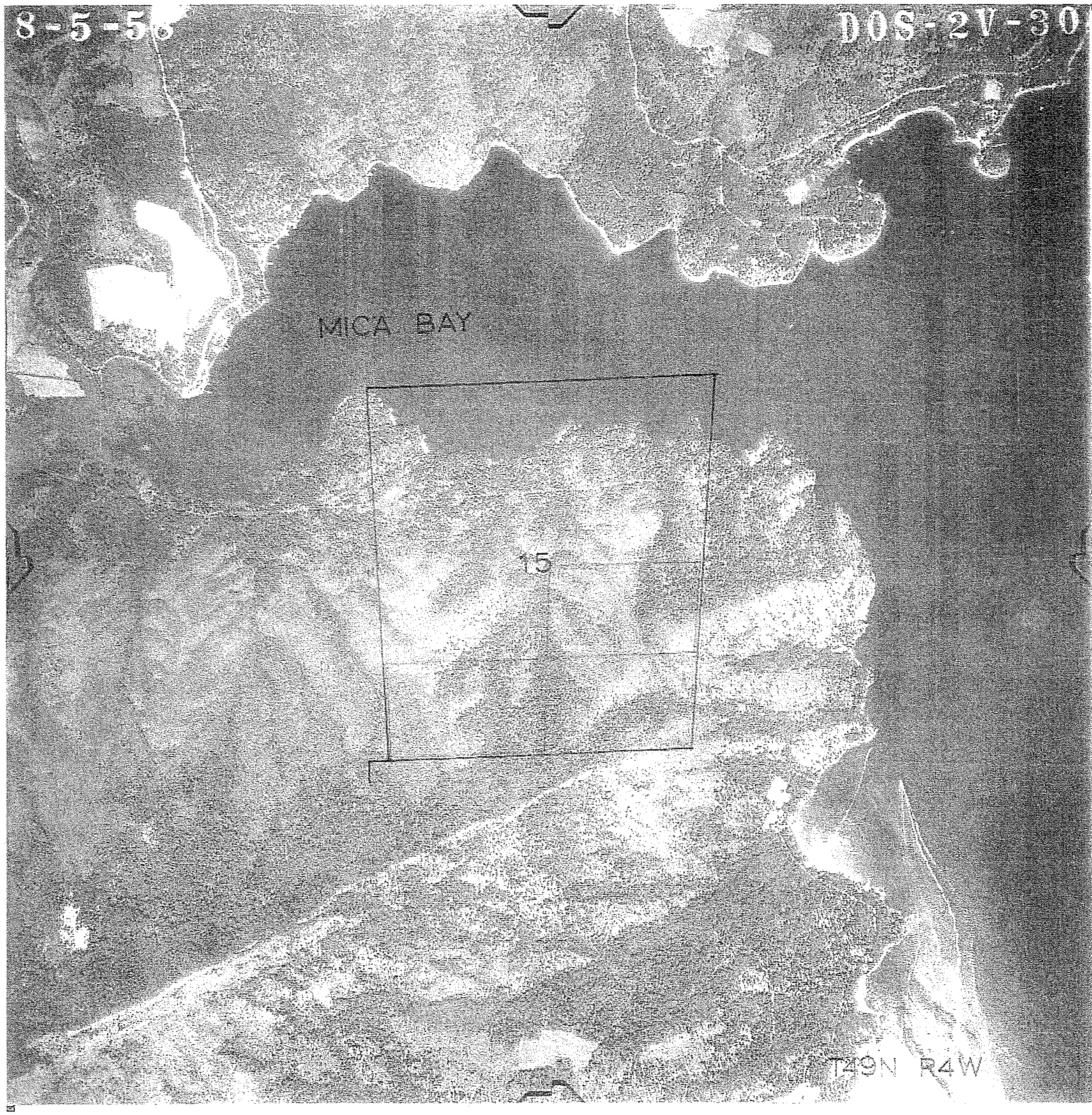
Idaho Transportation Department and Idaho Department of Environmental Quality

March 18, 2004

CH2MHILL

Appendix H

Aerial Photography



Source: Inland Empire Paper Company
Date: August 5, 1958
Water Surface Elevation: 647.7 m (2,124.9 ft)

0 2,000 4,000 Feet Approximate Scale

N W E S

FIGURE 1958-1-A
Mica Bay Aerial Photography
MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

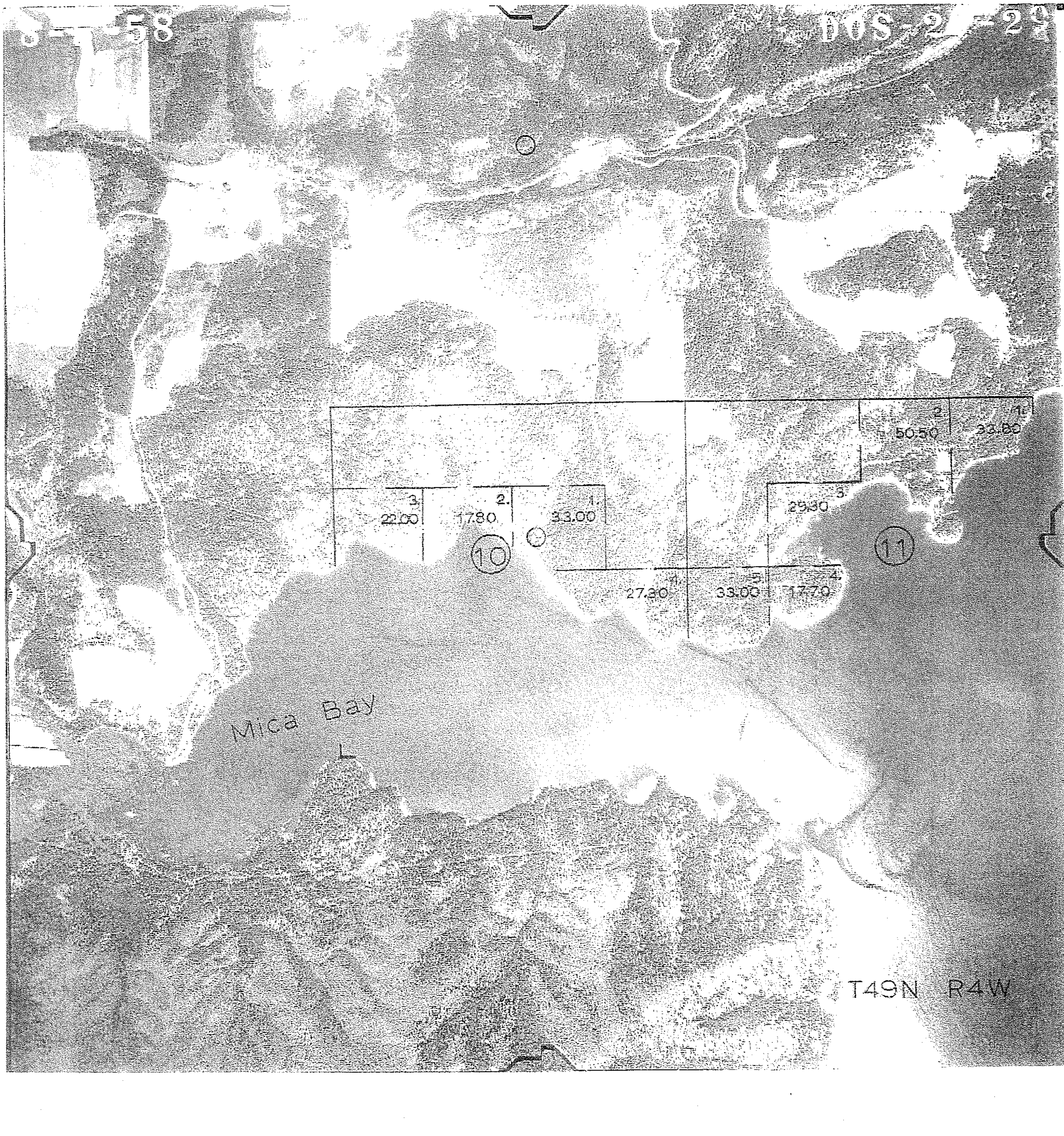
CH2MHILL

Source: Inland Empire Paper Company
Date: August 5, 1958
Water Surface Elevation: 647.7 m (2,124.9 ft)
0 500 1,000 Feet Approximate Scale

N W E S

FIGURE 1958-1-B
Mica Bay Aerial Photography
MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL



Source: Inland Empire Paper Company
Date: August 5, 1958
Water Surface Elevation: 647.7 m (2,124.9 ft)

0 2,000 4,000 Feet Approximate Scale

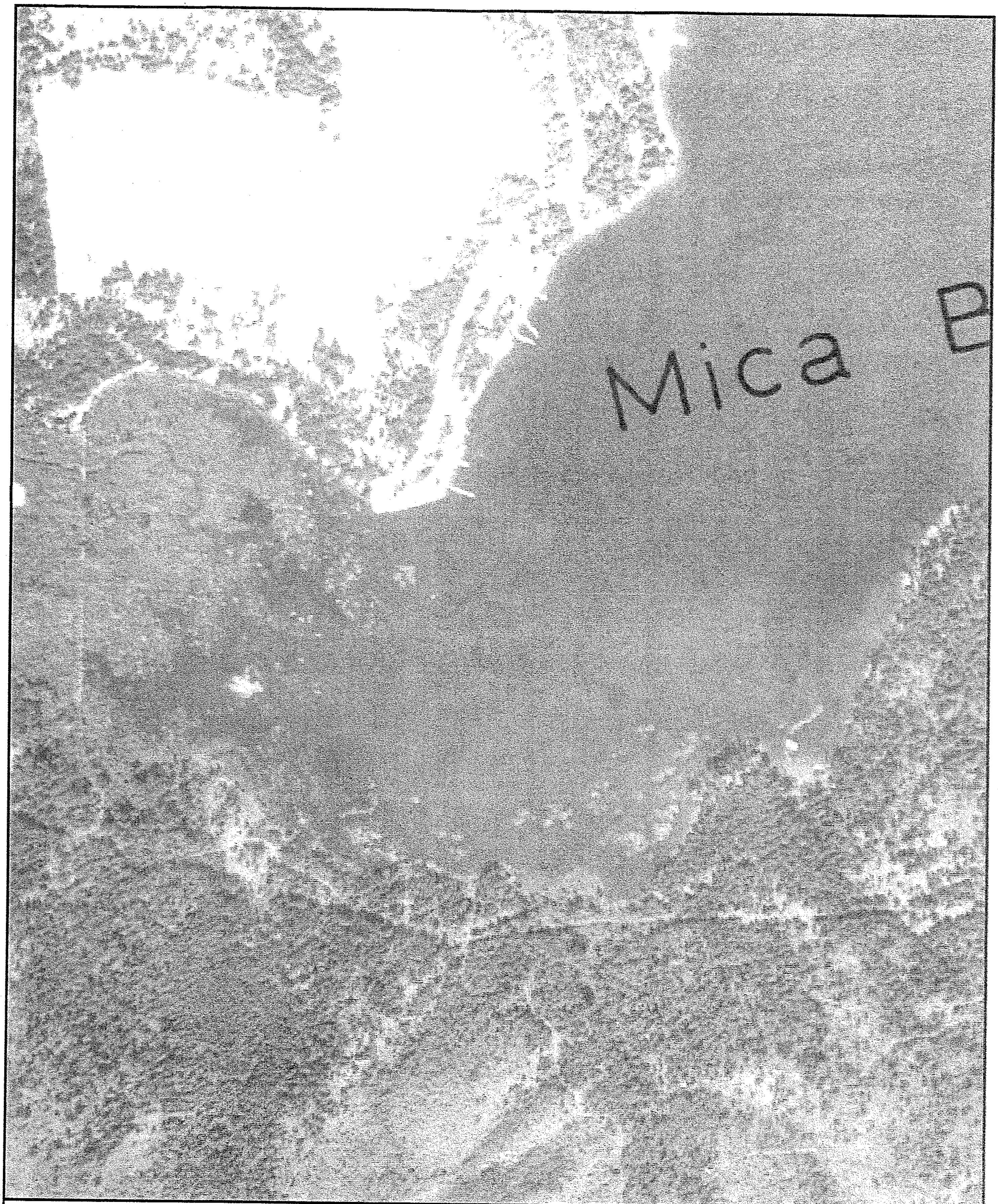
N W E S

FIGURE 1958-2-A

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL



Source: Inland Empire Paper Company
Date: August 5, 1958
Water Surface Elevation: 647.7 m (2,124.9 ft)

0 500 1,000 Feet Approximate Scale

N W E S

FIGURE 1958-2-B

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL

Source: Inland Empire Paper Company
Date: July 4, 1959
Water Surface Elevation: 647.5 m (2,124.2 ft)

0 2,000 4,000 Feet Approximate Scale

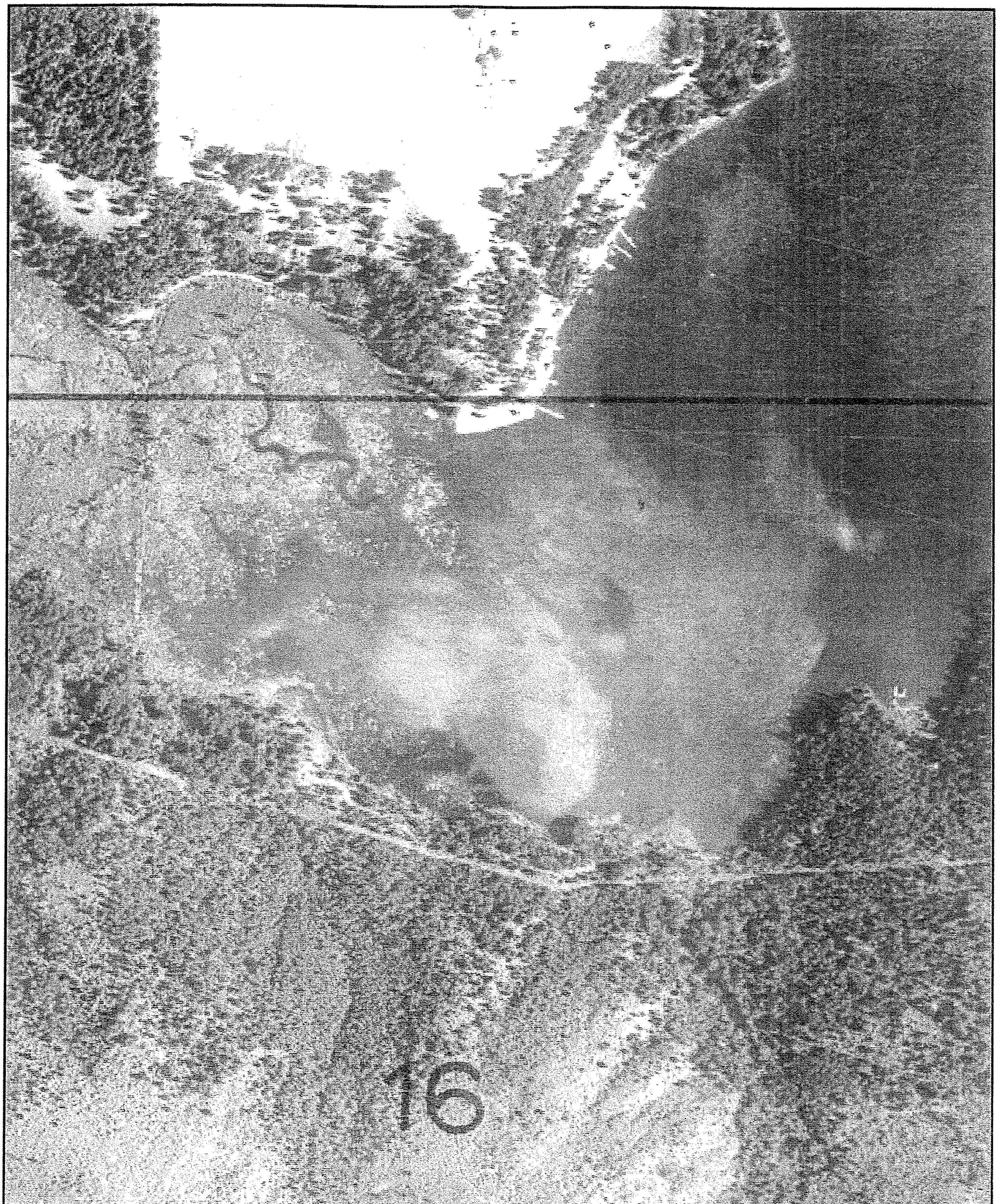
N W E S

FIGURE 1959-1-A

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL

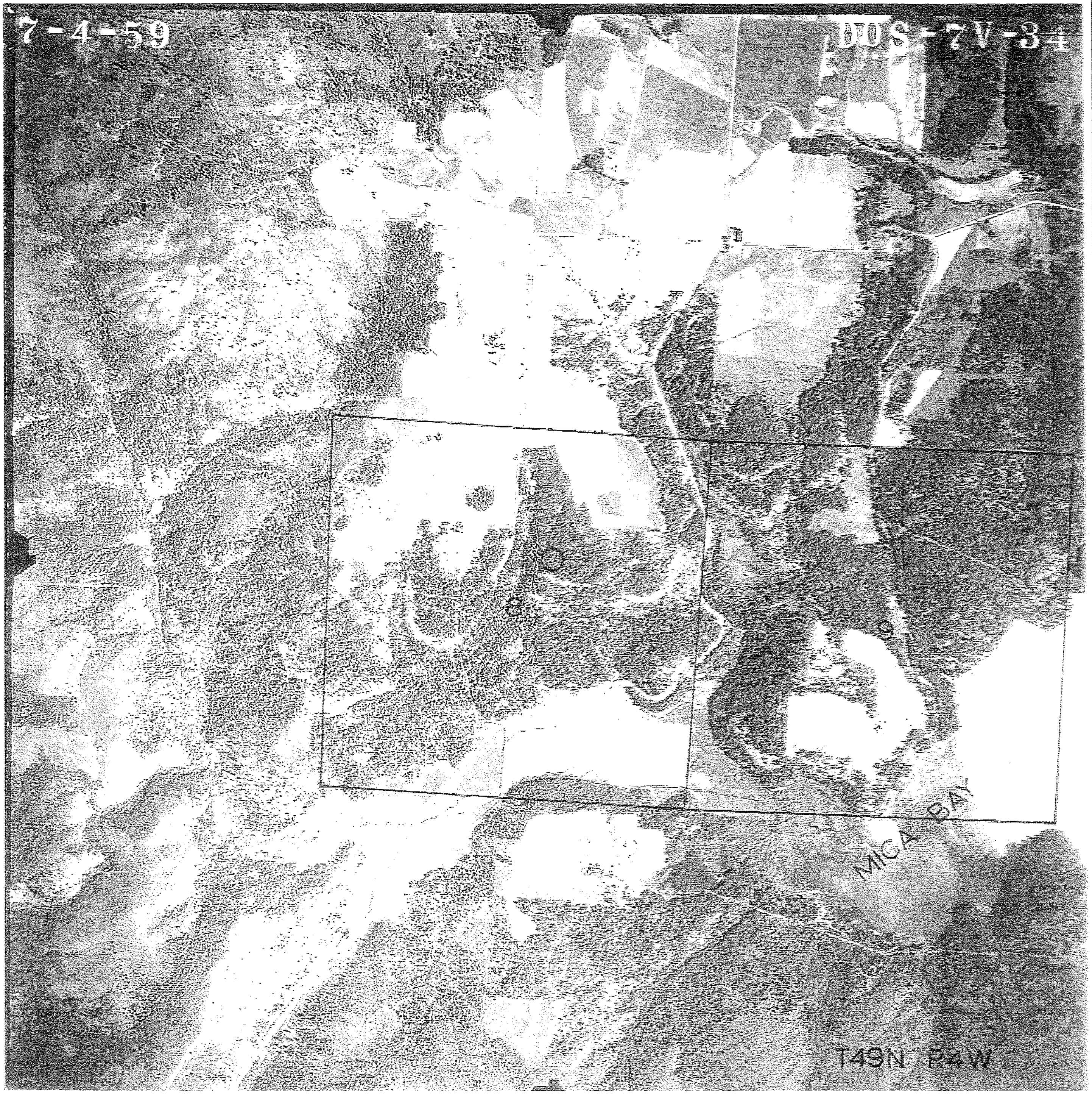


Source: Inland Empire Paper Company
Date: July 4, 1959
Water Surface Elevation: 647.5 m (2,124.2 ft)
0 500 1,000 Feet Approximate Scale

N W E S

FIGURE 1959-1-B
Mica Bay Aerial Photography
MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL



Source: Inland Empire Paper Company
Date: July 4, 1959
Water Surface Elevation: 647.5 m (2,124.2 ft)

0 2,000 4,000 Feet Approximate Scale

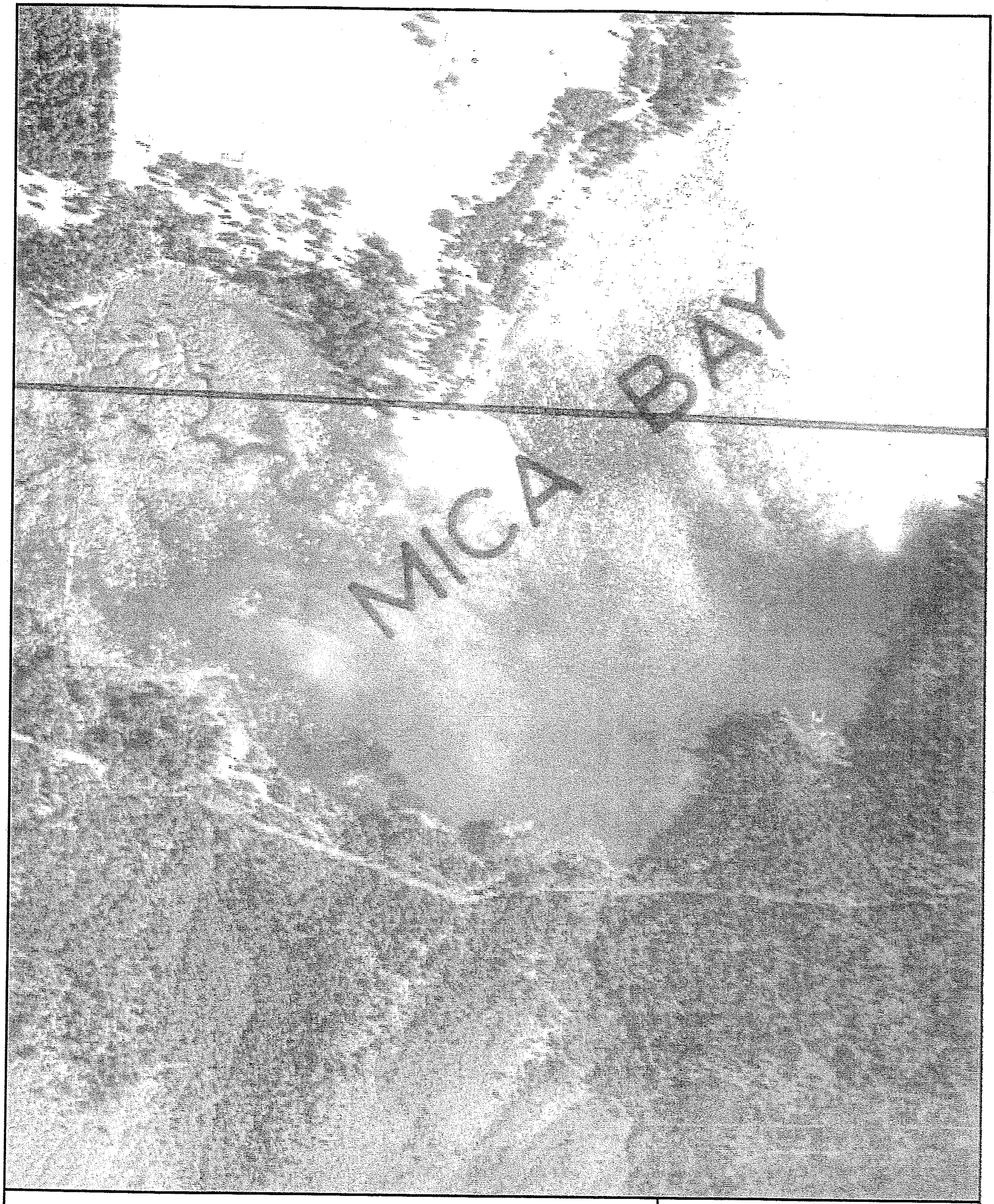
N W E S

FIGURE 1959-2-A

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL



Source: Inland Empire Paper Company
Date: July 4, 1959
Water Surface Elevation: 647.5 m (2,124.2 ft)

0 500 1,000 Feet Approximate Scale

N W E S

FIGURE 1959-2-B

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL

Source: Idaho Department of Lands
Date: August 18, 1965
Water Surface Elevation: 647.7 m (2,124.9 ft)

0 1,000 2,000 Feet Approximate Scale

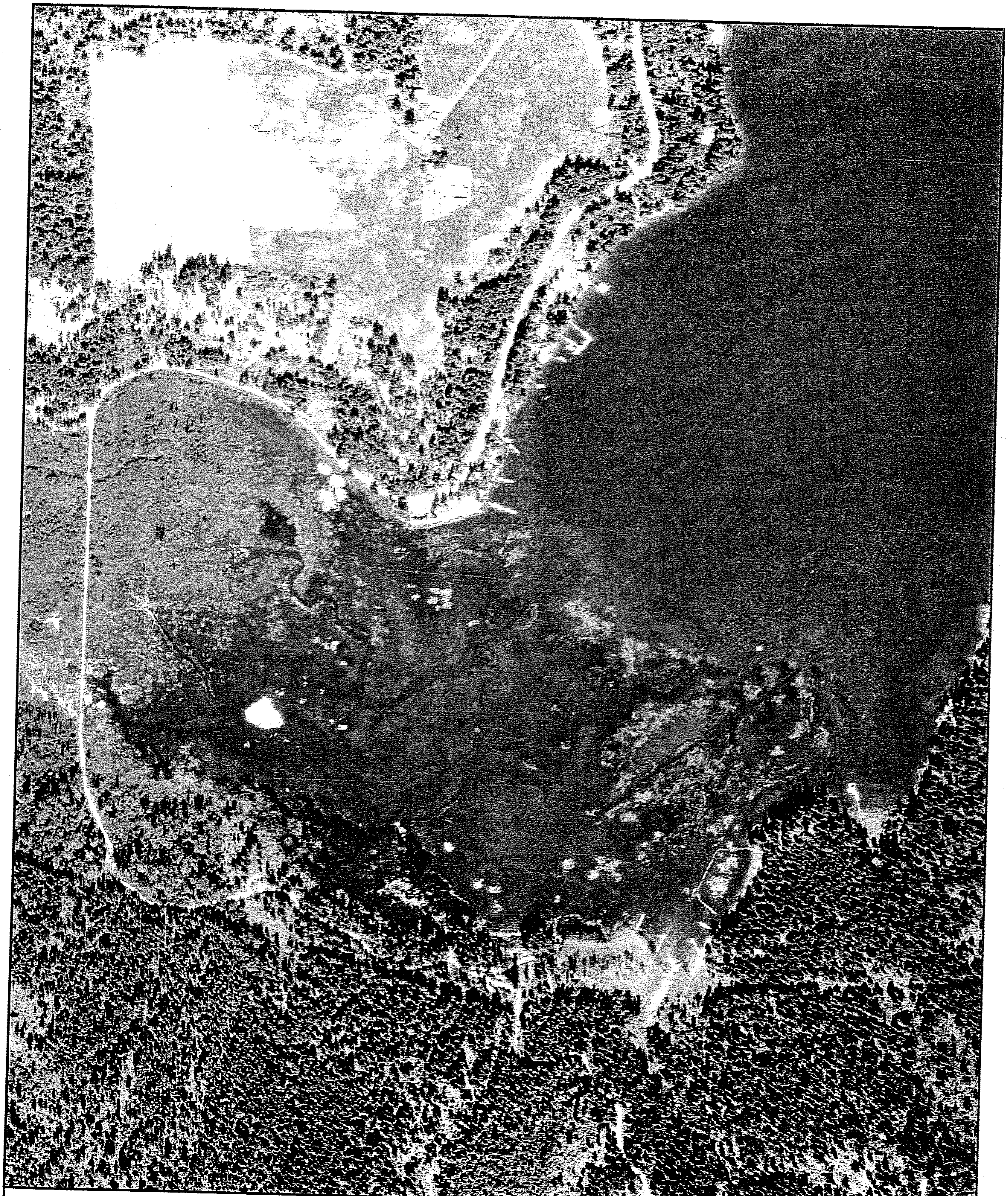
N W E S

FIGURE 1965-1-A

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL



Source: Idaho Department of Lands
Date: August 18, 1965
Water Surface Elevation: 647.7 m (2,124.9 ft)

0 500 1,000 Feet Approximate Scale

N W E S

FIGURE 1965-1-B

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL

Source: Idaho Department of Lands
Date: August 18, 1965
Water Surface Elevation: 647.7 m (2,124.9 ft)

0 2,000 4,000 Feet Approximate Scale

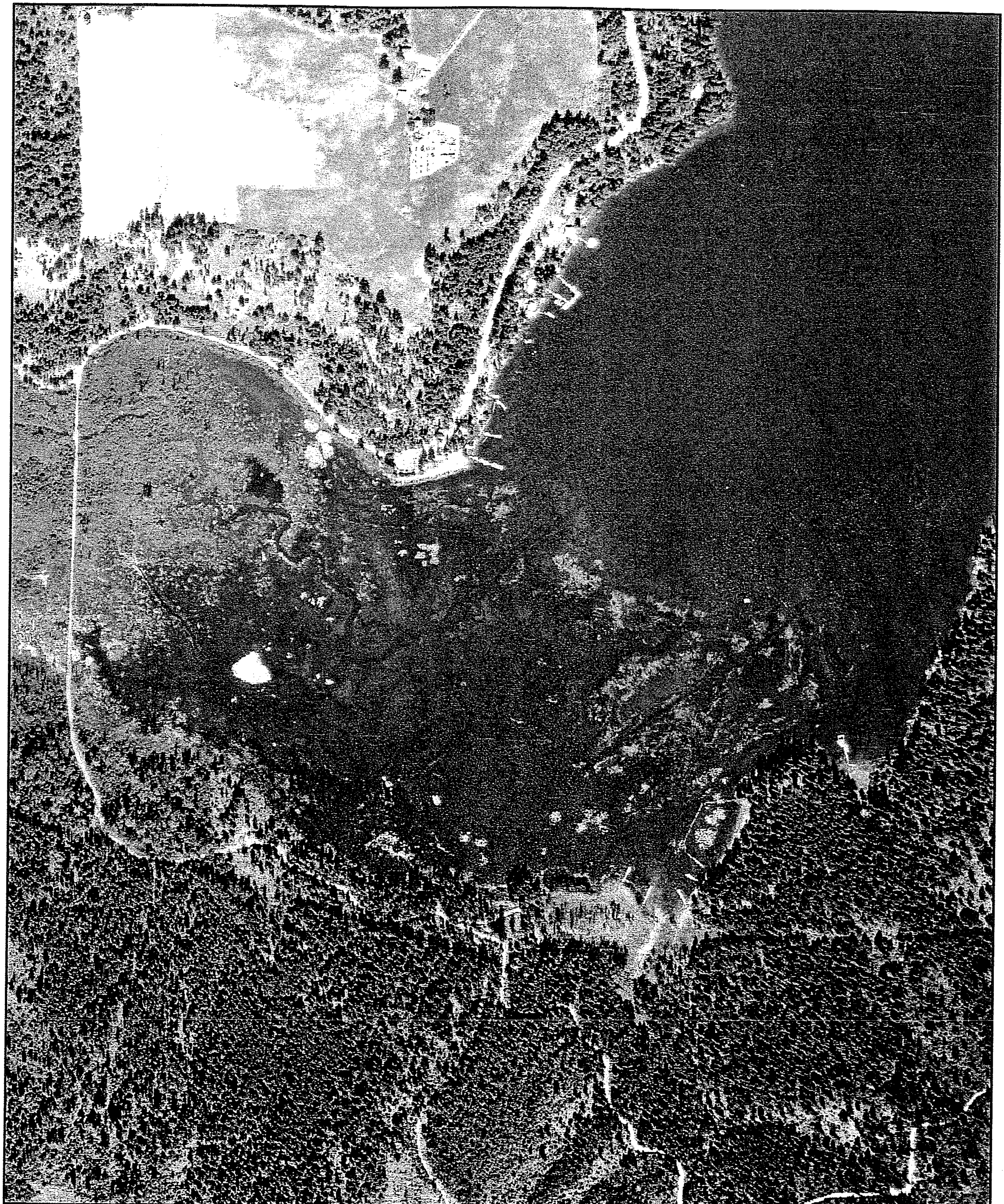
N W E S

FIGURE 1965-2-A

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL



Source: Idaho Department of Lands
Date: August 18, 1965
Water Surface Elevation: 647.7 m (2,124.9 ft)

0 500 1,000 Feet

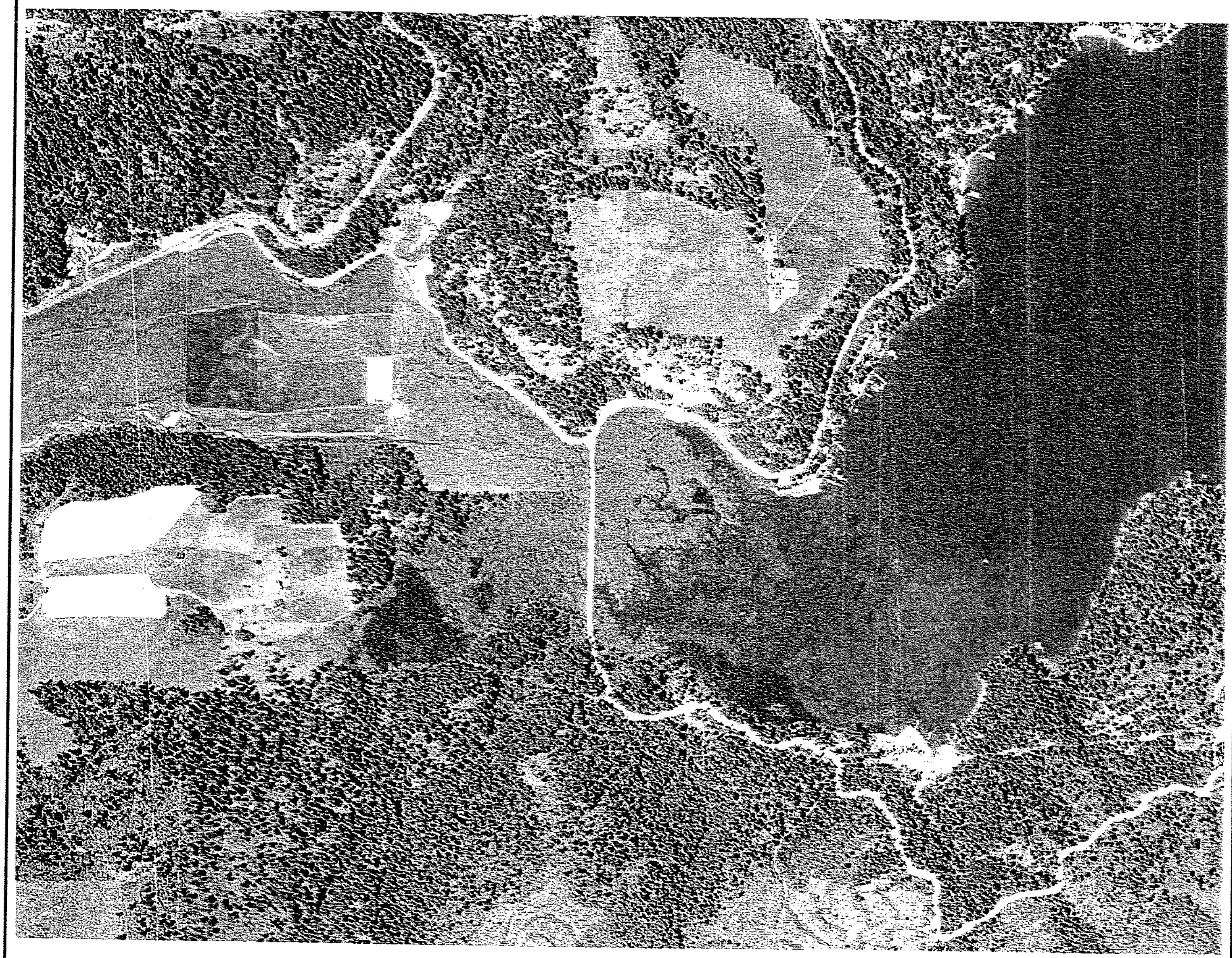
N W E S

FIGURE 1965-2-B

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL



Source: Idaho Department of Lands
Date: July 3, 1968
Water Surface Elevation: 647.7 m (2,125.0 ft)

0 1,000 2,000 Feet Approximate Scale

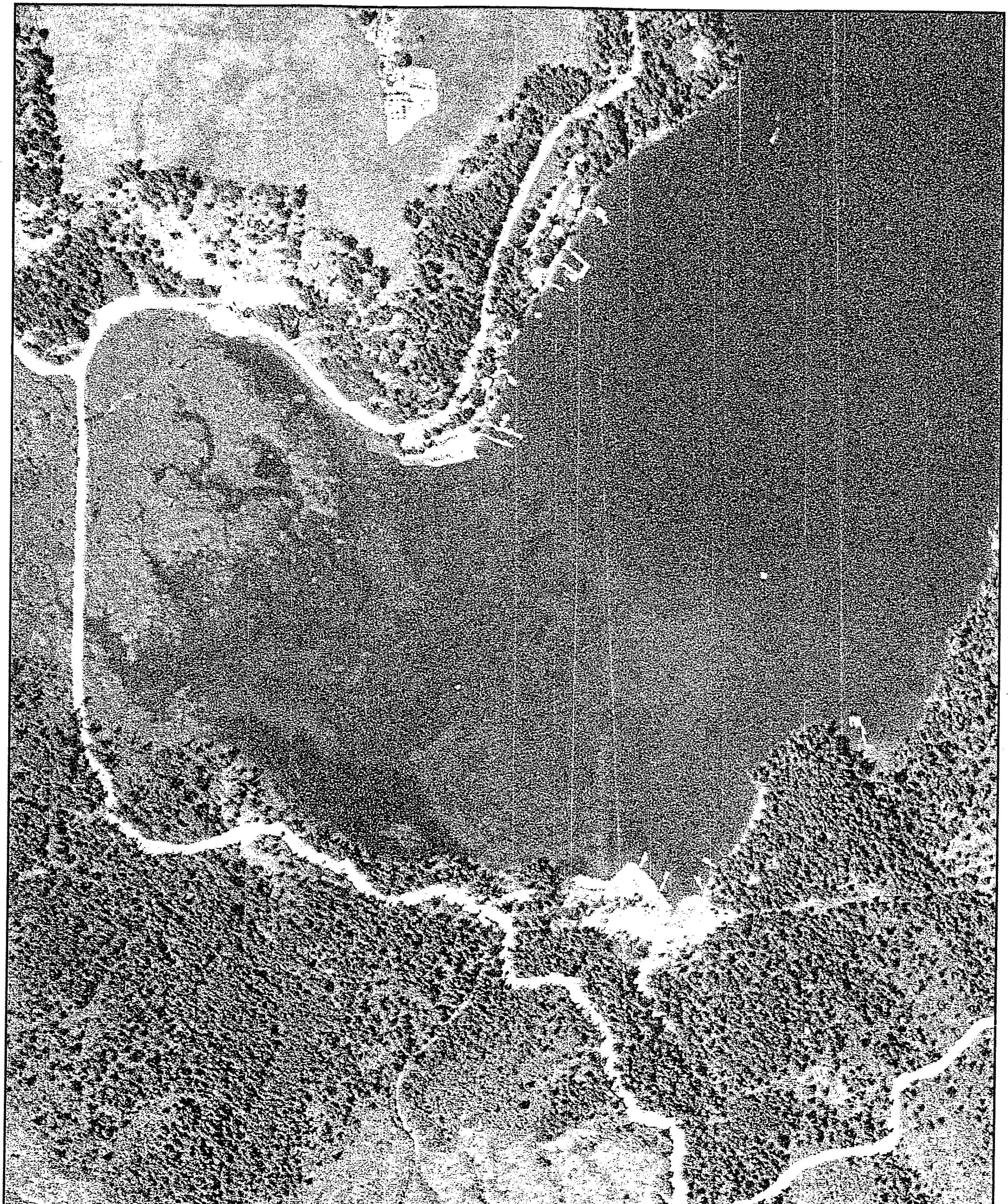
N W E S

FIGURE 1968-1-A

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL



Source: Idaho Department of Lands
Date: July 3, 1968
Water Surface Elevation: 647.7 m (2,125.0 ft)

FIGURE 1968-1-B

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL

Source: Idaho Department of Lands
Date: July 3, 1968
Water Surface Elevation: 647.7 m (2,125.0 ft)

0 5,000 10,000 Feet Approximate Scale

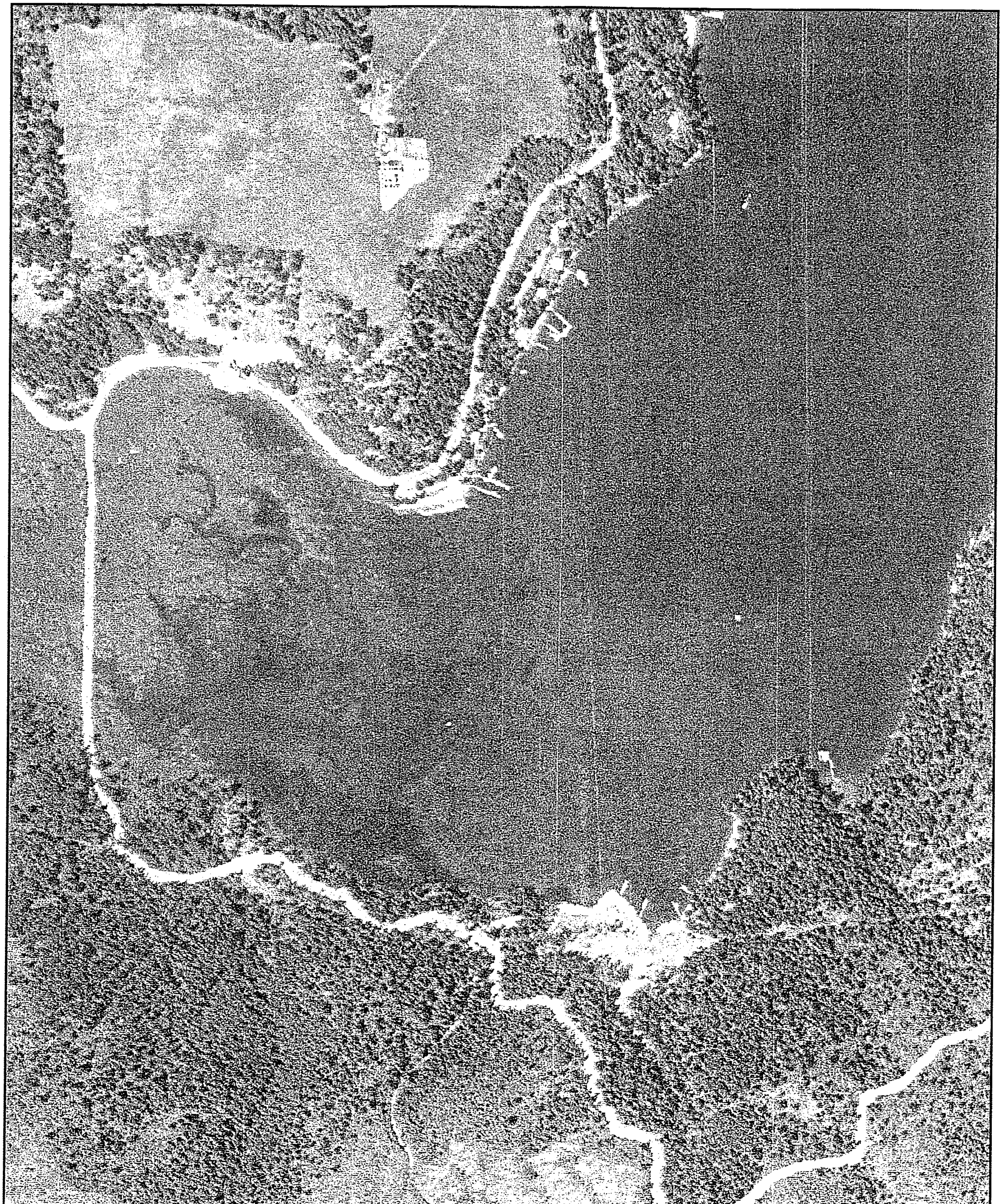
N W E S

FIGURE 1968-2-A

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

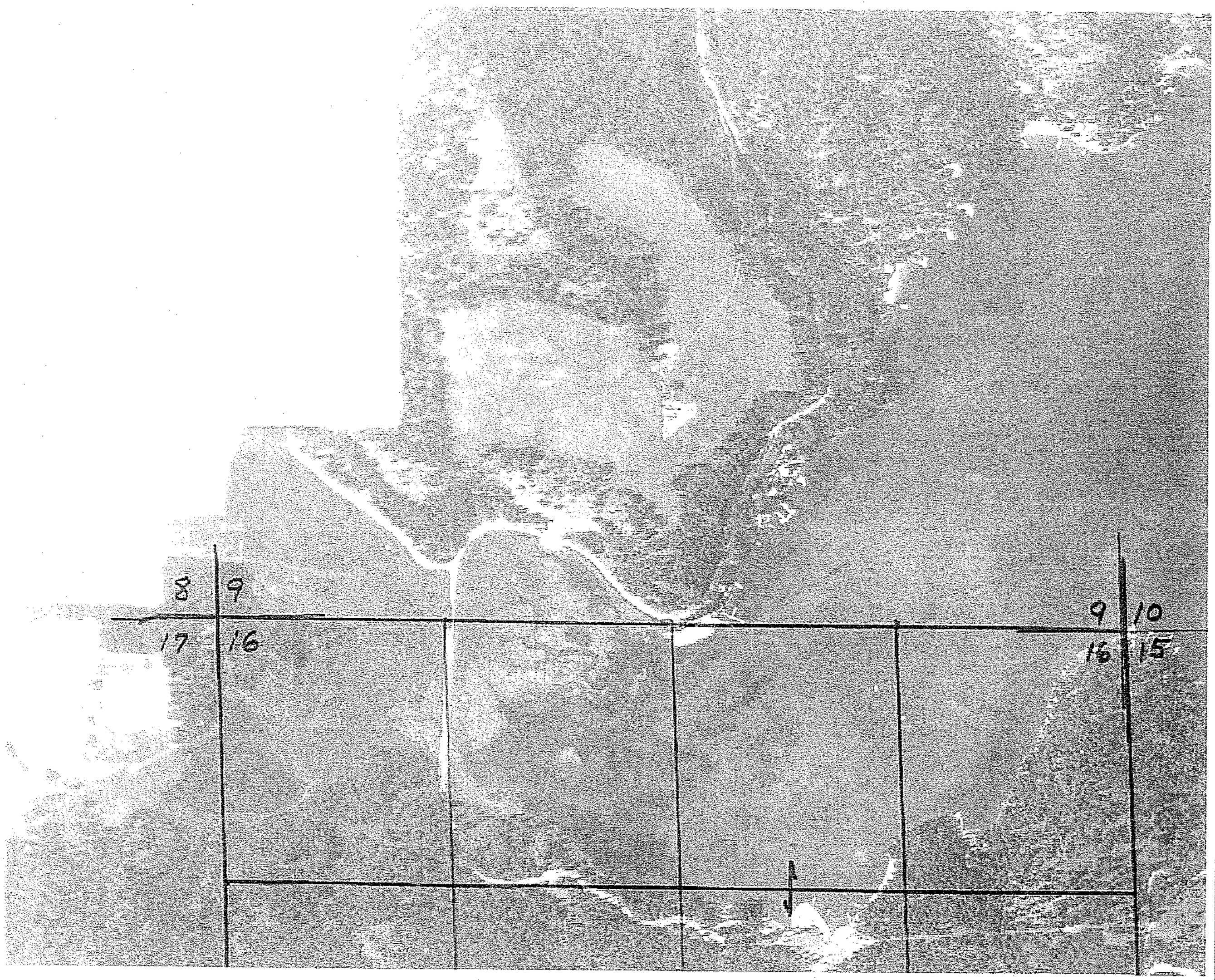
CH2MHILL



Source: Idaho Department of Lands
Date: July 3, 1968
Water Surface Elevation: 647.7 m (2,125.0 ft)
0 500 1,000 Feet Approximate Scale

FIGURE 1968-2-B
Mica Bay Aerial Photography
MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL



Source: Idaho Department of Lands
Date: July 6, 1970
Water Surface Elevation: 647.7 m (2,124.9 ft)

0 1,000 2,000 Feet Approximate Scale

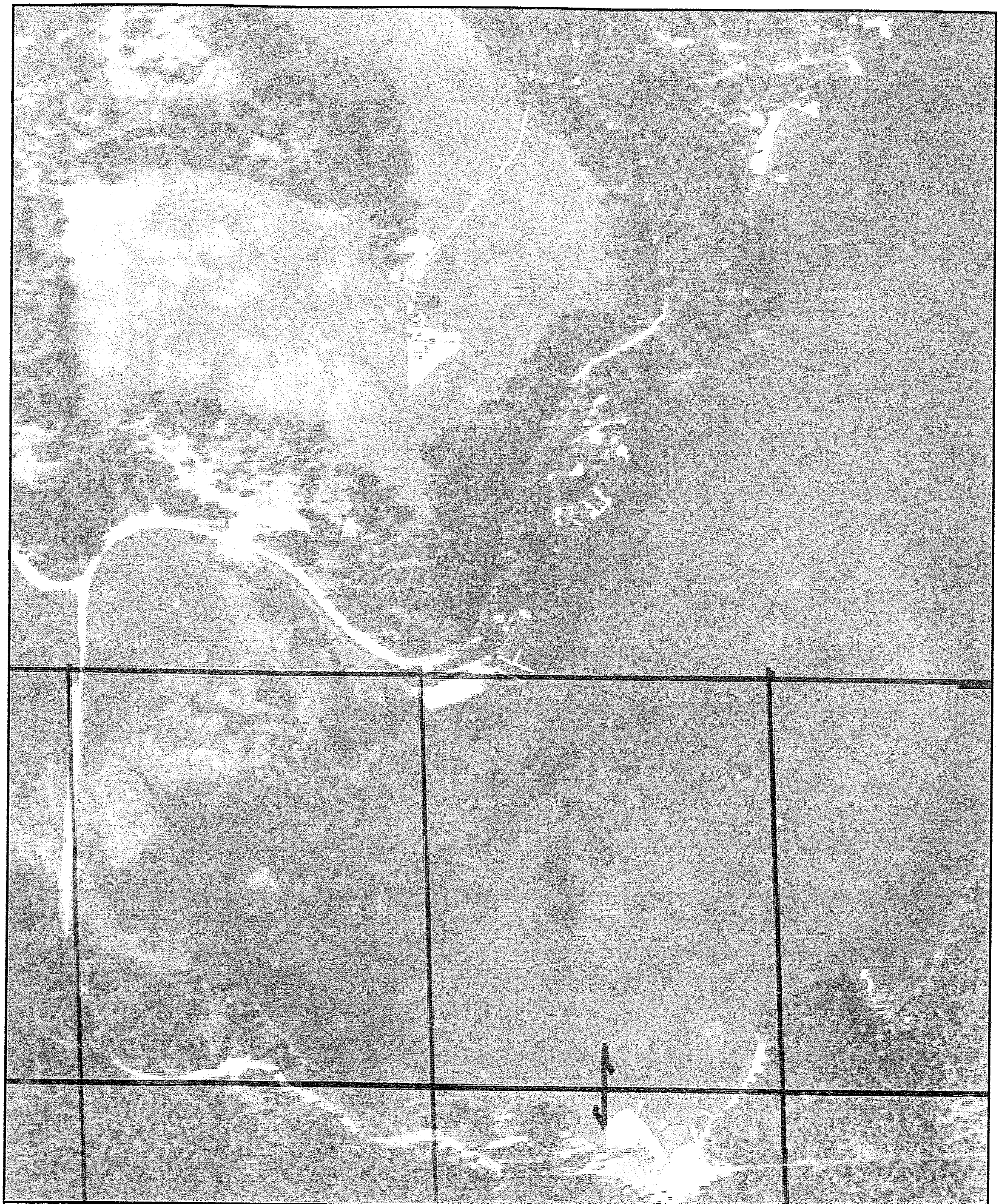
N W E S

FIGURE 1970-1-A

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL



Source: Idaho Department of Lands
Date: July 6, 1970
Water Surface Elevation: 647.7 m (2,124.9 ft)

0 500 1,000 Feet Approximate Scale

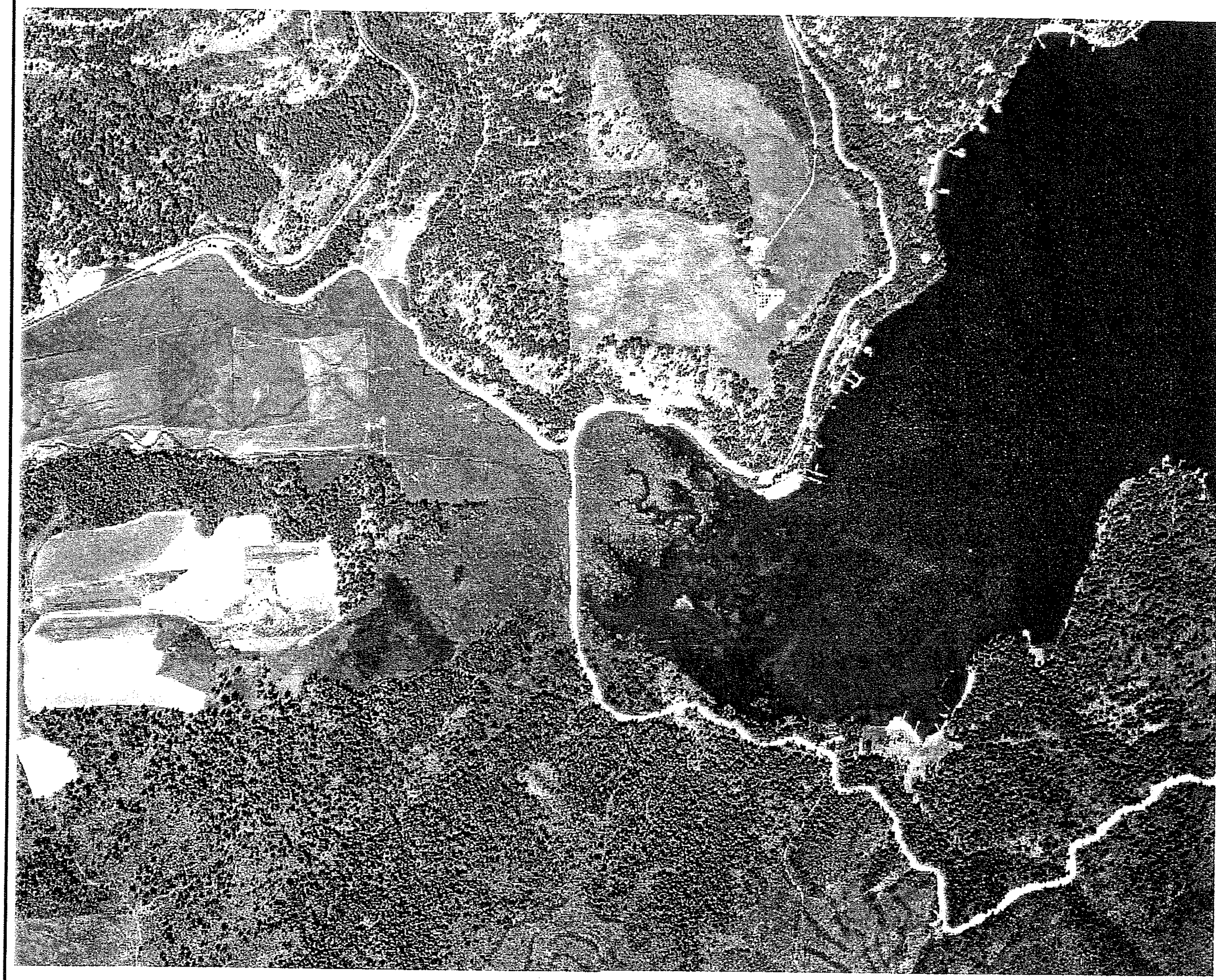
N W E S

FIGURE 1970-1-B

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL



Source: Idaho Department of Lands
Date: July 6, 1970
Water Surface Elevation: 647.7 m (2,124.9 ft)

0 1,000 2,000 Feet Approximate Scale

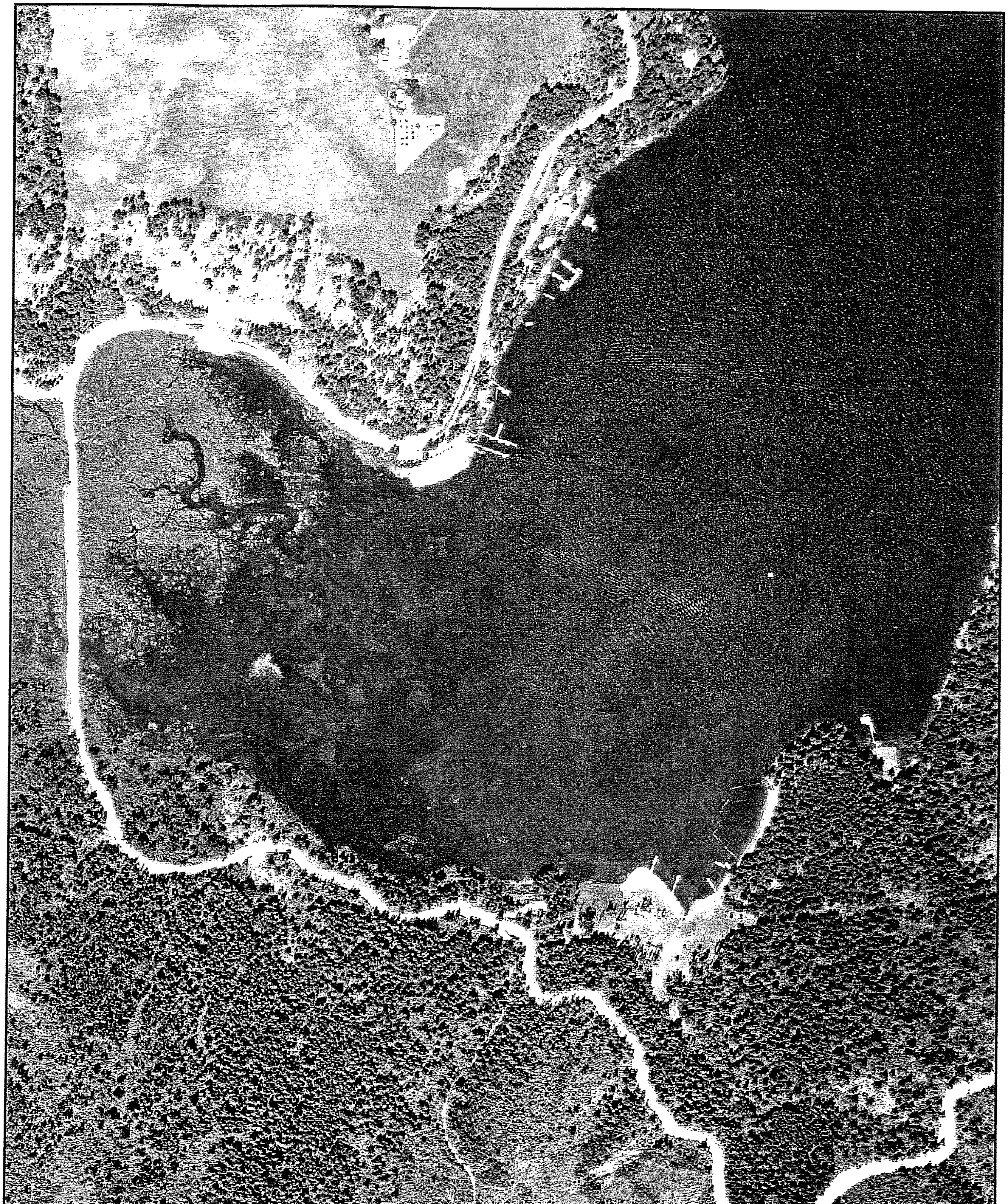
N W E S

FIGURE 1970-2-A

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL



Source: Idaho Department of Lands
Date: July 6, 1970
Water Surface Elevation: 647.7 m (2,124.9 ft)

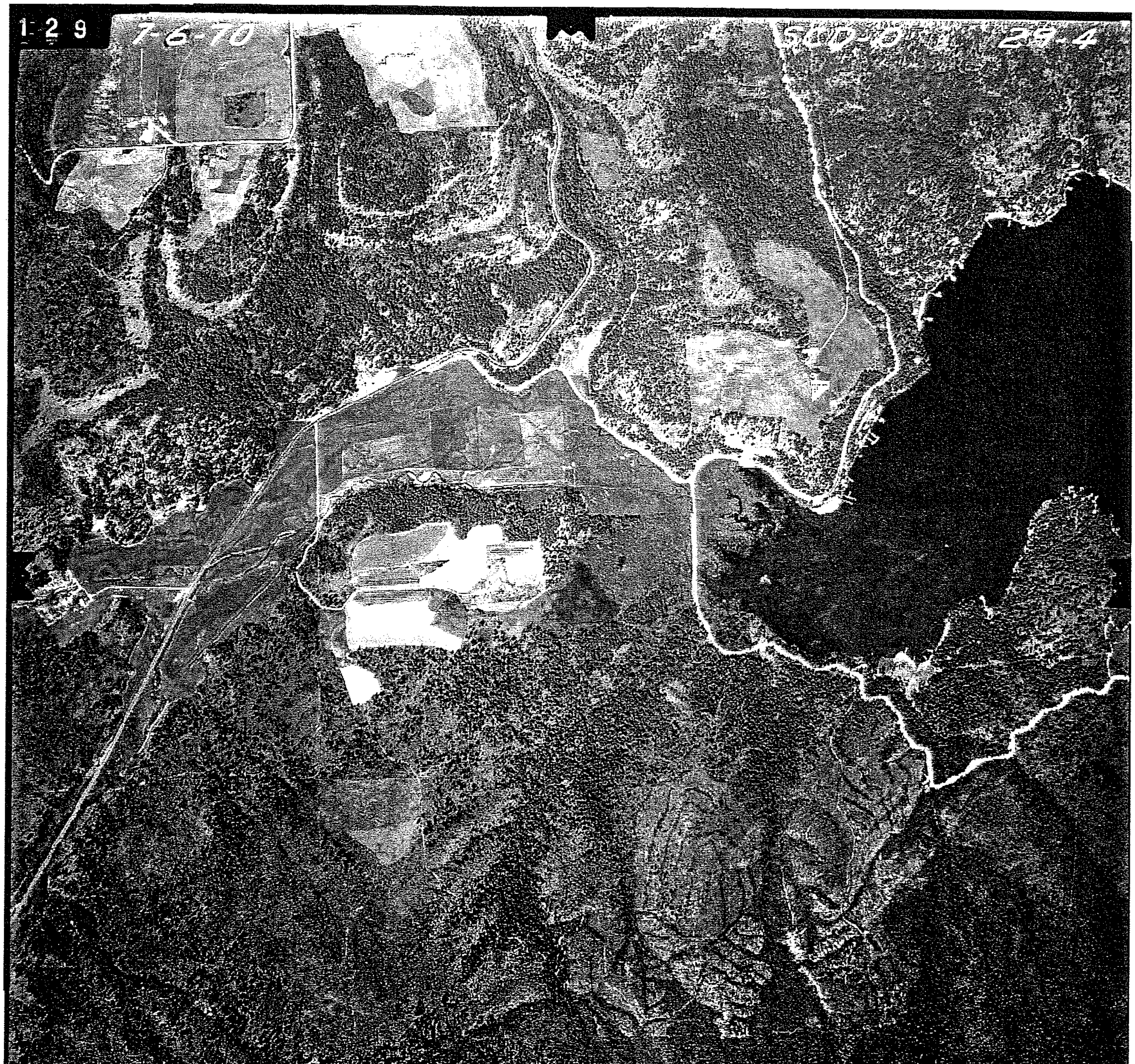
0 500 1,000 Feet Approximate Scale

N W E S

FIGURE 1970-2-B

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT



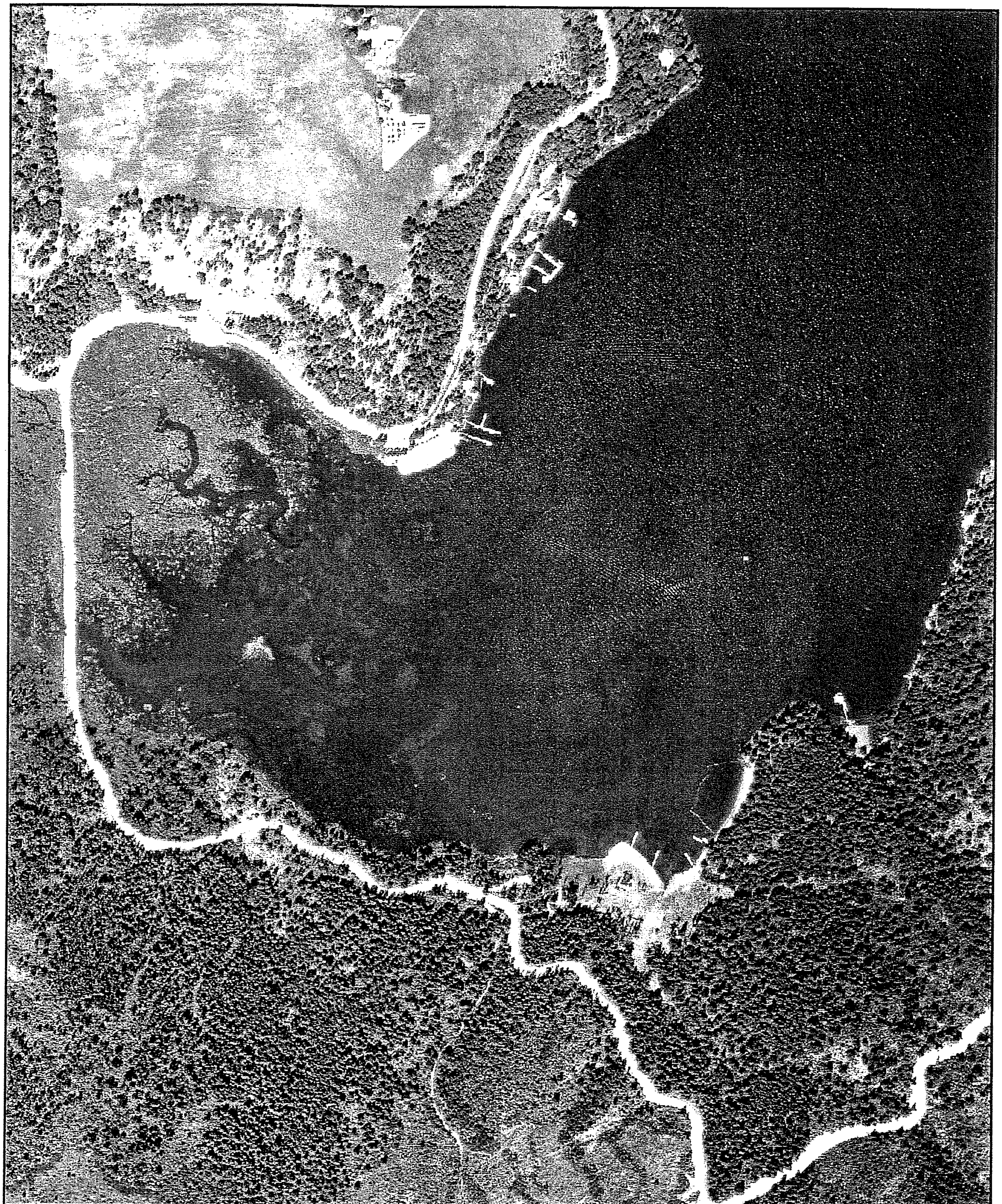
Source: Idaho Department of Lands
Date: July 6, 1970
Water Surface Elevation: 647.7 m (2,124.9 ft)

0 2,000 4,000 Feet Approximate Scale

N
W E
S

FIGURE 1970-3-A
Mica Bay Aerial Photography
MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL



Source: Idaho Department of Lands
Date: July 6, 1970
Water Surface Elevation: 647.7 m (2,124.9 ft)

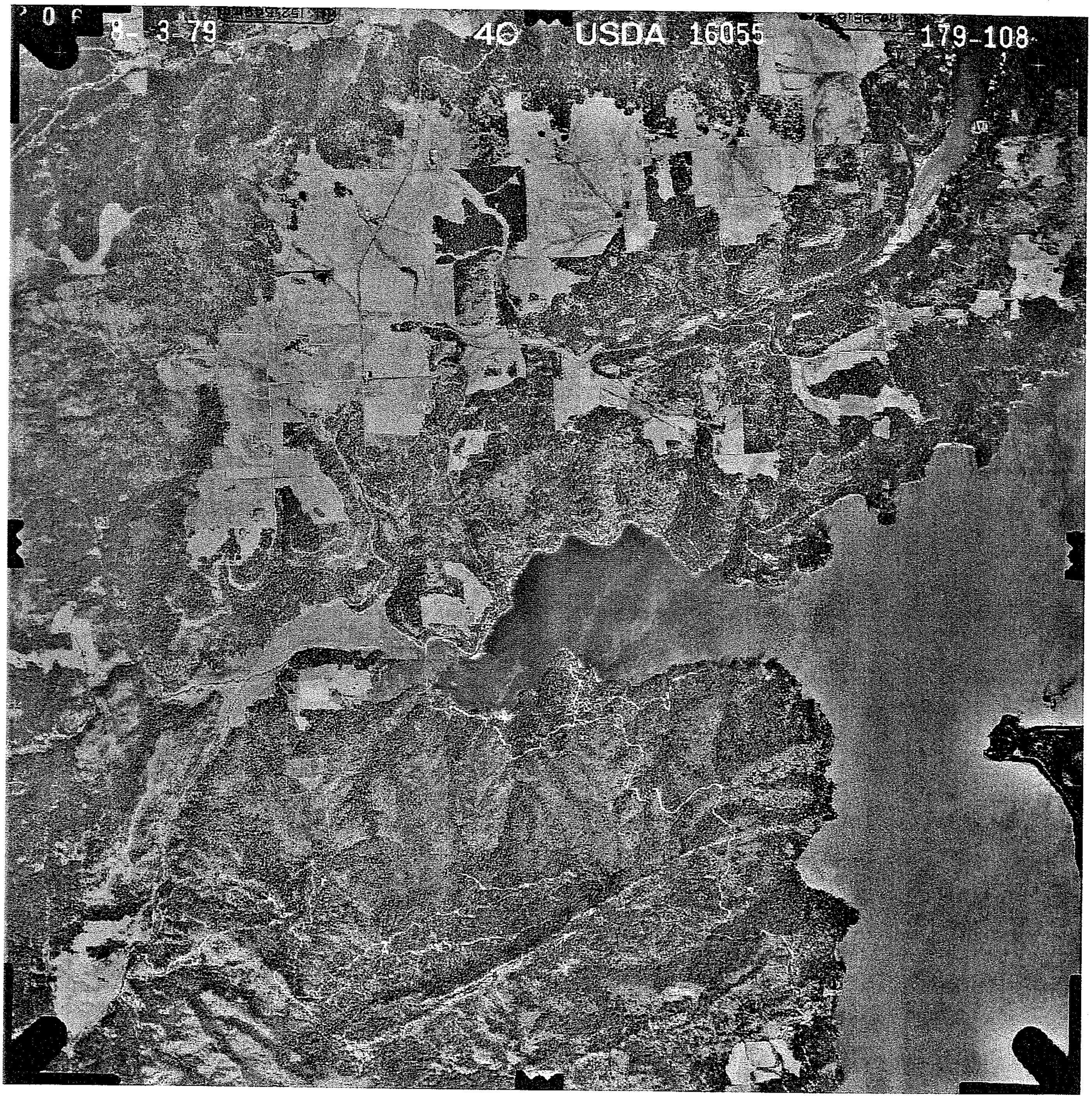
0 500 1,000 Feet Approximate Scale

FIGURE 1970-3-B

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL

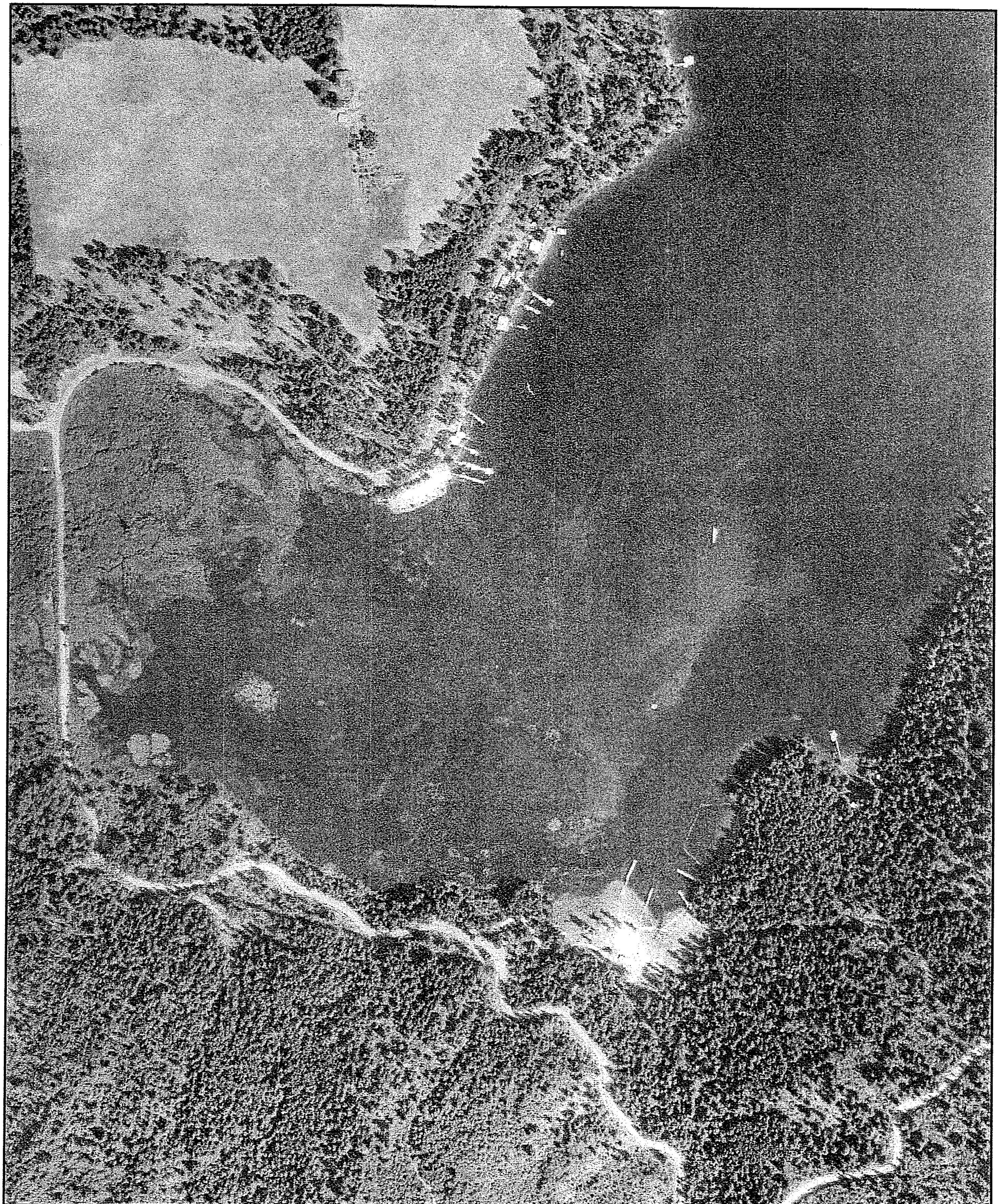


Source: USDA
Date: August 3, 1979
Water Surface Elevation: 647.7 m (2,124.9 ft)
0 5,000 10,000 Feet Approximate Scale

N W E S

FIGURE 1979-1-A
Mica Bay Aerial Photography
MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL



Source: USDA
Date: August 3, 1979
Water Surface Elevation: 647.7 m (2,124.9 ft)

0 500 1,000 Feet Approximate Scale

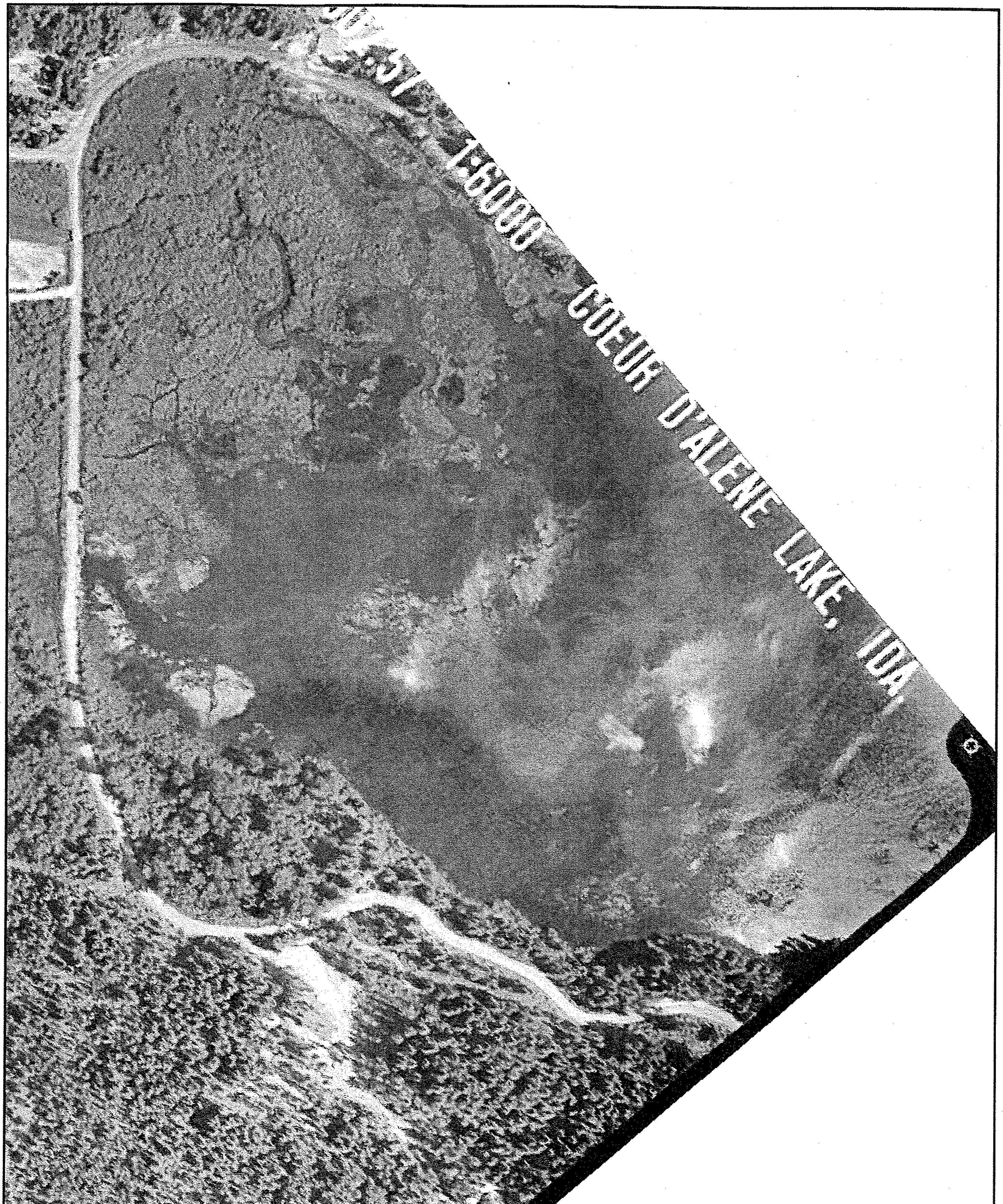
N W E S

FIGURE 1979-1-B

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL



Source: Idaho Transportation Department
Date: July 1984
Water Surface Elevation: 647.7 m (2,124.9 ft)

0 500 1,000 Feet Approximate Scale

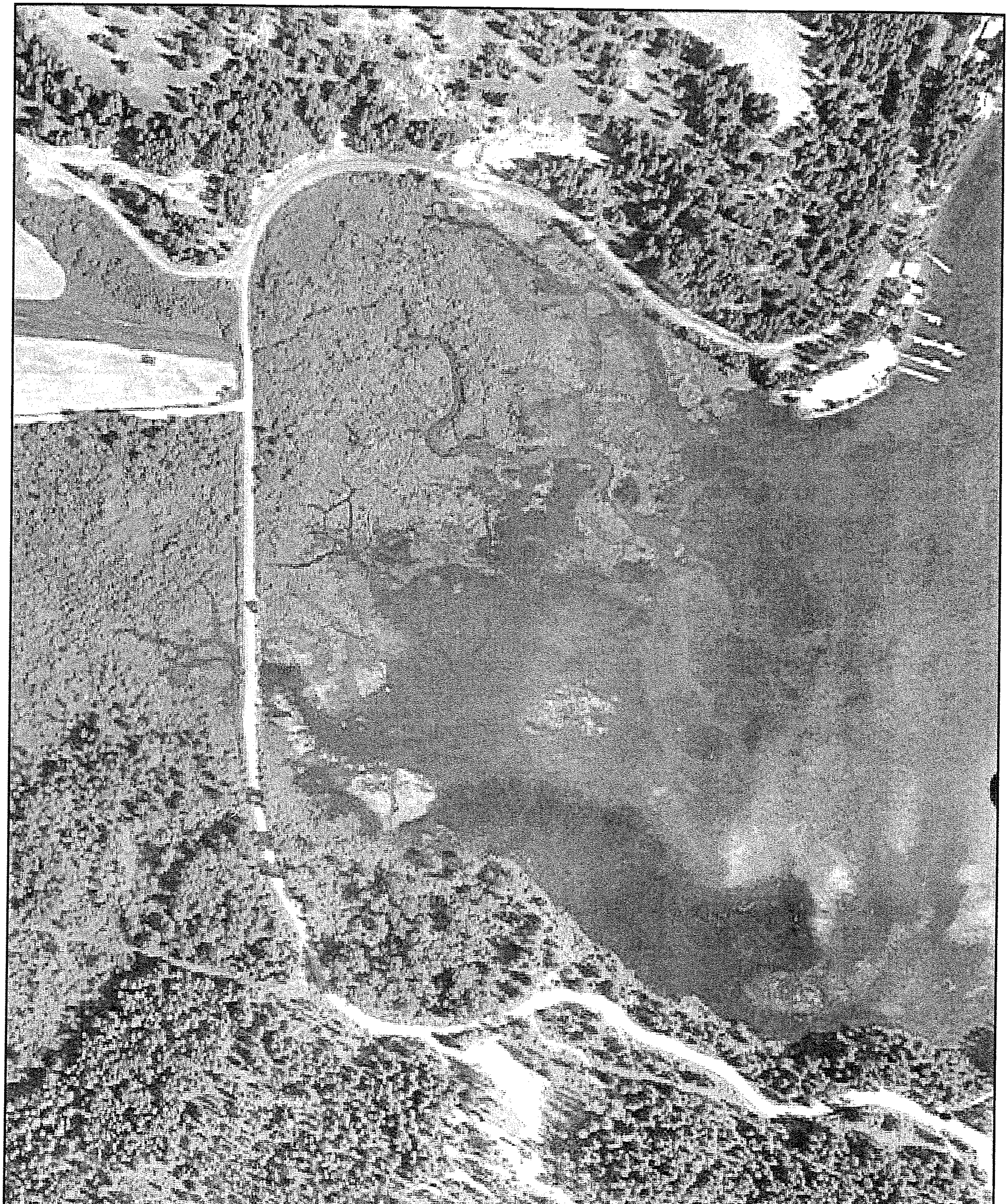
N W E S

FIGURE 1984-1-B

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL



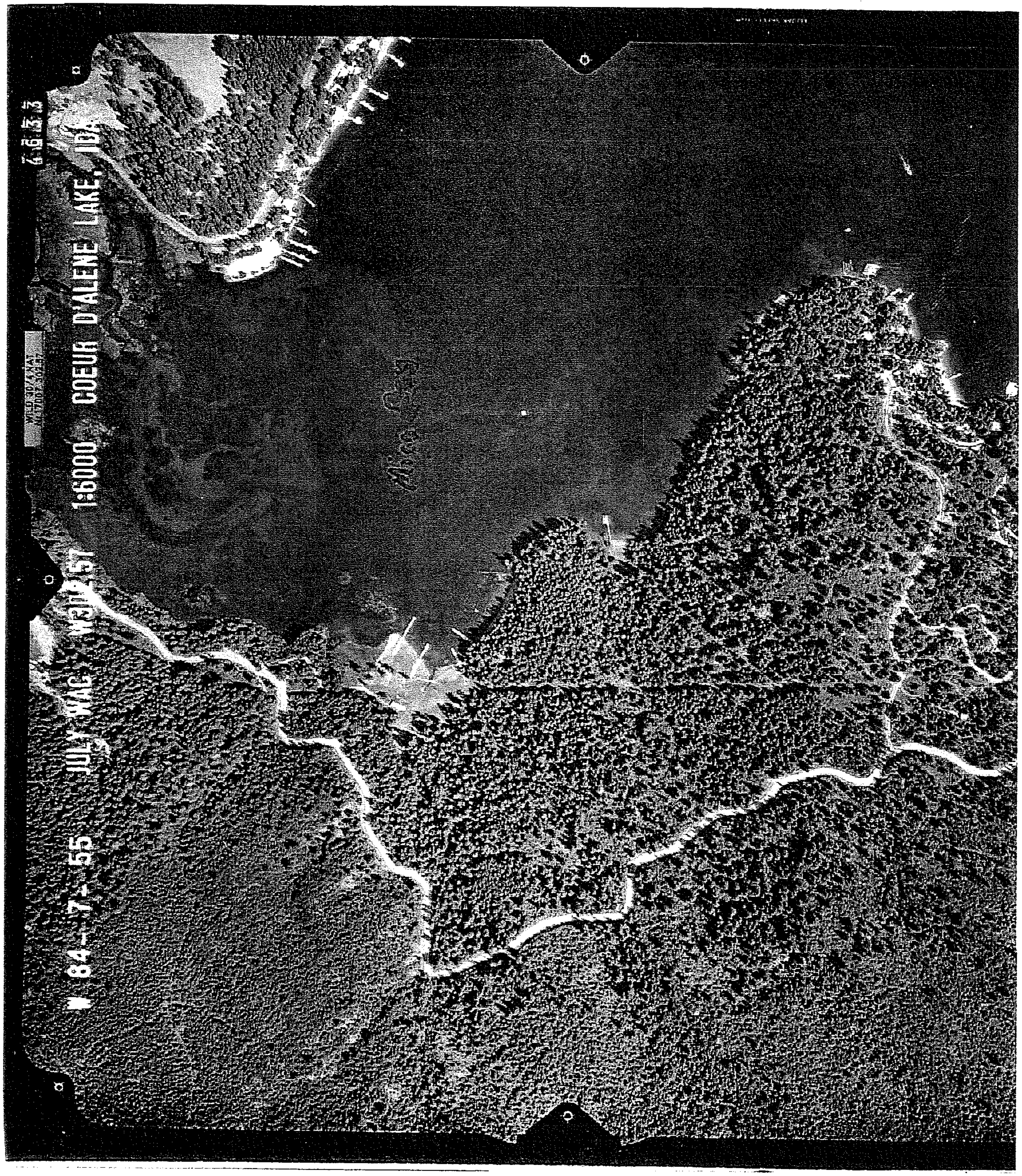
Source: Idaho Transportation Department
Date: July 1984
Water Surface Elevation: 647.7 m (2,124.9 ft)

0 500 1,000 Feet Approximate Scale

N W E S

FIGURE 1984-2-B
Mica Bay Aerial Photography
MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL



Source: Idaho Transportation Department
Date: July 1984
Water Surface Elevation: 647.7 m (2,124.9 ft)

0 500 1,000 Feet Approximate Scale

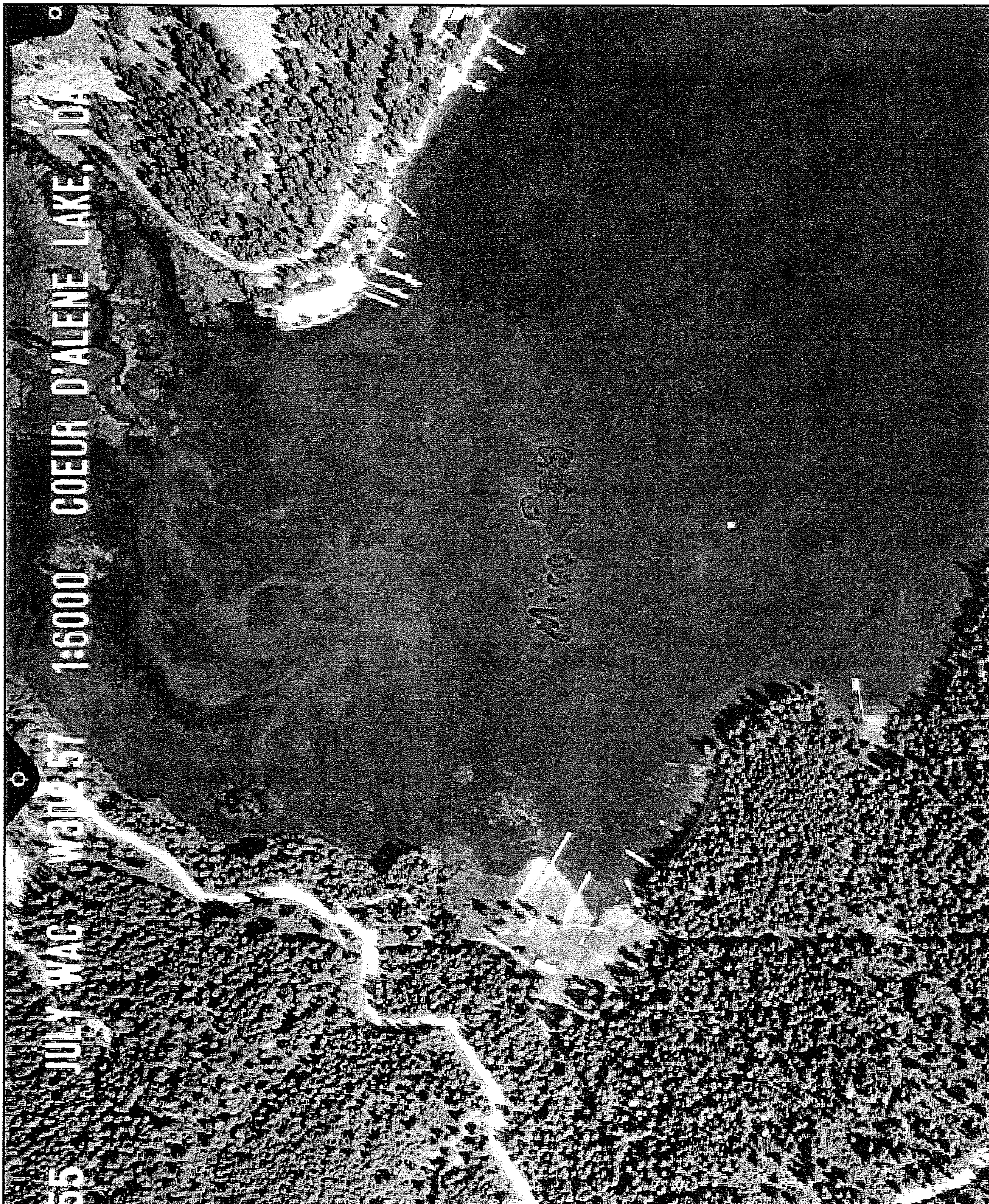
N W E S

FIGURE 1984-3-A

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL



Source: Idaho Transportation Department
Date: July 1984
Water Surface Elevation: 647.7 m (2,124.9 ft)

0 500 1,000 Feet

Approximate Scale

N W E S

FIGURE 1984-3-B

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL

Source: USDA
Date: June 22, 1992
Water Surface Elevation: 647.7 m (2,124.9 ft)

0 5,000 10,000 Feet Approximate Scale

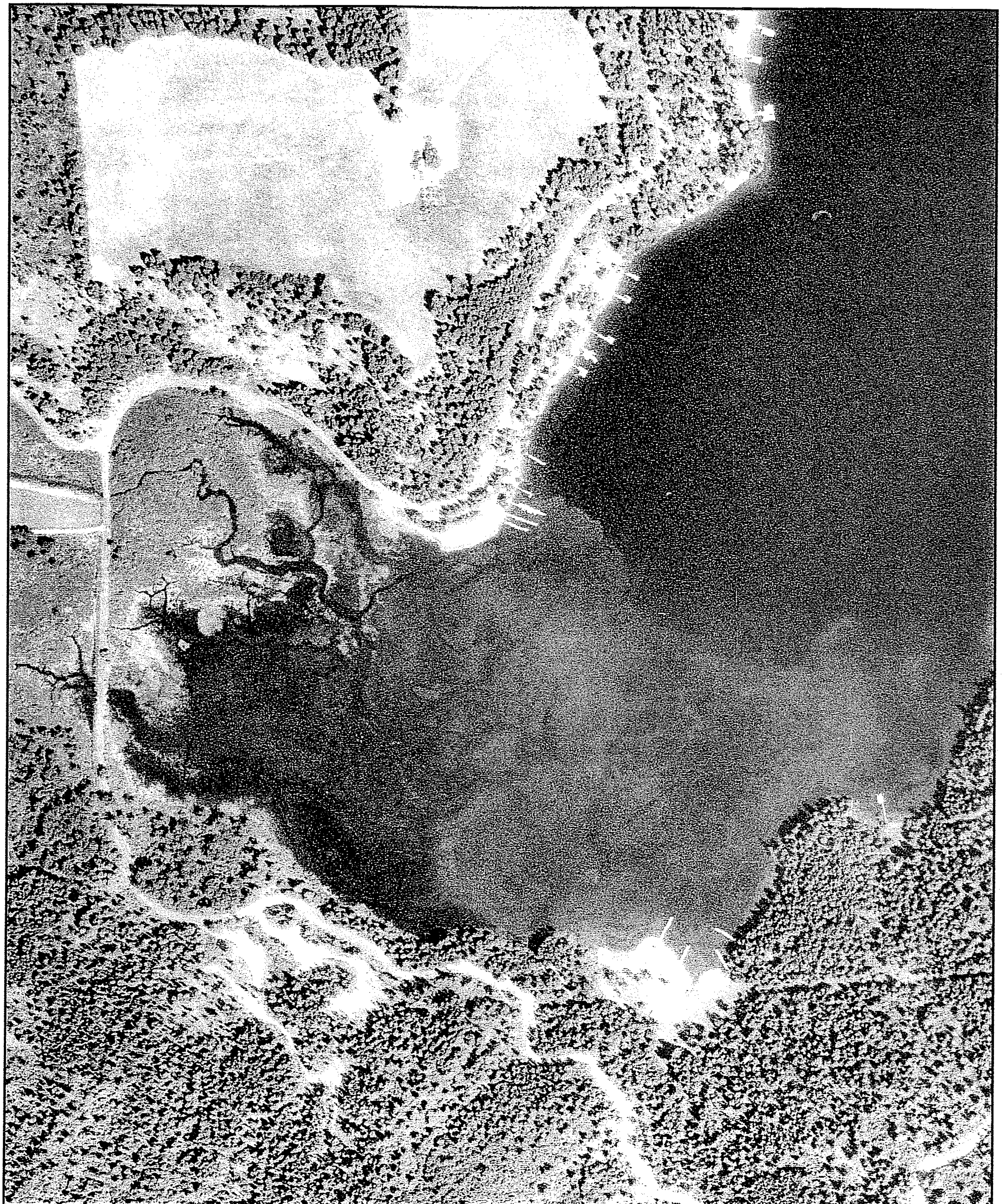
N W E S

FIGURE 1992-1-A

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL

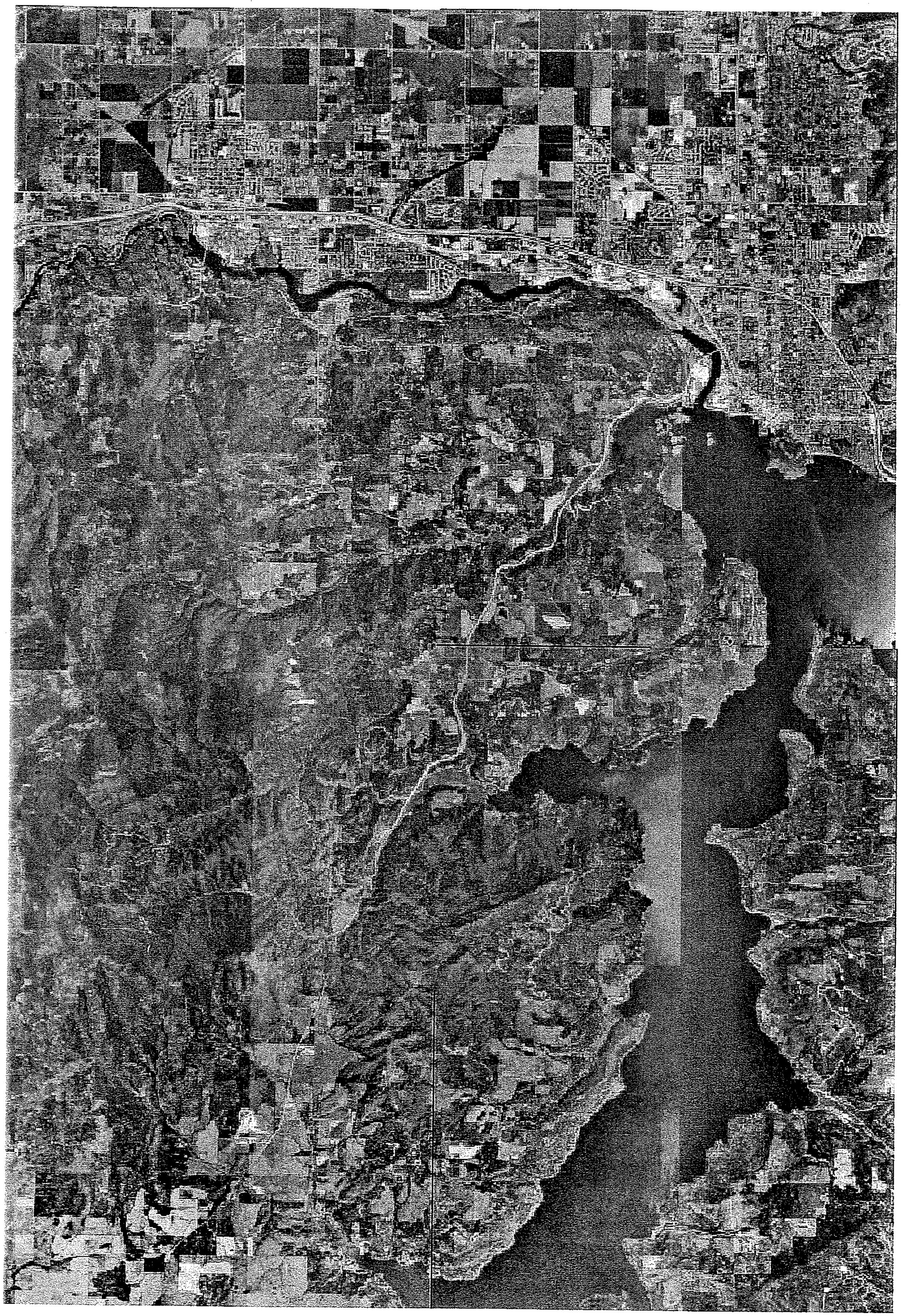


Source: USDA
Date: June 22, 1992
Water Surface Elevation: 647.7 m (2,124.9 ft)
0 500 1,000 Feet

N W E S

FIGURE 1992-1-B
Mica Bay Aerial Photography
MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL



Source: Idaho Department of Lands
Date: June 6, 1998
Water Surface Elevation: 647.6 m (2,124.6 ft)

0 10,000 20,000 Feet

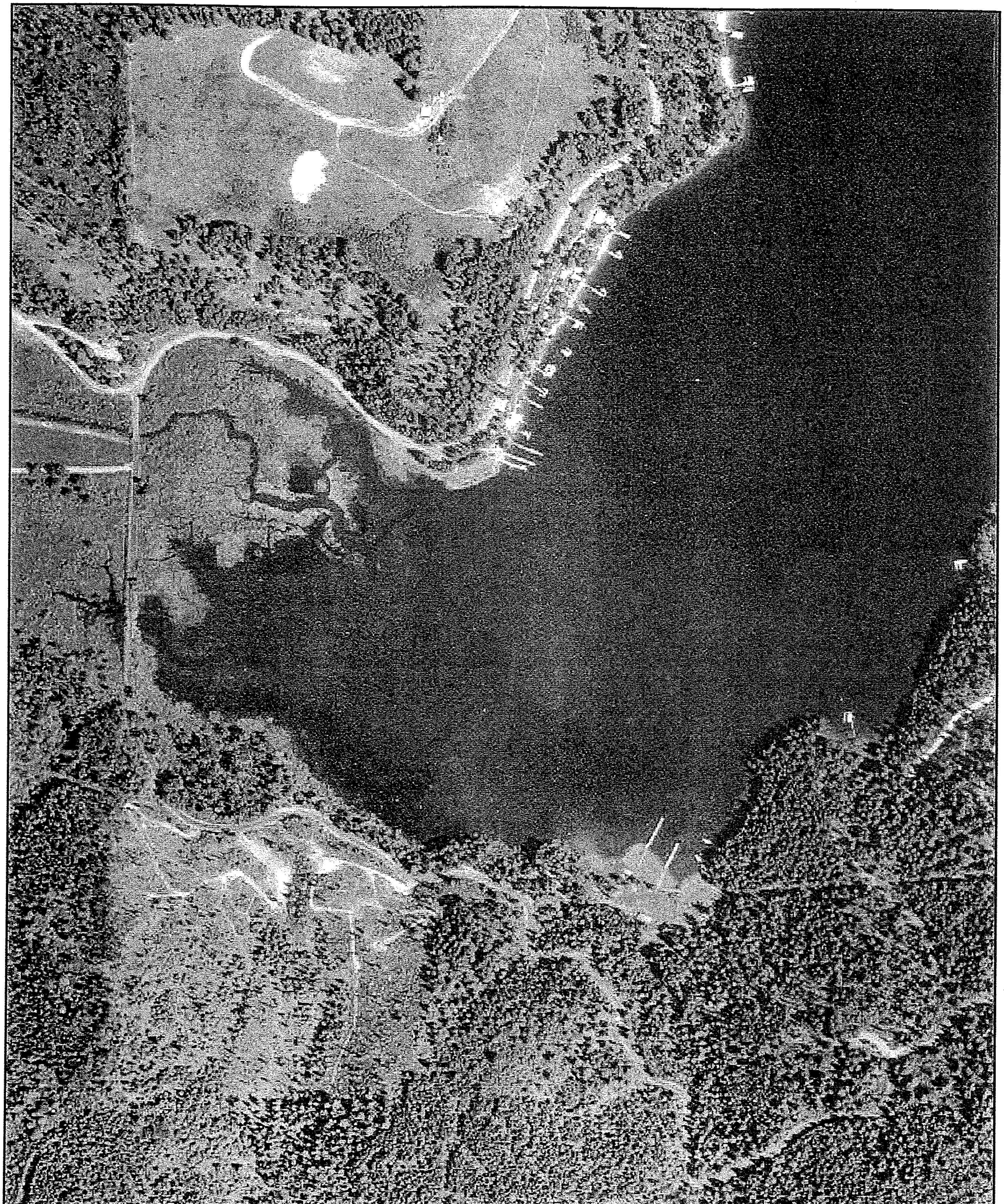
N W E S

FIGURE 1998-1-A

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL



Source: Idaho Department of Lands
Date: June 6, 1998
Water Surface Elevation: 647.6 m (2,124.6 ft)

0 500 1,000 Feet

N S W E

FIGURE 1998-1-B

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL

Source: Idaho Transportation Department
Date: September 23, 1998
Water Surface Elevation: 647.5 m (2,124.2 ft)

0 2,000 4,000 Feet Approximate Scale

N W E S

FIGURE 1998-2-A

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL

Source: Idaho Transportation Department
Date: September 23, 1998
Water Surface Elevation: 647.5 m (2,124.2 ft)

0 500 1,000 Feet Approximate Scale

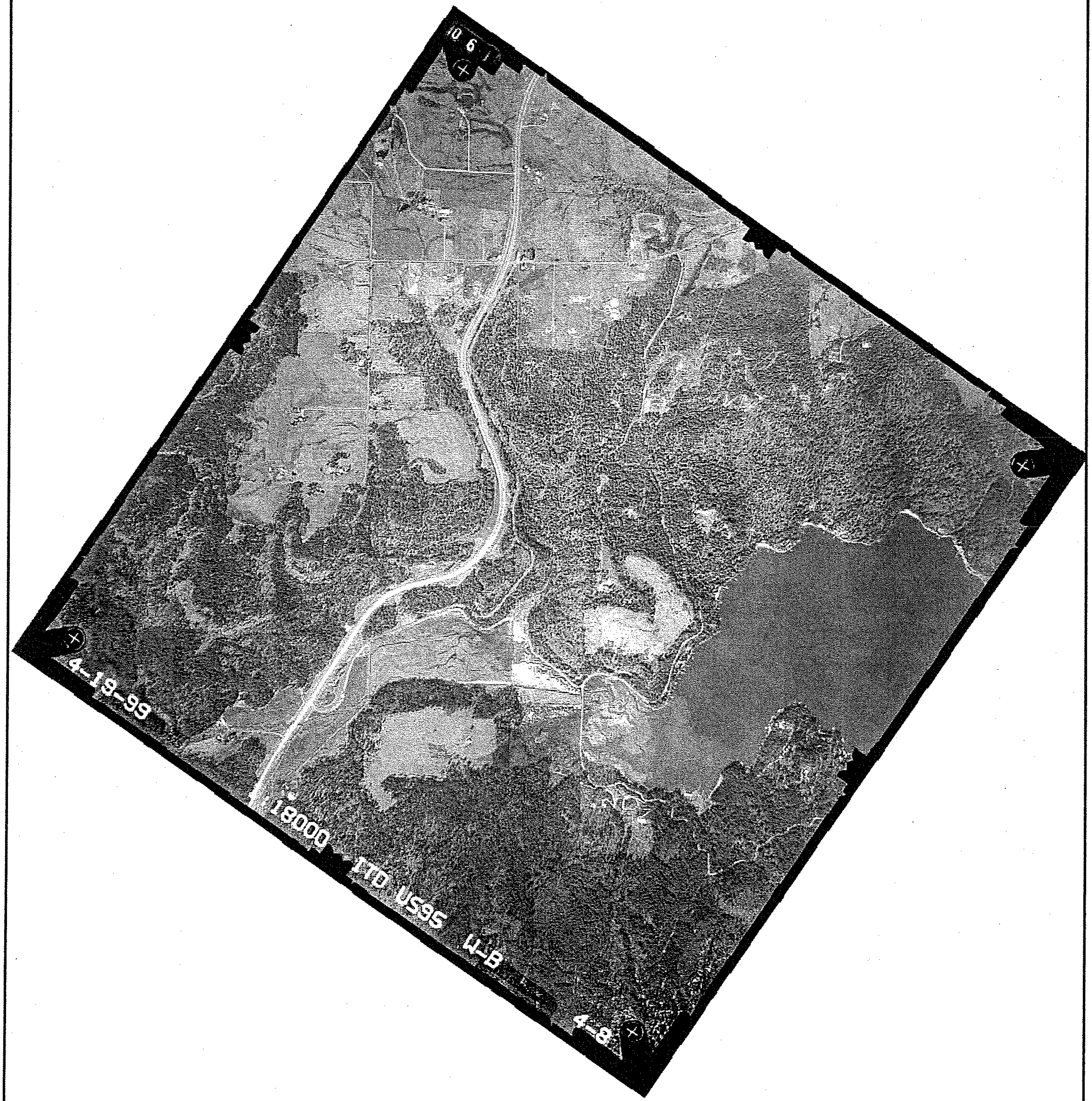
N S W E

FIGURE 1998-2-B

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL



Source: Idaho Transportation Department
Date: April 19, 1999
Water Surface Elevation: 647.2 m (2,123.2 ft)

0 2,000 4,000 Feet — Approximate Scale

N W E S

FIGURE 1999-1-A

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL

Source: Idaho Transportation Department
Date: April 19, 1999
Water Surface Elevation: 647.2 m (2,123.2 ft)

0 500 1,000 Feet Approximate Scale

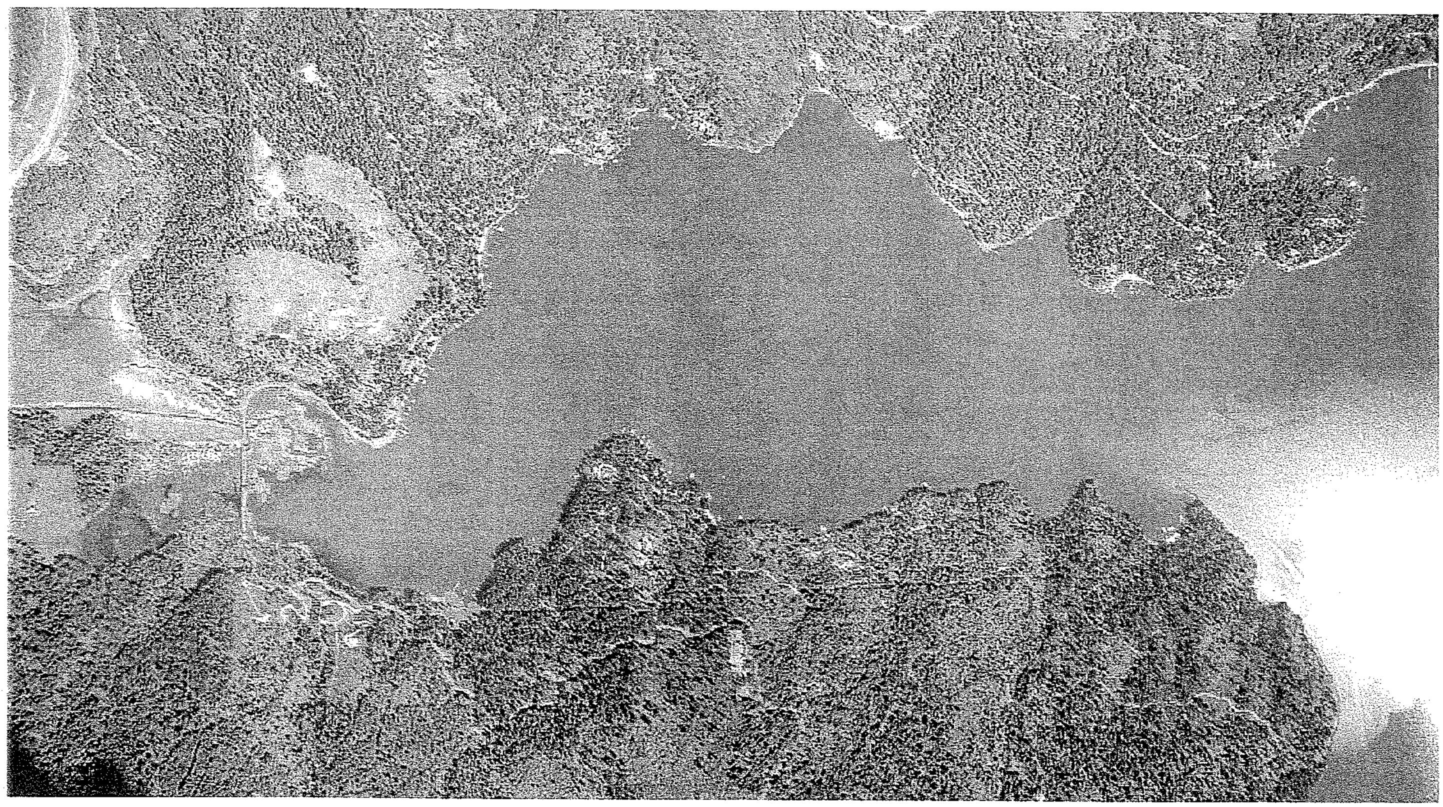
N
W E
S

FIGURE 1999-1-B

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL



Source: Idaho Transportation Department
Date: May 16, 2002
Water Surface Elevation: 647.7 m (2,125.0 ft)

0 2,000 4,000 Feet Approximate Scale

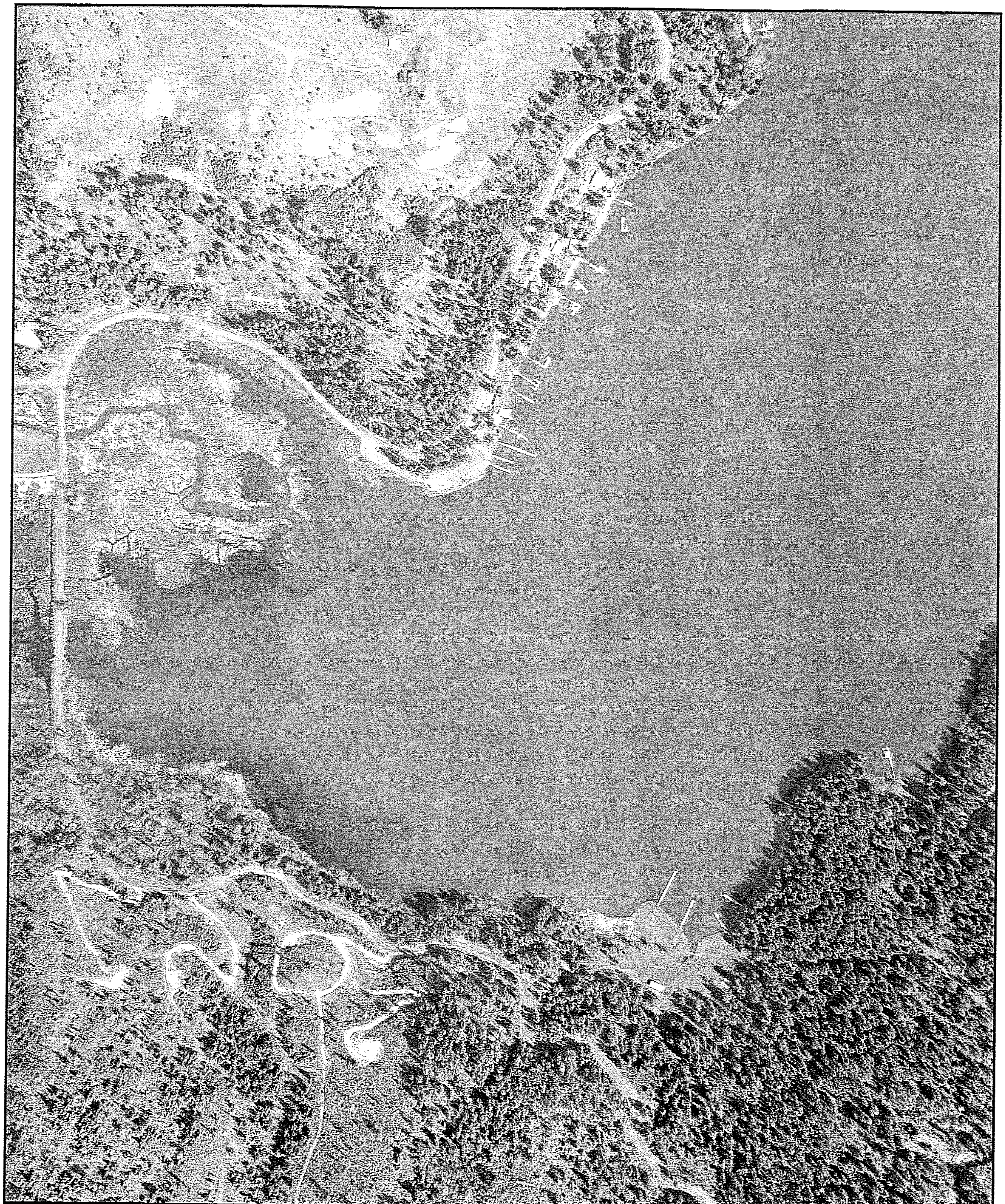
N W E S

FIGURE 2002-1-A

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL



Source: Idaho Transportation Department
Date: May 16, 2002
Water Surface Elevation: 647.7 m (2,125.0 ft)

0 500 1,000 Feet Approximate Scale

N W E S

FIGURE 2002-1-B

Mica Bay Aerial Photography

MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL

Source: Idaho Transportation Department
Date: June 13, 2002
Water Surface Elevation: 648.0 m (2,125.8 ft)
0 1,000 2,000 Feet Approximate Scale

N W E S

FIGURE 2002-2-A
Mica Bay Aerial Photography
MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

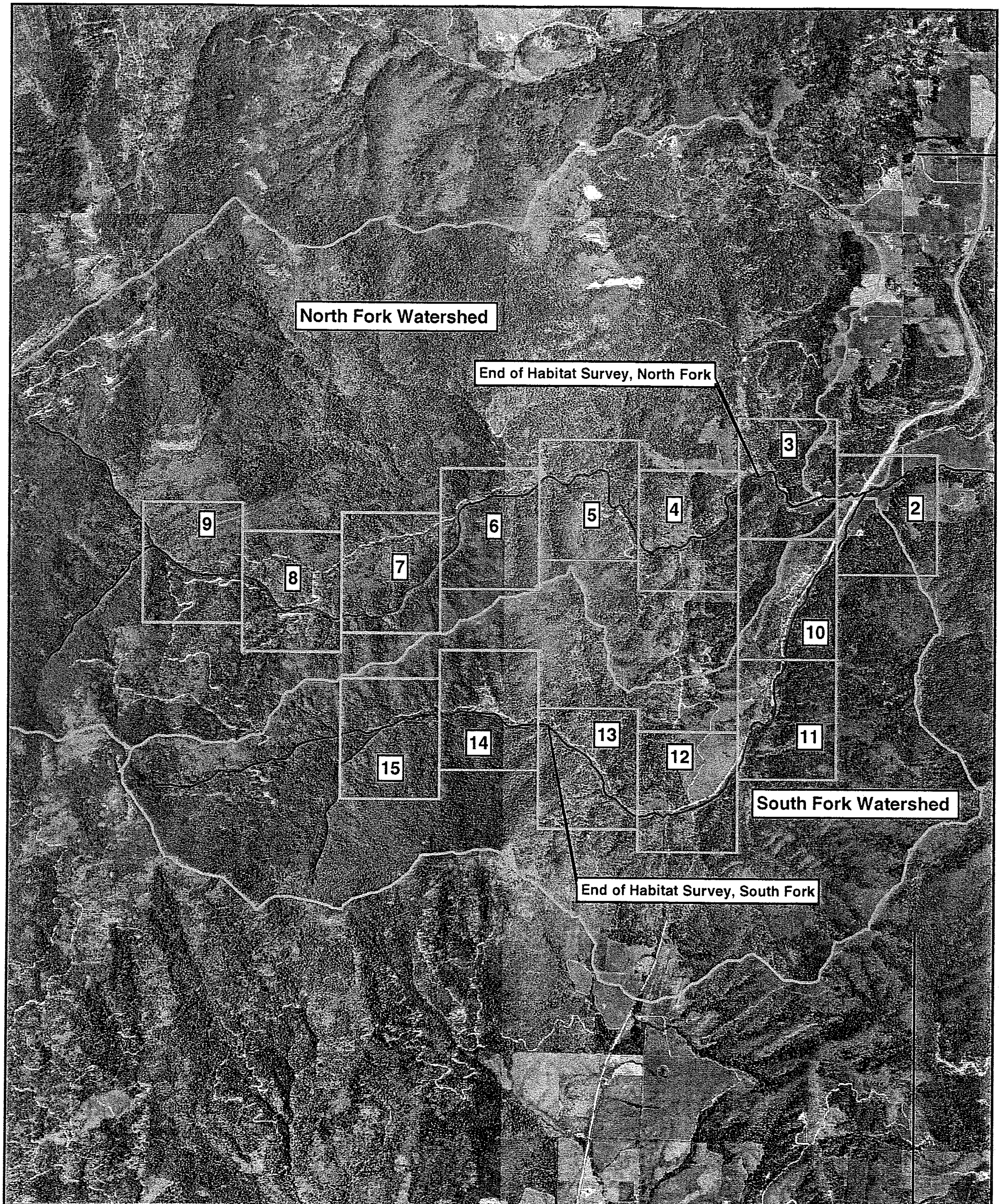
CH2MHILL

Source: Idaho Transportation Department
Date: June 13, 2002
Water Surface Elevation: 648.0 m (2,125.8 ft)
0 500 1,000 Feet Approximate Scale

FIGURE 2002-2-B
Mica Bay Aerial Photography
MICA BAY IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

CH2MHILL

Mica Bay



Mica Creek Aerial Key

Source: Idaho Department of Lands

Date: June 6, 1998

Mica Creek

Watershed Boundary

N W E S

0 5,000 10,000 Feet

FIGURE MC-1

Mica Creek Aerial Photography

MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

Mica Creek Aerial 2
Source: Idaho Department of Lands
Date: June 6, 1998

Mica Creek
Watershed Boundary

N W E S

0 500 1,000 Feet

FIGURE MC-2
Mica Creek Aerial Photography
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

Mica Creek Aerial 3
Source: Idaho Department of Lands
Date: June 6, 1998

Mica Creek
Watershed Boundary
N W E S
0 500 1,000 Feet

FIGURE MC-3
Mica Creek Aerial Photography
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

Mica Creek Aerial 4

Source: Idaho Department of Lands
Date: June 6, 1998

— Mica Creek
Watershed Boundary

N W E S

0 500 1,000 Feet

FIGURE MC-4

Mica Creek Aerial Photography

MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

Mica Creek Aerial 5
Source: Idaho Department of Lands
Date: June 6, 1998

— Mica Creek
Watershed Boundary

N W E S

0 500 1,000 Feet

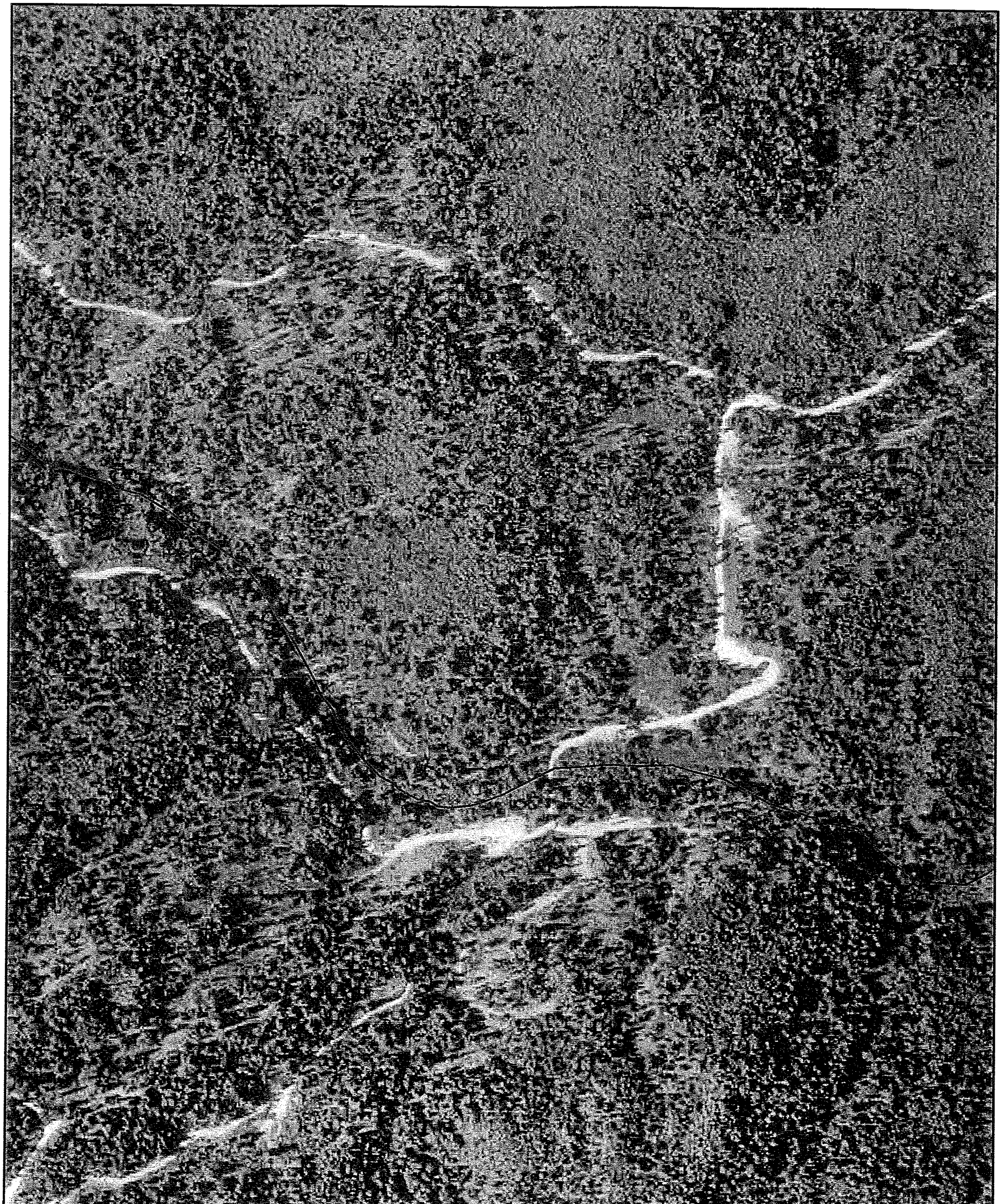
FIGURE MC-5
Mica Creek Aerial Photography
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

Mica Creek Aerial 6
Source: Idaho Department of Lands
Date: June 6, 1998

FIGURE MC-6
Mica Creek Aerial Photography
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

Mica Creek Aerial 7
Source: Idaho Department of Lands
Date: June 6, 1998

FIGURE MC-7
Mica Creek Aerial Photography
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT



Mica Creek Aerial 8
Source: Idaho Department of Lands
Date: June 6, 1998

FIGURE MC-8
Mica Creek Aerial Photography
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

Mica Creek Aerial 9
Source: Idaho Department of Lands
Date: June 6, 1998

Mica Creek
Watershed Boundary

N W E S

0 500 1,000 Feet

FIGURE MC-9
Mica Creek Aerial Photography
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

Mica Creek Aerial 10

Source: Idaho Department of Lands
Date: June 6, 1998

— Mica Creek
Watershed Boundary

N W E S

0 500 1,000 Feet

FIGURE MC-10

Mica Creek Aerial Photography

MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

Mica Creek Aerial 11
Source: Idaho Department of Lands
Date: June 6, 1998

FIGURE MC-11
Mica Creek Aerial Photography
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

Mica Creek Aerial 13
Source: Idaho Department of Lands
Date: June 6, 1998

Mica Creek
Watershed Boundary

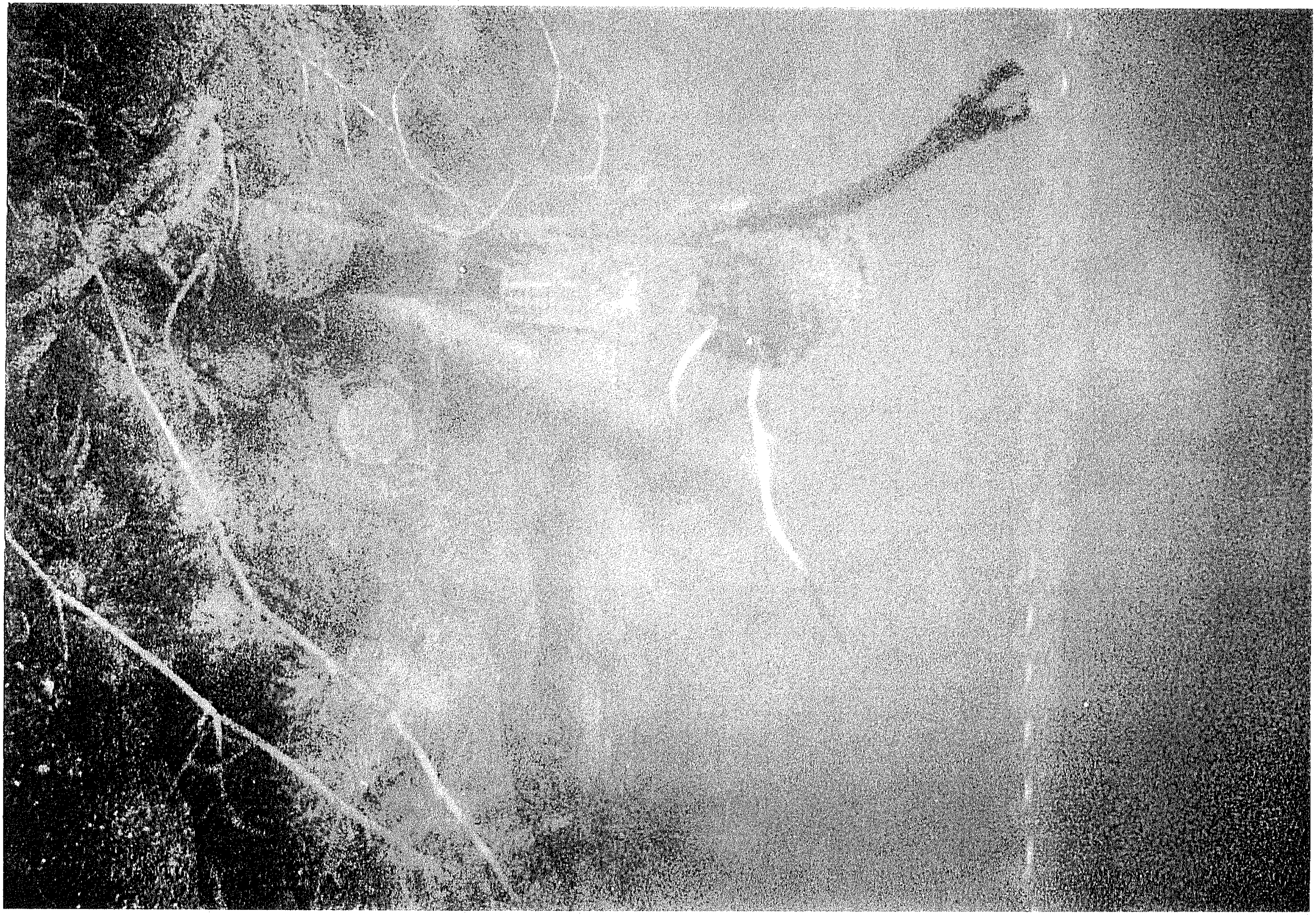
0 500 1,000 Feet

N W E S

FIGURE MC-13
Mica Creek Aerial Photography
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

Appendix I

Underwater Photography



MICA BAY IMPACT ASSESSMENT
COEUR D'ALENE LAKE, IDAHO

PHOTO 1
Water intake (August 12, 2003)

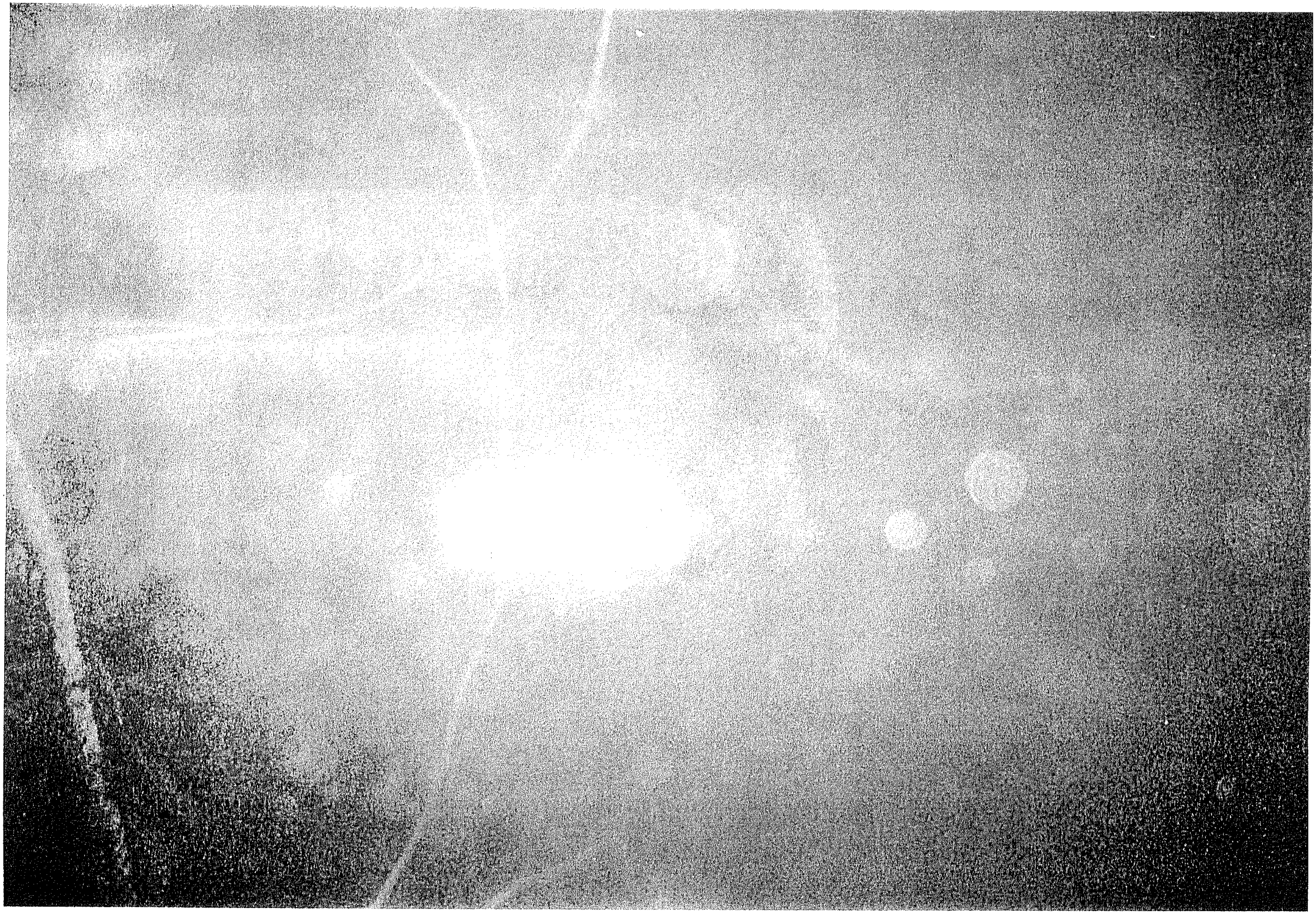


PHOTO 4
Water intake after diver cleaned by hand (August 12, 2003)

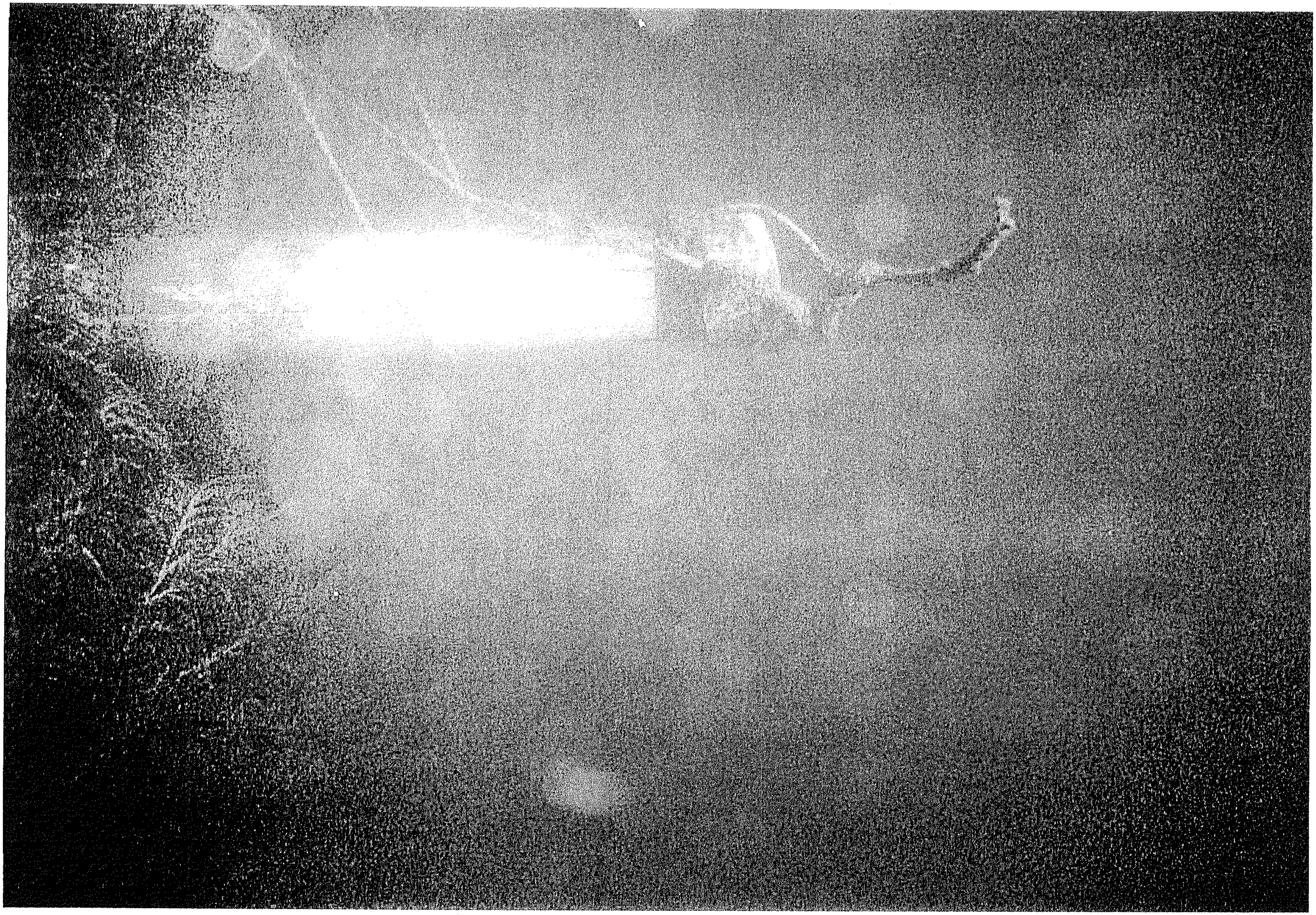


PHOTO 5
Water intake (August 12, 2003)

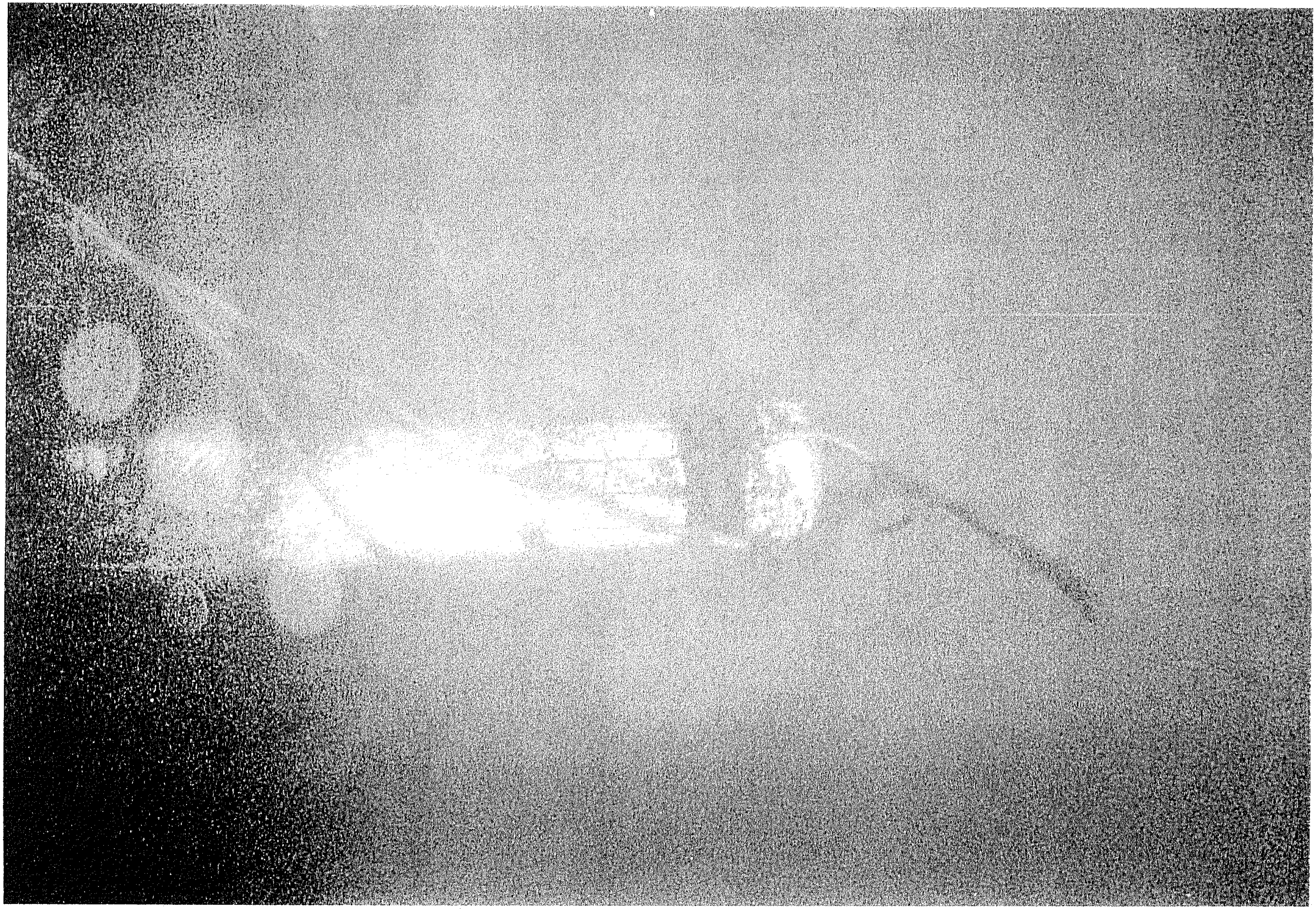


PHOTO 6
Water intake (August 12, 2003)

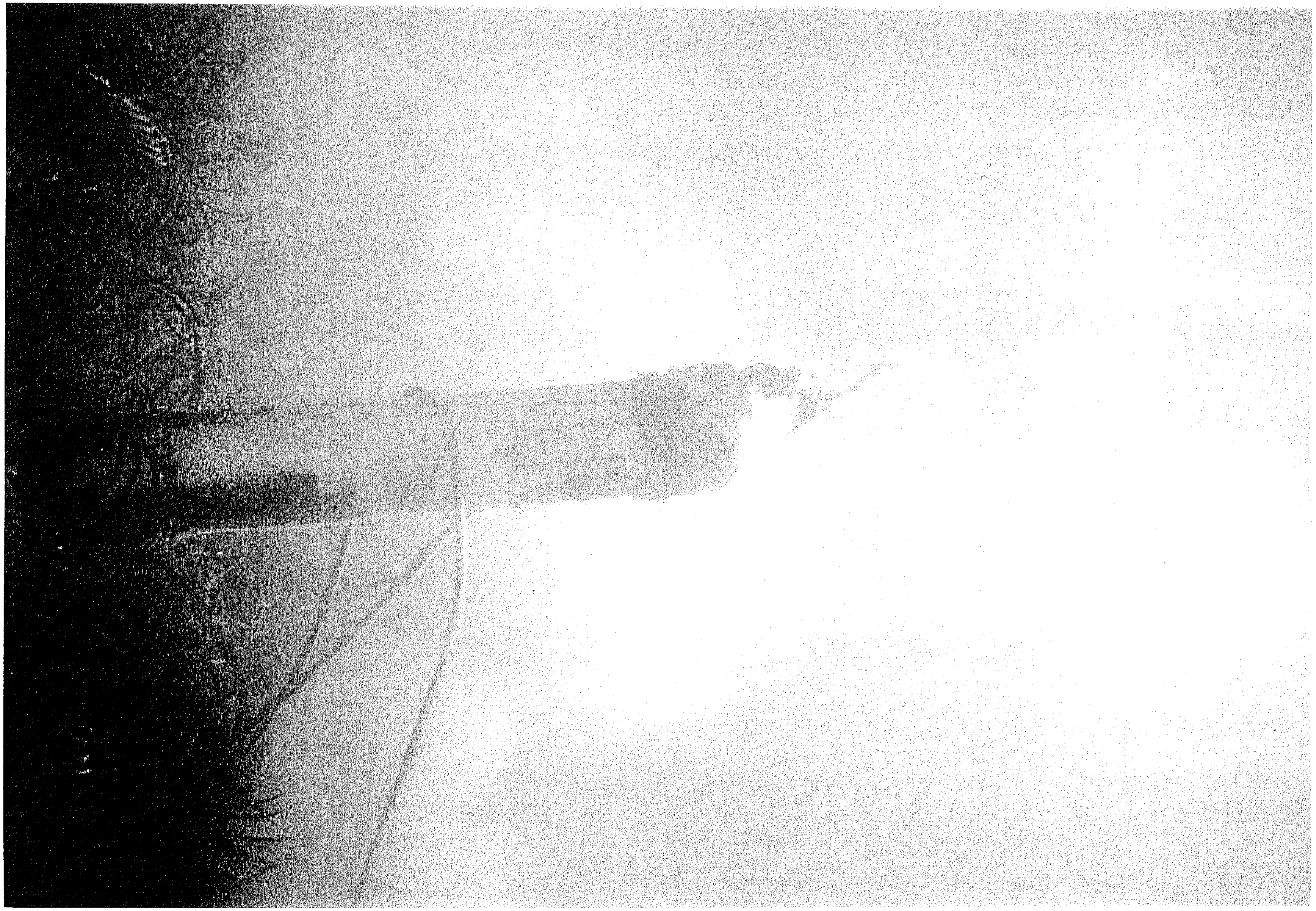
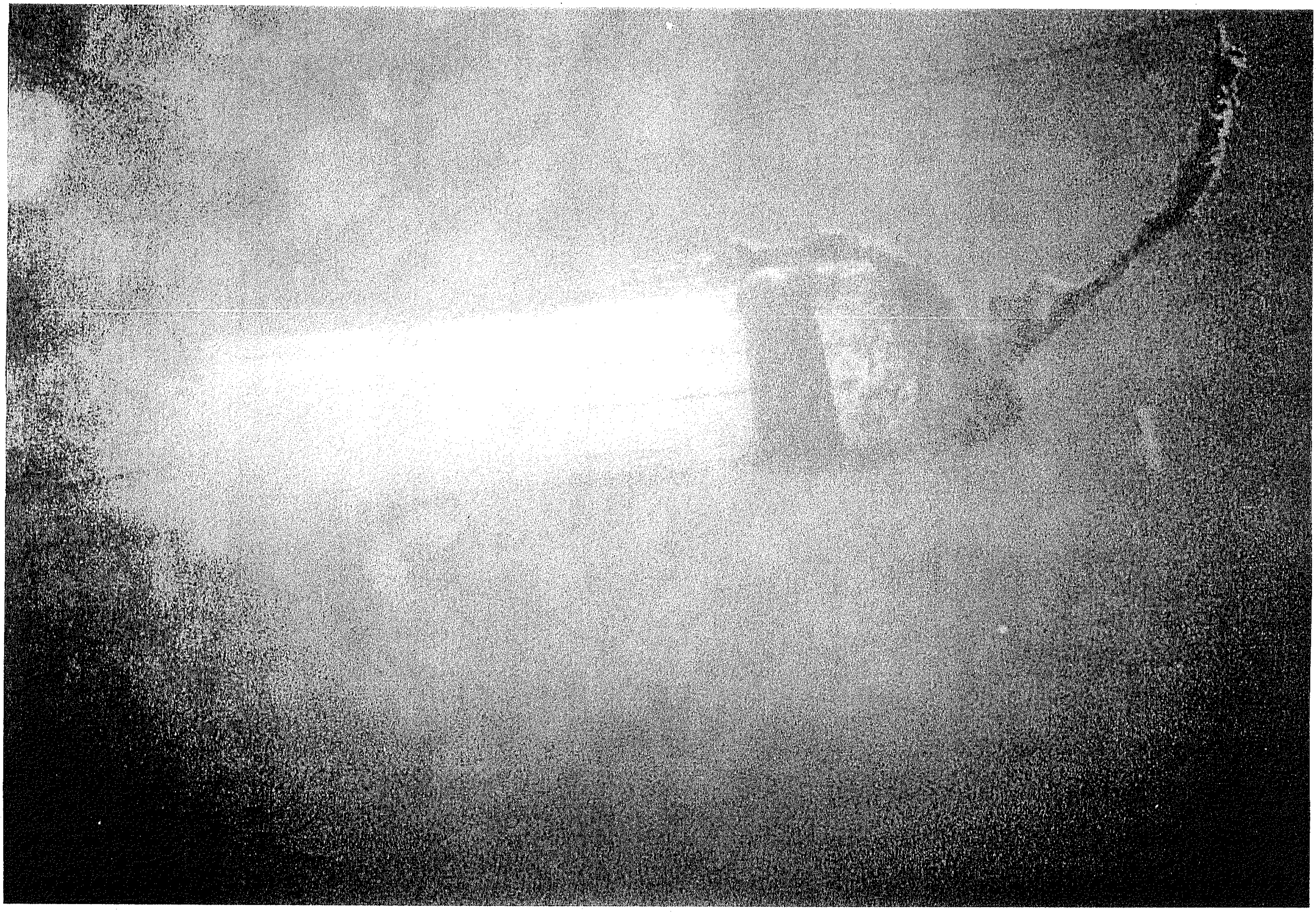


PHOTO 7
Water intake (August 12, 2003)



MICA BAY IMPACT ASSESSMENT
COEUR D'ALENE LAKE, IDAHO

PHOTO 8
Water intake (August 12, 2003)

PHOTO 9
Water intake (August 12, 2003)

PHOTO 10
Water intake (August 12, 2003)

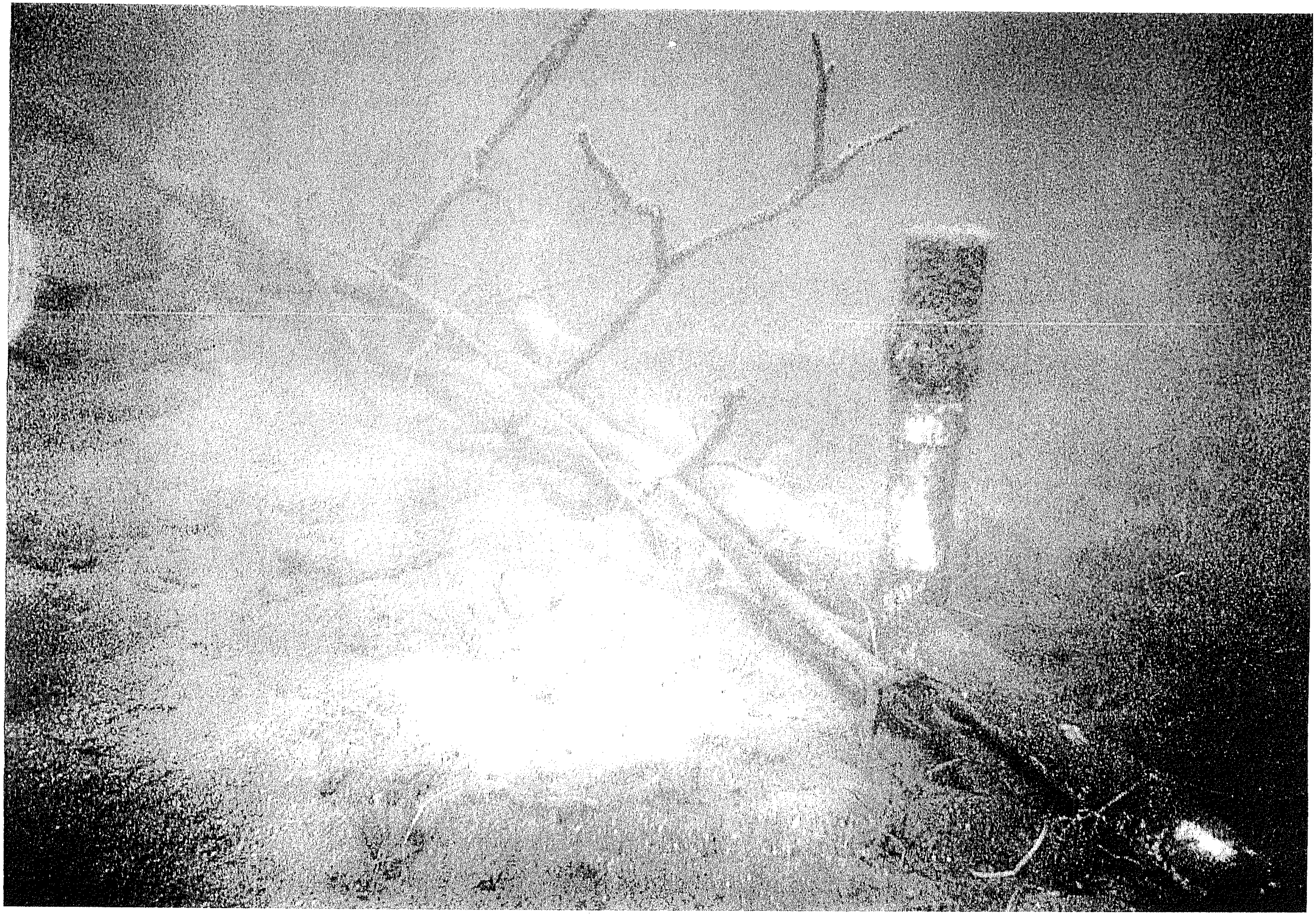


PHOTO 11
Water intake (August 12, 2003)

PHOTO 12
Water intake after diver cleaned with hand (August 12, 2003)

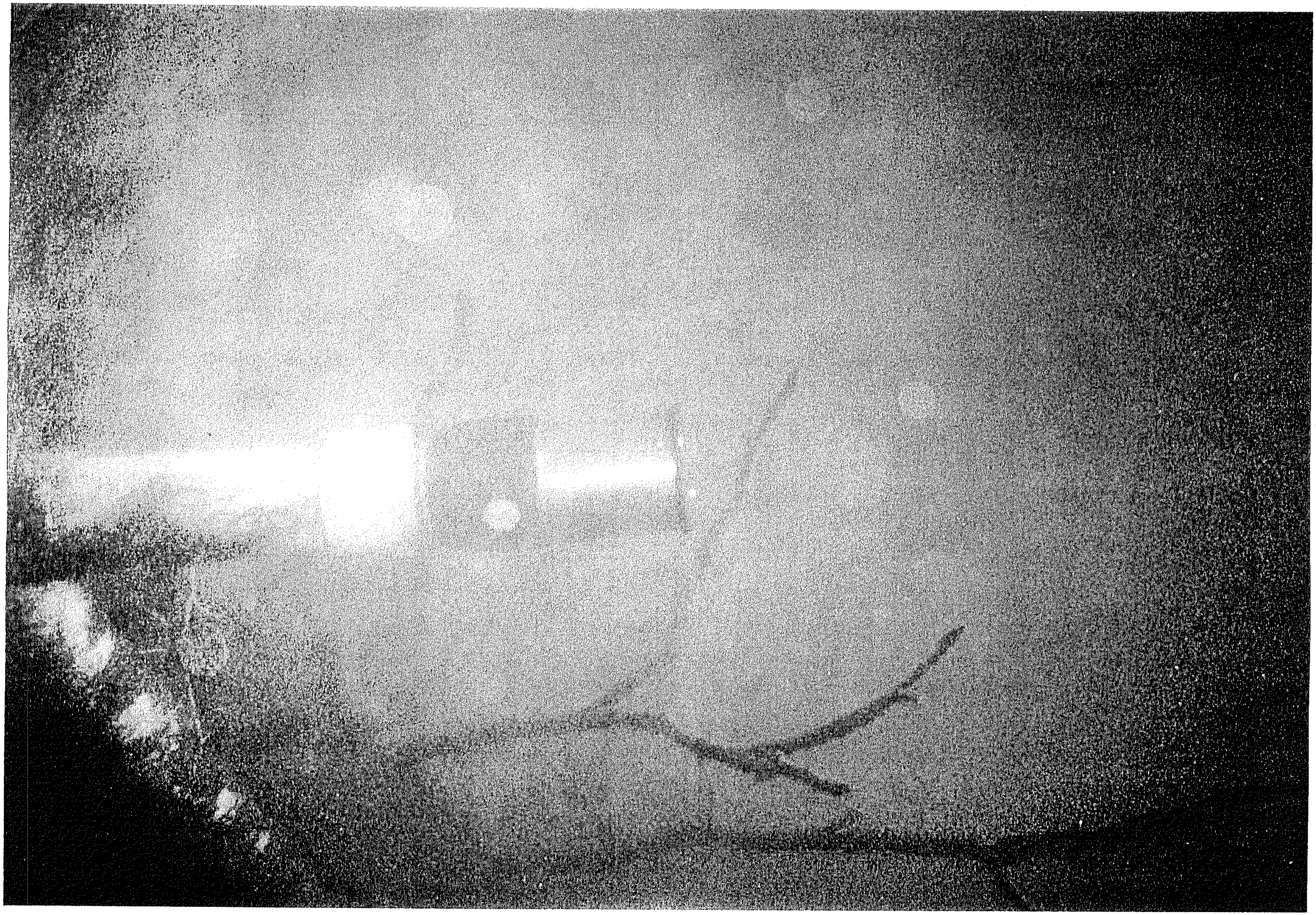


PHOTO 13
Water intake after diver cleaned with hand (August 12, 2003)

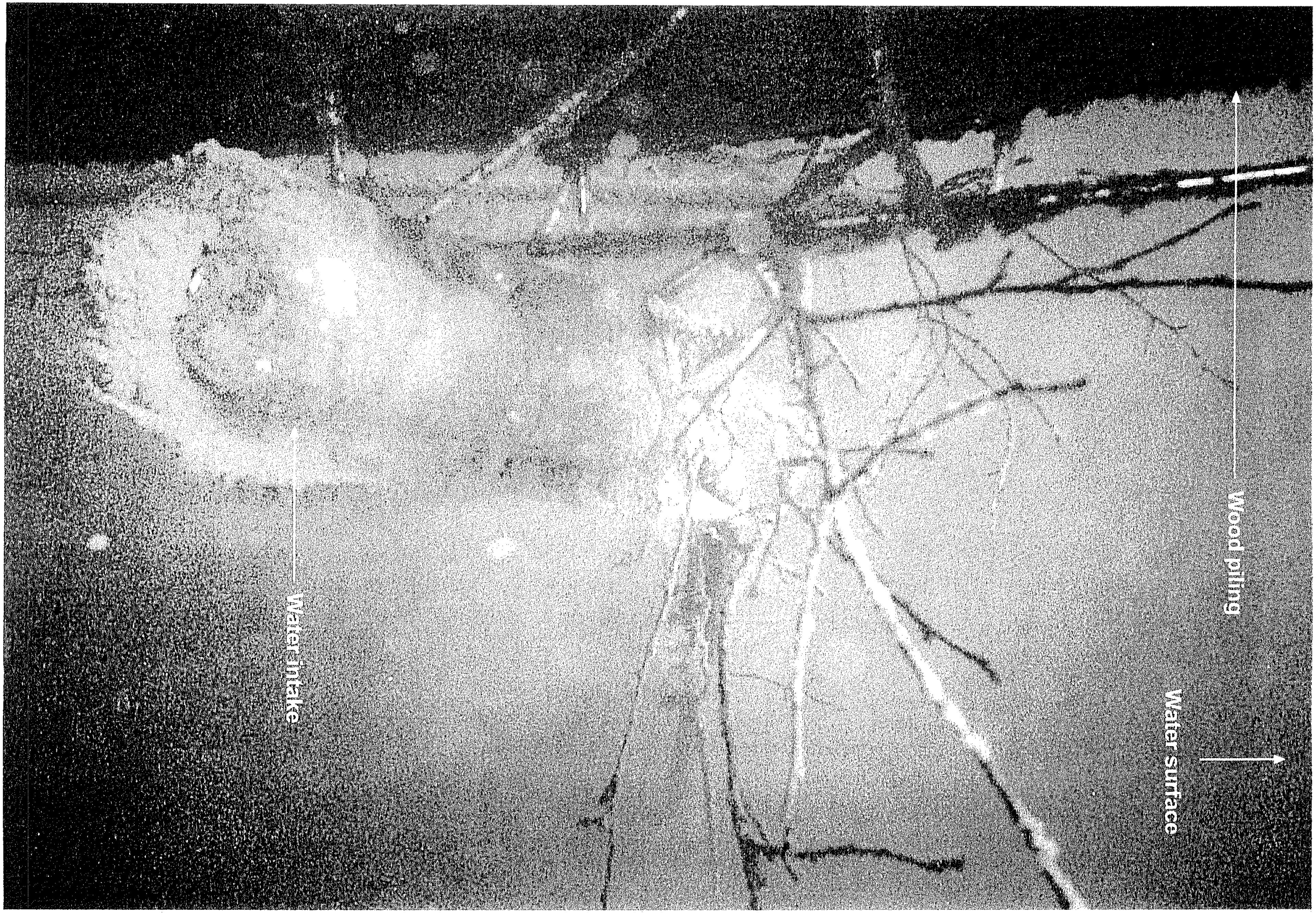


PHOTO 15
Water intake (August 12, 2003)

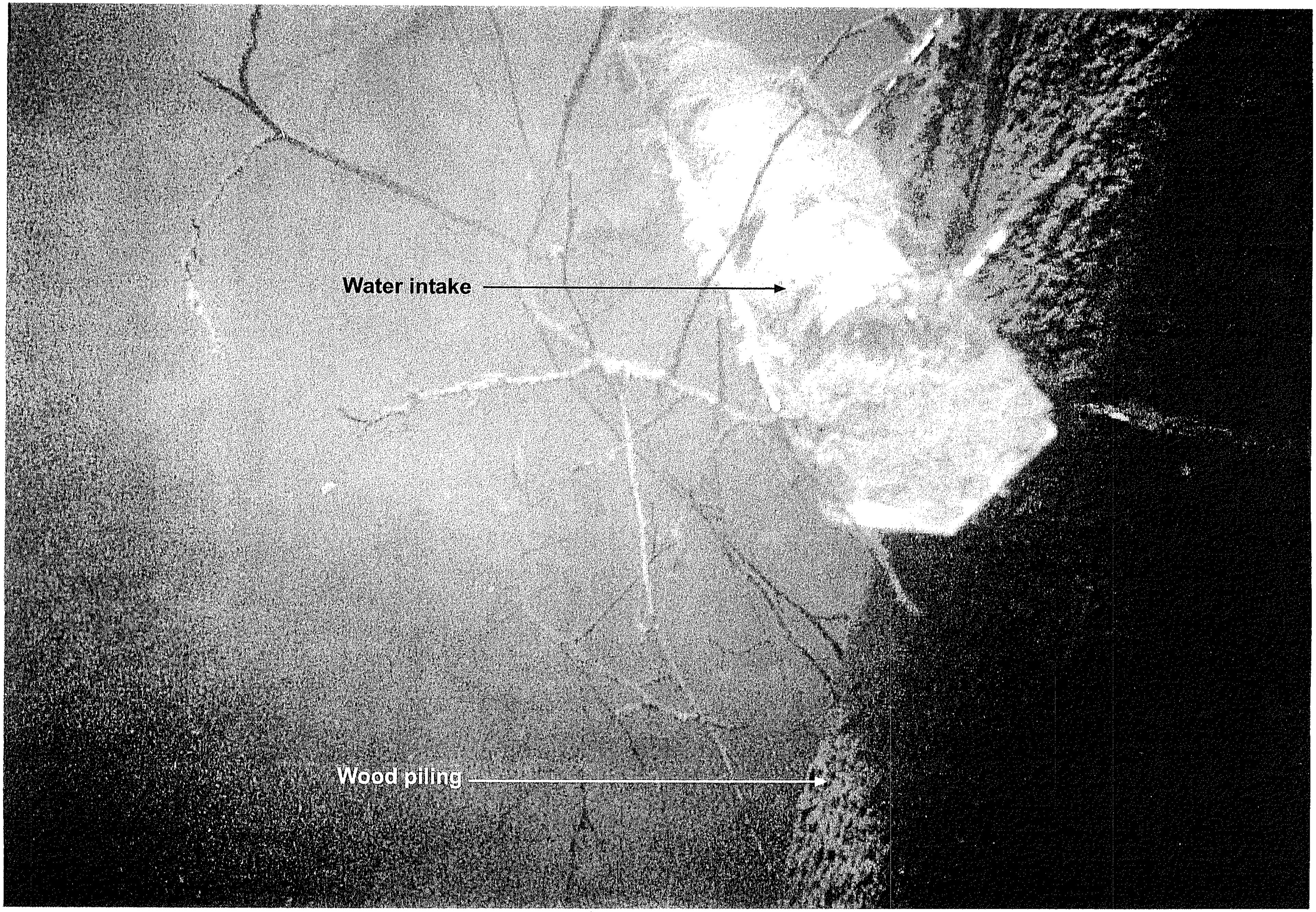


PHOTO 16
Water intake (August 12, 2003)

PHOTO 17
Water intake (August 12, 2003)

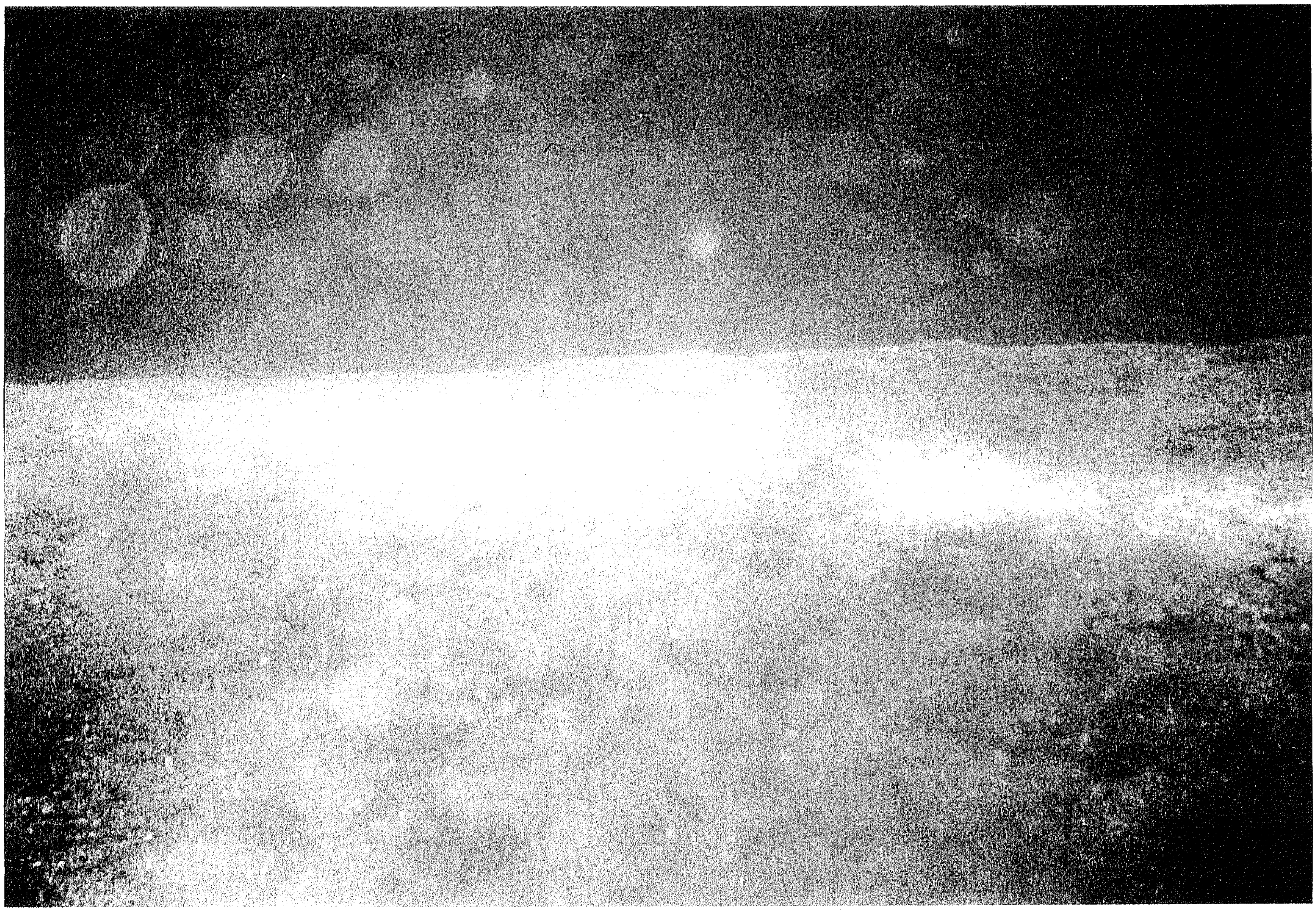


PHOTO 18
Lake bottom (August 12, 2003)

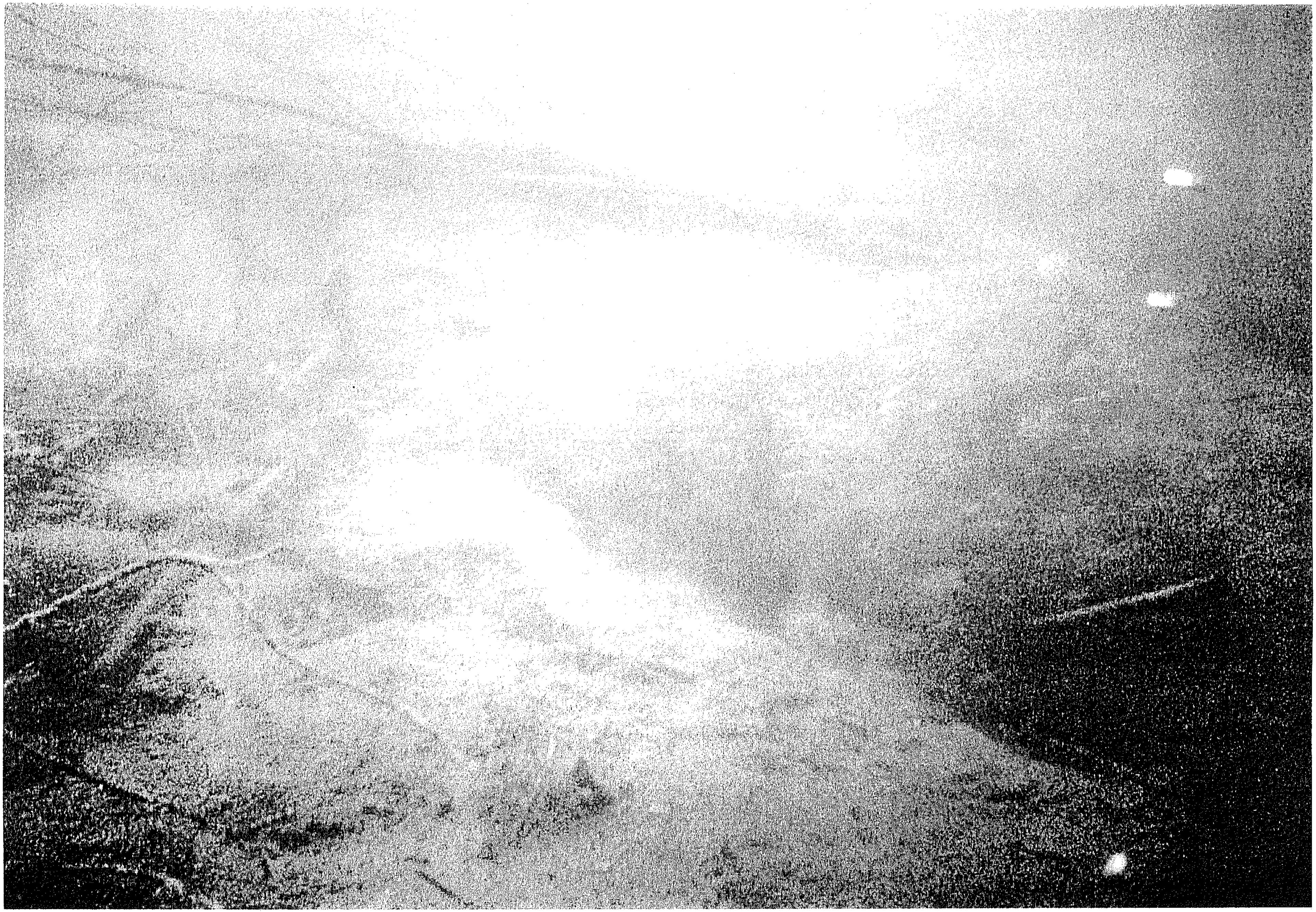


PHOTO 19
Lake bottom (August 12, 2003)

PHOTO 20
Lake bottom (August 12, 2003)

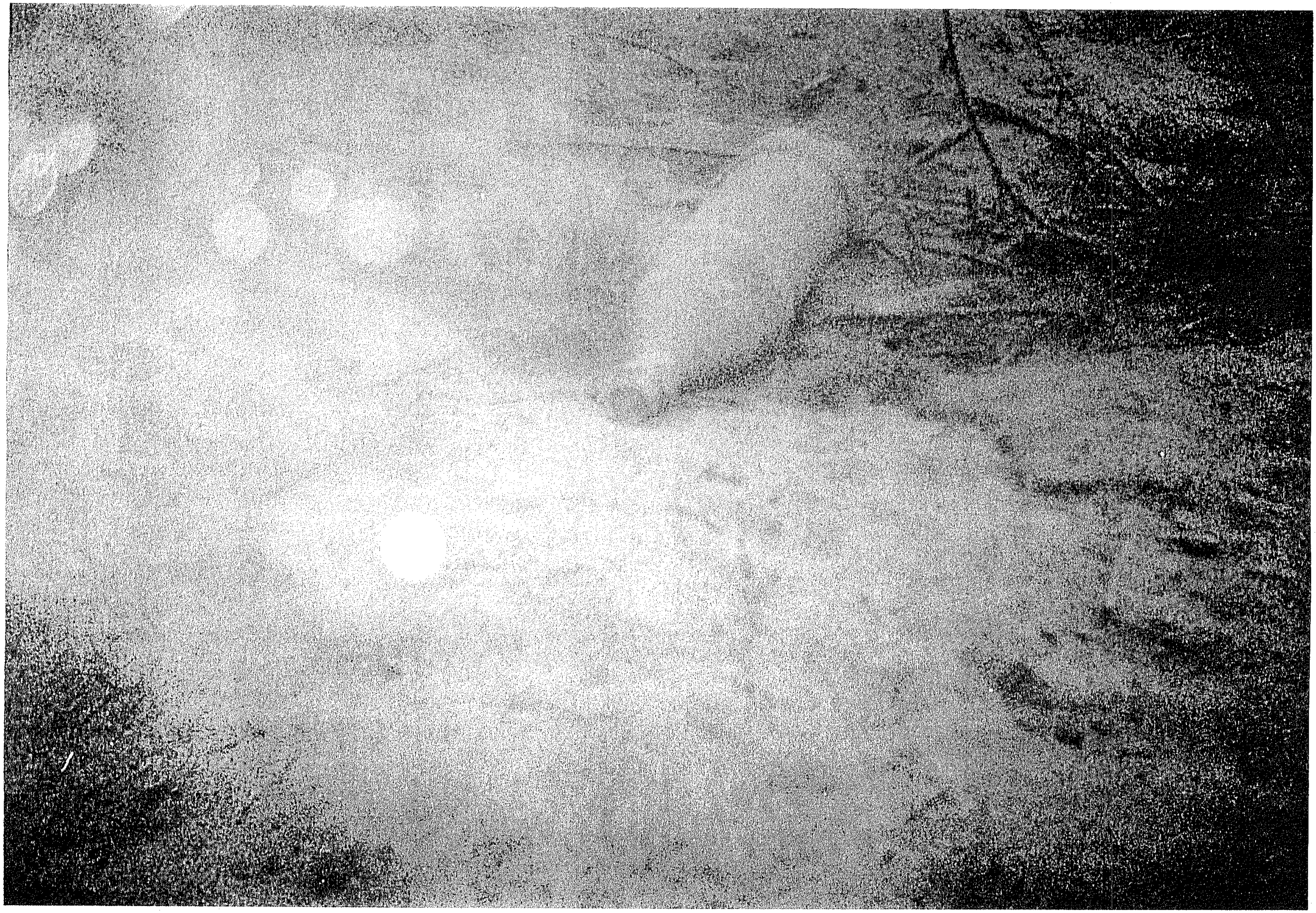


PHOTO 21
Lake bottom (August 12, 2003)

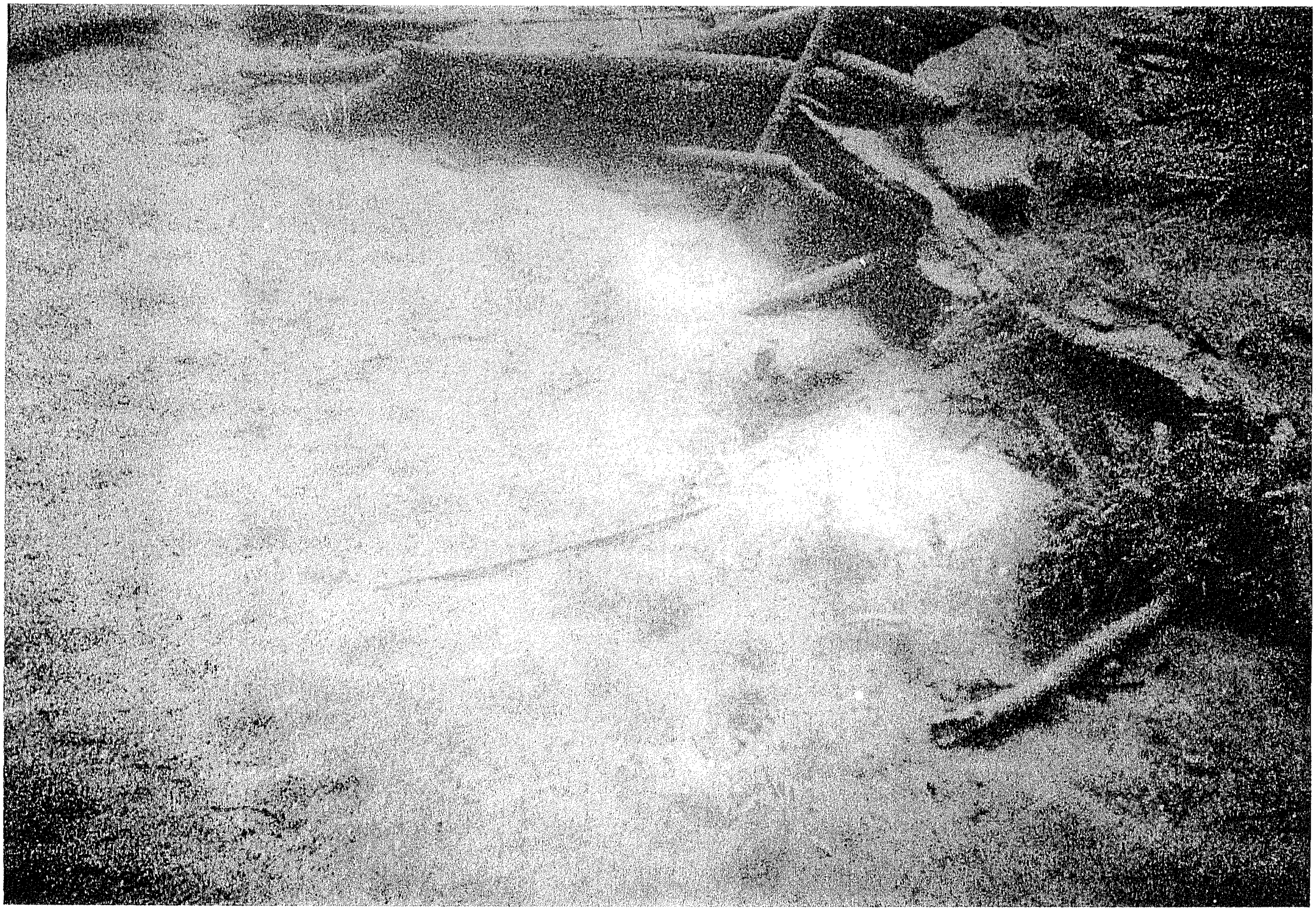


PHOTO 22
Lake bottom (August 12, 2003)

Appendix J

Quality Assurance Turbidity Plan

QUALITY ASSURANCE TURBIDITY SAMPLING PLAN
U.S. 95, Bellgrove to Mica Creek Project
Idaho Transportation Department
Project No. DHP-NH-CM-5110(119)

1.0 Introduction

This quality assurance turbidity sampling plan has been prepared to fulfill requirements described in paragraph 3.3 of the United States Environmental Protection Agency's (EPA) Request for Information and Compliance Order, dated May 8, 2002; item (2) of the EPA letter answering Idaho Department of Transportation (ITD) questions on EPA's 309(a) order (including Enclosure item relating to sampling location and frequency) dated June 19, 2002; and Information Request 16 of EPA's Section 308 letter to dated August 9, 2002. Via these documents, EPA has required turbidity monitoring at the U.S. 95 Bellgrove to Mica highway construction project (Project) along with development and submittal of a quality assurance sampling plan that describes the protocol for collection and analysis of water quality samples for the Project.

2.0 Sample Collection and Analysis History

During the period September 21, 2001 through March 21, 2002 turbidity samples were collected and analyzed by ITD personnel along the length of the construction project. Sample collection and analysis occurred on approximately a weekly basis. Turbidity sample collection methods included attaching a 20-milliliter (mL) sample vial to the end of a stick and dipping the vial into the water body. Samples were then analyzed using a Hach Model 2100P portable turbidimeter. Sample results were recorded in a dedicated field notebook.

On March 25, 2002, CH2M HILL was contracted by ITD to conduct water quality monitoring activities at the site. The following sub-sections describe the sampling locations and sample collection and analysis methodology used by CH2M HILL from March 25, 2002 through present.

2.1 Turbidity Sampling Locations

Figure 1 shows the locations of turbidity sampling locations currently sampled by CH2M HILL. Table 1 provides a summary of the current sampling locations including a brief description, GPS coordinates, and the date sampling was initiated.

Sample stations 1 through 11 were established by ITD in September 2001. Sample stations 12 through 15 were established by CH2M HILL in April 2002. Sample stations 16 through 29 were established by CH2M HILL in May 2002. All sample stations were inspected by EPA on June 11, 2002. EPA recommendations for sample station relocation were incorporated immediately following the inspection resulting in the existing sample station configuration depicted in Figure 1. EPA approved these locations in its June 19, 2002 letter, noting that additional sites are not needed to comply with paragraph 3.3 unless conditions change at the site.

2.2 Sample Collection and Analysis

CH2M HILL's sampling procedures were slightly modified compared to the original ITD sampling methods. All samples were collected using a 1-Liter (L) sample container. The sample container was attached to an extendable rod to allow samples to be collected at the mid-point of the channel at mid-depth for all sampling locations. In the event that turbidity was observed to be non-uniform at the sampling location, contingencies were made to allow for additional samples to be collected between channel mid-point and channel banks at mid-depth. However, non-uniform turbidity has not been observed at any of the sampling locations to date. Immediately following collection of the sample in the 1-L sample container, the sample was transferred to a 20-mL sample vial. The transfer was performed by pouring from the 1-L sample container into the 20-mL sample vial until the 1-L sample is exhausted. This method results in a completely mixed sample for analysis. The sample contained in the 20-mL sample vial was immediately analyzed to avoid any possible effects on the sample that could be caused by temperature changes or settling. Prior to analysis, samples were well shaken. Analysis of the samples was performed using the same Hach Model 2100P turbidimeter used by ITD personnel previously.

From March 25, 2002 through May 22, 2002 CH2M HILL collected and analyzed turbidity samples twice per day on weekdays and during all precipitation events. From May 23, 2002 through July 5, 2002 samples were collected and analyzed once per day on weekdays and during all precipitation events. From July 8, 2002 to present samples were collected and analyzed twice per week (Mondays and Thursdays) and during all precipitation events.

3.0 Sample Collection and Analysis Plan

This sample collection and analysis plan describes methods that will be used to collect, analyze, record and report turbidity samples at the Project in response to the EPA Compliance Order.

3.1 Sample Collection Locations

Turbidity sample collection locations for the site are shown on Figure 1 and are summarized in Table 1. To date, a total of 29 sampling stations have been established across the site. Review of Figure 1 and Table 1 shows that these locations are sufficient to determine the following:

- Background turbidity in all water bodies passing through the site prior to potential construction impacts.
- Turbidity in all water bodies after passing through the construction site.
- Turbidity of main streams/creeks (Fighting, Bellgrove, and South Fork Mica) after receiving tributary or site waters and turbidity of main stem Mica Creek and Mica Bay downstream of the site.

3.2 Sample Collection Frequency

Given the nature of the site and seasonal weather patterns, sample collection at the site is dependent on construction activities and weather. Therefore, sampling frequency should be as follows:

- Dry weather – Monday and Thursday of every week
- When cold enough for snow cover and freezing conditions – Weekdays in morning and afternoon
- During all precipitation events that may generate run-off
- During construction or earth-moving activities that may impact water quality

In general, all 29 stations will be visited during run-off generating precipitation events and sampled if flowing water is present. As construction progresses at the site, it may be appropriate to discontinue monitoring at some locations if all potential turbidity-causing Project activities are completed. In these cases, EPA will be notified in the monthly reports of any discontinued stations and provided the reasons for this decision. In addition, during dry periods and into the summer, some of the stations will be dry and cannot be sampled. The field notebook and other data records will reflect these conditions.

3.3 Sample Collection and Analysis

Turbidity samples will continue to be collected and analyzed as described in Section 2.2. If visual observations indicate that there is non-uniform turbidity across the stream width, the 3-point sampling scheme described in Section 2.2 will be employed and each of the 3 samples will be analyzed separately and recorded as such. It is anticipated that this may occur only in the larger streams (e.g., main stem Mica Creek) during high flow conditions. After analysis, station number, time of day, and turbidity will be recorded in a field notebook dedicated to turbidity sampling. In addition, prevailing weather conditions and noteworthy field observations that might influence turbidity at each station will be recorded in the notebook. In addition to Project-related activities, this will include any apparent sources of turbidity other than the Project (e.g., livestock access to the streams). Attempts will be made to account for any such non-Project related sources, such as moving the sampling point slightly upstream of the extraneous source, if possible. Sample results will then be transferred to an electronic database/spreadsheet for storage and analysis. After entry into the spreadsheet, the results will be checked against the field notebook by someone other than the individual entering the data to ensure that the data is correct.

3.4 Hach Model 2100P Turbidimeter Calibration

The Hach Model 2100P Turbidimeter will be calibrated once per quarter per manufacturer instructions. The turbidimeter will be calibrated using Hach Formazin turbidity solutions of 20, 100, and 800 NTU and distilled water (<0.5 NTU) per manufacturer instructions. In addition, a weekly check of the turbidimeter will be performed using Hach Gelex standards. After calibration of the turbidimeter, the Gelex standards will be run and values will be assigned. Each week, the Gelex standards will be run prior to sampling. If a difference of greater than +/- 10% is detected in the Gelex standard results, the turbidimeter will be recalibrated according to manufacturers instruction.

TABLE 2
Field and Laboratory Measurements

Station & Description	Date	Field Turbidity, NTU	ATL Lab Turbidity, NTU	ATL Lab Total Suspended Solids, mg/L
Station #28 South Fork Mica After 353 Fill	April 14, 2003	5.66	4.5	3.0
Station #29 South Fork Mica After 356 Fill Trib	April 14, 2003	5.48	4.40	2.0
Station #1 South Fork Mica Creek Background	July 3, 2003	3.05	2.37	<1.0
Station #2 South Fork Mica Creek Leaving Project	July 3, 2003	2.75	2.13	1.0
Station #3 Mica Creek After Confluence	July 3, 2003	1.78	1.19	<1.0
Station #7 South Fork Mica Creek Midway through Project	July 3, 2003	2.59	2.12	<1.0
Station #8 North Fork Mica Creek Background	July 3, 2003	1.61	1.00	<1.0
Station #9 Mica Bay Boat Launch	July 3, 2003	1.27	0.72	<1.0
Station #10 South Fork Mica Creek After Trib from South	July 3, 2003	3.03	2.36	<1.0
Station #12 Mica Creek at Loff's Bay Road Bridge	July 3, 2003	3.37	2.56	3.0
Station #24 South Fork Mica After 347 Trib	July 3, 2003	3.79	3.77	<1.0
Station #25 South Fork Mica After 350 Wall	July 3, 2003	4.42	2.88	1.0
Station #28 South Fork Mica After 353 Fill	July 3, 2003	3.52	3.18	<1.0
Station #29 South Fork Mica After 356 Fill Trib	July 3, 2003	3.28	3.01	1.0
Station #1 South Fork Mica Creek Background	January 30, 2004	12.9	11.3	7.5

TABLE 2
Field and Laboratory Measurements

Station & Description	Date	Field Turbidity, NTU	ATL Lab Turbidity, NTU	ATL Lab Total Suspended Solids, mg/L
Station #2 South Fork Mica Creek Leaving Project	January 30, 2004	34.6	30	24.0
Station #3 Mica Creek After Confluence	January 30, 2004	31.6	30.2	34.0
Station #7 South Fork Mica Creek Midway through Project	January 30, 2004	22.9	21.4	17.0
Station #8 North Fork Mica Creek Background	January 30, 2004	34.6	31.5	41.0
Station #9 Mica Bay Boat Launch	January 30, 2004	140	100	410
Station #10 South Fork Mica Creek After Trib from South	January 30, 2004	17.4	15.2	15.0
Station #12 Mica Creek at Loff's Bay Road Bridge	January 30, 2004	41.3	35.7	79.0
Station #25 South Fork Mica After 350 Wall	January 30, 2004	20.5	18.0	17.0
Station #28 South Fork Mica After 353 Fill	January 30, 2004	20.3	18.5	16.0
Station #29 South Fork Mica After 356 Fill Trib	January 30, 2004	24.5	22.6	20.0

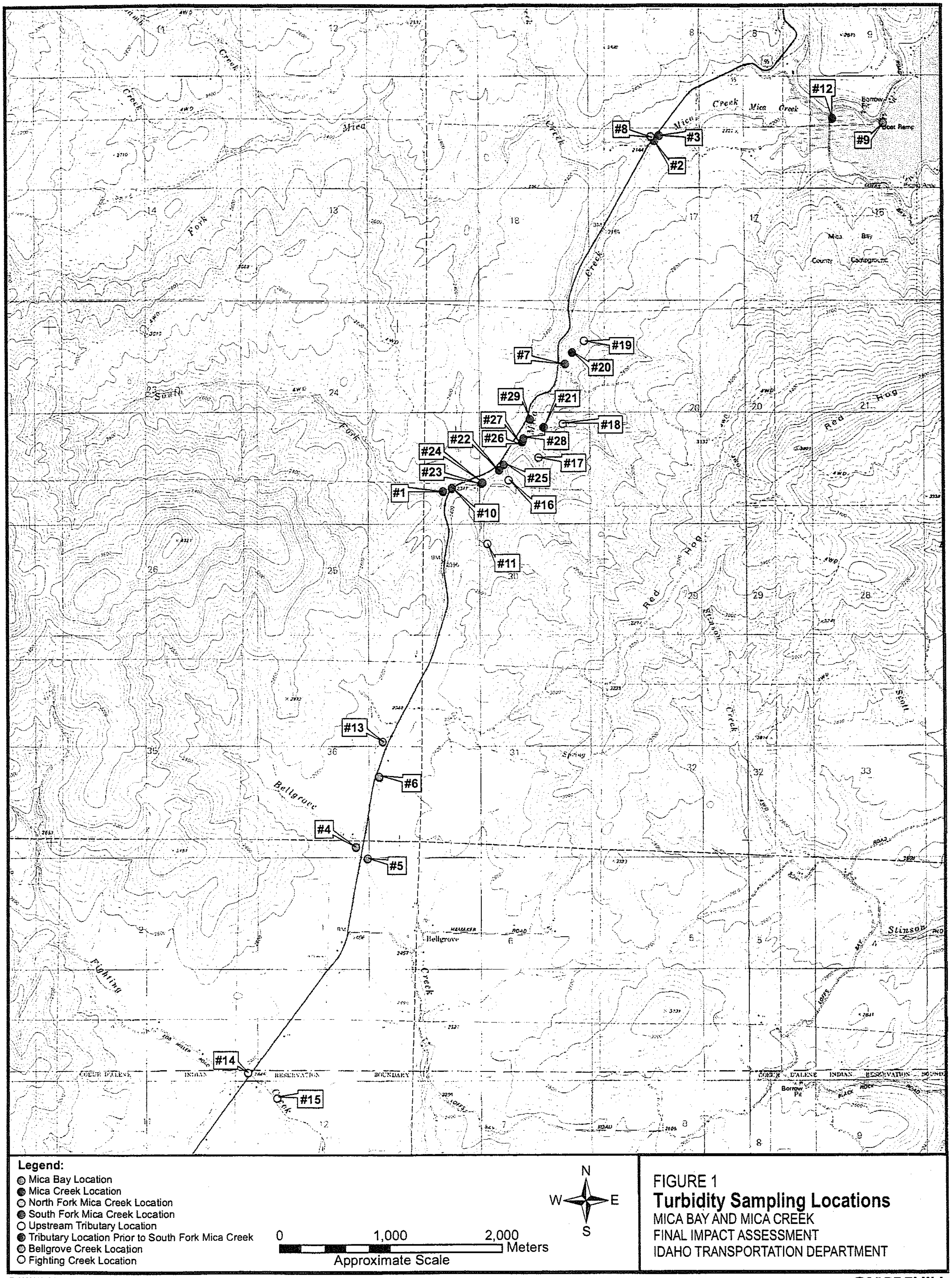
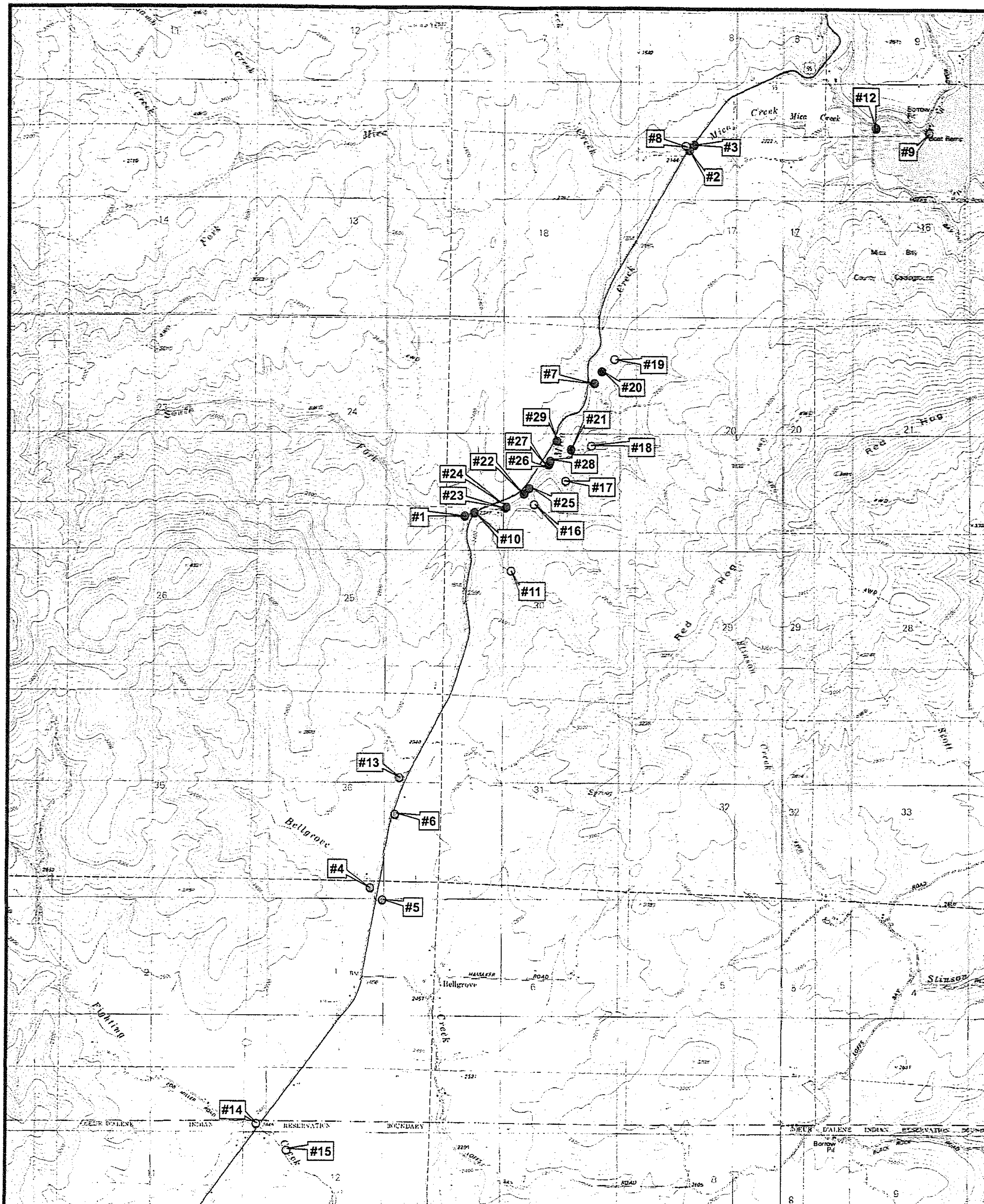


FIGURE 1
Turbidity Sampling Locations
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

T102003001BOI

CH2MHILL



Legend:
- Mica Bay Location
- Mica Creek Location
- North Fork Mica Creek Location
- South Fork Mica Creek Location
- Upstream Tributary Location
- Tributary Location Prior to South Fork Mica Creek
- Bellgrove Creek Location
- Fighting Creek Location

0 1,000 2,000 Meters
Approximate Scale

N W E S

FIGURE 1
Turbidity Sampling Locations
MICA BAY AND MICA CREEK
FINAL IMPACT ASSESSMENT
IDAHO TRANSPORTATION DEPARTMENT

T102003001BOI

CH2MHILL

South Fork Mica Creek and Mica Creek
Field Turbidity vs. Lab Turbidity

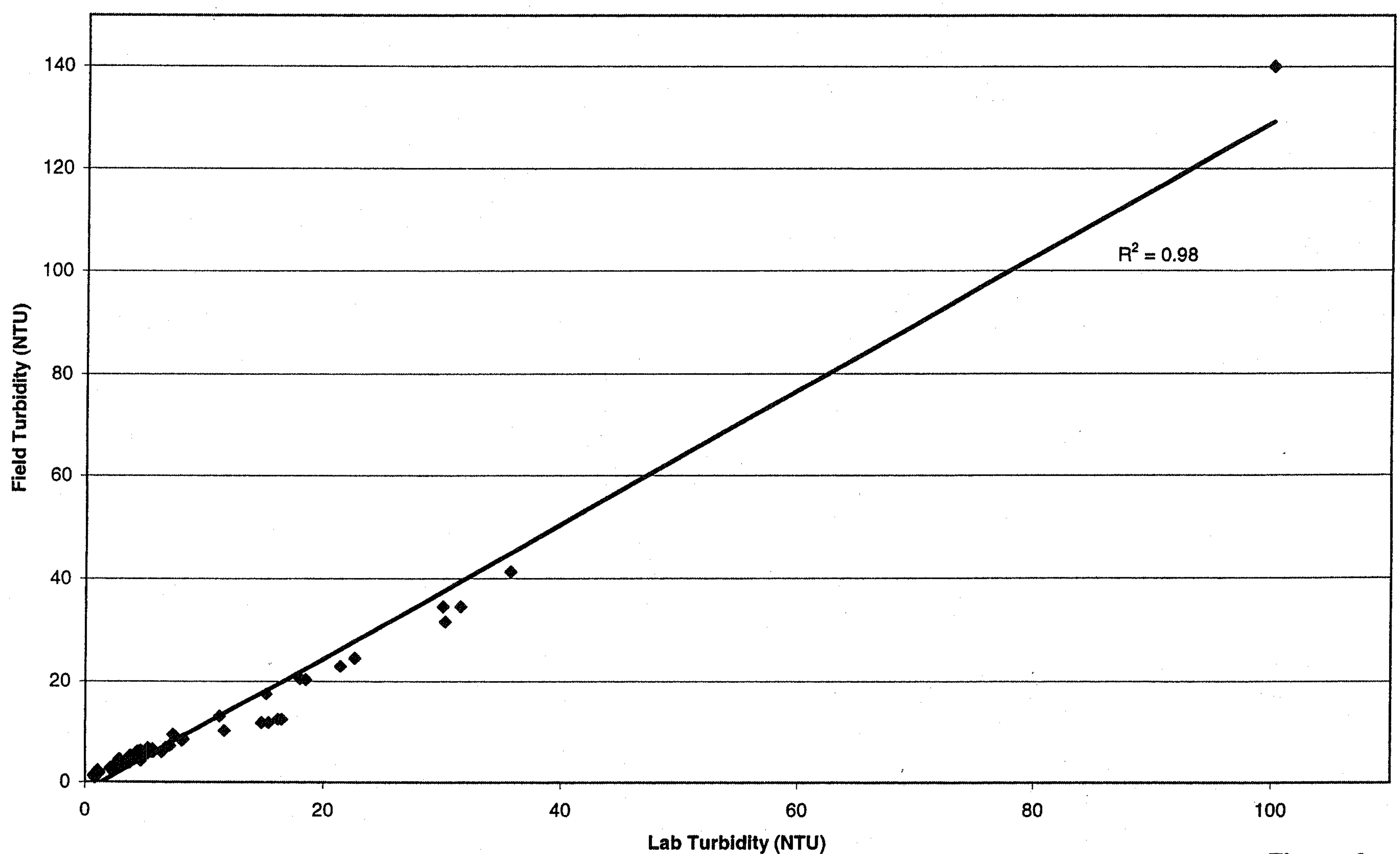


Figure 2

Appendix K

Selected ITD Construction Diaries

ITD-25 9-90
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT

EQUIPMENT

TYPE AND SIZE	NO. WORKING	NO. IDLE

PERSONNEL

NO. OF MEN	CLASSIFICATION

- Arrived on site @ 0645.
- Spoke w/ Mike Priebe via radio @ 0700. He told me that Don Carpenter had contacted the plant to cancel plantmix for today due to weather. Don, then, showed up @ the field office to make plans for Monday 10/15.
- Began snowing @ approx. 0715.
- Informed Scarsella that they needed to begin repair of silt fence @ 354~ draw area immediately. Also, emphasized importance of grading a berm on west edge of fills @ 350~± & 354~± to prevent any further erosion of slope. Foreman, Lory Reimann, told me that the berm was already in place, & the labor crew would begin silt fence repairs @ once.
- Disagreement over area ~~to~~ for the placing drain rock was resolved. Approx. 460 tons (417 tonnes) was placed in an inappropriate area. Scarsella will pay for this quantity. I.T.D. will pay for the rest.
- Flaggers walked off the road @ approx. 0815, while flagging for rock cap operation. Heavy snowfall had decreased visibility, covered signing, & slickened road. I agree w/ her decision to protect her flaggers, however Scarsella trucks continuing to haul without

(cont.)

DAY OF WEEK Fri. DATE 10/12/01 TIME WORK STARTED 0530 STOPPED 1730

WEATHER overcast-cool (rain & snow) SHEET NO. 76 (1 of 3)

PROJECT NO. DHP-NH-CM-5110 (119) KEY NO. 2815

CONTRACTOR Scarsella Bros. SIGNATURE [signature]

REVIEWED BY [signature]

ITD-25 9-90
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT

EQUIPMENT

TYPE AND SIZE	NO. WORKING	NO. IDLE

PERSONNEL

NO. OF MEN	CLASSIFICATION

(RockCap - Cont.)
traffic control. Trucks were entering highway southbound, through both lanes of US 95. This was a blind (or nearly blind) approach for them to see southbound traffic. I stopped the trucks @ the scale until this problem could resolved. Worked out an ~~situation~~ new operation where trucks wouldn't have to enter the highway on the return trip. Trucks back in operation in 15-20 minutes.

In the meanwhile, Kevin Thurber was verbally assaulted by Lory Reimann of Scarsella Bros. for holding the trucks. After hearing about this, I confronted Lory & Mike Lepka, told them that Kevin was acting under my direction, that there was an unsafe situation that needed to be rectified, & that as Project Inspector, it was my responsibility to ensure public safety & I would do that by any means deemed necessary. Informed Dave F. of the situation

- Met w/ Mike Lepka, Dave Fields, & Mike Moderie @ 1000. Discussed verbal abuse by foreman Lory Reimann to the I.T.D. inspectors & his possible removal from the project. Discussed back-up alarms on heavy equip. (again), & Scarsella's noncompliance w/ safety standards. Mike Moderie very adamant about compliance. Also discussed safety issues related to

DAY OF WEEK Fri. DATE 10/12/01 TIME WORK STARTED ← STOPPED —

WEATHER —

SHEET NO. 76 (2 of 3)

PROJECT NO. DHP-NH-CM-5110 (119) KEY NO. 2815

CONTRACTOR Scarsella Bros. SIGNATURE [signature]

REVIEWED BY [signature]

ITD-25 9-90
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT

EQUIPMENT — TYPE AND SIZE | NO. WORKING | NO. IDLE

PERSONNEL — NO. OF MEN | CLASSIFICATION

(Meeting - Cont.)
trenching for pipes (re: vertical walls). Discussion necessity for Scarsella to keep on top of the erosion/water pollution control throughout the project. Lepka stated that Scarsella would begin 8 hr. shifts on Monday, 10/15.
- Attempted to complete paperwork from yesterday w/ little luck, 1100.
- Left project for residency @ 1230. Returned @ 1315.
- Toured project w/ Scott Stokes - D.E., Dave Fields - R.E., David Karszm - Environmental Planner, & Randy Hirst - D.R.I. Erosion control & water pollution control were the main topics. Mr. Stokes emphasized the importance of ensuring the contractor was being conscientious in his efforts. Various other items along the same line were discussed.
- Contractor shut down operation @ 1530.
- Marc Johnson & I gathered water samples for turbidity testing from 1530 to 1600. See turbidity log for results.

* Note: Water in Bellgrove Creek & S.F. Mica Creek rose approx. 150 mm (6") as a result of snow & rain
- Gathered pictures of various areas where erosion control measures are being used.

DAY OF WEEK Fri. DATE 10/12/01 TIME WORK STARTED — STOPPED —

WEATHER — SHEET NO. 76 (3 of 3)

PROJECT NO. DHP-NH-CM-5110(119) KEY NO. 2815

CONTRACTOR Scarsella Bros. SIGNATURE [signature]

ITD-25 9-90 W
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

RW

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT
376~±	384~±	617-005A	A-1	Delineator Ty. 1	25	ea

RW

EQUIPMENT TYPE AND SIZE	NO. WORKING	NO. IDLE	PERSONNEL NO. OF MEN	CLASSIFICATION

- Arrived on site @ 0740.
- Scarsella working on erosion control (C.O. #9) in (3) different locations. Working on channel in front of Joy home, working @ sediment basin, & hauling/placing drain rock in washout areas of the new grade. Kevin T. & I will monitor activities.
- Harcon forming Pier 2 stemwall - S.F. Mica Creek Br. Tentatively scheduled concrete pour for 1300. D. Hulsizer & M. White will be inspecting/testing.
- Scarsella foreman (Lory) & I went to the different erosion control work locations to see how things were progressing. Work looks good in all areas.
- Ed. Gray (Materials I.A.) on site @ 0830. I told him about Harcon scheduled concrete pour @ 1300.

* Item #617-005A, Delineator Ty. 1: Checked & counted delineators placing through detour area @ north end of project - 25 total. Delineators placed @ 100' sp. for curves & 200' sp. for tangents, per Steve J. direction. Delineators asked for initially by the area maintenance foreman, Greg Munden, for snowplow operators

DAY OF WEEK Tues. DATE 12/18/01 TIME WORK STARTED 0600 STOPPED 1730
WEATHER partly cloudy, very cold SHEET NO. 114 (1 of 2)
PROJECT NO. DHP-NH-CM-5110(119) KEY NO. 2815
CONTRACTOR Scarsella Bros. SIGNATURE [signature]
REVIEWED BY [signature]

ITD-25 9-90 W
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT

EQUIPMENT TYPE AND SIZE	NO. WORKING	NO. IDLE	PERSONNEL NO. OF MEN	CLASSIFICATION

- Steve J. on site 1000± to 1100±.
- Began hauling/placing drain rock for road into Sediment Basin @ approx. 1230. G. Patrick collecting weigh tickets for hauling operation today.
- Harcon pouring Pier 2 stemwall - S.F. Mica Creek @ 1300±. D. Hulsizer inspecting, M. White & K. Thurber inspecting, & Ed Gray on site to do inspector assessment.
- Steve J. on site @ 1300±.
- Scarsella laborers continuing to reinforce sandbag dams throughout the project (5 laborers on site).
- Began snowing approx. 1430. Roadway snow covered @ 1515. Very slick road conditions.
- Left project @ 1600±

* Note: Nearly 1½ hrs to get to Big Creek office. Several accidents on I-90 from Cd'A to Rose Lake Jct.

DAY OF WEEK Tues. DATE 12/18/01 TIME WORK STARTED — STOPPED —
WEATHER ——— SHEET NO. 114 (2 of 2)
PROJECT NO. DHP-NH-CM-5110 (119) KEY NO. 2815
CONTRACTOR Scarsella Bros. SIGNATURE [signature]
REVIEWED BY [signature]

ITD-25 9-90
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT

EQUIPMENT

TYPE AND SIZE	NO. WORKING	NO. IDLE

PERSONNEL

NO. OF MEN	CLASSIFICATION

- Arrived on site @ 0705.
- Scarsella placing ~~dr~~ ^[kw] rock cap @ south end. Greg Grinell inspecting.
- Harcon has girders on site for Bellgrove Creek Br. - SBL. D. Hulsizer on site to watch operation.
- Lawrence Constr. planning concrete pour sometime this a.m.. Kevin Thurber will inspect & test if needed, otherwise Marc White will be on site.
- Adams & Clark survey crew continuing staking of subgrade.
- Scarsella exc./emb. in the 359~ area. Marc Johnson inspecting.
- Scarsella hauling drain ~~gravel~~ gravel to wick drain area. Gary Patrick pulling tickets.
- Jim Viebrock continuing to run gradations of rock cap & drain rock.
- Crusher is down today. No rock cap available for placement. Greg Grinell will assist Kevin Thurber w/ measurements of various pay quantity items.
- Scarsella laborers continuing to install water pollution/erosion control measures (silt fence, sand bag dams) @ various locations through the project, 0930.
- Worked in office 1000 to 1200, to catch up on last weeks paperwork.
- Asked Mike Fletcher, Scarsella foreman, about rock check dams in ditch through NB connector @ south end of project. I've been asking to have these installed in ditch leading to stilling basins for @ least 2 wks.. He said he'd get on it.

DAY OF WEEK Mon. DATE 10/22/01 TIME WORK STARTED 0600 STOPPED 1800

WEATHER overcast - cool (rain in the p.m.) SHEET NO. 81 (1 of 3)

PROJECT NO. DHP. NH. CM. 5110 (119) KEY NO. 2815

CONTRACTOR Scarsella Bros SIGNATURE [signature]

REVIEWED BY [signature]

JTD-25 9-90
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT

EQUIPMENT TYPE AND SIZE	NO. WORKING	NO. IDLE	PERSONNEL NO. OF MEN	CLASSIFICATION

- Scarsella plating various areas of the grade & main haul rd. w/ screened material from stockpile @ northend of project.
- Left project @ 1340 for residency. Returned @ 1530.
- Steve J. contacted me about excess turbidity in Mica Cr. I attempted to trace the source. Walked the creek from wooden bridge @ 354~± to wooden bridge below sediment basin @ 347~±. Water @ 347~ bridge was relatively clear, but within a distance of 50m below, it became turbid. A series of beaver dams had flooded the lower area & kept me from finding the exact location of the disturbance. I'll get waders from office & check it out further tomorrow.
- Scott Stokes, D.E. & John Perfect, M.E. on site @ 1600. Spoke w/ them briefly. Mr. Stokes asked me about the efforts of the contractor regarding water pollution/erosion control. I told him they were making progress, but were doing it slowly, in my opinion. He asked about the fill area @ 353~±. I told him that Steve J. & I had discussed this earlier, & concluded that this area became Scarsella's priority for erosion treatment. Explained that track walking this slope would require a winch dozer, so as to "yo-yo" the D-6 widetrack up & down the slopes. Mr. Stokes was em-

DAY OF WEEK Mon. DATE 10/22/01 TIME WORK STARTED — STOPPED —

WEATHER — SHEET NO. 81 (2 of 3)

PROJECT NO. DHP-NH-CM-5110(119) KEY NO. 2815

CONTRACTOR Scarsella Bros. SIGNATURE [signature]

ITD-25 9-90
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT

EQUIPMENT

TYPE AND SIZE	NO. WORKING	NO. IDLE

PERSONNEL

NO. OF MEN	CLASSIFICATION

(Stakes conversation - cont.)
phatic that something be done as quickly as possible, & that this job needs to be buttoned up for winter. I agreed, & told him that I was giving it my best effort.
- Overheard weather ~~bearea~~ bureau service giving a winter storm warning for tonight & tomorrow.
- Leaving the project @ 1630, stopped below new bridge site @ S.F. Mica Creek. Water is very discolored. This is apparently an accumulation of sediment, beginning @ the 348~ to 349~± area. Will notify contractor first thing in the a.m., & begin work to control sedimentation.

DAY OF WEEK Mon. DATE 10/22/01 TIME WORK STARTED — STOPPED —

WEATHER — SHEET NO. 81 (3 of 3)

PROJECT NO. DHP-NH-CM-5110 (119) KEY NO. 2815

CONTRACTOR Scarsella Bros. SIGNATURE [signature]

ITD-25 9-90 W
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT
353~±	356~±	C5-CKDAM	A-1	Rock Check Dams	28	ea

EQUIPMENT TYPE AND SIZE	NO. WORKING	NO. IDLE	PERSONNEL NO. OF MEN	CLASSIFICATION

- Arrived on site @ 0720.
- Toured most of project w/ Gary Patrick to show him areas of concern regarding erosion. Told him that Matia needed to treat areas, either permanently or temporarily, A.S.A.P. Also told him that just because Adams & Clark hasn't measured an area, that doesn't dictate where Matia may or may not spray. Areas can always be measured afterwards. Our main concern is to have all areas, prone to erosion, treated w/ mulch immediately.
- Toured most of project w/ Mike Fletcher, Scarsella foreman, from 0800 to 0900. Discussed water pollution/erosion control measures to be taken. Utilizing suggestions from Randy Hirst, & making other suggestions @ specific situations, explained to Fletcher the necessity to begin this work immediately.
- Upon returning to field office, Mike Lapka - super, showed me an A.V.O to Scarsella Bros. from Steve Johnson. We discussed the priority areas addressed on the A.V.O.. Steve, in his A.V.O., issued a "stop excavation" order. Marc Johnson informed me that scrapers shut down & excavation was stopped @ 0945.
- Measured/counted rock check dams in the 354~ draw area & 356~ draw area.
- Randy Hirst, D.R.I. on site @ 0930.
- Steve J. on site @ 1000.

DAY OF WEEK Tues. DATE 10/23/01 TIME WORK STARTED 0600 STOPPED 1730

WEATHER overcast - cool SHEET NO. 82 (1 of 3)

PROJECT NO. DHP-NH-CM-5110(119) KEY NO. 2815

CONTRACTOR Scarsella Bros. SIGNATURE [signature]

REVIEWED BY [signature]

ITD-25 9-90 W
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT

EQUIPMENT TYPE AND SIZE	NO. WORKING	NO. IDLE	NO. OF MEN	PERSONNEL CLASSIFICATION

- Walked through sediment basin area w/ Randy Hirst. He discovered where some of the sedimentation was coming from, but we discovered a much larger problem. Found that the outlet pipe, from the standpipe to the rip-rap basin, had water flowing beside & under. The compacting backfill had failed. Notified Mike Lopka of the problem. He said he'd contact Dale Fleming of D&E Roads and More. I contacted Steve J. to inform him of the situation.
- Spoke w/ Lory Reimann @ 1140. Told him that a sandbag checkdam in @ least (2) locations in small channel below sediment basin should be adequate for water pollution/erosion control. He understood.
- Mike McBdesie on site @ 1145±.
- Worked on paperwork from 1200-1300.

* Item C5-CKDAM, Rock Check Dams: Series of dams set up in draws & across access rds. @ 356~ & 353~ draws. Pay 18 ea. for 356~ & 10 ea. for 353~. Total = 28 ea.

- Contractor concentrating efforts on erosion control in various areas. Placing rip-rap in natural ditch area formed by fill against natural ground @ inlet side of embankment, 347~. Equip.- D-6 dozer & (2) 10-wheel enddumps.

DAY OF WEEK Tues. DATE 10/23/01 TIME WORK STARTED ——— STOPPED ———

WEATHER ———— SHEET NO. 82 (2 of 3)

PROJECT NO. DHP-NH-CM-5110 (119) KEY NO. 2815

CONTRACTOR Scarsella Bros. SIGNATURE [signature]

REVIEWED BY [signature]

ITD-25 9-90 W
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT

EQUIPMENT — TYPE AND SIZE — NO. WORKING — NO. IDLE

PERSONNEL — NO. OF MEN — CLASSIFICATION

(Silt Fence - Cont.)
#2 - 4 m, #3 - 5 m; 350~ draw = 5.5 m. Total = 96.5 meters.
* Item # 213-005A, Topsoil: 339+35 to 342 (rt.) = (290 l) (22.1 avg. w) (0.200 d) = 1281.8; 341+60 to 343~ (lt.) = (140 l) (18.25) (0.200) = 511.0. Total = 1281.8 + 511.0 = 1792.8 m3
- Worked on wingwall support block elevs. for Bellgrove Creek Br. - SBL, 1530 - 1600. Didn't complete. Will continue tomorrow.
- Left project @ 1615.

DAY OF WEEK Wed. DATE 10/24/01 TIME WORK STARTED — STOPPED —
WEATHER — SHEET NO. 83 (2 of 2)
PROJECT NO. DHP-NH-CM-5110(119) KEY NO. 2815
CONTRACTOR Scarsella Bros. SIGNATURE [signature]
REVIEWED BY [signature]

ITD-25 9-90 W
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT
345+73	348+40(Lt)	213-005A	A-1	Topsoil	1335.0	m3
See Below		205-005A	"	Excavation	285,200	m3 (Est.)

EQUIPMENT | PERSONNEL

TYPE AND SIZE	NO. WORKING	NO. IDLE	NO. OF MEN	CLASSIFICATION

- Arrived on site @ 0715.
- Checked sedimentation in Bellgrove Creek & S.F. Mica Creek first thing this a.m. Both creeks looked pretty good, w/ sedimentation decreased noticably from yesterday morning.
- Jim Ross on site this a.m. for tour of project.

* Item # 213-005A, Topsoil: Sta. 345+73 to 348+40 Lt. = (267-l) (25-avg.w) (0.200-d) = 1335.0 m3

- Scarsella plating haul road (& subgrade) from Sta. 331~± north.
- Much of the day spent in the field office calculating quantities for upcoming estimate cut-off.

* Item # 205-005A, Excavation: For estimate purposes & in agreement w/ contractor, pay 285,200 m3. See attached sheet.

- Scarsella continuing work on water pollution/erosion control.
- Scarsella placing rock cap @ south end of project. K. Thurber inspecting.
- Harcon & Lawrence continuing bridge & box culvert work. D. Hulsizer inspecting.
- IR 150 roller "seating" rock cap in subgrade as directed, from Sta. 324~± to 330~±.

DAY OF WEEK Thurs. DATE 10/25/01 TIME WORK STARTED 0600 STOPPED 1700
WEATHER overcast-cold (rain-snow mix) SHEET NO. 84 (1 of 2)
PROJECT NO. DHP-NH-CM-5110 (119) KEY NO. 2815
CONTRACTOR Scarsella Bros. SIGNATURE [signature]
REVIEWED BY [signature]

ITD-25 9-90 W
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT

EQUIPMENT

TYPE AND SIZE	NO. WORKING	NO. IDLE

PERSONNEL

NO. OF MEN	CLASSIFICATION

- D-6 widetrack walking slope @ 350~ fill area. M. Johnson inspecting.
- M. Priebe on site to break in on density testing w/ Marc Johnson.
- Wick drains being installed @ S.F. Mica Creek Str. site. Greg Grinnell inspecting. Marc White also watching operation, when not testing concrete.
- D-8 dozer ripping asphalt in detour area @ north end of project to get rid of abrupt edge between "old" 95 & newly paved diversion.
- R. Lassila working on pipe quantities in preparation for estimate cut-off.
- Randy Hirst on site this a.m. to review water pollution/erosion control measures being taken by contractor. See letter in file w/ suggestions for improvement.
- Began removing temp. creek crossing @ Bellgrove Cr. @ approx. 1400.
- Left project @ 1540.

DAY OF WEEK Thurs. DATE 10/25/01 TIME WORK STARTED — STOPPED —

WEATHER — SHEET NO. 84 (2 of 2)

PROJECT NO. DHP-NH-CM-5110 (119) KEY NO. 2815

CONTRACTOR Scarsella Bros. SIGNATURE [signature]

REVIEWED BY [signature]

ITD-25 9-90 W
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT

EQUIPMENT

TYPE AND SIZE	NO. WORKING	NO. IDLE

PERSONNEL

NO. OF MEN	CLASSIFICATION

- Arrived on site @ 0710.
- Scarsella using paddlewheel scraper in 309~ area
- Scarsella continuing to burn brush piles throughout project.
- Harcon working @ Bellgrove Creek Str. D. Hulsizer inspecting.
- Scarsella continuing to plate haul rd. w/ screened material from stockpile @ north end of project.
- Scarsella continuing to place rip-rap in ditches between natural ground & fills for erosion control.
- Installation of MSE wall @ 377~ scheduled to begin today. Marc White & Greg Grinell on site w/ Mike Moderie as technical engineer.
- Matia on site today. G. Patrick inspecting.
- Roach Constr. on site to install side drains. Kevin Thurber inspecting.
- Noticed discoloration in S.F. Mica Creek from Sta. 348~ downstream. Decided to investigate. Found (3) separate locations of stormwater discharge (347~ draw below sediment basin, 350~ wall area, & 356~ stream). Contacted Scarsella foreman, Cory, to let him know that more silt fence & sandbag dams would be required. He instructed laborers to meet w/ me @ a designated location. I took labor

DAY OF WEEK Tues. DATE 10/30/01 TIME WORK STARTED 0600 STOPPED 1730
WEATHER overcast-cold (rain) SHEET NO. 87 (1 of 3)
PROJECT NO. DHP-NH-CM-5110(119) KEY NO. 2815
CONTRACTOR Scarsella Bros. SIGNATURE [signature]
REVIEWED BY [signature]

ITD-25 9-90 W
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT

EQUIPMENT | **PERSONNEL**

TYPE AND SIZE | NO. WORKING | NO. IDLE | NO. OF MEN | CLASSIFICATION

(Erosion Control - Cont.)
crew to the bottom of the 350~ draw, as this appeared to be the location most in need of attention, to show them what was needed (silt fence & sandbag dams).
- Randy Hirst on site to tour problem areas w/ me @ 0930. We concurred on which were priority areas for erosion control.
- Checked in w/ Mike Priebe @ crusher lab. Sampling rock cap.
- Art Brand of Fighting Creek Materials told me that he wouldn't load riprap in anymore of Scarsella's enddumps as Fighting Creek was beginning to "muddy up" from the truck traffic through the pit. I told him that that would be his call & I appreciated him telling me. (1145).
- Steve J. on site @ 1245±, w/ environmental planners from I.T.D.
- Discovered another breach in the silt fence @ pier #1 location of S.F. Mica Cr. Str. Muddy water, flowing from haul rd, found it's way beneath improperly installed silt fence, & is running into S.F. Mica Cr. Notified Scarsella of problem, & asked that labor crew report to repair problem, 1320.
- Spoke w/ Lory Reimann, Scarsella foreman, @ 1400±. Told him about areas of stormwater discharge that would need to be worked. He told me that

DAY OF WEEK Tues. DATE 10/30/01 TIME WORK STARTED — STOPPED —
WEATHER — SHEET NO. 87 (2 of 3)
PROJECT NO. DHP-NH-CM-5110(119) KEY NO. 2815
CONTRACTOR Scarsella Bros. SIGNATURE [signature]
REVIEWED BY [signature]

ITD-25 9-90 W
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT

EQUIPMENT

TYPE AND SIZE	NO. WORKING	NO. IDLE

PERSONNEL

NO. OF MEN	CLASSIFICATION

(Stormwater discharge - cont.)
he was trying to find his labor crew. I said that I & the other inspectors on the project would keep a lookout for them.
- Spoke w/ Mike Hartz & David Karsann this afternoon. Much concern over erosion & water pollution. I chose to listen to their suggestions, rather than comment.
- Stormwater discharge into Mica Creek increased as rainfall became heavier in the p.m. Scarsella labor crew (2 man) attempting to control discharge w/ sandbag dams. In my opinion, Scarsella needs to concentrate all efforts on water pollution / erosion control.
- Received word @ 1535 that silt fence was repaired @ pier 1 of SF Mica Creek Str., by Greg Grinell.
- Left project @ 1550.

DAY OF WEEK Tues. DATE 10/30/01 TIME WORK STARTED — STOPPED —

WEATHER — SHEET NO. 87 (3 of 3)

PROJECT NO. DHP-NH-CM-5110(119) KEY NO. 2815

CONTRACTOR Scarsella Bros. SIGNATURE [signature]

REVIEWED BY [signature]

ITD-25 9-90 W
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT

EQUIPMENT

TYPE AND SIZE	NO. WORKING	NO. IDLE

PERSONNEL

NO. OF MEN	CLASSIFICATION

-Arrived on site @ 0710.
- Scarsella hauling/placing rock cap. See G. Patrick diary & weigh tickets for location & quantity.
- Harcon on site. D. Hulsizer inspecting.
- Scarsella working @ S.F. Mica Cr. Bridge & M.S.E. wall 377. Mike Moderie, Marc White, & Mike Priebe on site for inspecting/testing.
- K. Thurber continuing to monitor work for force account under C.O. #9 - C9 Erosion.
- Kevin discovered that sump hole for sediment basin was taking too much water & overflowing, causing discoloration in S.F. Mica Cr. I contacted Lory Reimann to inform him of the problem. He said he'd add another pump or "whatever it takes" to solve the problem.
- Weekly mtg., 0925 to 1000, w/ Scarsella, Harcon, & Safety Corporation in attendance. See notes attached.
- G. Patrick had to leave project @ 1100, for personal reasons. K. Thurber took pulling weigh tickets & inspecting laydown of rock cap. I took over for Kevin, monitoring erosion control work. As far as I can tell, no water pollution/erosion control work has been done this am.

DAY OF WEEK Wed. DATE 11/21/01 TIME WORK STARTED 0600 STOPPED 1800

WEATHER overcast - cold (rain) SHEET NO. 99 (1 of 2)

PROJECT NO. DHP-NH-CM-5110(119) KEY NO. 2815

CONTRACTOR Scarsella Bros. SIGNATURE [signature]

REVIEWED BY [signature]

ITD-25 9-90 W
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT

EQUIPMENT

TYPE AND SIZE	NO. WORKING	NO. IDLE

PERSONNEL

NO. OF MEN	CLASSIFICATION

- Steve Johnson notified me prior to weekly mtg., that a great deal of sedimentation in Mica Creek could be seen before the creek entered the project. He suggested that a turbidity test be taken. I did so @ approx. 1200. See results in log book & file.
- Scarsella began digging trench for French drain @ Sta. 338+60± for erosion protection. Will fill w/ drain rock. This work will be paid for by force acct. under Change Order #9. Equip. - Cat 235D trackhoe, Volvo A35 articulating end dump (for excavation) & (4) 10-wheel end dumps (drain rock).
- Scarsella foreman (Lory) informed me that trucks would be shut off @ 1430 today.
- Left project @ 1525.

DAY OF WEEK Wed. DATE 11/21/01 TIME WORK STARTED — STOPPED —

WEATHER — SHEET NO. 99 (2 of 2)

PROJECT NO. DHP-NH-CM-5110(119) KEY NO. 2815

CONTRACTOR Scarsella Bros SIGNATURE [signature]

REVIEWED BY [signature]

ITD-25 9-90 W
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT
304+80	312+40	640-015A	A-1	Subgrade Separation Geotextile	15,200	m2
See Pg. 2		626-115A	"	Rent Portable Tubular Markers	22	ea.

EQUIPMENT

TYPE AND SIZE	NO. WORKING	NO. IDLE

PERSONNEL

NO. OF MEN	CLASSIFICATION

- Arrived on site @ 0715
- Steve Johnson contacted me via cell phone to inform that the sediment basin had failed sometime between Wed. (11/21) afternoon & Fri. (11/23) morning. I walked into area to look @ the damage. Sand bag dikes seems to be effective as water is being channeled through drain rock, & is fairly clean coming out. I called Steve to tell him what I saw. Took photos of washout.
- Harcon working @ Bellgrove Creek Br. D. Hubsizer inspecting.
- Scarsella working @ 377 M.S.E. wall. M. White inspecting & M. Priebe testing compaction.
- Scarsella planning to begin C.O. 9 work @ 1000. Building french drains across grade in the 340~area. G. Patrick inspecting & taking weigh tickets.
- Met w/ Jeff Drager - M.E., Bill Capaul - geologist, Mike Moderie - S.E., Steve Johnson - T.S.E.A. @ sediment basin, approx. 0930. No decisions on the fix as of yet.
- Kevin Thurber took over for G. Patrick on C.O. #9 work. G. Patrick & I measured ~~the~~ subgrade separation geotextile @ south end of project. K. Thurber has other measurements north of Bellgrove Creek

DAY OF WEEK Mon. DATE 11/26/01 TIME WORK STARTED 0600 STOPPED 1600

WEATHER overcast - cold (snow/rain mix) SHEET NO. 100 (1 of 2)

PROJECT NO. DHP-NH-CM-5110 (119) KEY NO. 2815

CONTRACTOR Scarsella Bros. SIGNATURE [signature]

REVIEWED BY [signature]

ITD-25 9-90 W
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT

EQUIPMENT TYPE AND SIZE	NO. WORKING	NO. IDLE	PERSONNEL NO. OF MEN	CLASSIFICATION

* Item # 640-015A, Subgrade Separation Geotextile, Ty II : Field measured Sts. 304+80 to 312+40. Area = (760)(20) = 15,200 m2.
* Item # 626-115A, Rent Portable Tubular Markers: Inadvertently left out 22 markers. Pay @ this time.
- Assisted D. Hulsizer w/ concrete testing / cylinders @ Bellgrove Creek Br. in the p.m.
- Left project @ 1450.

DAY OF WEEK Mon. DATE 11/26/01 TIME WORK STARTED — STOPPED —

WEATHER — SHEET NO. 100 (2 of 2)

PROJECT NO. DHP-NH-CM-5110(119) KEY NO. 2815

CONTRACTOR Scarsella Bros. SIGNATURE [signature]

REVIEWED BY [signature]

ITD-25 9-90 W
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT

EQUIPMENT

TYPE AND SIZE	NO. WORKING	NO. IDLE

PERSONNEL

NO. OF MEN	CLASSIFICATION

- Arrived on site @ 0800. Very bad road conditions this morning.
- Scarsella laborers filling sandbags. K. Thurber inspecting force acct.
- Scarsella planning to backfill pier 2 - S.F. Mica Cr., w/ rock cap. M. White inspecting & pulling tickets
- Harcon & Rodbusters working @ S.F. Mica Cr. D. Hulsizer inspecting.
- Randy Hirst, D.R.I., on site this a.m.
- Heavy rainfall & above freezing temps are causing some sedimentation in the S.F. Mica Creek. Scarsella continuing efforts to control water pollution & erosion.
- Left project @ 1420

DAY OF WEEK Thurs. DATE 12/13/01 TIME WORK STARTED 0600 STOPPED 1530

WEATHER overcast - cold (rain/sleet/snow) SHEET NO. 111

PROJECT NO. DHP-NH-CM-5110(119) KEY NO. 2815

CONTRACTOR Scarsella Bros SIGNATURE [signature]

REVIEWED BY [signature]

ITD-25 9-90 W
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT

EQUIPMENT

TYPE AND SIZE	NO. WORKING	NO. IDLE

PERSONNEL

NO. OF MEN	CLASSIFICATION

- Worked on paperwork @ Big Creek office this a.m.
- Arrived on site @ 0800.
- Scarsella continuing C.O. 9 work. K. Thurber monitoring activities.
- Fedco on site to prepare pre-drill for additional piling @ S.F. Mica Cr. M. White inspecting.
- Harcon/Rodbusters continuing work @ S.F. Mica Cr. Br. D. Hilsizer inspecting.
- Safety Corp. Inc. beginning installation of delineators through detour area. Installing delineators @ 200' in tangent sect. & 100' in curve, as directed by Steve J. Installation will include both north & south bound lanes.
- Spoke w/ Steve J. this a.m., via telephone, about C.O. #9 work by Scarsella. He told me to inform Scarsella foreman, Lory R., to have @ least (4) laborers on site to construct erosion control measures. I instructed Kevin T. to notify Lory of this. Also, Steve J. said that if Scarsella couldn't get sufficient number of laborers through T.E.R.O. they were to call the Laborers local to fill the positions. Kevin T. reported that he had informed Lory R. of ~~all~~ both these directives. Lory said he'd begin trying to get people A.S.A.P.

DAY OF WEEK Fri. DATE 12/14/01 TIME WORK STARTED 0600 STOPPED 1530
WEATHER overcast-cold (rain/snow, high winds) SHEET NO. 112 (1 of 2)
PROJECT NO. DHP-NH-CM-5110(119) KEY NO. 2815
CONTRACTOR Scarsella Bros. SIGNATURE [signature]
REVIEWED BY [signature]

ITD-25 9-90 W
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT

EQUIPMENT | PERSONNEL

TYPE AND SIZE	NO. WORKING	NO. IDLE	NO. OF MEN	CLASSIFICATION

- Warmer weather & heavy rainfall over the past several days has caused several erosion control measures to be overrun by sediment. Kevin T. & I reviewed areas in an attempt to prioritize areas for repair. At this time, it appears that run-off from the Sediment Basin is the major contributor to sedimentation in Mica Creek. Kevin T. informed Scarsella labor crew to address this area first (approx. 1030).
- Kevin T. taking water samples @ designated locations for turbidity tests as directed by Steve J., 1300±
- Noticed @ least (2) more laborers for Scarsella, on site @ 1345. All involved in filling sandbags.
- Some minor activity @ Bellgrove Creek Br. See D. Hulsizer diary for details.
- Left project @ 1415.

* Note: Observation: Noticed a lot of discoloration of water in Cougar Bay. Comparatively, Cougar Bay appeared as bad, or worse than Mica Bay. This leads me to believe that warm temperatures & heavy rainfall over the past several days has caused sedimentation in all the drainages around Lake Coeur d'Alene, & that disturbed ground on this project is not solely responsible for sedimentation.

DAY OF WEEK Fri. DATE 12/14/01 TIME WORK STARTED — STOPPED —
WEATHER — SHEET NO. 112 (2 of 2)
PROJECT NO. DHP-NH-CM-5110 (119) KEY NO. 2815
CONTRACTOR Scarsella Bros. SIGNATURE [signature]
REVIEWED BY [signature]

ITD-25 9-90 W
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT

EQUIPMENT TYPE AND SIZE	NO. WORKING	NO. IDLE	PERSONNEL NO. OF MEN	CLASSIFICATION

- Checking calcs. & quantities in office this a.m.
- Arrived on site @ 0750.
- Unseasonably warm temps (mid to high 40's) & heavy rainfall have caused springlike runoff conditions. Combined w/ high winds, both Bellgrove Cr. & Mica Cr. have risen to very near flood level. Contractor is continuing efforts to prevent erosion & runoff from the project (i.e. repairing silt fence & installing/repairing sandbag dams).
- Received report from Worley Highway Dist., via Paul Montgomery, that 600 mm pipe installed across Fighting Creek Rd. has begun to washout. I informed Scarsella foreman, Lory. He said he'd find a solution & repair the problem A.S.A.P.
- Left project @ 1005, to meet w/ Greg McDowell (D.R.1.) to discuss some questions about equip. rentals & Form 270-C, Weekly Force Acct Materials Sheet.
- Pier 1 stemwall - S.F. Mica Cr. Br. scheduled for 1030. D. Hulsizer inspecting. Marc White & Kevin Thurber testing / making cylinders. Flaggers in place for traffic control.
- Returned to project @ 1400.

DAY OF WEEK Tues. DATE 01/08/02 TIME WORK STARTED 0600 STOPPED 1700
WEATHER overcast - cold (scattered showers) SHEET NO. 119 (1 of 2)
PROJECT NO. DHP-NH-CM-5110 (119) KEY NO. 2815
CONTRACTOR Scarsella Bros. SIGNATURE [signature]
REVIEWED BY [signature]

ITD-25 9-90 W
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT

EQUIPMENT — TYPE AND SIZE | NO. WORKING | NO. IDLE

PERSONNEL — NO. OF MEN | CLASSIFICATION

- Scarsella hauling rock cap & riprap to eroded areas of haul road. G. Patrick collecting weigh tickets.
- Steve Johnson on site @ 1430.
- Spoke w/ Don Hulsizer about concrete pour. He said everything went well. See his diary for further details.
- When not assisting w/ concrete testing, K. Thurber monitoring labor crew work under Change Order #9.
- Left project @ 1525 for Big Creek office.

DAY OF WEEK Tues. DATE 01/08/02 TIME WORK STARTED ~~06~~ [illegible] STOPPED —

WEATHER ______ SHEET NO. 119 (2 of 2)

PROJECT NO. DHP. NH. CM. 5110 (119) KEY NO. 2815

CONTRACTOR Scarsella Bros. SIGNATURE [signature]

REVIEWED BY [signature]

ITD-25 9-90 W
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT

EQUIPMENT

TYPE AND SIZE	NO. WORKING	NO. IDLE

PERSONNEL

NO. OF MEN	CLASSIFICATION

- Arrived on site @ 0730.
- Water level has dropped 6"-1' in both Bellgrove Creek & Mica Creek, & each has cleared a bit.
- Scarsella hauling riprap to repair washouts on haul road. G. Patrick collecting weigh tickets. After reviewing repair process, I decided that we would be unable to get an accurate volume measurement on placed riprap, due to inconsistencies in geography, soft soil conditions (riprap sinking), & voids discovered only after riprap had been placed over them. Discussed the situation w/ Scarsella foreman, Lory, & he asked if there was a conversion from mass to volume that would be acceptable to both parties. Together, we agreed that 1½ U.S. tons is roughly equivalent to 1 cubic meter. I will ~~right~~ be write an A.V.O. to the file regarding this matter & use weigh tickets as a basis for computing volume of riprap.
- Weekly meeting has been postponed. Ed DeWilde & Mark Duffner of Adams & Clark arrived for mtg. @ 0900. We discussed schedule of events in the near future, & any specific items requiring attention by Adams & Clarke.

DAY OF WEEK Wed. DATE 01/09/02 TIME WORK STARTED 0600 STOPPED 1700
WEATHER overcast - cold (light rain) SHEET NO. 120 (1 of 2)
PROJECT NO. DHP-NH-CM-5110(119) KEY NO. 2815
CONTRACTOR Scarsella Bros. SIGNATURE [signature]
REVIEWED BY [signature]

ITD-25 9-90 W
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT

EQUIPMENT — PERSONNEL

TYPE AND SIZE	NO. WORKING	NO. IDLE	NO. OF MEN	CLASSIFICATION

- Harcon continuing forming work @ Mica Cr. Br. D. Hulsizer inspecting.
- Scarsella preparing to do some work @ 377 M.S.E. wall. Hauling facing rock to area. M. White inspecting.
- Steve Johnson on site @ 1015. Picked up final quantities for estimate cutoff.
- Barry Pry of Kootenai Electric visiting @ 1030. Several questions about next phase of US 95 project. Couldn't answer any of them.
- Environmental tour of project, 1230-1430. Andrea Storjohann, Dave Fields, Mike Moderie, Steve Johnson, Bill Capaul, Mike Hartz, Dave Karsann, & Eric Krueger.
- Assisted Kevin T. w/ turbidity testing @ stream through 347~ fill area @ Andrea S. direction. Discovered that Goddi Logging operation had built a creek crossing (well outside R/W) @ end of approach @ 344+11 Rt. The crossing had completely washed out, leaving a 12' wide x 10' deep washout. I photographed area w/ Dave Field's digital camera. Turbidity in this area is extremely high (807 N.T.U.) Sampled (2) other locations. See photos & readings, along w/ descriptions, in file.

DAY OF WEEK Wed. DATE 01/09/02 TIME WORK STARTED — STOPPED —

WEATHER — SHEET NO. 120 (2 of 2)

PROJECT NO. DHP-NH-CM 5110(119) KEY NO. 2815

CONTRACTOR Scarsella Bros. SIGNATURE [signature]

REVIEWED BY [signature]

ITD-25 9-90 W
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT

EQUIPMENT

TYPE AND SIZE	NO. WORKING	NO. IDLE

PERSONNEL

NO. OF MEN	CLASSIFICATION

- Arrived on site @ 0640
- Above average temp. (45°F±) & high winds causing run-off conditions. Spoke w/ Mike Fletcher (foreman) about continuing water pollution/erosion control efforts. He told me that all of his operations would be directly related to that.
- Scarsella completing riprap basin @ 357~ pipe inlet & hauling excavated asphalt (from north end) to access rd. to 359~ M.S.E. wall.
- Scarsella labor crew continuing repair &/or new installation of silt fence.
- Harcon working @ Pier 1 - S.F. Mica Creek Br.
- Discovered several more areas requiring erosion control measures on the new grade from 331~ to 349~. Discussed these w/ Scarsella foreman. He said he'd begin work on them A.S.A.P.
- Left project @ 1005 to get vehicle serviced & deliver paperwork to res.
- Returned @ 1130.
- Steve J. informed me that turbidity testing would be done every Tues. & Thurs. in the p.m., as agreed to by I.D.E.Q.
-

(next page)

DAY OF WEEK Fri. DATE 02/22/02 TIME WORK STARTED 0530 STOPPED 1400

WEATHER overcast - cool (rain) SHEET NO. 143 (1 of 2)

PROJECT NO. DHP-NH-CM-5110 (119) KEY NO. 2815

CONTRACTOR Scarsella Bros. SIGNATURE [signature]

REVIEWED BY [signature]

ITD-25 9-90 W
27-008200-1

STANDARD CONSTRUCTION DIARY

INSTRUCTION: SEE 04-110.02 OF CONSTRUCTION MANUAL

FROM STATION	TO STATION	ITEM NO.	FUND SOURCE	DESCRIPTION	QUANTITY	UNIT

EQUIPMENT

TYPE AND SIZE	NO. WORKING	NO. IDLE

PERSONNEL

NO. OF MEN	CLASSIFICATION

- Had a lengthy discussion w/ Teri Briggs about "authorized" paddle time for flaggers. She disagrees that I don't pay standby time. I told her that in accordance w/ Sect. 630.05 of Idaho Standard Specs., no separate pay will be made for show up, standby, or relief time. She was obviously angry, & told me that she wanted to pursue this issue further w/ Steve J. I told her that she could pursue the issue, but I'm merely paying flagging hours according to the spec., 1230.
- Left project @ 1250.

DAY OF WEEK Fri. DATE 02/22/02 TIME WORK STARTED — STOPPED —
WEATHER — SHEET NO. 143 (2 of 2)
PROJECT NO. DHP-NH-CM-5110(119) KEY NO. 2815
CONTRACTOR Scarsella Bros. SIGNATURE [signature]
REVIEWED BY [signature]

Appendix L

FPA Notifications for Mica Bay Watershed

IDAHO DEPARTMENT OF LANDS

MICA AREA OFFICE
3706 INDUSTRIAL AVENUE
COEUR D ALENE ID 83815-8918
(208) 769-1577

October 8, 2002

CH2MHILL
700 Clearwater Lane
Boise ID 83712-7708
Attn: Steve Miller

Re: F.P.A. Notifications in the Mica Bay and Mica Creek watersheds (1988 to the present)

I have enclosed the compilation of the above data. As I mentioned on the phone our hard copy file only goes back seven years. Most of our data that we used was electronic copies on the computer (incomplete) that goes back through 1993 at our location and through 1991 at the staff office next door with even less complete information (their records lacked the legal description so we could not be certain if these records were in the watershed so they were eliminated).

The tables have been sorted by Notification number and by year.

Also mentioned in our phone conversation was that fact that I would not be able to accommodate the 3 day turn around time for public information requests. You agreed at that time to a 10 day period which would target October 10 as the due date for providing the information. The information should be ready on October 9, 2002 when you are in town. I'll look forward to meeting you and giving you the data which we've collected.

If you have questions regarding these reports or our procedure do not hesitate to contact me.

Sincerely,

Jim Rickerd
Forest Practices Advisor
jrickerd@idl.state.id.us

Encl.

c. AS - Mica
FPA - Coordinator
File

D:\Current FPA\Title 38

Idaho Forest Practice Notifications in the Mica Creek and Mica Bay Watersheds – Kootenai County
Compiled by the Idaho Department of Lands for a public record request by CH2MHILL – Steve Miller
September 27, 2002 (Sorted by heading that is in **bold print**)

Township (N) & Range (W)	Sec.	**Notification #**	Landowner	Operator	Year	Volume Reported (BdFt)
4904	03	12144F	Lee	Sims	1997	25,250
4904	03	41564F	Votova	Votova Logging	2000	7,360
4904	03	41768F	Fox	Kimball Bros.	2000	72,430
4904	03	41961F	Blankenship	Falcon	2000	40,140
4904	04	20512F	White, Skip	White, Skip	1999	52,150
4904	04	41483F	Schuler	Mundt	2000	1,270
4904	04	42153F	Tall Pines Prop.	Swift Co. Timber	2001	3,920
4904	04	47803F	Hosford	Hosford	2002	2,440
4904	04	48017F	Stefani	Northern Forest	2001	-0-
4904	04	93578F	Noble	Nearpass	1996	19,710
4904	04	97838F	Udell	W & R Timber Mgt	1996	203,680
4904	05	11699F	Winters	Ohmstede	1997	21,570
4904	05	20558F	McNeil	McNeil	1999	2,160
4904	05	20631F	Ross Jr.	Ross Jr.	1999	3,610
4904	05	25639F	Mills	Mills	2000	29,160
4904	05	41914F	Mills	Mills	2000	21,460
4904	05	42114F	Carter	Votava	2001	82,280
4904	05	46260F	Lee	Felix	2001	16,540
4904	05	48129F	Archer	Smalley	2001	3,920
4904	05	85929E	Jahns	Ottosen	1995	44,960
4904	06	11909F	Jones	Vidovich Forestry	1997	52,610
4904	06	15806F	Mort	Mort	1998	12,900
4904	06	41413F	Mort	Mort	2000	-0-
4904	06	93439E	Pfiefer	Montee	1995	28,940
4904	06	93441E	Sausser	Montee	1995	32,360
4904	06	93442E	Sausser	Montee	1995	23,020 1505 (pcs) 28.38 (t)
4904	06	93443E	Sausser	Montee	1995	37,340
4904	07	12321F	Godde	Webeco	1997	1,089,390
4904	07	12639F	Ratliff	Mundt	1997	3,850

Idaho Forest Practice Notifications in the Mica Creek and Mica Bay Watersheds – Kootenai County
Compiled by the Idaho Department of Lands for a public record request by CH2MHILL – Steve Miller
September 27, 2002 (Sorted by heading that is in **bold print**)

Township (N) & Range (W)	Sec.	**Notification #**	Landowner	Operator	Year	Volume Reported (BdFt)
4904	07	15728F	Ratliff	Mundt	1998	22,390 15.87 (t)
4904	07	20418F	Godde Trust	Webeco	1999	1,269,000 260.89 (t)
4904	07	20660F	Ratliff	Mundt	1999	-0-
4904	07	41006F	Godde	Webeco	2000	66,780
4904	07	73641F	Ratliff	Mundt	1992	-0-
4904	07	85939F	Ratliff	Mundt	1995	27,520
4904	08	11686F	Fitzsimmons	Mills	1997	11,360
4904	08	12275F	Toedter	Toedter	1997	49,250
4904	08	15356F	Toedter	Toedter	1998	7,792
4904	08	20735F	Weller	Weller	1999	44,130
4904	08	23404F	Weller	Weller	1999	35,990
4904	08	23432F	Geren	Geren	1999	14,810
4904	08	23454F	Toedter	Toedter	1999	67,060
4904	08	23475F	Weller	Weller	1999	57,370
4904	08	41404F	Mills	Bush	2000	27,030
4904	08	42116F	Weller	Weller	2001	2,810
4904	08	47261F	Weller	Darlas	2001	109,590
4904	08	47583F	Weller	Weller	2001	31,840
4904	08	47626F	Weller	Weller	2002	55,410
4904	08	47627F	Geren	Weller	2002	8,380
4904	08	47628F	Peterson	Weller	2002	17,170
4904	08	47672F	Weller	Weller	2002	14,160
4904	08	93881E	Toedter	J D Lumber	1996	732,210
4904	08	97123E	Botschin	Weber	1996	28,090
4904	09	25523F	McCormack Prop.	Inland Pacific	2000	-0-
4904	09	25538F	Yates	Votava	2000	7,080
4904	09	41883F	Blair	Sims	2001	1,470
4904	09	42245F	Bertschi	Jacobson	2001	3,500
4904	09	47347F	Hawn	Bush	2001	82,330

Idaho Forest Practice Notifications in the Mica Creek and Mica Bay Watersheds – Kootenai County
Compiled by the Idaho Department of Lands for a public record request by CH2MHILL – Steve Miller
September 27, 2002 (Sorted by heading that is in **bold print**)

Township (N) & Range (W)	Sec.	**Notification #**	Landowner	Operator	Year	Volume Reported (BdFt)
4904	09	47507F	Hunter	Votava	2002	172,960 42.87 (t)
4904	09	47923F	Arestad	Bush	2002	13,600
4904	10	11598F	Huetter	Akers	1996	77,010
4904	10	20507F	Wildman	Wildman	1999	2,020
4904	10	25548F	Wildman	Wildman	2000	4,660
4904	10	43603F	Wildman	Wildman	2001	4,210
4904	10	47500F	Huetter	Caswell	2002	12,690
4904	10	47501F	Magnuson	Caswell	2002	32,200
4904	15	12353F	Shadduck	Morrow	1995	2,560
4904	15	12657F	Hunter	York	1998	19,520
4904	15	48051F	Scott	Burnside	2002	-0-
4904	15	75550E	Godde	Webeco	1993	3,472,660
4904	15	93396E	Godde	Webeco	1995	1,911,160
4904	16	12191F	BLM	Shepard	1997	-0-
4904	16	15527F	Butts	Finney Bros.	1998	62,100
4904	16	20671F	Wagstaff	Jacobson	1999	1,370
4904	17	20659F	Ratliff	Mills	1999	1,770
4904	17	41036F	Ratliff	Mundt	2000	-0-
4904	17	41473F	Ratliff	Mundt	2000	3,840
4904	17	42177F	Mundt	Mundt	2001	-0-
4904	17	43199F	Idaho Dept. of Trans. (Highway 95 relocation project)	Scarsella/Webeco (Right of Way removal only)	2001	485,200 306.08 (t)
4904	17	43616F	Ratliff	Mills	2001	4,120
4904	17	47811F	Toedter	Toedter	2002	11,860
4904	17	47873F	Ratliff	Mundt	2002	4,040
4904	17	76437E	Mundt	Mundt	1993	19,440
4904	18	12703F	Godde	Webeco	1997	200,160
4904	18	15265F	Godde	Webeco	1998	258,150
4904	18	20220F	Godde	Webeco	1997	134,990
4904	18	31099F	Godde	Webeco	2000	586,826

Idaho Forest Practice Notifications in the Mica Creek and Mica Bay Watersheds – Kootenai County
Compiled by the Idaho Department of Lands for a public record request by CH2MHILL – Steve Miller
September 27, 2002 (Sorted by heading that is in **bold print**)

Township (N) & Range (W)	Sec.	**Notification #**	Landowner	Operator	Year	Volume Reported (BdFt)
4905	16	41715F	IFI	IFI	2000	173,264
4905	16	42849F	Idaho Dept. of Lands	Riley Ck.	2001	-0-
4905	21	11905F	Kroetch	Kienke	1997	1,430,800
4905	21	20751F	Godde	Webeco	1999	2,000,447 766.48 (t)
4905	23	25410F	Godde	Webeco	2000	76,550

Note: The equivalent tons (t) per board foot measure is approximately 4 – 5 tons per 1000 (M) board feet (BdFt)

Pieces would indicate post and pole harvesting

July 30, 1986

FOREST PRACTICE INSPECTION NARRATIVE

F.P.A. Notification No.: 36997C

Operator: Verton Kienke

Landowner: Mica Bay Land Company

Inspection Date: July 16, 1986

The culverts on Rock Creek and Cabin Creek have failed resulting in one-quarter to one-half of the fill material being washed downstream. These locations will have to be treated in one of the following ways:

1. Remove the culvert and fill material to open the channel preventing more sediment from being washed downstream.

2. Reinstall the existing pipe with a supplemental pipe (36" minimum) to insure adequate sizing (currently 30" pipes are at both locations - minimum CMP requirements are a 42" at Rock Ck and a 48" at Cabin Ck). The fill will have to be replaced with a more satisfactory material for road fill. A headwall will have to be provided for each culvert.

3. Replace both pipes and the fill. Install a 42" CMP at Rock Ck and a 48" CMP at Cabin Ck.

4. Construct bridges at both locations. A stream alteration permit will have to be obtained from the Idaho Department of Water Resources in any of the options.

The fill is sinking in the draw approximately one-quarter mile to the west of Rock Ck. The fill will have to be built up over the pipe.

Jim Rickerd

Jim Rickerd
Woodland Forester

JR:pk

STATE OF IDAHO
DEPARTMENT OF LANDS

FOREST PRACTICES REPORT

X	X	
Area Supervisor: X	Operator: X	Operation in Progress
For. Prod. Advisor: X		Inactive or Completed: X

Notice No. No Fork Mica Ck · 36997C — Inspection Date: 7/16/86

[X] Harvesting [ ] Road Construction [ ] Reforestation
[ ] Management of Slashings [ ] Chemicals & Fertilizers

Parent Material	Erosion Hazard
Various	Severe

Soil Type	Erosion Hazard
Kruse Silt Loam Schumacher Silt Loam Vasser Silt Loam	Severe Slopes Over 45%: No

Subdivision	Section	Township	Range
All	12	49N	5W
W2	14	49N	5W

Acres Inspected: 40 — Stream Class (If Any): I

Landowner:
Mica Bay Land Co.
Box 943
Coeur d'Alene, ID 83814
[ ] Contacted [ ] Present On Inspection

Operator:
Verton Kienke
315 2nd St.
Post Falls, ID 83854
[ ] Contacted [ ] Present On Inspection

X — Inspection NA — Not Applicable NI — Not Inspected

GENERAL RULES — 2		Satis	Unsatis
2.a.i.	Variance	NA	
a.ii.	Other Law	NI	
2.e.	Notification	X	
2.h.	Emergency Forest Practice	NA	

TIMBER HARVESTING RULES — 3		Satis	Unsatis
3.b.	Residual Stocking	X	
3.c.	Soil Protection	X	
c.i.	Skidding Erosion		
c.ii.	30% Limitation		
c.iii.	No. of skid trails & widths		
c.iii.	Tractor size appropriate		
c.iv.	Cable yarding		
3.d.	Location of Landings, Trails	X	
d.i.	Stable landings & skid trails		
d.ii.	Size of landings		
d.iii.	Landing fill; stabilization		
3.e.	Drainage Systems	X	
e.i.	Drainage, skid trails, stabil.		
e.ii.	Drainage, landings, stabil.		
3.f.	Treatment of Waste materials	X	
f.i.	Slash, waste out - Class I		
f.ii.	Slash, waste out - Class II		
f.iii.	Slash, waste out - SP Zones		
f.iv.	Oil, fuel out — SP Zones		
3.g.	Stream Protection	X	
g.i.	Skidding-stream xing - SP Zones		
g.ii.	Cable-stream xing - SP Zones		
g.iii.	Shading, stabil., filter Cl. I		
g.iv.	Shading, stabil., filter Cl. II		
3.h.i.	Scenic-wildlife-consideration	X	
h.ii.	Wildlife - aquatic consid.		
h.iii.	Wet areas consideration		
h.iv.	Wildlife escape cover - ¼ mi.		

ROAD CONSTRUCTION RULES — 4		Satis	Unsatis
4.b.	Plans & Specifications	X	
b.i.	Plan minimum in S.P. Zones		
b.ii.	Plan min. width - cuts & fills		
b.iii.	Plan vegetation between road & stream		
b.iv.	Plan waste to be stabilized		
b.v.	Plan culverts, erosion of fill		
b.vi.	Plan road drainage		
b.vii.	Plan road culverts & ditches		
b.viii.	Plan road dips, w-bars, x-drains		
b.ix.	Plan minimum stream xings		
b.x.	Plan minimum cuts & fills		
b.xi.	Plan culvert fish passage		
b.xii.	Plan min. discharge of sediment		
b.xiii.	Plan reuse or variance, old rds		
4.c.	Road Construction	X	
c.i.	Construction followed plan		
c.ii.	Excess mat. stash out-SP Zone		
c.iii.	Debris cleared from drainage ways		
c.iv.	Stabilize exposed areas		
c.v.	Compact and min. soft mat. in fills		
c.vi.	Stream crossings, other law		
c.vii.	Install drainage prior to runoff		
c.viii.	Remove berms on outsloped roads		
c.x.	Roads constrict. str. channel		
c.xi.	X-drains, culverts-min. erosion		
c.xii.	Relief culvert gradient OK		
c.xiii.	Wet weather constr. delay		
c.xiv.	Overhang, cuts & tree hazards		

ROAD MAINTENANCE RULES — 4		Satis	Unsatis
4.d.	Maint. done, minimum damage		X
d.i.	Sidecast out of streams	X	
d.ii.	Repair, stabil. sediment haz.		X
d.iii.	Active roads OK		X
d.iii(a)	Culverts, ditches OK		X
d.iii(b)	Crown, sloped, berms OK	X	
d.iii(c)	Min. subgrade drain., erosion		X
d.iii(d)	Surface ol. out of streams	NA	
d.iv.	Inactive roads OK		X
d.iv(a)	Culverts-ditches-slopes-drainage		X
d.iv(b)	Road closure	X	
d.v.	Abandoned roads OK		X
d.v.(a)	Sloped-drainage-vegetation	X	
d.v.(b)	Ditches clean	X	
d.v.(c)	Road closed	X	
d.v.(d)	Bridges - culverts removed		X

Comment or Explanation:

SEE NARRATIVE

Lange 3/25
Hawkins 5/50

Forest Practices Adviser: Jim Rickerd [signature]

Date of Report: 7/30/86

STATE OF IDAHO

DEPARTMENT OF LANDS

Mica Forest Protective District Office
3706 Industrial Ave. S., Coeur d'Alene, Idaho 83814

July 30, 1986

CERTIFIED MAIL #0387946

Verton Kienke
315 Second Street
Post Falls, ID 83854

FPA Notification No: 36997C
FPA Violation No. 05330
CEASE AND REPAIR ORDER

Dear Mr. Kienke,

As provided by Idaho Code, Title 38-1307 (2) (a), the operator, Verton Kienke of Post Falls, ID 83854, is ordered to cease all use of the main haul road in the North fork of Mica Creek (parts, Sec.7, T49N, R4W and parts, Sec.12, 13, 14, T49N, R5W, B.M.) and repair the unsatisfactory conditions deemed to be in violation by performing the following corrective actions:

1. Comply with corrective actions specified in the Forest Practices Report dated July 30, 1986.
2. Complete the corrective actions by August 25, 1986.

Contact this office (765-1311) within five (5) days of receipt of this notice to convey your intention to correct the unsatisfactory condition.

Sincerely,

Jim Rickerd
Woodland Forester

JR:pk
encl.

KEEP IDAHO GREEN

No. 0387946

RECEIPT FOR CERTIFIED MAIL

NO INSURANCE COVERAGE PROVIDED— NOT FOR INTERNATIONAL MAIL

(See Reverse)

SENT TO	Verton Klenke	
STREET AND NO.	315 Second St.	
P.O., STATE AND ZIP CODE	Post Falls, ID 83854	
POSTAGE		$
CONSULT POSTMASTER FOR FEES	CERTIFIED FEE	¢
OPTIONAL SERVICES	SPECIAL DELIVERY	¢
	RESTRICTED DELIVERY	¢
RETURN RECEIPT SERVICE	SHOW TO WHOM AND DATE DELIVERED	X ¢
	SHOW TO WHOM, DATE, AND ADDRESS OF DELIVERY	¢
	SHOW TO WHOM AND DATE DELIVERED WITH RESTRICTED DELIVERY	¢
	SHOW TO WHOM, DATE AND ADDRESS OF DELIVERY WITH RESTRICTED DELIVERY	¢
TOTAL POSTAGE AND FEES		$
POSTMARK OR DATE	8/1/86	

PS Form 3800, Apr. 1976

State of Idaho

NOTICE OF VIOLATION

Idaho State Board of Land Commissioners

Rules and Regulations

County: Kootenai	Date: July 30, 1986
[illegible]	Time: 3:30 [ ] AM [X] PM
Name: Verton Klenke	
Street Address: 315 Second St.	
City, State, Zip Code: Post Falls, ID 83854	
Has Violated Rule: 4d of Title 38, Chapter 13 I.C.A. of the Forest Practices Act.	
Violation: Culverts have failed in Rock Ck. & Cabin Ck., both Class I streams, resulting in deterioration of the roadway surface and subsequent damage to the water quality.	
Location (Place or Legal Description): Rock Ck-NENW,Sec.7,49N,4W; Cabin Ck-NENE,Sec.14,49N,6W	

You are hereby directed to:

~~1. Cease operations until the above rule has been complied with. (Line out 1 or 2 above)~~

2. Follow the instructions given in "A" below.

(Line out 1. or 2 above)

A. Correct unsatisfactory conditions as described in the Forest Practices Report dated 30 July, 1986 by August 25, 1986.

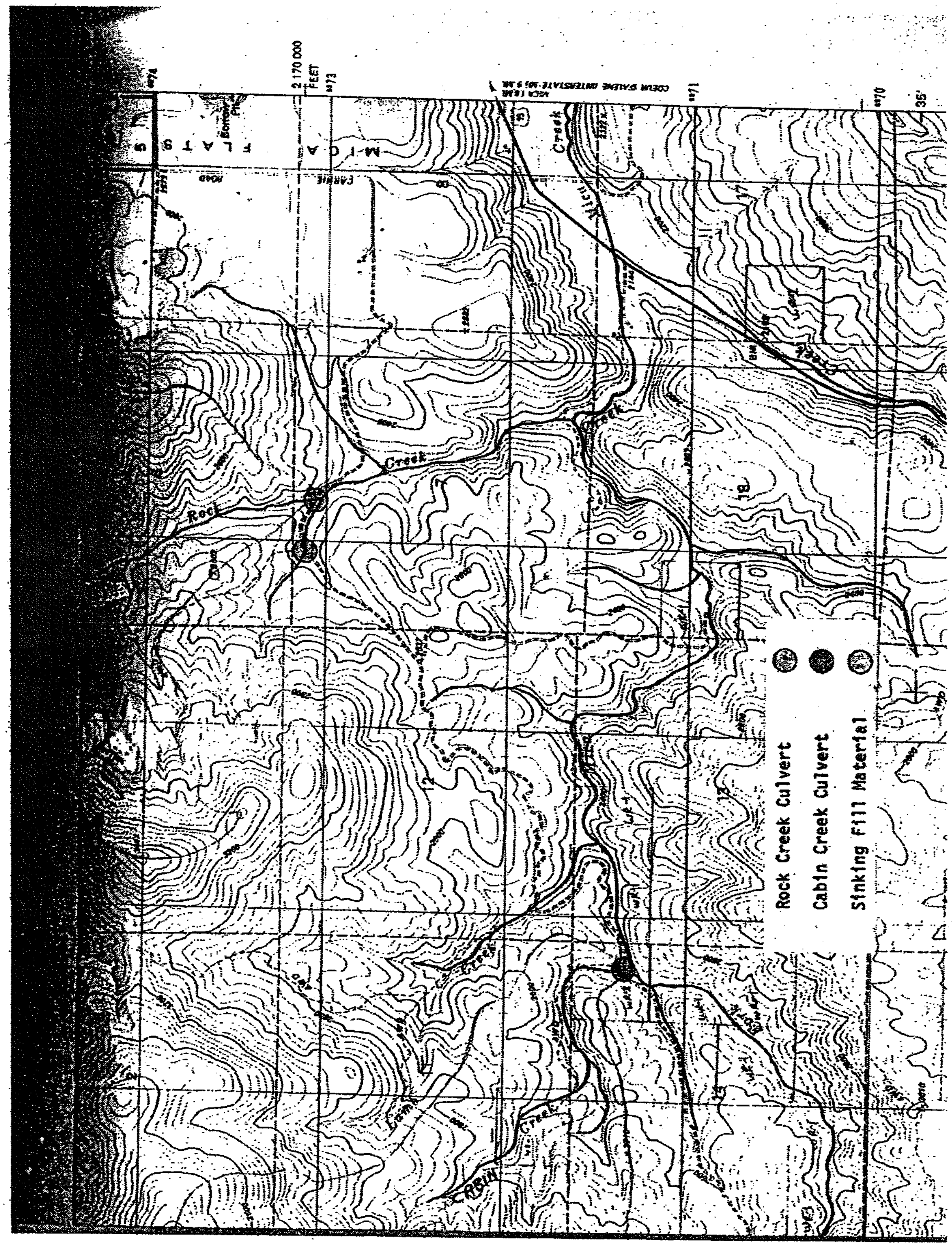
№ 05330

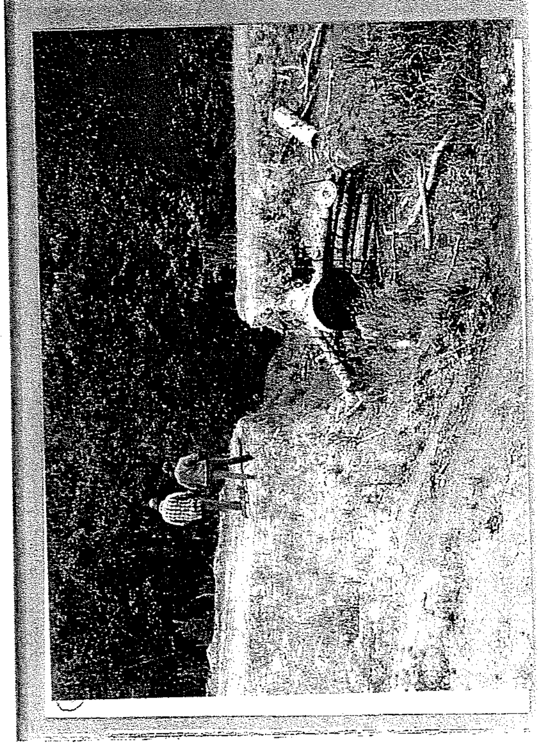
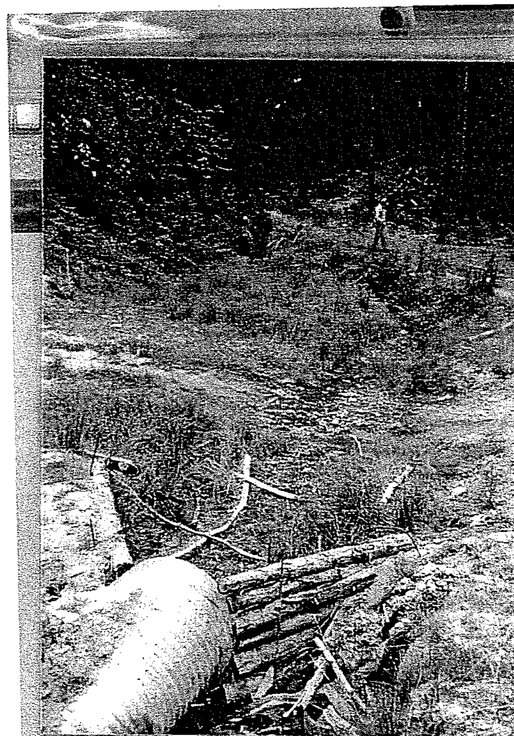
DL 864.1 (10/78)

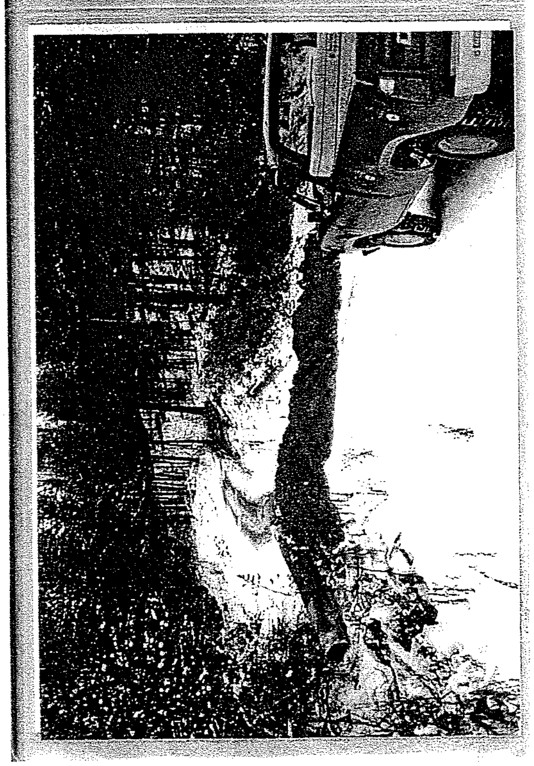
Jim Rickerd
Woodland Forester

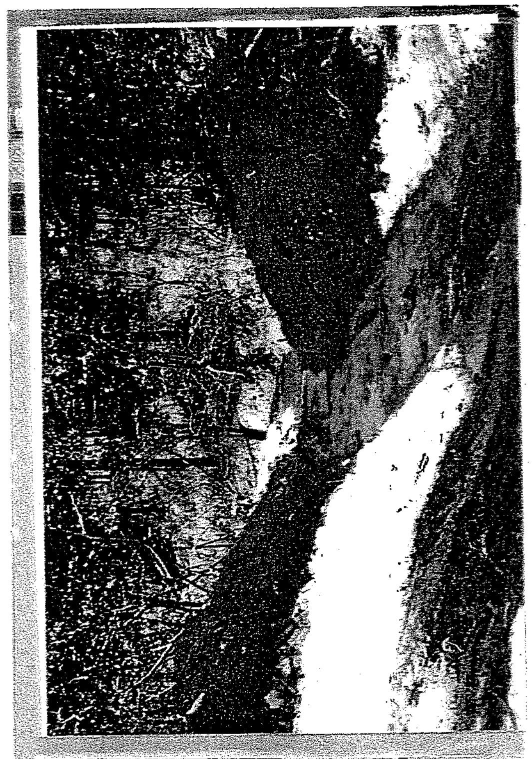
Forest Protective District: Mica

PS Form 3811, July 1983


Rock Creek Culvert
Cabin Creek Culvert
Sinking Fill Material
M I C A
F L A T S
Rock
Creek
Cabin
Creek






STATE OF IDAHO
DEPARTMENT OF LANDS

FOREST PRACTICES REPORT

North Fork
Mica Ck.

	Landowner	Pre-Operational
	X	
Area Supervisor	Operator	Operation in Progress
X	X	
For. Prac. Advisor		Inactive or Completed
X		X

Landowner: Mica Bay Land Co.
Box 943
Coeur d'Alene, ID 83814 ~~ 11-21-86
[X] Contacted [X] Present On Inspection

Operator: Verton Kienke
315 2nd Street
Post Falls, ID 83854
[X] Contacted [X] Present On Inspection

Notice No.: 36997C
Inspection Date: 8/7/86

[X] Harvesting [ ] Road Construction [ ] Reforestation
[X] Management of Slashings [ ] Chemicals & Fertilizers

Parent Material: Various
Erosion Hazard: Severe
Soil Type: Kruse Silt Loam, Schumacher Silt Loam, Vasser Silt Loam
Erosion Hazard: Severe
Slopes Over 45%: NO

Subdivision	Section	Township	Range
All	12	49N	5W
W2	14	49N	5W

Acres Inspected: 20
Stream Class (If Any): I

X — Inspected NA — Not Applicable NI — Not Inspected

GENERAL RULES — 2		Satis	Unsatis
2.a.i.	Variance	NA	
a.ii.	Other Law	NI	
2.a.	Notification	X	
2.h.	Emergency Forest Practice	NA	
TIMBER HARVESTING RULES — 3			
3.b.	Residual Stocking	X	
3.c.	Soil Protection	X	
c.i.	Skidding Erosion		
c.ii.	30% Limitation		
c.iii.	No. of skid trails & widths		
c.iii.	Tractor size appropriate		
c.iv.	Cable yarding		
3.d.	Location of Landings, Trails	X	
d.i.	Stable landings & skid trails		
d.ii.	Size of landings		
d.iii.	Landing fill, stabilization		
3.e.	Drainage Systems	X	
e.i.	Drainage, skid trails, stabilization		
e.ii.	Drainage, landings, stabilization		
3.f.	Treatment of Waste materials	X	
f.i.	Slash, waste out - Class I Stream		
f.ii.	Slash, waste out - Class II Stream		
f.iii.	Slash, waste out - SP Zones		
f.iv.	Oil, fuel out — SP Zones		
3.g.	Stream Protection	X	
g.i.	Skidding-stream xing - SP Zones		
g.ii.	Cable-stream xing - SP Zones		
g.iii.	Shading, stabil., filter Class I		
g.iv.	Shading, stabil., filter Class II		
3.h.i.	Scenic-wildlife consideration	X	
h.ii.	Wildlife - aquatic consideration		
h.iii.	Wet areas consideration		
h.iv.	Wildlife escape cover - ¼ mile		

ROAD CONSTRUCTION RULES — 4		Satis	Unsatis
4.b.	Plans & Specifications	X	
b.i.	Plan minimum in S.P. Zones		
b.ii.	Plan min. width - cuts & fills		
b.iii.	Plan vegetation between road & stream		
b.iv.	Plan waste to be stabilized		
b.v.	Plan culverts, erosion of fill		
b.vi.	Plan road drainage		
b.vii.	Plan road culverts & ditches		
b.viii.	Plan road dips, w-bars, x-drains		
b.ix.	Plan minimum stream xings		
b.x.	Plan minimum cuts & fills		
b.xi.	Plan culvert fish passage		
b.xii.	Plan min. discharge of sediment		
b.xiii.	Plan reuse or variance, old roads		
4.c.	Road Construction	X	
c.i.	Construction followed plan		
c.ii.	Excess material, slash out of SP Zone		
c.iii.	Debris cleared from drainage ways		
c.iv.	Stabilize exposed areas		
c.v.	Compact and min. soft material in fills		
c.vi.	Stream crossings, other law		
c.vii.	Install drainage prior to runoff		
c.viii.	Remove berms on outsloped roads		
c.x.	Roads constrict, stream channel		
c.xi.	X-drains, culverts-minimum, erosion		
c.xii.	Relief culvert gradient OK		
c.xiii.	Wet weather constr. delay		
c.xiv.	Overhang, cuts & tree hazards		

ROAD MAINTENANCE RULES — 4		Satis	Unsatis
4.d.	Maint. done, minimum damage		X
d.i.	Sidecast out of streams	X	
d.ii.	Repair, stabil. sediment haz.		X
d.iii.	Active roads OK		X
d.iii(a)	Culverts, ditches OK		X
d.iii(b)	Crown, sloped, berms OK	X	
d.iii(c)	Minimize subgrade drainage, erosion		X
d.iii(d)	Surface oil, out of streams	NA	
d.iv.	Inactive roads OK		X
d.iv(a)	Culverts-ditches-slopes-drainage		X
d.iv(b)	Road closure	X	
d.v.	Abandoned roads OK		X
d.v.(a)	Sloped-drainage-vegetation	X	
d.v.(b)	Ditches clean	X	
d.v.(c)	Road closed	X	
d.v.(d)	Bridges - culverts removed		X

Comment or Explanation:
I met with the landowner and operator to discuss corrective actions needed. It was agreed that repairs would be made.

Forest Practices Advisor: Jim Rickard
Date of Report: 11/20/86
Harvesting, Road Construction, Road Maintenance

DL-1020-4 (4-86)

insp rpt 36997c 08-07.doc

STATE OF IDAHO
DEPARTMENT OF LANDS

N. Fork
Mica Ck.

FOREST PRACTICES REPORT

Landowner X	Operator X	For. Prac. Advisor X
Pre-Operational	Operation in Progress	Inactive or Completed X

Report No. 36997C — Inspection Date 11/6/86

[X] Harvesting [ ] Road Construction [ ] Reforestation
[X] Management of Slashings [ ] Chemicals & Fertilizers

Parent Material: Various — Erosion Hazard: Severe — Mass Hazard: Severe — Slopes Over 45%:

Soil Type: Kruse Silt Loam, Schumacher Silt Loam, Vasser Silt Loam

Subdivision	Section	Township	Range
All	12	49N	5W
W2	14	49N	5W

Acres Inspected: 20 — Stream Class (If Any): I

Landowner: Mica Bay Land Co., Box 943, Coeur d'Alene, ID 83814 Jm 11-21-86
[ ] Contacted [ ] Present On Inspection

Operator: Verton Klenke, 315 2nd Street, Post Falls, ID 83854
[X] Contacted [ ] Present On Inspection

X — Inspection NA — Not Applicable NI — Not Inspected

GENERAL RULES — 2		Satis	Unsatis
2.a.i.	Variance	NA	
a.ii.	Other Law	NI	
2.e.	Notification	X	
2.h.	Emergency Forest Practice	NA	

TIMBER HARVESTING RULES — 3		Satis	Unsatis
3.b.	Residual Stocking	X	
3.c.	Soil Protection	X	
c.i.	Skidding Erosion		
c.ii.	30% Limitation		
c.iii.	No. of skid trails & widths		
c.iii.	Tractor size appropriate		
c.iv.	Cable yarding		
3.d.	Location of Landings, Trails	X	
d.i.	Size of landings & skid trails		
d.ii.	Size of landings		
d.iii.	Landing fill, stabilization		
3.e.	Drainage Systems	X	
e.i.	Drainage, skid trails, stabilization		
e.ii.	Drainage, landings, stabilization		
3.f.	Treatment of Waste materials	X	
f.i.	Slash, waste out - Class I Stream		
f.ii.	Slash, waste out - Class II Stream		
f.iii.	Slash, waste out - SP Zones		
f.iv.	Oil, fuel out — SP Zones		
3.g.	Stream Protection	X	
g.i.	Skidding-stream xing - SP Zones		
g.ii.	Cable-stream xing - SP Zones		
g.iii.	Shading, stabil., filter Class I		
g.iv.	Shading, stabil., filter Class II		
3.h.i.	Scenic-wildlife consideration	X	
h.ii.	Wildlife - aquatic consideration		
h.iii.	Wet areas consideration		
h.iv.	Wildlife escape cover - ¼ mile		

ROAD CONSTRUCTION RULES — 4		Satis	Unsatis
4.b.	Plans & Specifications	X	
b.i.	Plan minimum in S.P. Zones		
b.ii.	Plan min. width - cuts & fills		
b.iii.	Plan vegetation between road & stream		
b.iv.	Plan waste to be stabilized		
b.v.	Plan culverts, erosion of fill		
b.vi.	Plan road drainage		
b.vii.	Plan road culverts & ditches		
b.viii.	Plan road dips, w-bars, x-drains		
b.ix.	Plan minimum stream xings		
b.x.	Plan minimum cuts & fills		
b.xi.	Plan culvert fish passage		
b.xii.	Plan min. discharge of sediment		
b.xiii.	Plan reuse or variance, old roads		
4.c.	Road Construction	X	
c.i.	Construction followed plan		
c.ii.	Excess material, slash out of SP Zone		
c.iii.	Debris cleared from drainage ways		
c.iv.	Stabilize exposed areas		
c.v.	Compact and min. soft material in fills		
c.vi.	Stream crossings, other law		
c.vii.	Install drainage prior to runoff		
c.viii.	Remove berms on outsloped roads		
c.x.	Roads constrict, stream channel		
c.xi.	X-drains, culverts-minimum, erosion		
c.xii.	Relief culvert gradient OK		
c.xiii.	Wet weather constr. delay		
c.xiv.	Overhang, cuts & tree hazards		

ROAD MAINTENANCE RULES — 4		Satis	Unsatis
4.d.	Maint. done, minimum damage		X
d.i.	Sidecast out of streams	X	
d.ii.	Repair, stabil. sediment haz.		X
d.iii.	Active roads OK		X
d.iii(a)	Culverts, ditches OK		X
d.iii(b)	Crown, sloped, berms OK	X	
d.iii(c)	Minimize subgrade drainage, erosion		X
d.iii(d)	Surface oil, out of streams	X	
d.iv.	Inactive roads OK		X
d.iv(a)	Culverts-ditches-slopes-drainage		X
d.iv(b)	Road closure	X	
d.v.	Abandoned roads OK		X
d.v.(a)	Sloped-drainage-vegetation		X
d.v.(b)	Ditches clean	X	
d.v.(c)	Road closed	X	
d.v.(d)	Bridges - culverts removed		X

Comment or Explanation:
The corrective actions have not been started yet. A cost estimate has been prepared and the operator contacted on the phone. He is still planning to do the work.

Forest Practices Advisor: Jim Bickel [signature] — Date of Report: 11/20/86

Harvesting, Road Construction, Road Maintenance

DL-1020-A

insp rpt 36997c 11-06.doc

STATE OF IDAHO

DEPARTMENT OF LANDS
Mica Forest Protective District Office
3706 Industrial Ave. S. Coeur d'Alene, Idaho 83814

CERTIFIED MAIL

ESTIMATE OF REPAIRS

FPA Violation No.: 05330 & 05332

County Kootenai

Mr. Verton Kienke
315 Second Street
Post Falls, ID 83854

Notification No. 36997C & 36996C

Date November 7, 1986

RE: IDAHO FOREST PRACTICES ACT VIOLATIONS

Dear Verton,

On August 2 and August 6, 1986, you received Notice of Violation as the operator of record on Section 12; W2, Section 14;, NW4E2S2, Section 22; NW4, S4, Section 23; and SW4, Section 24, Township 49 North, Range 5 West, Boise Meridian. The rules violated were 3c, 3d, 3g, and 4d of Title 38, Chapter 13 I.C.A. of the Idaho Forest Practices Act.

As specified in this notice, you were to complete the work by August 25 and 30, 1986. You were also called in October to see if the work was completed. On November 6, 1986 an inspection by Jim Rickerd, Forest Practices Advisor, Idaho Department of Lands, found no repair work completed or in progress.

As required by Section 38-1307(2)(e)(1) of the Idaho Forest Practices Act, the Department of Lands has therefore made an estimate of the cost to repair the unsatisfactory conditions and the cost of reasonable administrative and legal fees necessary to obtain any required judgements.

KEEP IDAHO GREEN

Mr. Verton Klenke
page 2

Dozer transportation 80 Miles @ 1.53/mi.		76.50
Personnel & fuel transportation Service truck 80 Miles @ .20/mi.		16.00
Dozer	8 Hours @ 14.87/hr.	118.96
Operator	12 Hours @ 11.78/hr.	141.36
Helper	12 Hours @ 8.85/hr.	106.20
Grass seed 5# @ 1.35/#.		6.75
*Legal fees and counsel	20 Hours @ $65/hr.	1,300.00
	Estimated Subtotal:	$1,765.77
	**20% Administration:	353.15
		$2,118.92

*Recommended rate by Larry Jones
**Land Board Mandate

If the corrective actions aren't completed by November 15, 1986, the corrections will be made by the Department of Lands. Then as directed by Section 38-1307(2)(e)2, the Department will have a lien filed against any recorded real property in your name as provided in subsection (2)(e)3 of this section, to pay the above costs so that repairs may be made. Foreclosure of the lien is at the discretion of the Department.

A copy of the Idaho Forest Practices Act may be obtained from any Department of Lands office by request.

Sincerely,

Jim Rickard
Woodland Forester

cc: Landowner
Area Supervisor
Administrator - Division of Forest Resources

No. 0387948

RECEIPT FOR CERTIFIED MAIL

NO INSURANCE COVERAGE PROVIDED—
NOT FOR INTERNATIONAL MAIL
(See Reverse)

SENT TO			Verton Kienke
STREET AND NO.			315 Second St.
P.O., STATE AND ZIP CODE			Post Falls, Id 83854
POSTAGE			$ 22
CONSULT POSTMASTER FOR FEES	CERTIFIED FEE		75 ¢
	OPTIONAL SERVICES	SPECIAL DELIVERY	¢
		RESTRICTED DELIVERY	¢
	RETURN RECEIPT SERVICE	SHOW TO WHOM AND DATE DELIVERED	70 ¢
		SHOW TO WHOM, DATE, AND ADDRESS OF DELIVERY	¢
		SHOW TO WHOM AND DATE DELIVERED WITH RESTRICTED DELIVERY	¢
		SHOW TO WHOM, DATE AND ADDRESS OF DELIVERY WITH RESTRICTED DELIVERY	¢
TOTAL POSTAGE AND FEES			$ 1.67
POSTMARK OR DATE			NOV 10 1986

PS Form 3800, Feb. 1976

- SENDER: Complete items 1, 2, 3, and 4.
  Add your address in the "RETURN TO" space on reverse.

(CONSULT POSTMASTER FOR FEES)

1. The following service is requested (check one).
   - [X] Show to whom and date delivered
   - [ ] Show to whom, date, and address of delivery
2. [ ] RESTRICTED DELIVERY

TOTAL $

3. ARTICLE ADDRESSED TO:
   Verson Kienke
   315 Second St.
   Post Falls, ID 83854
4. TYPE OF SERVICE:
   - [ ] REGISTERED
   - [X] CERTIFIED
   - [ ] EXPRESS MAIL
   - [ ] INSURED
   - [ ] COD

   ARTICLE NUMBER: 0387948

   (Always obtain signature of addressee or agent)

I have received the article described above.
SIGNATURE [X] Addressee [ ] Authorized agent

5. DATE OF DELIVERY: 11-12-86

POSTMARK: NOV 12 1986

6. ADDRESSEE'S ADDRESS (Only if requested)
7. UNABLE TO DELIVER BECAUSE:

Est of Repair cert mail.doc

STATE OF IDAHO
DEPARTMENT OF LANDS N. Fork Mica Ck

FOREST PRACTICES REPORT

Bureau Chief	Landowner	Pre-Operational
X	X	
Supervisor	**Operator**	**Operation in Progress**
X	X	
Prac. Advisor		**Inactive or Completed**
X		X

Notice No.	36997C
Inspection Date	11/13/86
☒ Harvesting ☐ Road Construction ☐ Reforestation	☒ Management of Slashings ☐ Chemicals & Fertilizers
Parent Material	Various
Erosion Hazard	Severe
Erosion Hazard	Severe
Soil Type	Kruse Silt Loam Schumacher Silt Loam Vasser Silt Laom
Slopes Over 45%	NO

Subdivision	Section	Township	Range
All	12	49N	5W
W2	14	49N	5W

Acres Inspected: 20 Stream Class (if Any): I

Owner: Mica Bay Land Co
Box 943
Coeur d'Alene, ID 83814 JM 11-21-86

☐ Contacted ☐ Present On Inspection

Operator: Verton Kienke
315 2nd Street
Post Falls, ID 83854

☐ Contacted ☐ Present On Inspection

— Inspection NA — Not Applicable NI — Not Inspected

GENERAL RULES — 2		Satis	Unsatis
a.i.	Variance	NA	
a.ii.	Other Law	NI	
1.e.	Notification	X	
1.h.	Emergency Forest Practice	NA	
TIMBER HARVESTING RULES — 3			
1.b.	Residual Stocking	X	
1.c.	Soil Protection	X	
c.i.	Skidding Erosion		
c.ii.	30% Limitation		
c.iii.	No. of skid trails & widths		
c.iii.	Tractor size appropriate		
c.iv.	Cable yarding		
1.d.	Location of Landings, Trails	X	
d.i.	Stable landings & skid trails		
d.ii.	Size of landings		
d.iii.	Landing fill, stabilization		
1.e.	Drainage Systems	X	
e.i.	Drainage, skid trails, stabilization		
e.ii.	Drainage, landings, stabilization		
1.f.	Treatment of Waste materials	X	
f.i.	Slash, waste out - Class I Stream		
f.ii.	Slash, waste out - Class II Stream		
f.iii.	Slash, waste out - SP Zones		
f.iv.	Oil, fuel out — SP Zones		
1.g.	Stream Protection	X	
g.i.	Skidding-stream xing - SP Zones		
g.ii.	Cable-stream xing - SP Zones		
g.iii.	Shading, stabil., filter Class I		
g.iv.	Shading, stabil., filter Class II		
1.h.i.	Scenic-wildlife consideration	X	
h.ii.	Wildlife - aquatic consideration		
h.iii.	Wet areas consideration		
h.iv.	Wildlife escape cover - ¼ mile		

ROAD CONSTRUCTION RULES — 4		Satis	Unsatis
4.b.	Plans & Specifications	X	
b.i.	Plan minimum in S.P. Zones		
b.ii.	Plan min. width - cuts & fills		
b.iii.	Plan vegetation between road & stream		
b.iv.	Plan waste to be stabilized		
b.v.	Plan culverts, erosion of fill		
b.vi.	Plan road drainage		
b.vii.	Plan road culverts & ditches		
b.viii.	Plan road dips, w-bars, x-drains		
b.ix.	Plan minimum stream xings		
b.x.	Plan minimum cuts & fills		
b.xi.	Plan culvert fish passage		
b.xii.	Plan min. discharge of sediment		
b.xiii.	Plan reuse or variance, old roads		
4.c.	Road Construction	X	
c.i.	Construction followed plan		
c.ii.	Excess material, slash out of SP Zone		
c.iii.	Debris cleared from drainage ways		
c.iv.	Stabilize exposed areas		
c.v.	Compact and min. soft material in fills		
c.vi.	Stream crossings, other law		
c.vii.	Install drainage prior to runoff		
c.viii.	Remove berms on outsloped roads		
c.x.	Roads constrict, stream channel		
c.xi.	X-drains, culverts-minimum, erosion		
c.xii.	Relief culvert gradient OK		
c.xiii.	Wet weather constr. delay		
c.xiv.	Overhang, cuts & tree hazards		

ROAD MAINTENANCE RULES — 4		Satis	Unsatis
4.d.	Maint. done, minimum damage	X	
d.i.	Sidecast out of streams		
d.ii.	Repair, stabil. sediment haz.		
d.iii.	Active roads OK		
d.iii(a)	Culverts, ditches OK		
d.iii(b)	Crown, sloped, berms OK		
d.iii(c)	Minimize subgrade drainage, erosion		
d.iii(d)	Surface oil, out of streams		
d.iv.	Inactive roads OK		
d.iv(a)	Culverts-ditches-slopes-drainage		
d.iv(b)	Road closure		
d.v.	Abandoned roads OK		
d.v.(a)	Sloped-drainage-vegetation		
d.v.(b)	Ditches clean		
d.v.(c)	Road closed		
d.v.(d)	Bridges - culverts removed		

Comments or Explanation:
The operator has completed the necessary corrective work.

Forest Practices Advisor: Jim Bickel [signature] Date of Report: 11/20/86

insp rpt 36997c 11-13.doc

August 1, 1986

FOREST PRACTICE INSPECTION NARRATIVE

F.P.A. Notification No.: 36996C

Operator: Verton Kienke

Landowner: Mica BAy Land Co.

Inspection Date: July 16, 1986

A culvert has washed out in a tributary to South Fork of Mica Creek (see map for approximate location in SWNE, Sec.23, T49N, R5W). This unsatisfactory condition will have to be repaired by one of the following:

1. Reinstall a CMP, 18" minimum, with a headwall protecting the fill. Obtain a stream alteration permit prior to doing this work from the Idaho Department of Water Resources.

2. Remove the culvert and fill material to open the channel preventing more sediment from being washed downstream.

The temporary crossing mentioned in the inspection report dated October 1, 1985 still has not been removed as required.

This repair and removal will have to be completed by August 30, 1986.

Jim Rickerd
Woodland Forester

JR:pk

S.Fork ~~Mica Creek~~

[illegible] X	[illegible] X	
Area Supervisor X	Operator X	Operation in Progress
For. Prac. Advisor X		Inactive or Completed X

STATE OF IDAHO
DEPARTMENT OF LANDS

FOREST PRACTICES REPORT

36996C	7/16/86

[X] Harvesting ☐ Road Construction ☐ Reforestation
☐ Management of Slashings ☐ Chemicals & Fertilizers

Parent Material	Erosion Hazard
Various	Severe

Soil Type	Erosion Hazard
Kruse-Ulricher Association Lenz complex Vassar Silt Loam	Severe Slopes Over 45% No

Subdivision	Section	Township	Range
NW4E2S2 NW4,S2 SW4	22 23 24	49N	5W

Acres Inspected	Stream Class
40	I & II

Landowner
Mica Bay Land Co.
Box 943
Coeur d'Alene,ID 83814
☐ Contacted ☐ Present On Inspection

Operator
Verton Kienke
315 2nd St.
Post Falls,ID 83854
☐ Contacted ☐ Present On Inspection

X — Inspection NA — Not Applicable NI — Not Inspected

GENERAL RULES — 2		Satis	Unsatis
2.a.i.	Variance	NA	
a.ii.	Other Law	NI	
2.e.	Notification	X	
2.h.	Emergency Forest Practice	NA	

TIMBER HARVESTING RULES — 3		Satis	Unsatis
3.b.	Residual Stocking	X	
3.c.	Soil Protection		X
c.i.	Skidding Erosion	X	
c.ii.	30% Limitation		X
c.iii.	No. of skid trails & widths		X
c.iii.	Tractor size appropriate	X	
c.iv.	Cable yarding	NA	
3.d.	Location of Landings, Trails		X
d.i.	Stable landings & skid trails		X
d.ii.	Size of landings	X	
d.iii.	Landing fill, stabilization	X	
3.e.	Drainage Systems	X	
e.i.	Drainage, skid trails, stabil.		
e.ii.	Drainage, landings, stabil.		
3.f.	Treatment of Waste materials	X	
f.i.	Slash, waste out - Class I		
f.ii.	Slash, waste out - Class II		
f.iii.	Slash, waste out - SP Zones		
f.iv.	Oil, fuel out — SP Zones		
3.g.	Stream Protection		X
g.i.	Skidding-stream xing - SP Zones		X
g.ii.	Cable-stream xing - SP Zones	NA	
g.iii.	Shading, stabil., filter Cl. I	X	
g.iv.	Shading, stabil., filter Cl. II	X	
3.h.i.	Scenic-wildlife-consideration	X	
h.ii.	Wildlife - aquatic consid.		
h.iii.	Wet areas consideration		
h.iv.	Wildlife escape cover - ¼ mi.		

ROAD CONSTRUCTION RULES — 4		Satis	Unsatis
4.b.	Plans & Specifications	X	
b.i.	Plan minimum in S.P. Zones		
b.ii.	Plan min. width - cuts & fills		
b.iii.	Plan vegetation between road & stream		
b.iv.	Plan waste to be stabilized		
b.v.	Plan culverts, erosion of fill		
b.vi.	Plan road drainage		
b.vii.	Plan road culverts & ditches		
b.viii.	Plan road dips, w-bars, x-drains		
b.ix.	Plan minimum stream xings		
b.x.	Plan minimum cuts & fills		
b.xi.	Plan culvert fish passage		
b.xii.	Plan min. discharge of sediment		
b.xiii.	Plan reuse or variance, old rds		
4.c.	Road Construction	X	
c.i.	Construction followed plan		
c.ii.	Excess mat. slash out-SP Zone		
c.iii.	Debris cleared from drainage ways		
c.iv.	Stabilize exposed areas		
c.v.	Compact and min. soft mat. in fills		
c.vi.	Stream crossings, other law		
c.vii.	Install drainage prior to runoff		
c.viii.	Remove berms on outsloped roads		
c.x.	Roads constrict. str. channel		
c.xi.	X-drains, culverts-min. erosion		
c.xii.	Relief culvert gradient OK		
c.xiii.	Wet weather constr. delay		
c.xiv.	Overhang, cuts & tree hazards		

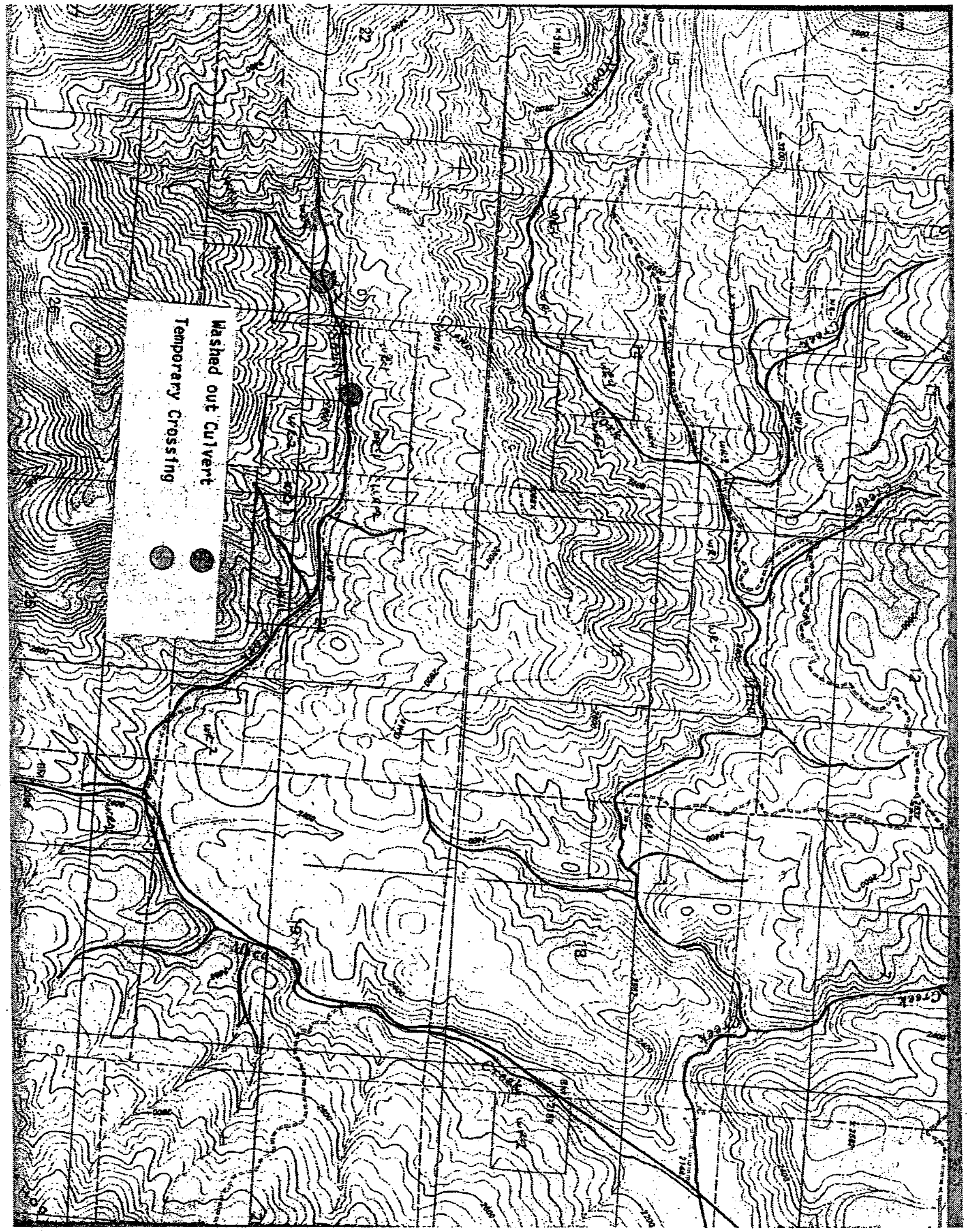
ROAD MAINTENANCE RULES — 4		Satis	Unsatis
4.d.	Maint. done, minimum damage		X
d.i.	Sidecast out of streams	X	
d.ii.	Repair, stabil. sediment haz.		X
d.iii.	Active roads OK		X
d.iii(a)	Culverts, ditches OK		X
d.iii(b)	Crown, sloped, berms OK	X	
d.iii(c)	Min. subgrade drain., erosion		
d.iii(d)	Surface oil, out of streams	X	
d.iv.	Inactive roads OK		X
d.iv(a)	Culverts-ditches-slopes-drainage		X
d.iv(b)	Road closure	X	
d.v.	Abandoned roads OK		X
d.v(a)	Sloped-drainage-vegetation		X
d.v(b)	Ditches clean	X	
d.v(c)	Road closed	X	
d.v(d)	Bridges - culverts removed		X

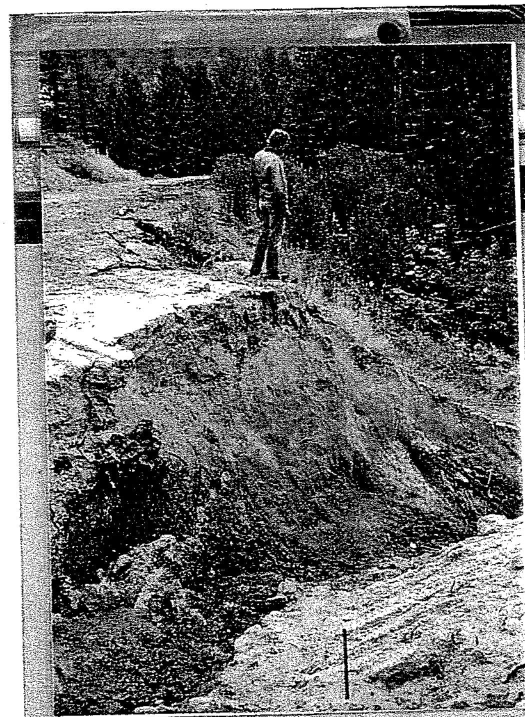
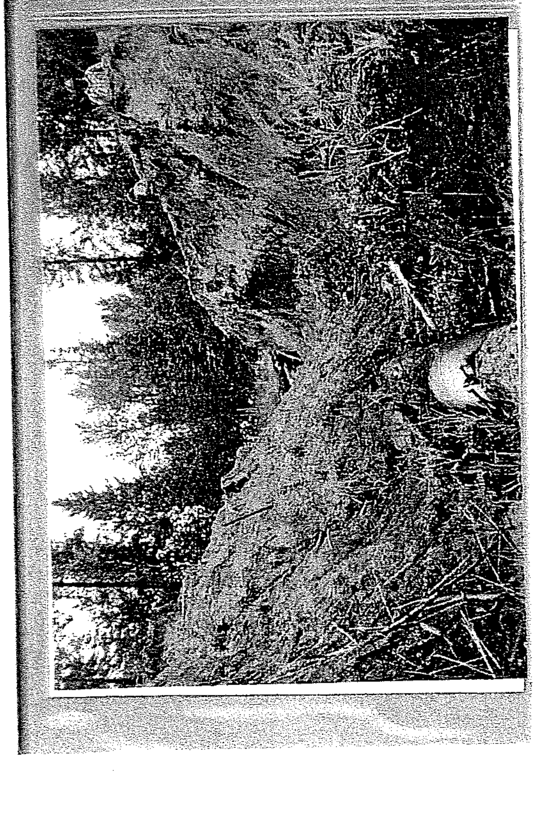
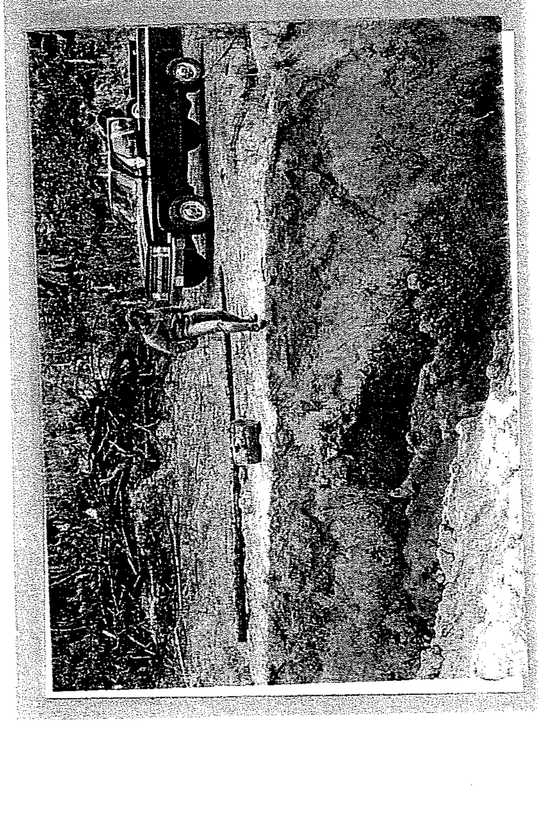
Comments or Explanation

SEE NARRATIVE

LANGE 3/23
[illegible] 5/50

Forest Practices Advisor:
Jim Rickel


Washed out Culvert
Temporary Crossing
Creek
Creek

STATE OF IDAHO

DEPARTMENT OF LANDS

Mica Forest Protective District Office
3706 Industrial Ave. S., Coeur d'Alene, Idaho 83814

August 1, 1986

CERTIFIED MAIL #0387947

Verton Kienke
415 Second Street
Post Falls, ID 83854

FPA Notification No: 36996C
FPA Violation No: 05332

CEASE AND REPAIR ORDER

Dear Mr. Kienke,

As provided by Idaho Code, Title 38-1307 (2) (a), the operater, Verton Kienke of Post Falls, ID 83854, is ordered to repair the unsatisfactory conditions in the SWNE and NESW, Section 23, T49N, R5W, B.M. deemed to be in violation by performing the following corrective actions:

1. Repair the washed out culvert and remove the temporary crossing as specified in the Forest Practices Report dated August 1, 1986.

2. Complete the corrective actions by August 30, 1986.

Contact this office (765-1311) within five (5) days of the receipt of this notice to convey your intentions to correct the unsatisfactory conditions.

Sincerely,

Jim Rickerd

Jim Rickerd
Woodland Forester

JR:pk
encl.

KEEP IDAHO GREEN

No. 0387947

RECEIPT FOR CERTIFIED MAIL

NO INSURANCE COVERAGE PROVIDED— NOT FOR INTERNATIONAL MAIL

(See Reverse)

SENT TO Verton Kienke		
STREET AND NO. 315 Second St.		
P.O., STATE AND ZIP CODE Post Falls, ID 83854		
POSTAGE		$
CONSULT POSTMASTER FOR FEES	CERTIFIED FEE	¢
OPTIONAL SERVICES	SPECIAL DELIVERY	¢
	RESTRICTED DELIVERY	¢
RETURN RECEIPT SERVICE	SHOW TO WHOM AND DATE DELIVERED	X ¢
	SHOW TO WHOM, DATE, AND ADDRESS OF DELIVERY	¢
	SHOW TO WHOM AND DATE DELIVERED WITH RESTRICTED DELIVERY	¢
	SHOW TO WHOM, DATE AND ADDRESS OF DELIVERY WITH RESTRICTED DELIVERY	¢
TOTAL POSTAGE AND FEES		$
POSTMARK OR DATE		8/3/86

PS Form 3800, Apr. 1976

State of Idaho

NOTICE OF VIOLATION

Idaho State Board of Land Commissioners
Rules and Regulations

County: Kootenai	Date: August 1, 1986
[redacted]	Time: 10:00 ☒ AM ☐ PM

NAME: Verton Kienke

Street Address: 315 Second St.

City, State, Zip Code: Post Falls, ID 83854

Has Violated Rule: 3c,3d,3g,4d of Title 38,Chapt.13 ICA of theForest Practice

Violation: A culvert has failed in a tributary (ClassII) to the South Fork of Mica Creek (Class I). A temporary crossing structure has not been removed in the headwaters of the South Fork of Mica Creek.

Location (Place or Legal Description): Culvert-SWNE;Temp.crossing-NESW; Sec.23,T49N,R5W

You are hereby directed to:

1. Cease operation until the above rule has been complied with per "A" below.
2. Follow the instructions given in "A" below.

(Line out 1, or 2 above)

A.

Correct unsatisfactory codditions as described in the Forest Practices Report dated August 1, 1986 by August 30, 1986

Jim Rickerd
Woodland Forester

Forest Protective District: MICA

Nº 05332

DL 864.1 (10/78)

SENDER: Complete items 1, 2, 3, and 4. Add your address in the "RETURN TO" space on reverse.

(CONSULT POSTMASTER FOR FEES)

1. The following service is requested (check one).
   - ☒ Show to whom and date delivered
   - ☐ Show to whom, date, and address of delivery
2. ☐ RESTRICTED DELIVERY

TOTAL $

3. ARTICLE ADDRESSED TO: Verton Kienke, So. Fk. Mica Ck., 315 2nd St., Post Falls, ID 83854

4. TYPE OF SERVICE: ☐ REGISTERED ☐ INSURED ☒ CERTIFIED ☐ COD ☐ EXPRESS MAIL

ARTICLE NUMBER: 0387947

(Always obtain signature of addressee or agent)

I have received the article described above.

SIGNATURE ☐ Addressee ☐ Authorized agent

DATE OF DELIVERY

6. ADDRESSEE'S ADDRESS (Only if requested)

7. UNABLE TO DELIVER BECAUSE:

PS Form 3811, July 1982

RETURN RECEIPT

NOV 5332 08-01.doc

STATE OF IDAHO
DEPARTMENT OF LANDS

FOREST PRACTICES REPORT

South Fork
Mica Creek

Notification No.: 36996C
Inspection Date: August 7, 1986

[X] Harvesting [ ] Road Construction [ ] Reforestation
[X] Management of Slashings [ ] Chemicals & Fertilizers

Parent Material: various
Erosion Hazard: Severe
Soil Type: Kruse-Ulricher Association, Lenz Complex, Vassar Silt Loam
Erosion Hazard: Severe
Slopes Over 45%: NO
Subdivision: NW4E2S2, NW4,S2, SW4
Section: 22, 23, 24
Township: 49N
Range: 5W
Acres Inspected: 20
Stream Class (If Any): I & II

Pre-Operational: X
Operation in Progress: X
Inactive or Completed: X

Owner: Mica Bay Land Co.
Box 943
Coeur d'Alene, ID 83814
[X] Contacted [X] Present On Inspection

Operator: Verton Kienke
315 2nd Street
Post Falls, ID 83854
[X] Contacted [X] Present On Inspection

mill 11-19-86

X — Inspected; NA — Not Applicable; NI — Not Inspected

GENERAL RULES — 2		Satis	Unsatis
2.a.i.	Variance	NA	
a.ii.	Other Law	NI	
2.e.	Notification	X	
2.h.	Emergency Forest Practice	NA	
TIMBER HARVESTING RULES — 3			
3.b.	Residual Stocking	X	
3.c.	Soil Protection	X	
c.i.	Skidding Erosion		
c.ii.	30% Limitation		
c.iii.	No. of skid trails & widths		
c.iii.	Tractor size appropriate		
c.iv.	Cable yarding		
3.d.	Location of Landings, Trails	X	
d.i.	Stable landings & skid trails		
d.ii.	Size of landings		
d.iii.	Landing fill stabilization		
3.e.	Drainage Systems	X	
e.i.	Drainage, skid trails, stabilization		
e.ii.	Drainage, landings, stabilization		
3.f.	Treatment of Waste materials	X	
f.i.	Slash, waste out - Class I Stream		
f.ii.	Slash, waste out - Class II Stream		
f.iii.	Slash, waste out - SP Zones		
f.iv.	Oil, fuel out — SP Zones		
3.g.	Stream Protection	X	
g.i.	Skidding-stream xing - SP Zones		
g.ii.	Cable-stream xing - SP Zones		
g.iii.	Shading, stabil., filter Class I		
g.iv.	Shading, stabil., filter Class II		
3.h.i.	Scenic-wildlife-consideration	X	
h.ii.	Wildlife - aquatic consideration		
h.iii.	Wet areas consideration		
h.iv.	Wildlife escape cover - ¼ mile		

ROAD CONSTRUCTION RULES — 4		Satis	Unsatis
4.b.	Plans & Specifications	X	
b.i.	Plan minimum in S.P. Zones		
b.ii.	Plan min. width - cuts & fills		
b.iii.	Plan vegetation between road & stream		
b.iv.	Plan waste to be stabilized		
b.v.	Plan culverts, erosion of fill		
b.vi.	Plan road drainage		
b.vii.	Plan road culverts & ditches		
b.viii.	Plan road dips, w-bars, x-drains		
b.ix.	Plan minimum stream xings		
b.x.	Plan minimum cuts & fills		
b.xi.	Plan culvert fish passage		
b.xii.	Plan min. discharge of sediment		
b.xiii.	Plan reuse or variance: old roads		
4.c.	Road Construction	X	
c.i.	Construction followed plan		
c.ii.	Excess material, slash out of SP Zone		
c.iii.	Debris cleared from drainage ways		
c.iv.	Stabilize exposed areas		
c.v.	Compact and min. soil material in fills		
c.vi.	Stream crossings, other law		
c.vii.	Install drainage prior to runoff		
c.viii.	Remove berms on outsloped roads		
c.x.	Roads constrict, stream channel		
c.xi.	X-drains, culverts-minimum, erosion		
c.xii.	Relief culvert gradient OK		
c.xiii.	Wet weather constr. delay		
c.xiv.	Overhang, cuts & tree hazards		

ROAD MAINTENANCE RULES — 4		Satis	Unsatis
4.d.	Maint. done, minimum damage		X
d.i.	Sidecast out of streams	X	
d.ii.	Repair, stabil. sediment haz.		X
d.iii.	Active roads OK		X
d.iii(a)	Culverts, ditches OK		X
d.iii(b)	Crown, sloped, berms OK	X	
d.iii(c)	Minimize subgrade drainage, erosion		X
d.iii(d)	Surface oil, out of streams	X	
d.iv.	Inactive roads OK		X
d.iv(a)	Culverts-ditches-slopes-drainage		X
d.iv(b)	Road closure	X	
d.v.	Abandoned roads OK		X
d.v.(a)	Sloped-drainage-vegetation		X
d.v.(b)	Ditches clean	X	
d.v.(c)	Road closed	X	
d.v.(d)	Bridges - culverts removed		X

Comment or Explanation:
I met with the landowner and operator to discuss corrective actions needed. There was a metal pipe in the landing area where I had assumed an old log culvert was. It was agreed to repair the wash out culvert.

Forest Practices Advisor: Jim Bickel [signature]
Date of Report: 11/17/86

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Forest Officer	Landowner	Pre-Operations
X	X	
Area Supervisor	**Operator**	**Operation in Progress**
X	X	
Fire Prot. Advisor		**Inactive or Completed**
X		X

STATE OF IDAHO
DEPARTMENT OF LANDS

South Fork Mica Creek

FOREST PRACTICES REPORT

Notification No.	Inspection Date
36996C	11/6/86

☒ Harvesting ☐ Road Construction ☐ Reforestation
☒ Management of Slashings ☐ Chemicals & Fertilizers

Parent Material	Erosion Hazard
various	Severe
Soil Type: Kruse-Ulricher Association Lenz Complex, Vassar Silt Loam	Erosion Hazard: Severe; Slopes Over 45%: NO

Subdivision	Section	Township	Range
NW4E2S2 NW4,S2 SW4	22 23 24	49N	5W

Acres Inspected	Stream Class (if Any)
20	I & II

Operator: Mica Bay Land Company
Box 943
Coeur d'Alene, ID 83814

11/17/86

☐ Contacted ☐ Present On Inspection

Owner: Verton Kienke
315 2nd Street
Post Falls, ID 83854

☒ Contacted ☐ Present On Inspection

X — Violation NA — Not Applicable NI — Not Inspected

GENERAL RULES — 2		Satis	Unsatis
2.a.i.	Variance	NA	
a.ii.	Other Law	NI	
2.a.	Notification	X	
2.h.	Emergency Forest Practice	NA	
TIMBER HARVESTING RULES — 3			
3.b.	Residual Stocking	X	
3.c.	Soil Protection	X	
c.i.	Skidding Erosion		
c.ii.	30% Limitation		
c.iii.	No. of skid trails & widths		
c.iii.	Tractor size appropriate		
c.iv.	Cable Yarding		
3.d.	Location of Landings, Trails	X	
d.i.	Stable landings & skid trails		
d.ii.	Size of landings		
d.iii.	Landing fill, stabilization		
3.e.	Drainage Systems	X	
e.i.	Drainage skid trails, stabilization		
e.ii.	Drainage landings, stabilization		
3.f.	Treatment of waste materials	X	
f.i.	Slash, waste out - Class I Stream		
f.ii.	Slash, waste out - Class II Stream		
f.iii.	Slash, waste out - SP Zones		
f.iv.	Oil, fuel out — SP Zones		
3.g.	Stream Protection	X	
g.i.	Skidding-stream xing - SP Zones		
g.ii.	Cable yarding, xing - SP Zones		
g.iii.	Shading, stabil., filter Class I		
g.iv.	Shading, stabil., filter Class II		
3.h.i.	Scenic - wildlife consideration	X	
h.ii.	Wildlife, aquatic consideration		
h.iii.	Wet areas consideration		
h.iv.	Wildlife ...		

ROAD CONSTRUCTION RULES — 4		Satis	Unsatis
4.b.	Plans & Specifications	X	
b.i.	Plan minimum in S.P. Zones		
b.ii.	Plan min. width - cuts & fills		
b.iii.	Plan vegetation between road & stream		
b.iv.	Plan waste to be stabilized		
b.v.	Plan culverts, erosion of fill		
b.vi.	Plan road drainage		
b.vii.	Plan road culverts & ditches		
b.viii.	Plan road dips, w-bars, x-drains		
b.ix.	Plan minimum stream xings		
b.x.	Plan minimum cuts & fills		
b.xi.	Plan culvert fish passage		
b.xii.	Plan min. discharge of sediment		
b.xiii.	Plan reuse or variance, old roads		
4.c.	Road Construction	X	
c.i.	Construction followed plan		
c.ii.	Excess material, slash out of SP Zone		
c.iii.	Debris cleared from drainage ways		
c.iv.	Stabilize exposed areas		
c.v.	Compact and min. soil material in fills		
c.vi.	Stream crossings, other law		
c.vii.	Install drainage prior to runoff		
c.viii.	Remove berms on outsloped roads		
c.x.	Roads constrict, stream channel		
c.xi.	X-drains, culverts-minimum, erosion		
c.xii.	Relief culvert gradient OK		
c.xiii.	Wet weather constr. delay		
c.xiv.	Overhang, cuts & tree hazards		

ROAD MAINTENANCE RULES — 4		Satis	Unsatis
4.d.	Maint. cond. minimum damage		X
d.i.	Sidecast out of streams	X	
d.ii.	Repair, stabil. sediment haz.		X
d.iii.	Active roads OK		X
d.iii(a)	Culverts, ditches OK		X
d.iii(b)	Crown, sloped, berms OK	X	
d.iii(c)	Minimize subgrade drainage, erosion		X
d.iii(d)	Surface oil, out of streams	X	
d.iv.	Inactive roads OK		X
d.iv(a)	Culverts-ditches-slopes-drainage		X
d.iv(b)	Road closure	X	
d.v.	Abandoned roads OK		X
d.vi(a)	Sloped-drainage-vegetation		X
d.vi(b)	Ditches clean	X	
d.vi(c)	Road closed	X	
d.vi(d)	Bridges - culverts removed		X

Comments or Exceptions

The corrective actions necessary have not been started yet; a cost estimate has been prepared and the operator contacted on the phone. He is still planning to complete the work.

Forest Practices Advisor	Date of Report
Jim Bickel	11/18/86

insp rpt 36996c 11-06.doc

STATE OF IDAHO
DEPARTMENT OF LANDS

FOREST PRACTICES REPORT

South Fork Mica Creek

X	X	
X	X	
X		X

Landowner: Mica Bay Land Co., Box 943, Coeur d'Alene, ID 83814 ☐ Contacted ☐ Present On Inspection

Operator: Verton Kienke, 315 2nd Street, Post Falls, ID 83854 ☐ Contacted ☒ Present On Inspection

Inspection No.: 36996C **Inspection Date:** 11/13/86

☒ Harvesting ☐ Road Construction ☐ Reforestation
☒ Management of Slashings ☐ Chemicals & Fertilizers

Forest Materials: various — Severe

Soil Type: Kruse-Ulricher Association, Lenz Complex, Vassar Silt Loam — Severe — NO

Subdivision: NW4E2S2, NW4,S2, SW4 **Section:** 22, 23, 24 **Township:** 49N **Range:** 5W

Acres: 20 **Stream Class (If Any):** I & II

X — Inspection NA — Not Applicable NI — Not Inspected

GENERAL RULES — 2		Satis.	Unsatis.
2.a.i.	Variance	NA	
2.a.ii.	Other Law	NT	
2.e.	Notification	X	
2.h.	Emergency Forest Practice	NA	
TIMBER HARVESTING RULES — 3			
3.b.	Residual Stocking	X	
3.c.	Soil Protection	X	
c.i.	Skidding Erosion		
c.ii.	30% Limitation		
c.iii.	No. of skid trails & widths		
c.iii.	Tractor size appropriate		
c.iv.	Cable yarding		
3.d.	Location of Landings, Trails	X	
d.i.	Stable landings & skid trails		
d.ii.	Size of landings		
d.iii.	Landing fill, stabilization		
3.e.	Drainage Systems	X	
e.i.	Drainage, skid trails, stabilization		
e.ii.	Drainage, landings, stabilization		
3.f.	Treatment of Waste materials	X	
f.i.	Slash, waste out - Class I Stream		
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f.iii.	Slash, waste out - SP Zones		
f.iv.	Oil, fuel out — SP Zones		
3.g.	Stream Protection	X	
g.i.	Skidding-stream xing - SP Zones		
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g.iii.	Shading, stabil., filter Class I		
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3.h.i.	Scenic-wildlife consideration	X	
h.ii.	Wildlife - aquatic consideration		
h.iii.	Wet areas consideration		
h.iv.	Wildlife escape cover - ¼ mile		

ROAD CONSTRUCTION RULES — 4		Satis.	Unsatis.
4.b.	Plans & Specifications	X	
b.i.	Plan minimum in S.P. Zones		
b.ii.	Plan min. width - cuts & fills		
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b.xi.	Plan culvert fish passage		
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4.c.	Road Construction	X	
c.i.	Construction followed plan		
c.ii.	Excess material, slash out of SP Zone		
c.iii.	Debris cleared from drainage ways		
c.iv.	Stabilize exposed areas		
c.v.	Compact and min. soft material in fills		
c.vi.	Stream crossings, other law		
c.vii.	Install drainage prior to runoff		
c.viii.	Remove berms on outsloped roads		
c.x.	Roads constrict, stream channel		
c.xi.	X-drains, culverts-minimum, erosion		
c.xii.	Relief culvert gradient OK		
c.xiii.	Wet weather constr. delay		
c.xiv.	Overhang, cuts & tree hazards		

ROAD MAINTENANCE RULES — 4		Satis.	Unsatis.
4.d.	Maint. cons. minimum damage	X	
d.i.	Sidecast out of streams		
d.ii.	Repair, stabil. sediment has		
d.iii.	Active roads OK		
d.iii(a)	Culverts, ditches OK		
d.iii(b)	Crown, sloped, berms OK		
d.iii(c)	Minimize subgrade drainage, erosion		
d.iii(d)	Surface oil, out of streams		
d.iv.	Inactive roads OK		
d.iv(a)	Culverts-ditches-slopes drainage		
d.iv(b)	Road closure		
d.v.	Abandoned roads OK		
d.v.(a)	Slopes-drainage-vegetation		
d.v.(b)	Ditches clean		
d.v.(c)	Road closed		
d.v.(d)	Bridges - culverts removed		

Comments or Instructions:

The operator has completed the necessary corrective work.

Forest Practices Advisor: Jim [signature] **Date of Report:** 11/18/86

Appendix M

Effects of Suspended Sediment on Fish: A Literature Review

Suspended Sediment Effects on Fish: A Literature Review

This literature review was conducted to gain pertinent literature information regarding the potential effects of suspended sediments on fish, primarily salmonids. Effects of suspended sediments on fish include effects on fish behavior, effects on fish physiology, and effects on fish habitat.

Suspended sediments are usually silt and clay particles that are between 2 and 60 micrometers (μm) in diameter. Suspended sediments can be directly measured as total suspended sediment (TSS) in milligrams per liter (mg/L) but are frequently measured indirectly as turbidity. Turbidity is the optical property of water resulting in a loss of light transmission caused by absorption and scattering. Turbidity is typically measured in Nephlometric Turbidity Units (NTUs). Regression equations correlating turbidity and TSS (Sigler et al., 1984; Lloyd et al., 1987; and Scannell, 1988) have been published, but these correlation's are typically site-specific (Rowe et al., 2003; Duchrow and Everhardt, 1971; Kunkle and Comer, 1971). While suspended sediments are often the main contributors to turbidity, other nonsediment sources that affect light transmission (that is, natural tannins and algae) can also influence turbidity. Most recent literature studies on suspended sediment effects report TSS.

The scientific data regarding the effects of suspended sediments on fish have been derived from laboratory experiments (for example, artificial channels with variable TSS conditions); observations of natural systems (for example, population comparisons between habitats differentially influenced by TSS); and *in situ* experiments (for example, caged fish exposed to variable TSS conditions). Because of the variable approaches and methods used in these studies, generalization and extrapolation of their results to specific areas of concern must be made with caution.

Influences on individual fish, fish populations, and fish communities have been associated with stream TSS loads and turbidities. The TSS influences on fish reported in the literature range from beneficial to detrimental. Elevated TSS conditions have been reported to enhance cover conditions and reduce piscivorous fish and bird predation risks. Elevated TSS conditions have also been reported to cause physiological stresses, reduce growth, and adversely affect survival. Significant suspended sediment levels have been observed to alter fish community composition from salmonid to nonsalmonid fish (for example, creek chub), which better tolerate or prefer more turbid water (Gradall and Swenson, 1992).

Of key importance in considering the effects of TSS on fish are the frequency and the duration of the exposure (not just the TSS concentration) (Newcombe and Jensen, 1996). Adverse effects can become more pronounced with increased TSS concentrations and longer exposure durations in aquatic systems where elevated TSS conditions occur infrequently. In systems where elevated TSS conditions occur more frequently, fish can become acclimated to increased TSS levels and adverse affects can be less pronounced or nullified. Newcombe (2003) created a model that takes into account duration of exposure and suspended sediment concentration to project possible effects on fish. The model is

$$SEV = -4.49 + 0.92(\log_e x) - 2.59(\log_e y)$$

- Behavioral effects: avoidance (holding or migration changes), attraction (TSS as cover; reduced predation risk), reduced feeding success, increased "coughing" or "gill flaring"
- Physical effects: stress, tissue damage, reduced growth, mortality
- Habitat effects: increased sedimentation, fill gravel interstitial spaces, decrease intergravel dissolved oxygen concentrations, decrease residual pool volumes, decrease spawning and emergence success

Behavioral Effects

High levels of sediment can reduce light penetration and inhibit primary production, abrade and clog fish gills, prevent feeding by sight feeders, stop migration, and cause fish to avoid the use of turbid reaches. Increased turbidity generally reduces visibility and decreases the ability of sight-feeding fish to obtain food (Berg and Northcoat, 1985) and thus reduces feeding habitat.

Avoidance is the primary fish behavioral response to locally turbid water. Avoiding areas with elevated TSS or turbidity may lead to fishless reaches in natural systems (DeVore et al., 1980; Birtwell et al., 1984; and Scannell, 1988). All life stages of salmonids have been observed to prefer clear water when given the option of clear or turbid water (Bisson and Bilby, 1982). Salmonids move laterally (Servizi and Martens, 1992) and/or downstream to avoid turbid areas (McLeay et al., 1984, 1987). Avoidance of turbid water may begin as turbidities approach 30 NTU (Sigler et al., 1984; Lloyd, 1987). Servizi and Martens (1992) noted a threshold for the onset of avoidance at 37 NTU (300 mg/L TSS). However, Berg and Northcoat (1985) provide evidence that juvenile coho salmon did not avoid moderate turbidity increases when background levels were low, but exhibited significant avoidance when turbidity exceeded a threshold that was relatively high (>70 NTU). At turbidities of between 10 and 30 NTUs there is generally altered behavior, avoidance and a reduction in feeding rates over the course of 24 hours (Rowe et al., 2003). At chronic (continuous) exposures as low as 15 NTUs survival rates of some species have been effected. Other species have experienced reduced growth rates at chronic exposures of 22 NTUs (Rowe et al., 2003).

Salmonids experience a loss of habitat by avoiding turbid water. High turbidity levels may cause abandonment of traditional spawning habitat, displacement from current habitat, and underutilization or avoidance of available habitat. Salmonid migration may be interrupted or blocked in the fish's attempt to avoid turbid water (Newcombe and Jensen, 1996).

Turbid water can be beneficial in somewhat low concentrations and act as cover to protect fish from predation. Fish that remain in turbid water experience a reduction in predation from piscivorous fish and birds (Gregory and Levings, 1988). In systems with intense predation pressure, this provides a beneficial trade-off (e.g., enhanced survival) to the cost of potential physical effects (e.g., reduced growth). A study done regarding the effects of turbidity on predation showed that prey are more active in turbid water and utilize areas in the turbid water column that would otherwise be unsafe in clear water. The results of this study show that turbid water acts as protective cover and allows fish to exist in otherwise more "riskier" habitat (Gregory, 1993). Turbidity levels of about 23 NTU have been found to minimize bird and fish predation risks (Gregory, 1993).

Fish growth is also inhibited by reduced feeding rates due to the behavioral effects mentioned previously. Elevated TSS concentrations can decrease salmonid fitness by thickening the gill epithelium and reducing respiratory efficiency (Bell, 1973, as cited in Waters, 1995).

The mechanisms of TSS-related mortality are not well understood. Acute TSS-related mortality has been demonstrated in laboratory or controlled *in situ* exposures where the fish were unable to avoid the elevated TSS conditions (i.e., the fish were in artificial streams or caged in natural streams). Elevated TSS concentrations alone have not been shown to cause mortality (McLeay et al., 1987; Redding et al., 1987; and Reynolds et al., 1989). It has been shown that juvenile salmon and steelhead trout can adapt when exposed to short term increased TSS concentrations. In a laboratory experiment, juvenile coho salmon and steelhead were subjected to 2000-4000mg/L of suspended sediment for several days, showing an immediate increase in stress, then within 5 days of initial exposure, returning to control stress levels (Reeding and Schreck, 1987). Elevated suspended sediment concentrations appear to have a synergistic effect with other causes of mortality. For example, salmonids appear to be more prone to bacterial- and viral-induced mortality when exposed to TSS concentrations of 2,000 to 3,000 mg/L for 7 or 8 days (Redding et al., 1987).

TSS-related mortality in salmonids depends on several factors, such as life stage, particle size, and water temperature. Significant mortality (>50 percent) usually occurs at suspended sediment concentrations in the range of 500 to 6,000 mg/L (Lloyd, 1987; Sigler et al., 1984). Older, larger salmonids are generally more tolerant of high suspended sediment concentrations (200 to 20,000 mg/L) than juvenile salmonids, eggs, and larvae (Sigler et al., 1984). Particle size affects mortality, with decreases in lethal tolerance as particle size increases (Servizi and Martens, 1987). Finer particles tend to clog gillrakers, erode gill filaments, and reduces growth (Sigler, 1984). Tolerance is also temperature related. Survivorship is optimal at about 7 degrees C (44.6 degrees Fahrenheit (F)), with reduced survivorship at higher (18 degrees C [64.4 degrees F]) and lower (2 degrees C [35.6 degrees F]) temperatures (Servizi and Martens, 1991).

Habitat Effects

Increased turbidity in streams can lead to an increase in sedimentation. The primary concern of increased sedimentation on fisheries resources is the potential for degrading and/or decreasing spawning habitat (Shirazi et al., 1979). Although, rearing habitat can also be degraded and/or decreased by increased sedimentation such as a decrease in residual pool volumes.

A basic necessity for quality fish habitat is freedom from excessive sediment and turbidity (Everest, 1987) and retention of desirable channel morphology and stability (Bisson et al. 1987; Sullivan et al. 1987). Persistent long term sediment sources are the most detrimental to fish and fish habitat with low gradient streams being more vulnerable to irreversible clogging than high gradient streams (Chamberlin, 1982). Pool volumes may be decreased, resulting in direct loss of living space (Reiser and Bjornn 1979; Toews and Brownlee 1981).

There is considerable literature concerning sedimentation effects on fish. A general conclusion reached by a review of literature is that the greatest adverse impact of sedimentation is on incubating embryos and larval fish. Sedimentation can cause high

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Appendix N

Mica Creek Aquatic Data

Stream Habitat Index Values

Stream Habitat Index (SHI) Values

Reach level SHI scores for the habitat measures collected during September 2002 surveys, as described in the Framework (IDEQ 2002). The values in **bold**, adjacent to the habitat measure, represent the value for the habitat measure within the specific reach. Values that are underlined represent the mean for the NMR ecoregion metric as described in Grafe ed (2002).

REACH MS-1. Scoring Criteria for the Northern and Middle Rockies Ecoregion SHI.

	Score										
Habitat Measure	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Instream Cover	0	1-2	3-4	5-6	**7-8**	9-10	11-12	13-14	15-16	17-18	19-20
Large Organic Debris (#s)	0	1-3	4-7	**8-12**	13-17	18-26	27-36	37-48	49-60	61-73	>73
Percent fines <2.5mm	≥40	35-39.9	30-34.9	25-29.9	20-24.9	15-19.9	10-14.9	7-9.9	**5-6.9**	3-4.9	<3
Embeddedness	0	1-2	3-4	5-6	7-8	9-10	11-12	13-14	**15-16**	17-18	19-20
Wolman size classes	1-3	4				5	6	7	8	**9**	10
Channel shape	0-1	2-3	4	5	6	**7**	8	9	10-11	12-13	14-15
% Bank vegetation cover	<30	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	**80-84.9**		85-89.9	90-94.9	95-100
% Canopy cover	<10	10-19.9	**20-24.9**	25-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	≥90
Disruptive pressures	0	1	2	**3**	4	5	6	7	8	9	10
Zone of influence	0	1	**2**	3	4	5	6	7	8	9	10

REACH SF-1/SF-2. Scoring criteria for the Northern and Middle Rockies Ecoregion SHI.

	Score										
Habitat Measure	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Instream Cover	0	1-2	3-4	5-6	**7-8**	9-10	11-12	13-14	15-16	17-18	19-20
Large Organic Debris (#s)	0	1-3	4-7	8-12	13-17	18-26	27-36	**37-48**	49-60	61-73	>73
Percent fines <2.5mm	≥40	35-39.9	30-34.9	25-29.9	20-24.9	15-19.9	10-14.9	7-9.9	**5-6.9**	3-4.9	<3
Embeddedness	0	1-2	3-4	5-6	7-8	9-10	11-12	13-14	**15-16**	17-18	19-20
Wolman size classes	1-3	4				5	6	7	8	**9**	10
Channel shape	0-1	2-3	4	5	6	**7**	8	9	10-11	12-13	14-15
% Bank vegetation cover	<30	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	**80-84.9**		85-89.9	90-94.9	95-100
% Canopy cover	<10	10-19.9	**20-24.9**	25-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	≥90
Disruptive pressures	0	1	2	3	4	**5**	6	7	8	9	10
Zone of influence	0	1	2	3	4	**5**	6	7	8	9	10

REACH SF-3. Scoring criteria for the Northern and Middle Rockies Ecoregion SHI.

	Score										
Habitat Measure	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Instream Cover	0	1-2	3-4	5-6	7-8	9-10	11-12	<u>13-14</u>	**15-16**	17-18	19-20
Large Organic Debris (#s)	0	1-3	4-7	**8-12**	13-17	18-26	<u>27-36</u>	37-48	49-60	61-73	>73
Percent fines <2.5mm	≥40	35-39.9	30-34.9	25-29.9	20-24.9	15-19.9	**10-14.9**	7-9.9	5-6.9	3-4.9	<3
Embeddedness	0	1-2	3-4	5-6	7-8	9-10	<u>11-12</u>	13-14	15-16	**17-18**	19-20
Wolman size classes	1-3	4				5	6	<u>7</u>	8	**9**	10
Channel shape	0-1	2-3	4	**5**	6	7	<u>8</u>	9	10-11	12-13	14-15
% Bank vegetation cover	<30	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-84.9		85-89.9	<u>90-94.9</u>	**95-100**
% Canopy cover	<10	**10-19.9**	20-24.9	25-29.9	30-39.9	<u>40-49.9</u>	50-59.9	60-69.9	70-79.9	80-89.9	≥90
Disruptive pressures	0	1	2	3	4	5	6	**7**	<u>8</u>	9	10
Zone of influence	0	1	2	3	4	5	6	<u>7</u>	8	9	10

REACH SF-4. Scoring criteria for the Northern and Middle Rockies Ecoregion SHI.

	Score										
Habitat Measure	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Instream Cover	0	1-2	3-4	5-6	7-8	**9-10**	11-12	<u>13-14</u>	15-16	17-18	19-20
Large Organic Debris (#s)	0	1-3	4-7	8-12	**13-17**	18-26	<u>27-36</u>	37-48	49-60	61-73	>73
Percent fines <2.5mm	**≥40**	35-39.9	30-34.9	25-29.9	20-24.9	15-19.9	<u>10-14.9</u>	7-9.9	5-6.9	3-4.9	<3
Embeddedness	0	1-2	3-4	5-6	7-8	**9-10**	<u>11-12</u>	13-14	15-16	17-18	19-20
Wolman size classes	1-3	4				5	6	<u>7</u>	8	**9**	10
Channel shape	0-1	2-3	**4**	5	6	7	<u>8</u>	9	10-11	12-13	14-15
% Bank vegetation cover	<30	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-84.9		85-89.9	<u>90-94.9</u>	**95-100**
% Canopy cover	<10	10-19.9	**20-24.9**	25-29.9	30-39.9	<u>40-49.9</u>	50-59.9	60-69.9	70-79.9	80-89.9	≥90
Disruptive pressures	0	1	2	3	4	5	6	7	<u>**8**</u>	9	10
Zone of influence	0	1	2	3	4	5	6	<u>7</u>	**8**	9	10

REACH USF-1. Scoring Criteria for the Northern and Middle Rockies Ecoregion SHI.

	Score										
Habitat Measure	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Instream Cover	0	1-2	3-4	5-6	**7-8**	9-10	11-12	13-14	15-16	17-18	19-20
Large Organic Debris (#s)	0	1-3	4-7	8-12	13-17	18-26	27-36	37-48	**49-60**	61-73	>73
Percent fines <2.5mm	≥40	35-39.9	30-34.9	25-29.9	20-24.9	15-19.9	10-14.9	7-9.9	**5-6.9**	3-4.9	<3
Embeddedness	0	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	**19-20**
Wolman size classes	1-3	4				5	6	7	8	**9**	10
Channel shape	0-1	2-3	4	5	**6**	7	8	9	10-11	12-13	14-15
% Bank vegetation cover	<30	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-84.9		85-89.9	90-94.9	**95-100**
% Canopy cover	**<10**	10-19.9	20-24.9	25-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	≥90
Disruptive pressures	0	1	2	3	4	5	6	7	**8**	9	10
Zone of influence	0	1	2	3	4	5	6	7	**8**	9	10

REACH USF-2. Scoring Criteria for the Northern and Middle Rockies Ecoregion SHI.

	Score										
Habitat Measure	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Instream Cover	0	1-2	3-4	5-6	**7-8**	9-10	11-12	13-14	15-16	17-18	19-20
Large Organic Debris (#s)	0	1-3	4-7	8-12	13-17	18-26	27-36	**37-48**	49-60	61-73	>73
Percent fines <2.5mm	≥40	35-39.9	30-34.9	25-29.9	**20-24.9**	15-19.9	10-14.9	7-9.9	5-6.9	3-4.9	<3
Embeddedness	0	1-2	3-4	5-6	7-8	9-10	11-12	**13-14**	15-16	17-18	19-20
Wolman size classes	1-3	4				5	6	**7**	8	9	10
Channel shape	0-1	2-3	4	**5**	6	7	8	9	10-11	12-13	14-15
% Bank vegetation cover	<30	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-84.9		85-89.9	90-94.9	**95-100**
% Canopy cover	<10	**10-19.9**	20-24.9	25-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	≥90
Disruptive pressures	0	1	2	3	4	5	6	7	**8**	9	10
Zone of influence	0	1	2	3	4	5	6	7	**8**	9	10

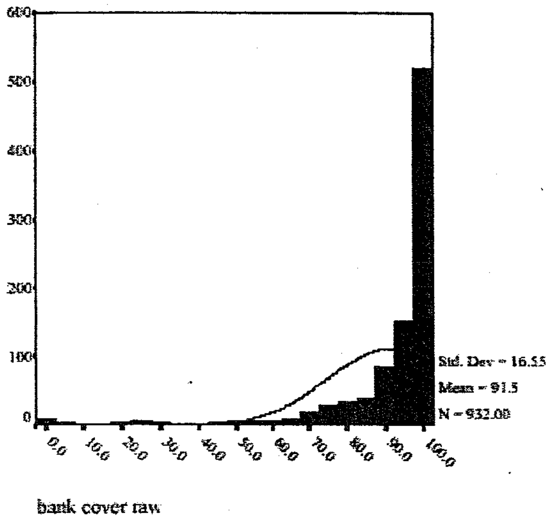
REACH NF-1. Scoring Criteria for the Northern and Middle Rockies Ecoregion SHI.

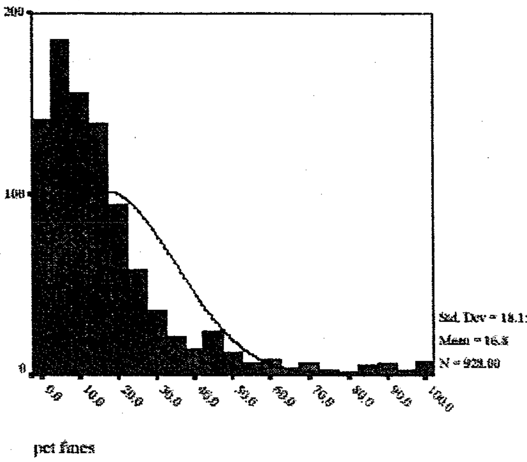
	Score										
Habitat Measure	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Instream Cover	0	1-2	3-4	**5-6**	7-8	9-10	11-12	13-14	15-16	17-18	19-20
Large Organic Debris (#s)	0	1-3	4-7	8-12	13-17	18-26	27-36	**37-48**	49-60	61-73	>73
Percent fines <2.5mm	≥40	35-39.9	30-34.9	25-29.9	20-24.9	15-19.9	10-14.9	7-9.9	**5-6.9**	3-4.9	<3
Embeddedness	0	1-2	3-4	5-6	7-8	9-10	11-12	13-14	**15-16**	17-18	19-20
Wolman size classes	1-3	4				5	**6**	7	8	9	10
Channel shape	0-1	2-3	4	5	**6**	7	8	9	10-11	12-13	14-15
% Bank vegetation cover	<30	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	**80-84.9**		85-89.9	90-94.9	95-100
% Canopy cover	**<10**	10-19.9	20-24.9	25-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	≥90
Disruptive pressures	0	1	2	3	**4**	5	6	7	8	9	10
Zone of influence	0	1	2	3	4	**5**	6	7	8	9	10

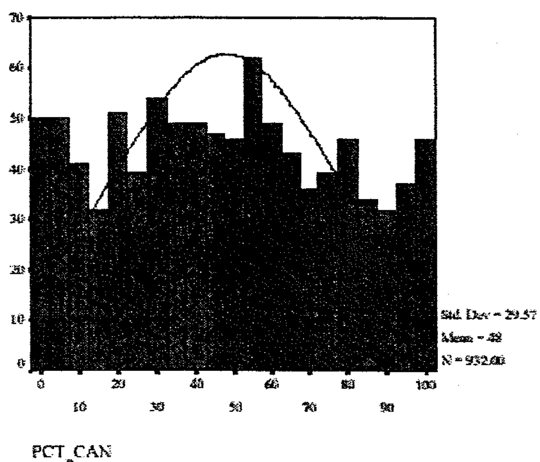
Histograms and Mean Values for the Stream Habitat Matrices

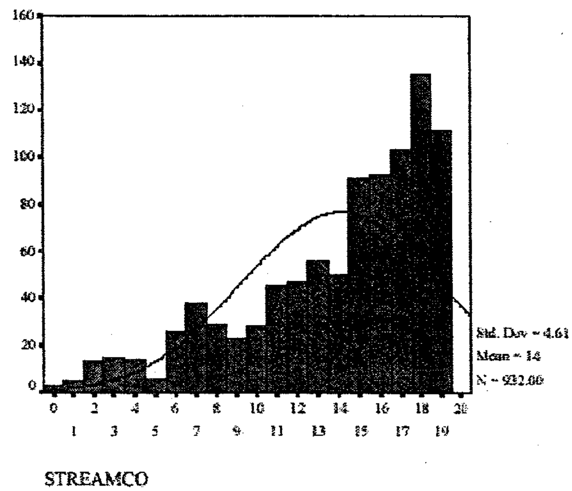
Histograms and mean values for the NMR SHI metrics (Grafe ed. 2002)

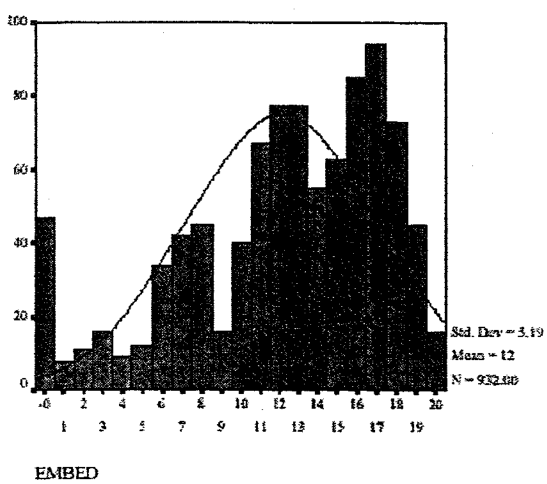
Northern and Middle Rockies histograms: 932 sites

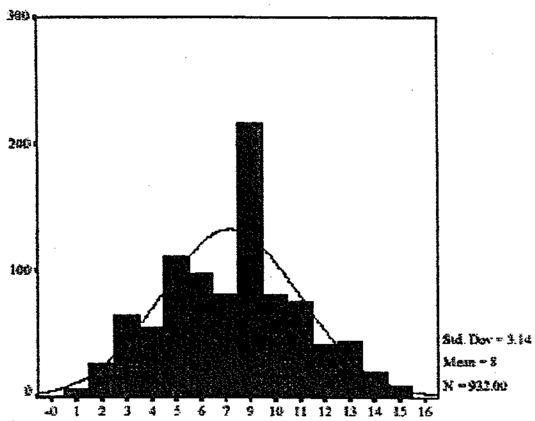












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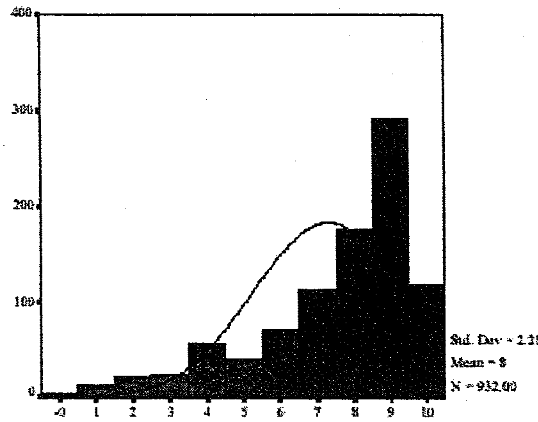
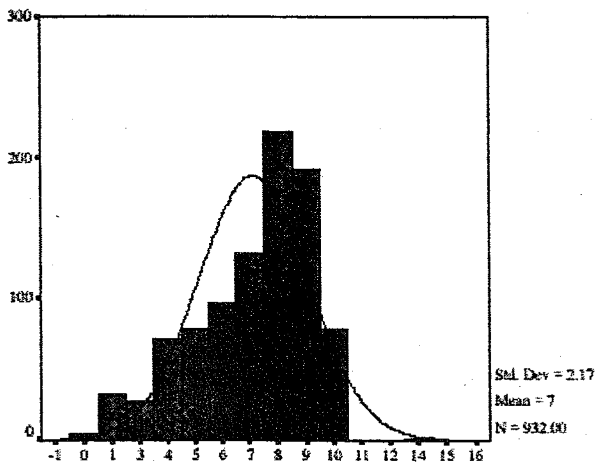


DISPRES



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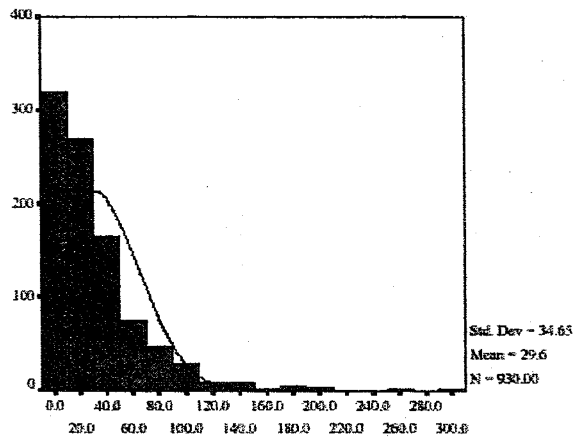

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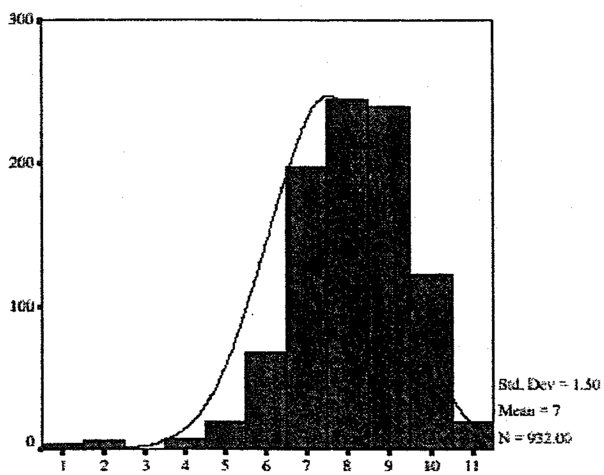


wolmann size classes

Scour Chain Data

Summary of Change in Cross-Section Areas from July 2003 to December 2003

		TOTAL TRANSECT WIDTH				ACTIVE CHANNEL WIDTH			
		scour	***deposition***	***net change***	***dominant***	***scour***	***deposition***	***net change***	***dominant***
Transect No.	***Location***	***(ft^2)***	***(ft^2)***	***(ft^2)***	***process***	***(ft^2)***	***(ft^2)***	***(ft^2)***	***process***
one	downstream	0.20	1.60	1.40	deposition	0.15	0.30	0.15	deposition
	middle	0.40	0.96	0.56	deposition	0.13	0.58	0.45	deposition
	upstream	0.50	2.06	1.56	deposition	0.05	1.40	1.35	deposition
two	downstream	2.05	0.78	-1.27	scour	1.45	0.25	-1.20	scour
	middle	3.18	2.26	-0.92	scour	1.90	1.73	-0.17	scour
	upstream	0.35	0.60	0.25	deposition	0.07	0.45	0.38	deposition
three	downstream	0.10	2.16	2.06	deposition	0.03	1.23	1.20	deposition
	middle	1.13	0.80	-0.33	scour	0.90	0.30	-0.60	scour
	upstream	2.85	0.33	-2.52	scour	1.40	0.13	-1.27	scour
four	downstream	0.77	2.03	1.26	deposition	0.40	1.58	1.18	deposition
	upstream	1.53	0.45	-1.08	scour	1.35	0.08	-1.27	scour
five	downstream	0.33	1.20	0.87	deposition	0.30	0.98	0.68	deposition
	middle	0.29	1.39	1.10	deposition	0.29	0.25	-0.04	scour
	upstream	7.38	0.30	-7.08	scour	5.00	0.00	-5.00	scour
six	downstream	0.58	4.60	4.02	deposition	0.25	2.50	2.25	deposition
	middle	0.25	15.38	15.13	deposition	0.25	6.35	6.10	deposition
	upstream	0.45	3.28	2.83	deposition	0.15	1.40	1.25	deposition

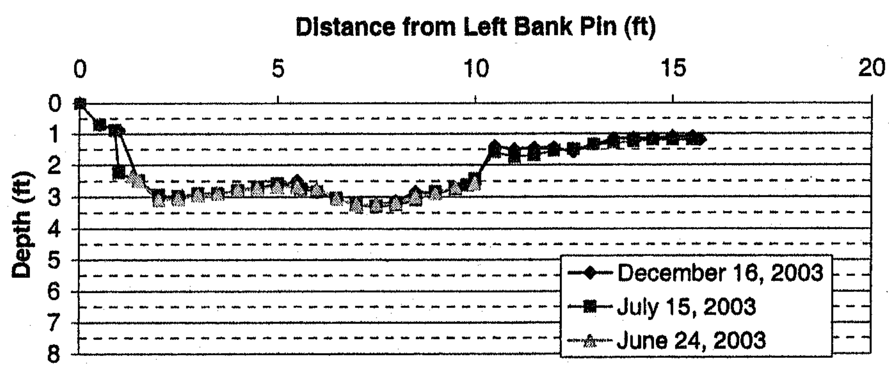
Scour 1: Downstream transect

Distance from Left Pin (feet)	12/16/2003 Tape to Bed (feet)
0.0	0.00
0.5	0.70
1.0	0.90
1.5	2.50
2.0	3.00
2.5	3.00
3.0	2.95
3.5	2.90
4.0	2.80
4.5	2.75
5.0	2.65
5.5	2.50
6.0	2.85
6.5	3.05
7.0	3.25
7.5	3.25
8.0	3.15
8.5	2.85
9.0	2.90
9.5	2.75
9.8	2.65
10.0	2.50
10.5	1.40
11.0	1.50
11.5	1.45
12.0	1.45
12.5	1.60
13.0	1.35
13.5	1.15
14.0	1.15
14.5	1.15
15.0	1.10
15.5	1.10
15.7	1.2

Distance from Left Pin (feet)	07/15/2003 Tape to Bed (feet)
0.0	0.00
0.5	0.70
0.9	0.90
1.0	2.25
1.5	2.50
2.0	2.95
2.5	3.00
3.0	2.90
3.5	2.90
4.0	2.80
4.5	2.70
5.0	2.60
5.5	2.70
5.6	2.75
6.0	2.85
6.5	3.05
7.0	3.25
7.5	3.30
8.0	3.25
8.5	3.10
9.0	2.85
9.5	2.75
9.8	2.65
10.0	2.45
10.5	1.60
11.0	1.75
11.5	1.70
12.0	1.55
12.5	1.50
13.0	1.35
13.5	1.30
14.0	1.25
14.5	1.20
15.0	1.20
15.5	1.20

Distance from Left Pin (feet)	06/24/2003 Tape to Bed (feet)
1.35	2.35
1.5	2.50
2	3.10
2.5	3.05
3	2.95
3.5	2.90
4	2.80
4.5	2.75
5	2.70
5.5	2.70
6	2.75
6.5	3.05
7	3.25
7.5	3.25
8	3.20
8.5	3.00
9	2.90
9.5	2.70
10	2.60

Scour 1: Downstream Transect



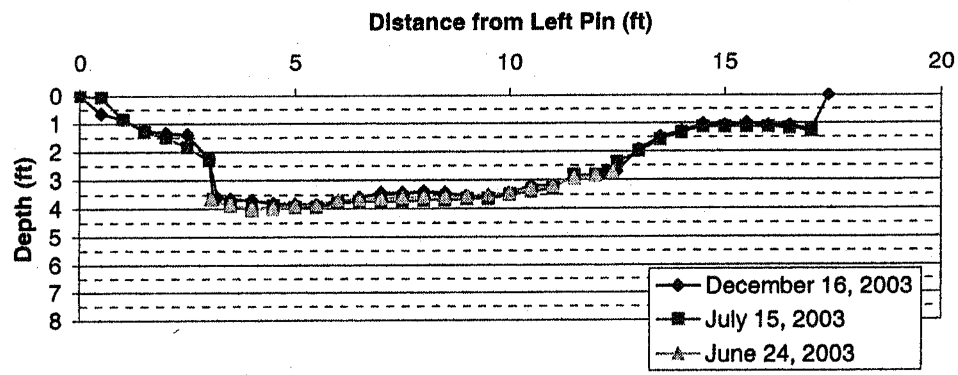
Scour 1: Upstream transect

Distance from Left Pin (feet)	12/16/2003 Tape to Bed (feet)
0.0	0.00
0.5	0.65
1.0	0.85
1.5	1.25
2.0	1.35
2.5	1.40
3.0	2.25
3.2	3.60
3.5	3.65
4.0	3.70
4.5	3.80
5.0	3.85
5.5	3.85
6.0	3.80
6.5	3.60
7.0	3.45
7.5	3.45
8.0	3.40
8.5	3.45
9.0	3.55
9.5	3.55
10.0	3.45
10.5	3.20
11.0	3.20
11.5	2.95
12.0	2.85
12.5	2.70
13.0	1.95
13.5	1.50
14.0	1.30
14.5	1.05
15.0	1.10
15.5	1.00
16.0	1.10
16.5	1.10
17.0	1.25
17.4	0.00

Distance from Left Pin (feet)	07/15/2003 Tape to Bed (feet)
0.0	0.00
0.5	0.06
1.0	0.85
1.5	1.30
2.0	1.50
2.5	1.85
3.0	2.30
3.1	3.65
3.5	3.90
4.0	4.05
4.5	3.90
5.0	3.95
5.5	3.95
6.0	3.80
6.5	3.75
7.0	3.75
7.5	3.75
8.0	3.70
8.5	3.70
9.0	3.65
9.5	3.65
10.0	3.50
10.5	3.40
11.0	3.30
11.5	2.85
12.0	2.85
12.3	2.75
12.5	2.40
13.0	2.00
13.5	1.60
14.0	1.35
14.5	1.15
15.0	1.15
15.5	1.15
16.0	1.15
16.5	1.20
17.0	1.30

Distance from Left Pin (feet)	06/24/2003 Tape to Bed (feet)
3.1	3.65
3.5	3.85
4.0	4.00
4.5	4.00
5.0	3.90
5.5	3.85
6.0	3.70
6.5	3.65
7.0	3.65
7.5	3.60
8.0	3.60
8.5	3.60
9.0	3.55
9.5	3.50
10.0	3.45
10.5	3.30
11.0	3.20
11.5	2.95
12.0	2.85
12.4	2.75
17.4	

Scour 1: Upstream Transect



Scour 2: Downstream transect

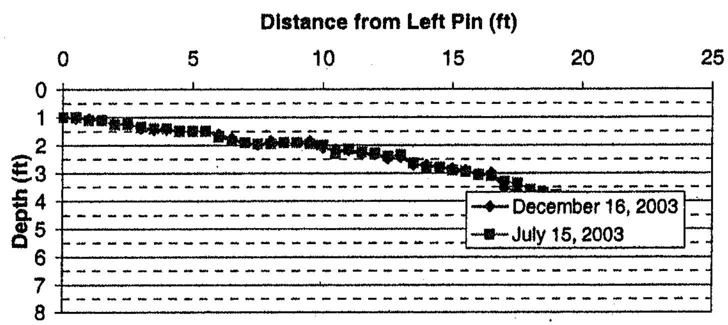
Distance from Left Pin (feet)	12/16/2003 Tape to Bed (feet)
0	1.00
0.5	1.05
1.0	1.05
1.5	1.10
2.0	1.25
2.5	1.20
3.0	1.40
3.5	1.45
4.0	1.45
4.5	1.50
5.0	1.50
5.5	1.50
6.0	1.60
6.5	1.75
7.0	1.90
7.5	2.00
8.0	1.85
8.5	1.90
9.0	1.90
9.5	1.85
9.8	2.00
10.0	2.10
10.5	2.15
11.0	2.20
11.5	2.35
12.0	2.35
12.5	2.50
13.0	2.45
13.5	2.70
14.0	2.70
14.5	2.80
15.0	2.85
15.5	2.90
16.0	3.05
16.5	3.00
17.0	3.55
17.5	3.65
18.0	3.80
18.5	3.85
19.0	4.00
19.5	4.05
20.0	4.05
20.5	4.05
21.0	4.30
21.5	4.35
22.0	4.45
22.5	4.50

Distance from Left Pin (feet)	07/15/2003 Tape to Bed (feet)
0.0	1.00
0.5	1.00
1.0	1.10
1.5	1.10
2.0	1.25
2.5	1.25
3.0	1.35
3.5	1.40
4.0	1.40
4.5	1.50
5.0	1.50
5.5	1.50
6.0	1.70
6.5	1.85
7.0	1.90
7.5	1.95
8.0	1.95
8.5	1.90
9.0	1.90
9.5	1.95
10.0	2.00
10.5	2.30
11.0	2.15
11.5	2.25
12.0	2.30
12.5	2.40
13.0	2.35
13.5	2.65
14.0	2.80
14.5	2.80
15.0	2.90
15.5	2.95
16.0	3.05
16.5	3.10
17.0	3.30
17.5	3.35
18.0	3.60
18.5	3.70
19.0	3.80
19.5	3.85
20.0	4.00
20.5	4.10
21.0	4.15
21.5	4.25
22.0	4.40
22.5	4.45
23.0	4.45

Distance from Left Pin (feet)	12/16/2003 Tape to Bed (feet)
23.0	4.45
23.5	4.40
24.0	4.35
24.5	4.35
25.0	4.20
25.5	4.15
26.0	4.05
26.5	4.00
27.0	3.85
27.5	3.85
28.0	3.55
28.5	3.45
29.0	3.25
29.5	3.25
30.0	3.10
30.5	3.10
31.0	3.20
31.5	3.15
32.0	3.10
32.5	2.90
33.0	2.35
33.5	2.20
34.0	2.10
34.5	2.15
35.0	2.05
35.5	2.20
36.0	2.05
36.5	2.00
37.0	2.00
37.5	2.25
38.0	2.05
38.5	2.15
39.0	2.45
39.5	2.50
40.0	2.60
40.3	3.30

Distance fror Left Pin (feet)	07/15/2003 Tape to Bed (feet)
23.5	4.40
24.0	4.35
24.5	4.30
25.0	4.20
25.5	4.10
26.0	4.00
26.5	3.95
27.0	3.90
27.5	3.70
28.0	3.55
28.5	3.40
29.0	3.30
29.5	3.10
30.0	3.10
30.5	3.05
31.0	3.00
31.5	3.05
32.0	3.00
32.5	2.85
33.0	2.40
33.3	2.30
33.5	2.20
34.0	2.15
34.5	2.20
35.0	2.10
35.5	2.20
36.0	1.95
36.5	1.95
37.0	2.10
37.5	2.05
38.0	2.05
38.5	2.20
39.0	2.25
39.5	2.55
40.0	2.70

Scour 2: Downstream Transect



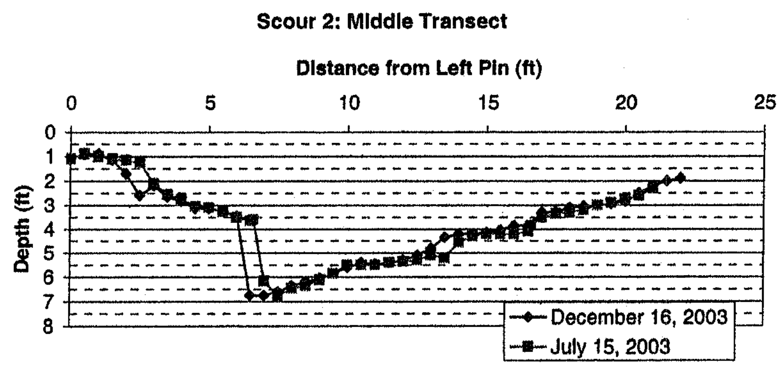
Scour 2: Middle transect

Distance from Left Pin (feet)	12/16/2003 Tape to Bed (feet)
0.0	1.10
0.5	0.90
1.0	0.90
1.5	1.15
2.0	1.70
2.5	2.60
3.0	2.20
3.5	2.65
4.0	2.85
4.5	3.15
5.0	3.15
5.5	3.25
6.0	3.45
6.5	6.75
7.0	6.75
7.5	6.60
8.0	6.35
8.5	6.20
9.0	6.05
9.5	5.85
10.0	5.60
10.5	5.40
11.0	5.45
11.5	5.40
12.0	5.30
12.5	5.10
13.0	4.80
13.5	4.35
14.0	4.20
14.5	4.20
15.0	4.15
15.5	4.05
16.0	3.85
16.5	3.85
17.0	3.30
17.5	3.30
18.0	3.10
18.5	3.05
19.0	3.00
19.5	2.95
20.0	2.85
20.5	2.50
21.0	2.20
21.5	2.00
22.0	1.90

Distance from Left Pin (feet)	07/15/2003 Tape to Bed (feet)
0.0	1.10
0.5	0.90
1.0	1.00
1.5	1.10
2.0	1.15
2.5	1.25
3.0	2.10
3.5	2.55
4.0	2.75
4.5	3.05
5.0	3.10
5.5	3.25
6.0	3.50
6.5	3.65
6.6	3.60
7.0	6.15
7.5	6.75
8.0	6.45
8.5	6.35
9.0	6.10
9.5	5.85
10.0	5.50
10.5	5.50
11.0	5.50
11.5	5.40
12.0	5.35
12.5	5.30
13.0	5.10
13.5	5.20
14.0	4.55
14.5	4.30
15.0	4.20
15.5	4.20
16.0	4.20
16.5	4.10
16.6	3.85
17.0	3.50
17.5	3.35
18.0	3.30
18.5	3.20
19.0	3.00
19.5	2.90
20.0	2.75
20.5	2.60
21.0	2.30

Distance from Left Pin (feet)	12/16/2003 Tape to Bed (feet)
22.5	1.70
23.0	1.75
23.2	1.70

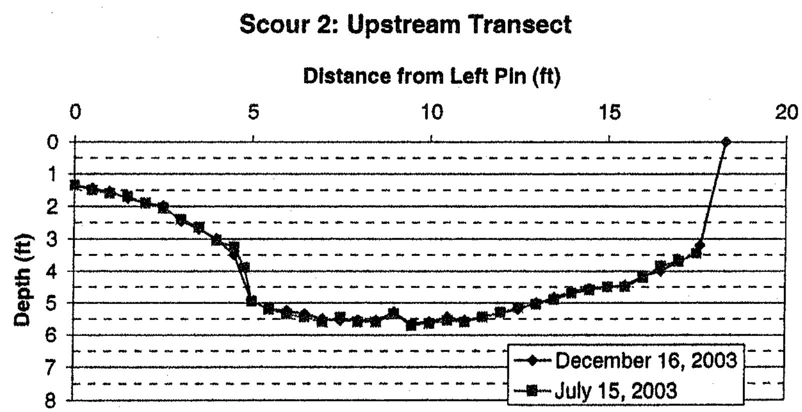
Distance fror Left Pin (feet)	07/15/2003 Tape to Bed (feet)
21.5	2.10
22.0	2.00
22.5	1.80
23.0	1.80



Scour 2: Upstream transect

Distance from Left Pin (feet)	12/16/2003 Tape to Bed (feet)
0.0	1.35
0.5	1.45
1.0	1.55
1.5	1.75
2.0	1.90
2.5	2.00
3.0	2.45
3.5	2.70
4.0	3.00
4.5	3.50
5.0	4.95
5.5	5.20
6.0	5.25
6.5	5.35
7.0	5.50
7.5	5.55
8.0	5.55
8.5	5.55
9.0	5.30
9.5	5.65
10.0	5.60
10.5	5.45
11.0	5.55
11.5	5.45
12.0	5.30
12.5	5.20
13.0	5.00
13.5	4.85
14.0	4.65
14.5	4.55
15.0	4.50
15.5	4.45
16.0	4.15
16.5	4.00
17.0	3.70
17.5	3.45
17.6	3.20
18.3	0.00

Distance from Left Pin (feet)	07/15/2003 Tape to Bed (feet)
0.0	1.35
0.5	1.50
1.0	1.60
1.5	1.70
2.0	1.90
2.5	2.05
3.0	2.40
3.5	2.65
4.0	3.05
4.5	3.25
4.8	3.90
5.0	4.95
5.5	5.20
6.0	5.35
6.5	5.45
7.0	5.60
7.5	5.45
8.0	5.60
8.5	5.60
9.0	5.35
9.5	5.70
10.0	5.65
10.5	5.55
11.0	5.60
11.5	5.45
12.0	5.30
12.5	5.15
13.0	5.05
13.5	4.90
14.0	4.70
14.5	4.60
15.0	4.50
15.5	4.50
16.0	4.20
16.5	3.85
17.0	3.70
17.5	3.45



Scour 3: Downstream transect

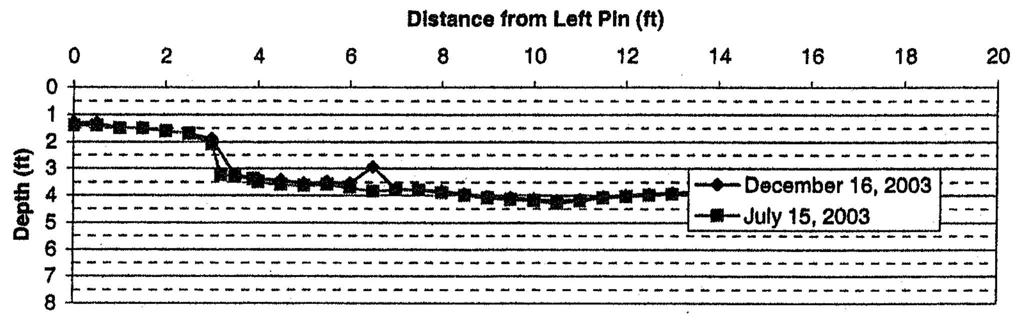
Distance from Left Pin (feet)	12/16/2003 Tape to Bed (feet)
0.0	1.30
0.5	1.30
1.0	1.50
1.5	1.50
2.0	1.60
2.5	1.70
3.0	1.90
3.5	3.25
4.0	3.40
4.5	3.45
5.0	3.55
5.5	3.50
6.0	3.55
6.5	2.95
7.0	3.75
7.5	3.80
8.0	3.85
8.5	3.95
9.0	4.05
9.5	4.10
10.0	4.15
10.5	4.20
11.0	4.15
11.5	4.05
12.0	4.00
12.5	3.95
13.0	3.90
13.5	3.90
14.0	3.85
14.5	3.85
15.0	3.85
15.5	3.90
16.0	3.90
16.5	3.90
17.0	3.90
17.5	3.80
18.0	3.75
18.5	3.75

Distance from Left Pin (feet)	07/15/2003 Tape to Bed (feet)
0.0	1.40
0.5	1.40
1.0	1.50
1.5	1.50
2.0	1.60
2.5	1.70
3.0	2.10
3.2	3.25
3.5	3.30
3.9	3.40
4.0	3.50
4.5	3.60
5.0	3.65
5.5	3.60
6.0	3.70
6.5	3.85
7.0	3.80
7.5	3.80
8.0	3.90
8.5	4.00
9.0	4.10
9.5	4.15
10.0	4.20
10.5	4.30
11.0	4.20
11.5	4.10
12.0	4.05
12.5	4.00
13.0	3.95
13.5	3.90
14.0	3.85
14.5	3.85
15.0	3.90
15.5	3.95
16.0	3.90
16.5	3.90
17.0	3.90
17.5	3.90

Distance from Left Pin (feet)	12/16/2003 Tape to Bed (feet)
19.0	3.70
19.5	3.60
20.0	3.50
20.5	3.50
21.0	3.45
21.3	3.45
21.5	2.90
22.0	2.35
22.5	2.50
23.0	2.45
23.5	2.30
24.0	2.10
24.5	1.95
25.0	1.90
25.5	1.80
26.0	1.75
26.5	1.75
27.0	1.50
27.5	1.55
28.0	1.50
28.5	1.45
29.0	1.30

Distance from Left Pin (feet)	07/15/2003 Tape to Bed (feet)
18.0	3.85
18.5	3.85
19.0	3.85
19.2	3.80
19.5	3.55
20.0	3.55
20.5	3.50
21.0	3.50
21.5	2.80
22.00	2.60
22.5	2.60
23.0	2.45
23.5	2.30
24.0	2.20
24.5	2.05
25.0	2.00
25.5	1.85
26.0	1.75
26.5	1.75
27.0	1.80
27.5	1.50
28.0	1.50
28.5	1.55
29.0	1.35

Scour 3: Downstream Transect



Scour 3: Middle transect

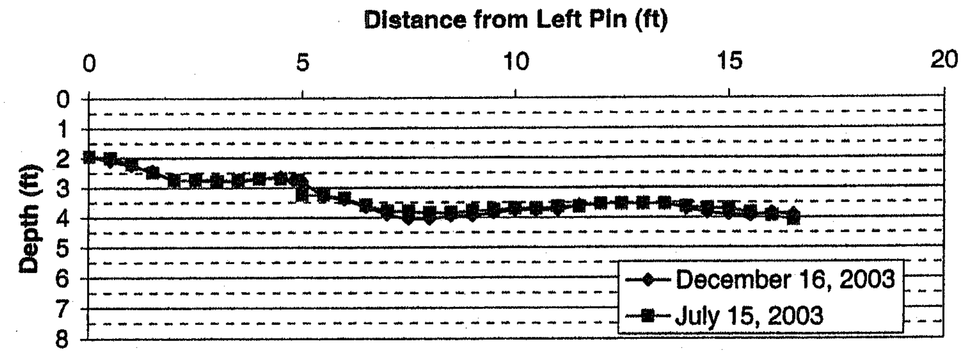
Distance from Left Pin (feet)	12/16/2003 Tape to Bed (feet)
0.0	1.95
0.5	2.10
1.0	2.25
1.5	2.45
2.0	2.75
2.5	2.75
3.0	2.75
3.5	2.80
4.0	2.70
4.5	2.65
4.8	2.75
5.0	2.80
5.5	3.30
6.0	3.40
6.5	3.65
7.0	3.90
7.5	4.05
8.0	4.05
8.5	3.95
9.0	3.95
9.5	3.85
10.0	3.75
10.5	3.75
11.0	3.75
11.5	3.60
12.0	3.55
12.5	3.55
13.0	3.55
13.5	3.55
14.0	3.70
14.5	3.85
15.0	3.90
15.5	3.95
16.0	3.85
16.5	3.90

Distance from Left Pin (feet)	07/15/2003 Tape to Bed (feet)
0.0	1.95
0.5	2.00
1.0	2.20
1.5	2.50
2.0	2.75
2.5	2.75
3.0	2.80
3.5	2.75
4.0	2.70
4.5	2.70
4.9	2.75
5.0	3.25
5.5	3.25
6.0	3.35
6.5	3.60
7.0	3.80
7.5	3.80
8.0	3.85
8.5	3.85
9.0	3.80
9.5	3.75
10.0	3.70
10.5	3.70
11.0	3.65
11.5	3.65
12.0	3.55
12.5	3.55
13.0	3.55
13.5	3.55
14.0	3.65
14.5	3.70
15.0	3.70
15.5	3.85
16.0	3.95
16.5	4.10

Distance from Left Pin (feet)	12/16/2003 Tape to Bed (feet)
17.0	3.85
17.5	4.10
18.0	4.15
18.5	4.15
19.0	4.05
19.5	3.00
20.0	2.30
20.5	1.80
21.0	1.25
21.5	1.25
21.75	1.30

Distance from Left Pin (feet)	07/15/2003 Tape to Bed (feet)
17.0	4.10
17.5	4.05
18.0	4.15
18.5	4.20
19.0	3.80
19.2	3.25
19.5	3.00
20.0	2.40
20.5	1.95
21.0	1.35
21.5	1.25

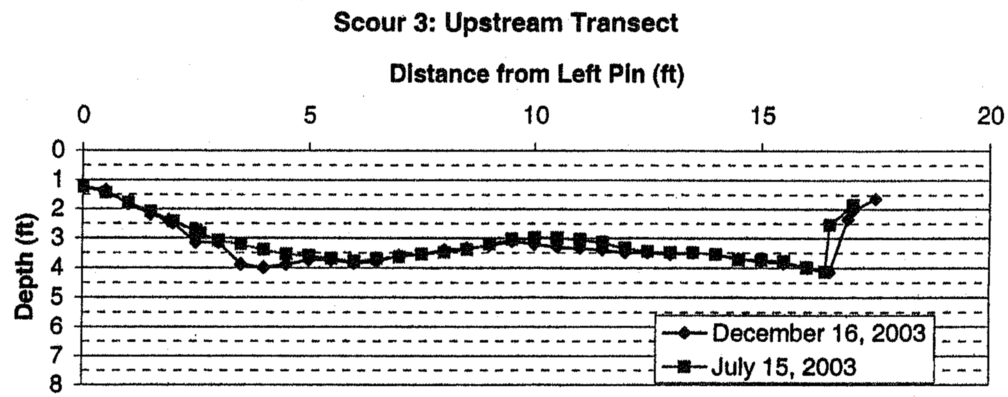
Scour 3: Middle Transect



Scour 3: Upstream transect

Distance from Left Pin (feet)	12/16/2003 Tape to Bed (feet)
0.0	1.25
0.5	1.35
1.0	1.85
1.5	2.20
1.9	2.40
2.0	2.50
2.5	3.15
3.0	3.15
3.5	3.90
4.0	4.00
4.5	3.90
5.0	3.75
5.5	3.75
6.0	3.85
6.5	3.80
7.0	3.60
7.5	3.55
8.0	3.40
8.5	3.35
9.0	3.25
9.5	3.10
10.0	3.20
10.5	3.30
11.0	3.35
11.5	3.40
12.0	3.50
12.5	3.50
13.0	3.55
13.5	3.50
14.0	3.55
14.5	3.70
15.0	3.80
15.5	3.85
16.0	4.00
16.5	4.15
16.9	2.35
17.0	2.05
17.5	1.65

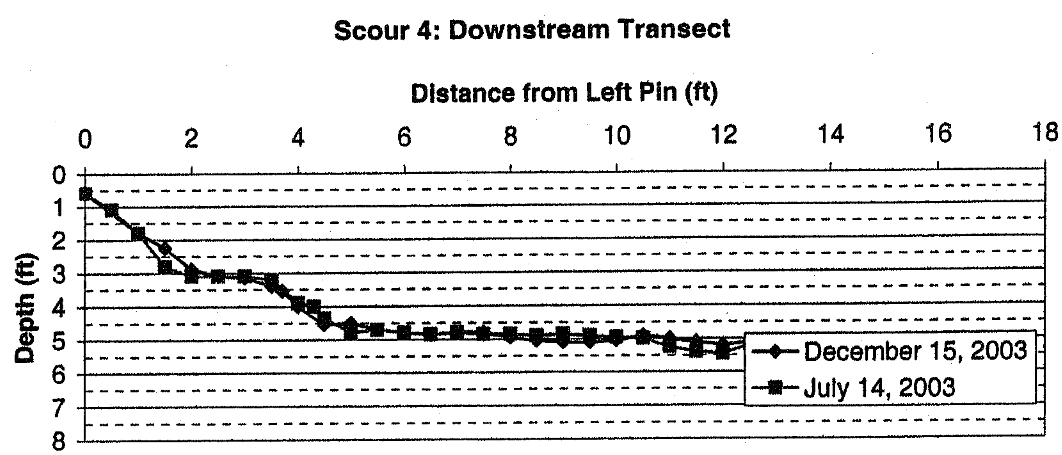
Distance from Left Pin (feet)	07/15/2003 Tape to Bed (feet)
0.0	1.25
0.5	1.45
1.0	1.80
1.5	2.10
2.0	2.45
2.5	2.75
2.6	2.85
3.0	3.10
3.5	3.20
4.0	3.40
4.5	3.55
5.0	3.60
5.5	3.70
6.0	3.80
6.5	3.70
7.0	3.65
7.5	3.55
8.0	3.50
8.5	3.40
9.0	3.20
9.5	3.05
10.0	3.00
10.5	3.00
11.0	3.05
11.5	3.15
12.0	3.35
12.5	3.45
13.0	3.50
13.5	3.50
14.0	3.55
14.5	3.75
15.0	3.75
15.5	3.80
16.0	4.00
16.4	4.15
16.5	2.55
17.0	1.85



Scour 4: Downstream transect

Distance from Left Pin (feet)	12/15/2003 Tape to Bed (feet)
0.0	0.58
1.0	1.80
1.5	2.25
2.0	2.90
2.5	3.10
3.0	3.15
3.5	3.40
3.7	3.55
4.0	4.00
4.5	4.55
5.0	4.50
5.5	4.70
6.0	4.80
6.5	4.85
7.0	4.80
7.5	4.80
8.0	4.95
8.5	5.05
9.0	5.10
9.5	5.10
10.0	5.05
10.5	4.90
11.0	5.00
11.5	5.10
12.0	5.20
12.5	5.10
13.0	5.10
13.5	5.20
14.0	5.20
14.5	5.25
15.0	5.25
15.5	5.10
16.0	4.80
16.5	4.60
17.0	4.35
17.5	4.25
18.0	3.45
18.5	1.75
19.0	1.45
19.2	1.40

Distance from Left Pin (feet)	07/14/2003 Tape to Bed (feet)
0.0	0.58
0.5	1.10
1.0	1.80
1.5	2.80
2.0	3.10
2.5	3.10
3.0	3.10
3.5	3.20
4.0	3.90
4.3	4.00
4.5	4.35
5.0	4.80
5.5	4.70
6.0	4.80
6.5	4.85
7.0	4.80
7.5	4.85
8.0	4.85
8.5	4.90
9.0	4.85
9.5	4.90
10.0	4.95
10.5	5.00
11.0	5.25
11.5	5.40
12.0	5.45
12.5	5.20
13.0	5.50
13.5	5.45
14.0	5.45
14.5	5.35
15.0	5.30
15.5	5.20
16.0	5.05
16.5	4.85
17.0	4.50
17.5	4.05
18.0	3.50
18.1	2.15
18.5	1.80
19.0	1.55

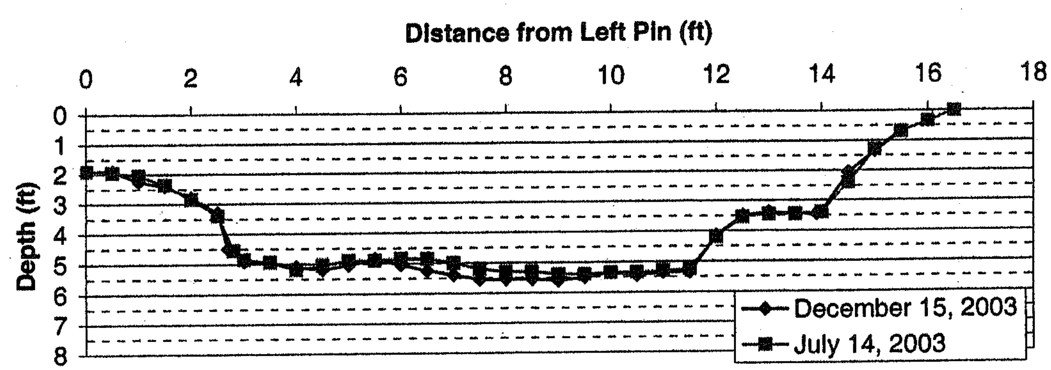


Scour 4: Upstream transect

Distance from Left Pin (feet)	12/15/2003 Tape to Bed (feet)
0.0	1.90
0.5	1.90
1.0	2.25
1.5	2.40
2.0	2.80
2.5	3.30
2.7	4.50
3.0	4.90
3.5	4.95
4.0	5.10
4.5	5.20
5.0	5.05
5.5	4.85
6.0	5.05
6.5	5.25
7.0	5.40
7.5	5.55
8.0	5.55
8.5	5.55
9.0	5.60
9.5	5.50
10.0	5.35
10.5	5.45
11.0	5.35
11.5	5.35
12.0	4.15
12.5	3.50
13.0	3.40
13.5	3.45
13.9	3.45
14.0	3.40
14.5	2.05
15.0	1.35
15.5	0.70
16.0	0.35
16.5	0.00

Distance from Left Pin (feet)	07/14/2003 Tape to Bed (feet)
0.0	1.90
0.5	1.95
1.0	2.05
1.5	2.35
2.0	2.85
2.5	3.40
2.8	4.55
3.0	4.85
3.5	4.95
4.0	5.20
4.5	5.05
5.0	4.90
5.5	4.90
6.0	4.85
6.5	4.85
7.0	5.00
7.5	5.20
8.0	5.30
8.5	5.30
9.0	5.40
9.5	5.40
10.0	5.35
10.5	5.35
11.0	5.30
11.5	5.25
12.0	4.20
12.5	3.55
13.0	3.45
13.5	3.45
14.0	3.40
14.5	2.40
15.0	1.30
15.5	0.70
16.0	0.35
16.5	0.00

Scour 4: Upstream Transect



Scour 5: Downstream transect

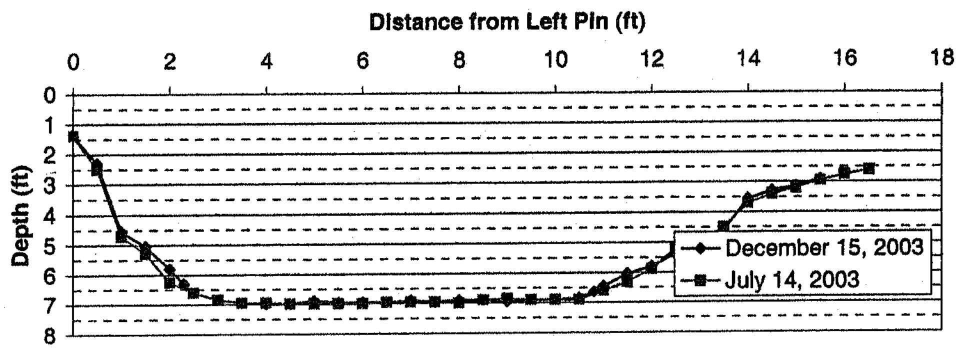
Distance from Left Pin (feet)	12/15/2003 Tape to Bed (feet)
0	1.40
0.5	2.30
1.0	4.55
1.5	5.05
2.0	5.80
2.3	6.30
2.5	6.60
3.0	6.85
3.5	6.95
4.0	7.00
4.5	7.00
5.0	6.90
5.5	6.95
6.0	6.95
6.5	6.95
7.0	6.90
7.5	6.95
8.0	6.90
8.5	6.90
9.0	6.95
9.5	6.90
10.0	6.90
10.5	6.85
10.8	6.65
11.0	6.45
11.5	6.05
12.0	5.80
12.5	5.40
13.0	5.10
13.5	4.60
14.0	3.55
14.5	3.30
15.0	3.15
15.5	2.90

Distance from Left Pin (feet)	07/14/2003 Tape to Bed (feet)
0.0	1.40
0.5	2.50
1.0	4.70
1.5	5.30
2.0	6.25
2.5	6.60
3.0	6.85
3.5	6.95
4.0	6.95
4.5	7.00
5.0	7.00
5.5	7.00
6.0	7.00
6.5	6.95
7.0	6.95
7.5	6.95
8.0	7.00
8.5	6.90
9.0	6.85
9.5	6.90
10.0	6.90
10.5	6.90
11.0	6.60
11.5	6.30
12.0	5.90
12.5	5.20
13.0	4.95
13.5	4.50
14.0	3.70
14.5	3.40
15.0	3.20
15.5	2.95
16.0	2.75
16.5	2.60

Distance from Left Pin (feet)	12/15/2003 Tape to Bed (feet)
16.0	2.70
16.5	2.55
17.0	2.50
17.5	2.40
18.0	1.00
18.5	0.55
18.7	0.55

Distance from Left Pin (feet)	07/14/2003 Tape to Bed (feet)
17.0	2.40

Scour 5: Downstream Transect

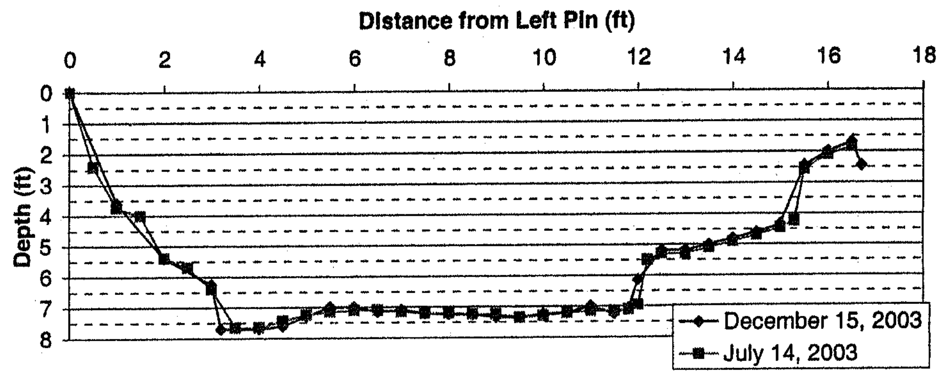


Scour 5: Middle transect

Distance from Left Pin (feet)	12/15/2003 Tape to Bed (feet)
0.0	0.00
1.0	3.60
2.0	5.40
3.0	6.25
3.2	7.70
4.0	7.70
4.5	7.60
5.0	7.30
5.5	7.00
6.0	7.00
6.5	7.15
7.0	7.10
7.5	7.20
8.0	7.25
8.5	7.25
9.0	7.35
9.5	7.35
10.0	7.25
10.5	7.20
11.0	7.00
11.5	7.25
11.8	7.05
12.0	6.15
12.5	5.20
13.0	5.20
13.5	5.00
14.0	4.80
14.5	4.60
15.0	4.35
15.5	2.45
16.0	2.00
16.5	1.70
16.7	2.45

Distance from Left Pin (feet)	07/14/2003 Tape to Bed (feet)
0.0	0.00
0.5	2.40
1.0	3.75
1.5	4.00
2.0	5.40
2.5	5.70
3.0	6.40
3.5	7.65
4.0	7.65
4.5	7.45
5.0	7.25
5.5	7.15
6.0	7.10
6.5	7.10
7.0	7.15
7.5	7.20
8.0	7.20
8.5	7.25
9.0	7.25
9.5	7.35
10.0	7.30
10.5	7.20
11.0	7.15
11.5	7.15
11.8	7.10
12.0	6.95
12.2	5.50
12.5	5.30
13.0	5.30
13.5	5.10
14.0	4.90
14.5	4.70
15.0	4.45
15.3	4.25
15.5	2.55
16.0	2.10
16.5	1.85

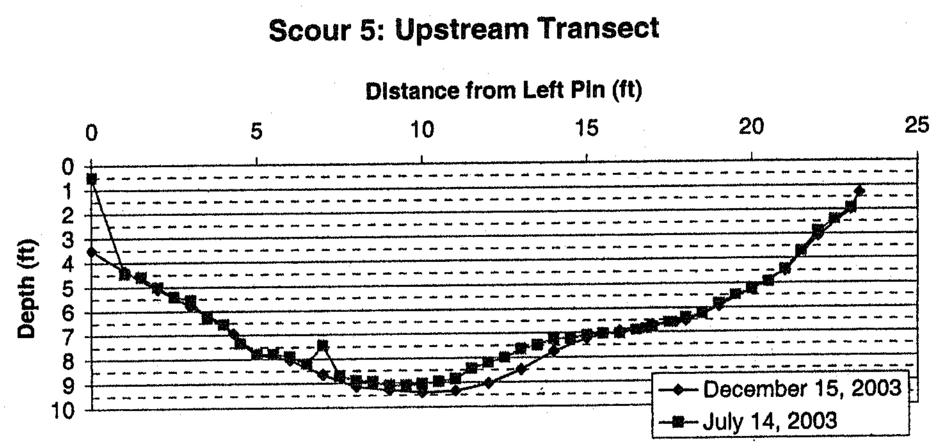
Scour 5: Middle Transect



Scour 5: Upstream transect

Distance from Left Pin (feet)	12/15/2003 Tape to Bed (feet)
0.0	3.50
1.0	4.35
2.0	5.10
3.0	5.80
4.0	6.55
4.3	6.95
5.0	7.80
6.0	8.05
7.0	8.65
8.0	9.15
9.0	9.30
10.0	9.40
11.0	9.35
12.0	9.05
13.0	8.50
14.0	7.75
15.0	7.25
16.0	6.95
17.0	6.70
17.7	6.60
18.0	6.55
19.0	5.95
20.0	5.25
21.0	4.50
22.0	3.10
23.0	2.00
23.25	1.30

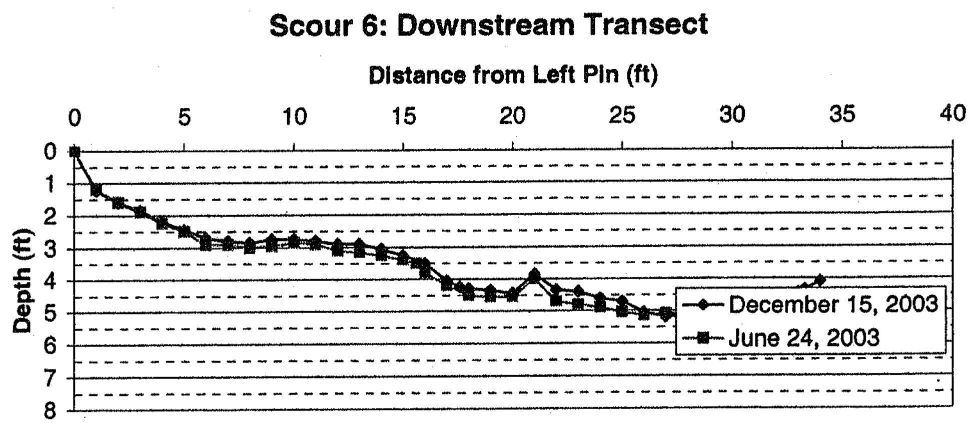
Distance from Left Pin (feet)	07/14/2003 Tape to Bed (feet)
0.0	0.50
1.0	4.45
1.5	4.60
2.0	5.00
2.5	5.40
3.0	5.55
3.5	6.30
4.0	6.55
4.5	7.35
5.0	7.80
5.5	7.80
6.0	7.90
6.5	8.20
7.0	7.45
7.5	8.70
8.0	8.90
8.5	8.95
9.0	9.10
9.5	9.10
10.0	9.05
10.5	8.95
11.0	8.85
11.5	8.45
12.0	8.20
12.5	8.00
13.0	7.65
13.5	7.50
14.0	7.25
14.5	7.25
15.0	7.10
15.5	7.05
16.0	7.05
16.5	6.90
16.8	6.85
17.0	6.80
17.5	6.60
18.0	6.40
18.5	6.25
19.0	5.85
19.5	5.50
20.0	5.25
20.5	4.95
21.0	4.45
21.5	3.70
22.0	2.90
22.5	2.40
23.0	1.95



Scour 6: Downstream transect

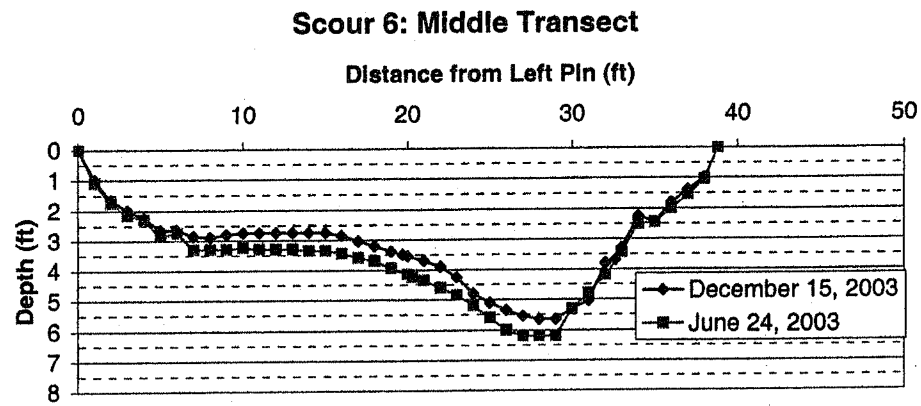
Distance from Left Pin (feet)	12/15/2003 Tape to Bed (feet)
0	0.00
1.0	1.25
2.0	1.60
3.0	1.85
4.0	2.20
5.0	2.45
6.0	2.70
7.0	2.80
8.0	2.85
9.0	2.75
10.0	2.75
11.0	2.80
12.0	2.90
13.0	2.90
14.0	3.05
15.0	3.25
16.0	3.50
17.0	4.05
17.6	4.25
18.0	4.30
19.0	4.35
20.0	4.45
21.0	3.85
22.0	4.35
23.0	4.40
24.0	4.60
25.0	4.70
26.0	5.05
27.0	5.20
28.0	5.15
29.0	5.25
30.0	4.70
31.0	5.20
32.0	4.75
33.0	4.45
33.3	4.35
34.0	4.10
35.0	3.20
36.0	2.85
37.0	2.40
38.0	2.00
39.0	1.10

Distance from Left Pin (feet)	06/24/2003 Tape to Bed (feet)
0	0
1	1.2
2	1.6
3	1.9
4	2.25
5	2.5
6	2.9
7	2.9
8	3
9	2.95
10	2.85
11	2.9
12	3.1
13	3.15
14	3.25
15	3.4
15.6	3.5
16	3.8
17	4.2
18	4.5
19	4.55
20	4.55
21	4
22	4.7
23	4.8
24	4.9
25	5.05
26	5.15
27	5.1
28	5.1
29	5.25
29.5	5.25
30	4.6
31	5.2
32	4.9
33	4.5
33.3	4.5
34	4.05
35	3.1
36	2.85
37	2.3
38	1.95
39.5	0



Scour 6: Middle transect

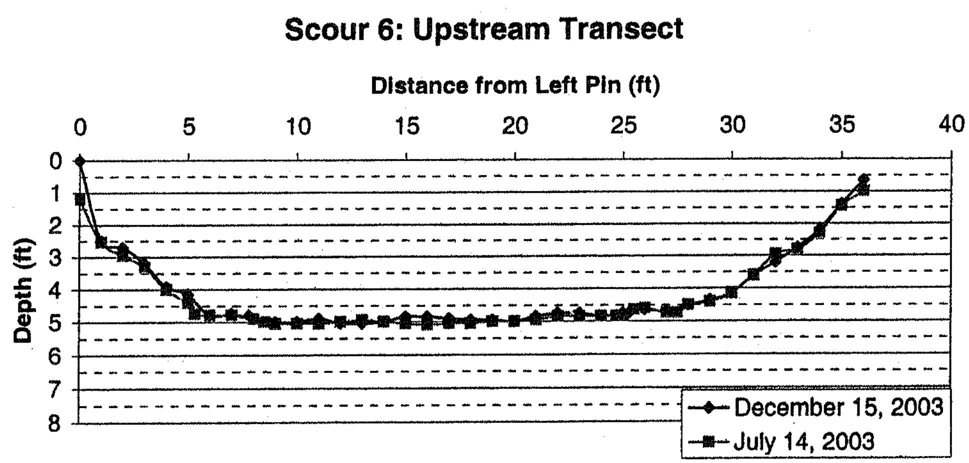
Distance from Left Pin (feet)	12/15/2003 Tape to Bed (feet)	Distance from Left Pin (feet)	06/24/2003 Tape to Bed (feet)	Compare Station
0.0	0.00	0	0	
1.0	1.00	1	1.1	0.10
2.0	1.65	2	1.75	0.10
3.0	2.00	3	2.15	0.15
4.0	2.25	4	2.3	0.05
5.0	2.65	5	2.85	0.20
6.0	2.65	6	2.75	0.10
7.0	2.85	7	3.3	0.45
8.0	2.90	8	3.3	0.40
9.0	2.80	9	3.3	0.50
10.0	2.75	10	3.25	0.50
11.0	2.75	11	3.3	0.55
12.0	2.75	12	3.3	0.55
13.0	2.75	13	3.3	0.55
14.0	2.75	14	3.35	0.60
15.0	2.75	15	3.35	0.60
16.0	2.85	16	3.45	0.60
17.0	3.05	17	3.6	0.55
18.0	3.20	18	3.7	0.50
19.0	3.40	19	3.95	0.55
19.7	3.50	20	4.15	0.60
20.0	3.55	20.3	4.25	
21.0	3.70	21	4.35	0.65
22.0	3.90	22	4.6	0.70
23.0	4.25	23	4.85	0.60
24.0	4.80	24	5.2	0.40
25.0	5.10	25	5.6	0.50
26.0	5.35	26	6	0.65
27.0	5.55	27	6.2	0.65
28.0	5.65	28	6.2	0.55
29.0	5.65	29	6.2	0.55
30.0	5.30	30	5.3	0.00
31.0	5.05	31	4.8	-0.25
32.0	3.80	32	4.2	0.40
32.6	3.70	33	3.45	0.15
33.0	3.30	34	2.5	0.25
34.0	2.25	35	2.45	0.00
35.0	2.45	36	2	0.20
36.0	1.80	37	1.55	0.15
37.0	1.40	38	1.05	0.05
38.0	1.00	38.8	0	



Scour 6: Upstream transect

Distance from Left Pin (feet)	12/15/2003 Tape to Bed (feet)
0.0	0.00
1.0	2.50
2.0	2.70
3.0	3.20
4.0	3.90
5.0	4.15
6.0	4.80
7.0	4.75
8.0	4.90
7.8	4.80
9.0	5.00
10.0	5.00
11.0	4.90
12.0	5.05
13.0	5.05
14.0	5.00
15.0	4.85
16.0	4.85
17.0	4.90
18.0	4.95
19.0	4.95
20.0	5.00
21.0	4.85
22.0	4.75
23.0	4.75
24.0	4.85
25.0	4.75
25.3	4.75
26.0	4.65
27.0	4.70
28.0	4.50
29.0	4.35
30.0	4.15
31.0	3.60
32.0	3.20
33.0	2.75
34.0	2.20
35.0	1.40
36.0	0.65

Distance from Left Pin (feet)	07/14/2003 Tape to Bed (feet)
0.0	1.20
1.0	2.55
2.0	2.95
3.0	3.30
4.0	4.00
5.0	4.40
5.3	4.75
6.0	4.80
7.0	4.80
8.0	4.90
8.5	5.00
9.0	5.05
10.0	5.05
11.0	5.05
12.0	5.00
13.0	4.95
14.0	5.00
15.0	5.05
16.0	5.10
17.0	5.05
18.0	5.05
19.0	5.00
20.0	5.00
21.0	4.95
22.0	4.85
23.0	4.85
24.0	4.85
24.7	4.85
25.0	4.85
25.5	4.65
26.0	4.60
27.0	4.75
27.5	4.75
28.0	4.50
29.0	4.40
30.0	4.15
31.0	3.60
32.0	2.95
33.0	2.80
34.0	2.30
35.0	1.45
36.0	1.00



Wolman Pebble Count Data

MICA CREEK: WOLMAN PEBBLE COUNT DATA

STATION	DATE	SEDIMENT NAME	CODE	SIZE RANGE	TYPE	PERCENT
MS	09/18/2002	Silt/Clay	MM0001	0-1 mm	Riffle 1	0
MS	09/18/2002	Silt/Clay	MM0001	0-1 mm	Riffle 2	0
MS	06/25/2003	Silt/Clay	MM0001	0-1 mm	Riffle 1	0
MS	09/18/2003	Silt/Clay	MM0001	0-1 mm	Riffle 1	0
NF	09/22/2002	Silt/Clay	MM0001	0-1 mm	Riffle 1	2
NF	09/22/2002	Silt/Clay	MM0001	0-1 mm	Riffle 2	0
NF	06/20/2003	Silt/Clay	MM0001	0-1 mm	Riffle 1	0
NF	06/20/2003	Silt/Clay	MM0001	0-1 mm	Riffle 2	0
NF	06/20/2003	Silt/Clay	MM0001	0-1 mm	Riffle 3	0
NF	09/19/2003	Silt/Clay	MM0001	0-1 mm	Riffle 1	0
NF	09/19/2003	Silt/Clay	MM0001	0-1 mm	Riffle 2	0
SF1	09/19/2002	Silt/Clay	MM0001	0-1 mm	Riffle 1	0
SF1	09/19/2002	Silt/Clay	MM0001	0-1 mm	Riffle 2	6
SF1	06/18/2003	Silt/Clay	MM0001	0-1 mm	Riffle 1	0
SF1	06/18/2003	Silt/Clay	MM0001	0-1 mm	Riffle 2	3
SF1	09/17/2003	Silt/Clay	MM0001	0-1 mm	Riffle 1	0
SF1	09/17/2003	Silt/Clay	MM0001	0-1 mm	Riffle 2	0
SF2	09/20/2002	Silt/Clay	MM0001	0-1 mm	Riffle 1	0
SF2	09/20/2002	Silt/Clay	MM0001	0-1 mm	Riffle 2	0
SF2	06/17/2003	Silt/Clay	MM0001	0-1 mm	Riffle 1	2
SF2	06/17/2003	Silt/Clay	MM0001	0-1 mm	Riffle 2	0
SF2	09/16/2003	Silt/Clay	MM0001	0-1 mm	Riffle 1	0
SF2	09/16/2003	Silt/Clay	MM0001	0-1 mm	Riffle 2	0
SF3	09/20/2002	Silt/Clay	MM0001	0-1 mm	Riffle 1	0
SF3	09/20/2002	Silt/Clay	MM0001	0-1 mm	Riffle 2	0
SF3	06/16/2003	Silt/Clay	MM0001	0-1 mm	Riffle 1	0
SF3	06/16/2003	Silt/Clay	MM0001	0-1 mm	Riffle 2	0
SF3	09/15/2003	Silt/Clay	MM0001	0-1 mm	Riffle 1	0
SF3	09/15/2003	Silt/Clay	MM0001	0-1 mm	Riffle 2	0
USF	09/21/2002	Silt/Clay	MM0001	0-1 mm	Riffle 1	2
USF	09/21/2002	Silt/Clay	MM0001	0-1 mm	Riffle 2	0
USF	06/16/2003	Silt/Clay	MM0001	0-1 mm	Riffle 1	0
USF	06/16/2003	Silt/Clay	MM0001	0-1 mm	Riffle 2	0
USF	09/20/2003	Silt/Clay	MM0001	0-1 mm	Riffle 1	0
USF	09/20/2003	Silt/Clay	MM0001	0-1 mm	Riffle 2	0
USF	09/20/2003	Silt/Clay	MM0001	0-1 mm	Riffle 3	0
MS	09/18/2002	Sand	MM0002.5	1.1-2.5 mm	Riffle 1	6
MS	09/18/2002	Sand	MM0002.5	1.1-2.5 mm	Riffle 2	4
MS	06/25/2003	Sand	MM0002.5	1.1-2.5 mm	Riffle 1	11
MS	09/18/2003	Sand	MM0002.5	1.1-2.5 mm	Riffle 1	15
NF	09/22/2002	Sand	MM0002.5	1.1-2.5 mm	Riffle 1	6
NF	09/22/2002	Sand	MM0002.5	1.1-2.5 mm	Riffle 2	4
NF	06/20/2003	Sand	MM0002.5	1.1-2.5 mm	Riffle 1	11
NF	06/20/2003	Sand	MM0002.5	1.1-2.5 mm	Riffle 2	10
NF	06/20/2003	Sand	MM0002.5	1.1-2.5 mm	Riffle 3	7
NF	09/19/2003	Sand	MM0002.5	1.1-2.5 mm	Riffle 1	9
NF	09/19/2003	Sand	MM0002.5	1.1-2.5 mm	Riffle 2	10

STATION	DATE	SEDIMENT NAME	CODE	SIZE RANGE	TYPE	PERCENT
SF1	09/19/2002	Sand	MM0002.5	1.1-2.5 mm	Riffle 1	8
SF1	09/19/2002	Sand	MM0002.5	1.1-2.5 mm	Riffle 2	6
SF1	06/18/2003	Sand	MM0002.5	1.1-2.5 mm	Riffle 1	28
SF1	06/18/2003	Sand	MM0002.5	1.1-2.5 mm	Riffle 2	12
SF1	09/17/2003	Sand	MM0002.5	1.1-2.5 mm	Riffle 1	7
SF1	09/17/2003	Sand	MM0002.5	1.1-2.5 mm	Riffle 2	7
SF2	09/20/2002	Sand	MM0002.5	1.1-2.5 mm	Riffle 1	4
SF2	09/20/2002	Sand	MM0002.5	1.1-2.5 mm	Riffle 2	10
SF2	06/17/2003	Sand	MM0002.5	1.1-2.5 mm	Riffle 1	11
SF2	06/17/2003	Sand	MM0002.5	1.1-2.5 mm	Riffle 2	4
SF2	09/16/2003	Sand	MM0002.5	1.1-2.5 mm	Riffle 1	18
SF2	09/16/2003	Sand	MM0002.5	1.1-2.5 mm	Riffle 2	5
SF3	09/20/2002	Sand	MM0002.5	1.1-2.5 mm	Riffle 1	12
SF3	09/20/2002	Sand	MM0002.5	1.1-2.5 mm	Riffle 2	8
SF3	06/16/2003	Sand	MM0002.5	1.1-2.5 mm	Riffle 1	22
SF3	06/16/2003	Sand	MM0002.5	1.1-2.5 mm	Riffle 2	18
SF3	09/15/2003	Sand	MM0002.5	1.1-2.5 mm	Riffle 1	14
SF3	09/15/2003	Sand	MM0002.5	1.1-2.5 mm	Riffle 2	9
USF	09/21/2002	Sand	MM0002.5	1.1-2.5 mm	Riffle 1	4
USF	09/21/2002	Sand	MM0002.5	1.1-2.5 mm	Riffle 2	6
USF	06/16/2003	Sand	MM0002.5	1.1-2.5 mm	Riffle 1	5
USF	06/16/2003	Sand	MM0002.5	1.1-2.5 mm	Riffle 2	2
USF	09/20/2003	Sand	MM0002.5	1.1-2.5 mm	Riffle 1	4
USF	09/20/2003	Sand	MM0002.5	1.1-2.5 mm	Riffle 2	2
USF	09/20/2003	Sand	MM0002.5	1.1-2.5 mm	Riffle 3	11
MS	09/18/2002	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 1	2
MS	09/18/2002	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 2	2
MS	06/25/2003	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 1	4
MS	09/18/2003	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 1	4
NF	09/22/2002	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 1	6
NF	09/22/2002	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 2	2
NF	06/20/2003	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 1	16
NF	06/20/2003	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 2	16
NF	06/20/2003	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 3	7
NF	09/19/2003	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 1	14
NF	09/19/2003	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 2	8
SF1	09/19/2002	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 1	16
SF1	09/19/2002	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 2	6
SF1	06/18/2003	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 1	25
SF1	06/18/2003	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 2	4
SF1	09/17/2003	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 1	30
SF1	09/17/2003	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 2	7
SF2	09/20/2002	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 1	14
SF2	09/20/2002	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 2	8
SF2	06/17/2003	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 1	10
SF2	06/17/2003	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 2	2
SF2	09/16/2003	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 1	7
SF2	09/16/2003	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 2	10

STATION	DATE	SEDIMENT NAME	CODE	SIZE RANGE	TYPE	PERCENT
SF3	09/20/2002	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 1	2
SF3	09/20/2002	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 2	6
SF3	06/16/2003	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 1	7
SF3	06/16/2003	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 2	2
SF3	09/15/2003	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 1	11
SF3	09/15/2003	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 2	10
USF	09/21/2002	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 1	8
USF	09/21/2002	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 2	6
USF	06/16/2003	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 1	5
USF	06/16/2003	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 2	7
USF	09/20/2003	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 1	8
USF	09/20/2003	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 2	3
USF	09/20/2003	Very Fine Pebble	MM0006	2.51-6 mm	Riffle 3	12
MS	09/18/2002	Pebble	MM0015	6.1-15 mm	Riffle 1	4
MS	09/18/2002	Pebble	MM0015	6.1-15 mm	Riffle 2	0
MS	06/25/2003	Pebble	MM0015	6.1-15 mm	Riffle 1	4
MS	09/18/2003	Pebble	MM0015	6.1-15 mm	Riffle 1	5
NF	09/22/2002	Pebble	MM0015	6.1-15 mm	Riffle 1	28
NF	09/22/2002	Pebble	MM0015	6.1-15 mm	Riffle 2	12
NF	06/20/2003	Pebble	MM0015	6.1-15 mm	Riffle 1	25
NF	06/20/2003	Pebble	MM0015	6.1-15 mm	Riffle 2	30
NF	06/20/2003	Pebble	MM0015	6.1-15 mm	Riffle 3	11
NF	09/19/2003	Pebble	MM0015	6.1-15 mm	Riffle 1	31
NF	09/19/2003	Pebble	MM0015	6.1-15 mm	Riffle 2	12
SF1	09/19/2002	Pebble	MM0015	6.1-15 mm	Riffle 1	44
SF1	09/19/2002	Pebble	MM0015	6.1-15 mm	Riffle 2	14
SF1	06/18/2003	Pebble	MM0015	6.1-15 mm	Riffle 1	26
SF1	06/18/2003	Pebble	MM0015	6.1-15 mm	Riffle 2	11
SF1	09/17/2003	Pebble	MM0015	6.1-15 mm	Riffle 1	43
SF1	09/17/2003	Pebble	MM0015	6.1-15 mm	Riffle 2	19
SF2	09/20/2002	Pebble	MM0015	6.1-15 mm	Riffle 1	8
SF2	09/20/2002	Pebble	MM0015	6.1-15 mm	Riffle 2	16
SF2	06/17/2003	Pebble	MM0015	6.1-15 mm	Riffle 1	8
SF2	06/17/2003	Pebble	MM0015	6.1-15 mm	Riffle 2	5
SF2	09/16/2003	Pebble	MM0015	6.1-15 mm	Riffle 1	7
SF2	09/16/2003	Pebble	MM0015	6.1-15 mm	Riffle 2	0
SF3	09/20/2002	Pebble	MM0015	6.1-15 mm	Riffle 1	6
SF3	09/20/2002	Pebble	MM0015	6.1-15 mm	Riffle 2	6
SF3	06/16/2003	Pebble	MM0015	6.1-15 mm	Riffle 1	6
SF3	06/16/2003	Pebble	MM0015	6.1-15 mm	Riffle 2	5
SF3	09/15/2003	Pebble	MM0015	6.1-15 mm	Riffle 1	9
SF3	09/15/2003	Pebble	MM0015	6.1-15 mm	Riffle 2	6
USF	09/21/2002	Pebble	MM0015	6.1-15 mm	Riffle 1	16
USF	09/21/2002	Pebble	MM0015	6.1-15 mm	Riffle 2	16
USF	06/16/2003	Pebble	MM0015	6.1-15 mm	Riffle 1	21
USF	06/16/2003	Pebble	MM0015	6.1-15 mm	Riffle 2	27
USF	09/20/2003	Pebble	MM0015	6.1-15 mm	Riffle 1	17
USF	09/20/2003	Pebble	MM0015	6.1-15 mm	Riffle 2	11

STATION	DATE	SEDIMENT NAME	CODE	SIZE RANGE	TYPE	PERCENT
USF	09/20/2003	Pebble	MM0015	6.1-15 mm	Riffle 3	18
MS	09/18/2002	Coarse Pebble	MM0031	15.1-31 mm	Riffle 1	2
MS	09/18/2002	Coarse Pebble	MM0031	15.1-31 mm	Riffle 2	12
MS	06/25/2003	Coarse Pebble	MM0031	15.1-31 mm	Riffle 1	2
MS	09/18/2003	Coarse Pebble	MM0031	15.1-31 mm	Riffle 1	4
NF	09/22/2002	Coarse Pebble	MM0031	15.1-31 mm	Riffle 1	48
NF	09/22/2002	Coarse Pebble	MM0031	15.1-31 mm	Riffle 2	38
NF	06/20/2003	Coarse Pebble	MM0031	15.1-31 mm	Riffle 1	38
NF	06/20/2003	Coarse Pebble	MM0031	15.1-31 mm	Riffle 2	37
NF	06/20/2003	Coarse Pebble	MM0031	15.1-31 mm	Riffle 3	30
NF	09/19/2003	Coarse Pebble	MM0031	15.1-31 mm	Riffle 1	42
NF	09/19/2003	Coarse Pebble	MM0031	15.1-31 mm	Riffle 2	30
SF1	09/19/2002	Coarse Pebble	MM0031	15.1-31 mm	Riffle 1	12
SF1	09/19/2002	Coarse Pebble	MM0031	15.1-31 mm	Riffle 2	12
SF1	06/18/2003	Coarse Pebble	MM0031	15.1-31 mm	Riffle 1	9
SF1	06/18/2003	Coarse Pebble	MM0031	15.1-31 mm	Riffle 2	14
SF1	09/17/2003	Coarse Pebble	MM0031	15.1-31 mm	Riffle 1	7
SF1	09/17/2003	Coarse Pebble	MM0031	15.1-31 mm	Riffle 2	10
SF2	09/20/2002	Coarse Pebble	MM0031	15.1-31 mm	Riffle 1	0
SF2	09/20/2002	Coarse Pebble	MM0031	15.1-31 mm	Riffle 2	12
SF2	06/17/2003	Coarse Pebble	MM0031	15.1-31 mm	Riffle 1	21
SF2	06/17/2003	Coarse Pebble	MM0031	15.1-31 mm	Riffle 2	13
SF2	09/16/2003	Coarse Pebble	MM0031	15.1-31 mm	Riffle 1	11
SF2	09/16/2003	Coarse Pebble	MM0031	15.1-31 mm	Riffle 2	8
SF3	09/20/2002	Coarse Pebble	MM0031	15.1-31 mm	Riffle 1	2
SF3	09/20/2002	Coarse Pebble	MM0031	15.1-31 mm	Riffle 2	8
SF3	06/16/2003	Coarse Pebble	MM0031	15.1-31 mm	Riffle 1	11
SF3	06/16/2003	Coarse Pebble	MM0031	15.1-31 mm	Riffle 2	7
SF3	09/15/2003	Coarse Pebble	MM0031	15.1-31 mm	Riffle 1	12
SF3	09/15/2003	Coarse Pebble	MM0031	15.1-31 mm	Riffle 2	12
USF	09/21/2002	Coarse Pebble	MM0031	15.1-31 mm	Riffle 1	28
USF	09/21/2002	Coarse Pebble	MM0031	15.1-31 mm	Riffle 2	28
USF	06/16/2003	Coarse Pebble	MM0031	15.1-31 mm	Riffle 1	26
USF	06/16/2003	Coarse Pebble	MM0031	15.1-31 mm	Riffle 2	29
USF	09/20/2003	Coarse Pebble	MM0031	15.1-31 mm	Riffle 1	19
USF	09/20/2003	Coarse Pebble	MM0031	15.1-31 mm	Riffle 2	21
USF	09/20/2003	Coarse Pebble	MM0031	15.1-31 mm	Riffle 3	27
MS	09/18/2002	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 1	26
MS	09/18/2002	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 2	26
MS	06/25/2003	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 1	17
MS	09/18/2003	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 1	11
NF	09/22/2002	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 1	10
NF	09/22/2002	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 2	42
NF	06/20/2003	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 1	10
NF	06/20/2003	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 2	7
NF	06/20/2003	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 3	39
NF	09/19/2003	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 1	5
NF	09/19/2003	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 2	38

STATION	DATE	SEDIMENT NAME	CODE	SIZE RANGE	TYPE	PERCENT
SF1	09/19/2002	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 1	18
SF1	09/19/2002	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 2	10
SF1	06/18/2003	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 1	2
SF1	06/18/2003	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 2	11
SF1	09/17/2003	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 1	2
SF1	09/17/2003	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 2	12
SF2	09/20/2002	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 1	6
SF2	09/20/2002	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 2	6
SF2	06/17/2003	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 1	10
SF2	06/17/2003	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 2	15
SF2	09/16/2003	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 1	13
SF2	09/16/2003	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 2	14
SF3	09/20/2002	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 1	0
SF3	09/20/2002	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 2	8
SF3	06/16/2003	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 1	4
SF3	06/16/2003	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 2	3
SF3	09/15/2003	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 1	5
SF3	09/15/2003	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 2	19
USF	09/21/2002	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 1	34
USF	09/21/2002	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 2	26
USF	06/16/2003	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 1	22
USF	06/16/2003	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 2	21
USF	09/20/2003	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 1	28
USF	09/20/2003	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 2	30
USF	09/20/2003	Very Coarse Pebble	MM0064	31.1-64 mm	Riffle 3	21
MS	09/18/2002	Small Cobble	MM0128	64.1-128 mm	Riffle 1	22
MS	09/18/2002	Small Cobble	MM0128	64.1-128 mm	Riffle 2	48
MS	06/25/2003	Small Cobble	MM0128	64.1-128 mm	Riffle 1	39
MS	09/18/2003	Small Cobble	MM0128	64.1-128 mm	Riffle 1	31
NF	09/22/2002	Small Cobble	MM0128	64.1-128 mm	Riffle 1	0
NF	09/22/2002	Small Cobble	MM0128	64.1-128 mm	Riffle 2	2
NF	06/20/2003	Small Cobble	MM0128	64.1-128 mm	Riffle 1	0
NF	06/20/2003	Small Cobble	MM0128	64.1-128 mm	Riffle 2	0
NF	06/20/2003	Small Cobble	MM0128	64.1-128 mm	Riffle 3	6
NF	09/19/2003	Small Cobble	MM0128	64.1-128 mm	Riffle 1	0
NF	09/19/2003	Small Cobble	MM0128	64.1-128 mm	Riffle 2	2
SF1	09/19/2002	Small Cobble	MM0128	64.1-128 mm	Riffle 1	2
SF1	09/19/2002	Small Cobble	MM0128	64.1-128 mm	Riffle 2	16
SF1	06/18/2003	Small Cobble	MM0128	64.1-128 mm	Riffle 1	8
SF1	06/18/2003	Small Cobble	MM0128	64.1-128 mm	Riffle 2	18
SF1	09/17/2003	Small Cobble	MM0128	64.1-128 mm	Riffle 1	9
SF1	09/17/2003	Small Cobble	MM0128	64.1-128 mm	Riffle 2	19
SF2	09/20/2002	Small Cobble	MM0128	64.1-128 mm	Riffle 1	28
SF2	09/20/2002	Small Cobble	MM0128	64.1-128 mm	Riffle 2	24
SF2	06/17/2003	Small Cobble	MM0128	64.1-128 mm	Riffle 1	16
SF2	06/17/2003	Small Cobble	MM0128	64.1-128 mm	Riffle 2	16
SF2	09/16/2003	Small Cobble	MM0128	64.1-128 mm	Riffle 1	11
SF2	09/16/2003	Small Cobble	MM0128	64.1-128 mm	Riffle 2	14

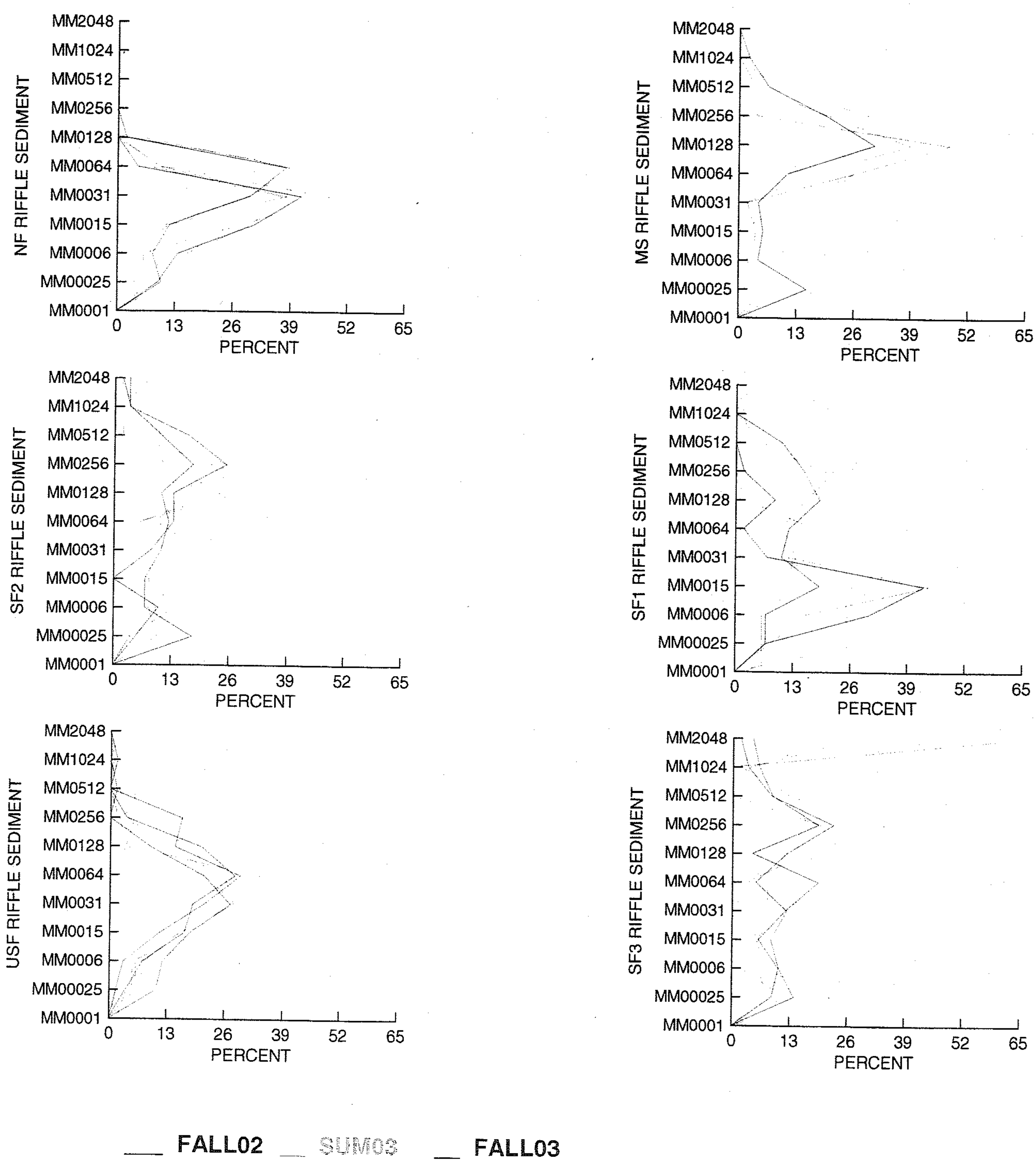
STATION	DATE	SEDIMENT NAME	CODE	SIZE RANGE	TYPE	PERCENT
SF3	09/20/2002	Small Cobble	MM0128	64.1-128 mm	Riffle 1	6
SF3	09/20/2002	Small Cobble	MM0128	64.1-128 mm	Riffle 2	12
SF3	06/16/2003	Small Cobble	MM0128	64.1-128 mm	Riffle 1	11
SF3	06/16/2003	Small Cobble	MM0128	64.1-128 mm	Riffle 2	16
SF3	09/15/2003	Small Cobble	MM0128	64.1-128 mm	Riffle 1	12
SF3	09/15/2003	Small Cobble	MM0128	64.1-128 mm	Riffle 2	4
USF	09/21/2002	Small Cobble	MM0128	64.1-128 mm	Riffle 1	4
USF	09/21/2002	Small Cobble	MM0128	64.1-128 mm	Riffle 2	12
USF	06/16/2003	Small Cobble	MM0128	64.1-128 mm	Riffle 1	19
USF	06/16/2003	Small Cobble	MM0128	64.1-128 mm	Riffle 2	4
USF	09/20/2003	Small Cobble	MM0128	64.1-128 mm	Riffle 1	21
USF	09/20/2003	Small Cobble	MM0128	64.1-128 mm	Riffle 2	15
USF	09/20/2003	Small Cobble	MM0128	64.1-128 mm	Riffle 3	9
MS	09/18/2002	Large Cobble	MM0256	128.1-256 mm	Riffle 1	30
MS	09/18/2002	Large Cobble	MM0256	128.1-256 mm	Riffle 2	4
MS	06/25/2003	Large Cobble	MM0256	128.1-256 mm	Riffle 1	20
MS	09/18/2003	Large Cobble	MM0256	128.1-256 mm	Riffle 1	20
NF	09/22/2002	Large Cobble	MM0256	128.1-256 mm	Riffle 1	0
NF	09/22/2002	Large Cobble	MM0256	128.1-256 mm	Riffle 2	0
NF	06/20/2003	Large Cobble	MM0256	128.1-256 mm	Riffle 1	0
NF	06/20/2003	Large Cobble	MM0256	128.1-256 mm	Riffle 2	0
NF	06/20/2003	Large Cobble	MM0256	128.1-256 mm	Riffle 3	0
NF	09/19/2003	Large Cobble	MM0256	128.1-256 mm	Riffle 1	0
NF	09/19/2003	Large Cobble	MM0256	128.1-256 mm	Riffle 2	0
SF1	09/19/2002	Large Cobble	MM0256	128.1-256 mm	Riffle 1	0
SF1	09/19/2002	Large Cobble	MM0256	128.1-256 mm	Riffle 2	22
SF1	06/18/2003	Large Cobble	MM0256	128.1-256 mm	Riffle 1	2
SF1	06/18/2003	Large Cobble	MM0256	128.1-256 mm	Riffle 2	20
SF1	09/17/2003	Large Cobble	MM0256	128.1-256 mm	Riffle 1	2
SF1	09/17/2003	Large Cobble	MM0256	128.1-256 mm	Riffle 2	16
SF2	09/20/2002	Large Cobble	MM0256	128.1-256 mm	Riffle 1	22
SF2	09/20/2002	Large Cobble	MM0256	128.1-256 mm	Riffle 2	12
SF2	06/17/2003	Large Cobble	MM0256	128.1-256 mm	Riffle 1	11
SF2	06/17/2003	Large Cobble	MM0256	128.1-256 mm	Riffle 2	25
SF2	09/16/2003	Large Cobble	MM0256	128.1-256 mm	Riffle 1	18
SF2	09/16/2003	Large Cobble	MM0256	128.1-256 mm	Riffle 2	25
SF3	09/20/2002	Large Cobble	MM0256	128.1-256 mm	Riffle 1	8
SF3	09/20/2002	Large Cobble	MM0256	128.1-256 mm	Riffle 2	20
SF3	06/16/2003	Large Cobble	MM0256	128.1-256 mm	Riffle 1	17
SF3	06/16/2003	Large Cobble	MM0256	128.1-256 mm	Riffle 2	34
SF3	09/15/2003	Large Cobble	MM0256	128.1-256 mm	Riffle 1	23
SF3	09/15/2003	Large Cobble	MM0256	128.1-256 mm	Riffle 2	19
USF	09/21/2002	Large Cobble	MM0256	128.1-256 mm	Riffle 1	2
USF	09/21/2002	Large Cobble	MM0256	128.1-256 mm	Riffle 2	4
USF	06/16/2003	Large Cobble	MM0256	128.1-256 mm	Riffle 1	2
USF	06/16/2003	Large Cobble	MM0256	128.1-256 mm	Riffle 2	5
USF	09/20/2003	Large Cobble	MM0256	128.1-256 mm	Riffle 1	4
USF	09/20/2003	Large Cobble	MM0256	128.1-256 mm	Riffle 2	16

STATION	DATE	SEDIMENT NAME	CODE	SIZE RANGE	TYPE	PERCENT
USF	09/20/2003	Large Cobble	MM0256	128.1-256 mm	Riffle 3	0
MS	09/18/2002	Small Boulder	MM0512	256.1-512 mm	Riffle 1	8
MS	09/18/2002	Small Boulder	MM0512	256.1-512 mm	Riffle 2	4
MS	06/25/2003	Small Boulder	MM0512	256.1-512 mm	Riffle 1	4
MS	09/18/2003	Small Boulder	MM0512	256.1-512 mm	Riffle 1	7
NF	09/22/2002	Small Boulder	MM0512	256.1-512 mm	Riffle 1	0
NF	09/22/2002	Small Boulder	MM0512	256.1-512 mm	Riffle 2	0
NF	06/20/2003	Small Boulder	MM0512	256.1-512 mm	Riffle 1	0
NF	06/20/2003	Small Boulder	MM0512	256.1-512 mm	Riffle 2	0
NF	06/20/2003	Small Boulder	MM0512	256.1-512 mm	Riffle 3	0
NF	09/19/2003	Small Boulder	MM0512	256.1-512 mm	Riffle 1	0
NF	09/19/2003	Small Boulder	MM0512	256.1-512 mm	Riffle 2	0
SF1	09/19/2002	Small Boulder	MM0512	256.1-512 mm	Riffle 1	0
SF1	09/19/2002	Small Boulder	MM0512	256.1-512 mm	Riffle 2	6
SF1	06/18/2003	Small Boulder	MM0512	256.1-512 mm	Riffle 1	0
SF1	06/18/2003	Small Boulder	MM0512	256.1-512 mm	Riffle 2	4
SF1	09/17/2003	Small Boulder	MM0512	256.1-512 mm	Riffle 1	0
SF1	09/17/2003	Small Boulder	MM0512	256.1-512 mm	Riffle 2	10
SF2	09/20/2002	Small Boulder	MM0512	256.1-512 mm	Riffle 1	4
SF2	09/20/2002	Small Boulder	MM0512	256.1-512 mm	Riffle 2	2
SF2	06/17/2003	Small Boulder	MM0512	256.1-512 mm	Riffle 1	10
SF2	06/17/2003	Small Boulder	MM0512	256.1-512 mm	Riffle 2	11
SF2	09/16/2003	Small Boulder	MM0512	256.1-512 mm	Riffle 1	11
SF2	09/16/2003	Small Boulder	MM0512	256.1-512 mm	Riffle 2	17
SF3	09/20/2002	Small Boulder	MM0512	256.1-512 mm	Riffle 1	0
SF3	09/20/2002	Small Boulder	MM0512	256.1-512 mm	Riffle 2	0
SF3	06/16/2003	Small Boulder	MM0512	256.1-512 mm	Riffle 1	15
SF3	06/16/2003	Small Boulder	MM0512	256.1-512 mm	Riffle 2	13
SF3	09/15/2003	Small Boulder	MM0512	256.1-512 mm	Riffle 1	9
SF3	09/15/2003	Small Boulder	MM0512	256.1-512 mm	Riffle 2	9
USF	09/21/2002	Small Boulder	MM0512	256.1-512 mm	Riffle 1	0
USF	09/21/2002	Small Boulder	MM0512	256.1-512 mm	Riffle 2	2
USF	06/16/2003	Small Boulder	MM0512	256.1-512 mm	Riffle 1	0
USF	06/16/2003	Small Boulder	MM0512	256.1-512 mm	Riffle 2	5
USF	09/20/2003	Small Boulder	MM0512	256.1-512 mm	Riffle 1	0
USF	09/20/2003	Small Boulder	MM0512	256.1-512 mm	Riffle 2	0
USF	09/20/2003	Small Boulder	MM0512	256.1-512 mm	Riffle 3	2
MS	09/18/2002	Medium Boulder	MM1024	512.1-1024 mm	Riffle 1	0
MS	09/18/2002	Medium Boulder	MM1024	512.1-1024 mm	Riffle 2	0
MS	06/25/2003	Medium Boulder	MM1024	512.1-1024 mm	Riffle 1	0
MS	09/18/2003	Medium Boulder	MM1024	512.1-1024 mm	Riffle 1	2
NF	09/22/2002	Medium Boulder	MM1024	512.1-1024 mm	Riffle 1	0
NF	09/22/2002	Medium Boulder	MM1024	512.1-1024 mm	Riffle 2	0
NF	06/20/2003	Medium Boulder	MM1024	512.1-1024 mm	Riffle 1	0
NF	06/20/2003	Medium Boulder	MM1024	512.1-1024 mm	Riffle 2	0
NF	06/20/2003	Medium Boulder	MM1024	512.1-1024 mm	Riffle 3	0
NF	09/19/2003	Medium Boulder	MM1024	512.1-1024 mm	Riffle 1	0
NF	09/19/2003	Medium Boulder	MM1024	512.1-1024 mm	Riffle 2	0

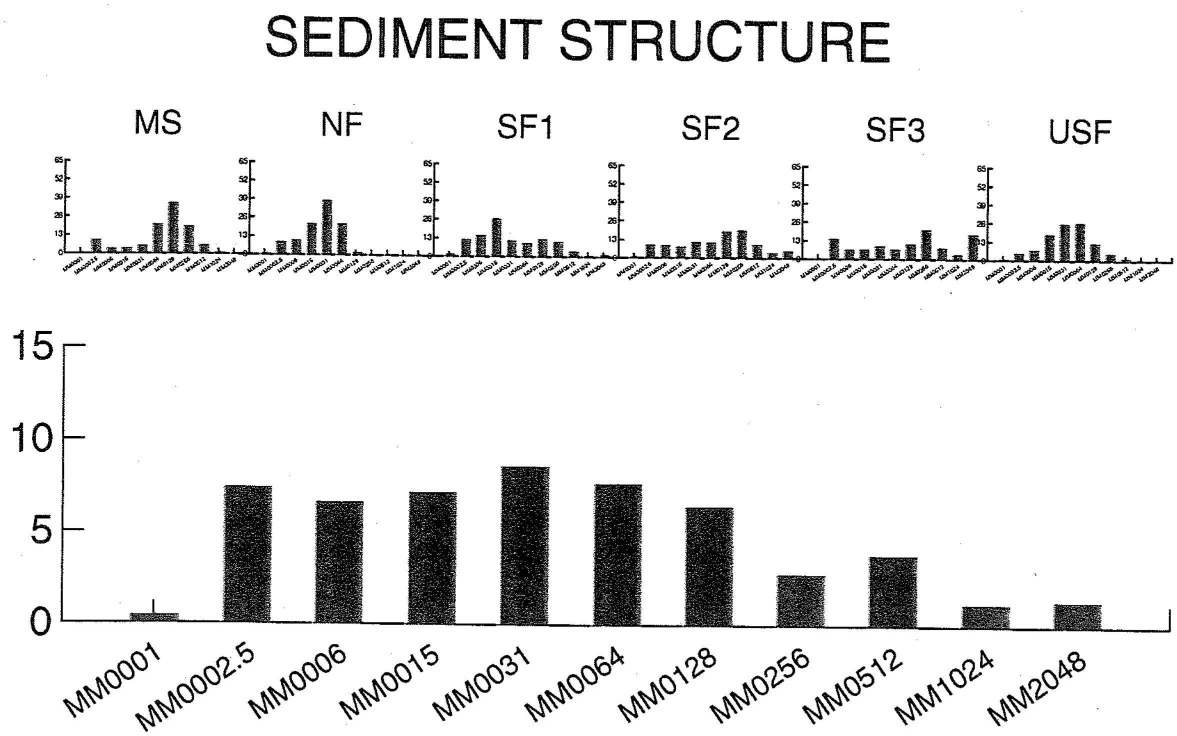
STATION	DATE	SEDIMENT NAME	CODE	SIZE RANGE	TYPE	PERCENT
SF1	09/19/2002	Medium Boulder	MM1024	512.1-1024 mm	Riffle 1	0
SF1	09/19/2002	Medium Boulder	MM1024	512.1-1024 mm	Riffle 2	0
SF1	06/18/2003	Medium Boulder	MM1024	512.1-1024 mm	Riffle 1	0
SF1	06/18/2003	Medium Boulder	MM1024	512.1-1024 mm	Riffle 2	1
SF1	09/17/2003	Medium Boulder	MM1024	512.1-1024 mm	Riffle 1	0
SF1	09/17/2003	Medium Boulder	MM1024	512.1-1024 mm	Riffle 2	0
SF2	09/20/2002	Medium Boulder	MM1024	512.1-1024 mm	Riffle 1	6
SF2	09/20/2002	Medium Boulder	MM1024	512.1-1024 mm	Riffle 2	2
SF2	06/17/2003	Medium Boulder	MM1024	512.1-1024 mm	Riffle 1	2
SF2	06/17/2003	Medium Boulder	MM1024	512.1-1024 mm	Riffle 2	4
SF2	09/16/2003	Medium Boulder	MM1024	512.1-1024 mm	Riffle 1	4
SF2	09/16/2003	Medium Boulder	MM1024	512.1-1024 mm	Riffle 2	3
SF3	09/20/2002	Medium Boulder	MM1024	512.1-1024 mm	Riffle 1	0
SF3	09/20/2002	Medium Boulder	MM1024	512.1-1024 mm	Riffle 2	4
SF3	06/16/2003	Medium Boulder	MM1024	512.1-1024 mm	Riffle 1	2
SF3	06/16/2003	Medium Boulder	MM1024	512.1-1024 mm	Riffle 2	2
SF3	09/15/2003	Medium Boulder	MM1024	512.1-1024 mm	Riffle 1	4
SF3	09/15/2003	Medium Boulder	MM1024	512.1-1024 mm	Riffle 2	6
USF	09/21/2002	Medium Boulder	MM1024	512.1-1024 mm	Riffle 1	0
USF	09/21/2002	Medium Boulder	MM1024	512.1-1024 mm	Riffle 2	0
USF	06/16/2003	Medium Boulder	MM1024	512.1-1024 mm	Riffle 1	0
USF	06/16/2003	Medium Boulder	MM1024	512.1-1024 mm	Riffle 2	0
USF	09/20/2003	Medium Boulder	MM1024	512.1-1024 mm	Riffle 1	0
USF	09/20/2003	Medium Boulder	MM1024	512.1-1024 mm	Riffle 2	2
USF	09/20/2003	Medium Boulder	MM1024	512.1-1024 mm	Riffle 3	0
MS	09/18/2002	Large Boulder	MM2048	+1024.1 mm	Riffle 1	0
MS	09/18/2002	Large Boulder	MM2048	+1024.1 mm	Riffle 2	0
MS	06/25/2003	Large Boulder	MM2048	+1024.1 mm	Riffle 1	0
MS	09/18/2003	Large Boulder	MM2048	+1024.1 mm	Riffle 1	0
NF	09/22/2002	Large Boulder	MM2048	+1024.1 mm	Riffle 1	0
NF	09/22/2002	Large Boulder	MM2048	+1024.1 mm	Riffle 2	0
NF	06/20/2003	Large Boulder	MM2048	+1024.1 mm	Riffle 1	0
NF	06/20/2003	Large Boulder	MM2048	+1024.1 mm	Riffle 2	0
NF	06/20/2003	Large Boulder	MM2048	+1024.1 mm	Riffle 3	0
NF	09/19/2003	Large Boulder	MM2048	+1024.1 mm	Riffle 1	0
NF	09/19/2003	Large Boulder	MM2048	+1024.1 mm	Riffle 2	0
SF1	09/19/2002	Large Boulder	MM2048	+1024.1 mm	Riffle 1	0
SF1	09/19/2002	Large Boulder	MM2048	+1024.1 mm	Riffle 2	2
SF1	06/18/2003	Large Boulder	MM2048	+1024.1 mm	Riffle 1	0
SF1	06/18/2003	Large Boulder	MM2048	+1024.1 mm	Riffle 2	3
SF1	09/17/2003	Large Boulder	MM2048	+1024.1 mm	Riffle 1	0
SF1	09/17/2003	Large Boulder	MM2048	+1024.1 mm	Riffle 2	0
SF2	09/20/2002	Large Boulder	MM2048	+1024.1 mm	Riffle 1	8
SF2	09/20/2002	Large Boulder	MM2048	+1024.1 mm	Riffle 2	8
SF2	06/17/2003	Large Boulder	MM2048	+1024.1 mm	Riffle 1	2
SF2	06/17/2003	Large Boulder	MM2048	+1024.1 mm	Riffle 2	5
SF2	09/16/2003	Large Boulder	MM2048	+1024.1 mm	Riffle 1	2
SF2	09/16/2003	Large Boulder	MM2048	+1024.1 mm	Riffle 2	3

STATION	DATE	SEDIMENT NAME	CODE	SIZE RANGE	TYPE	PERCENT
SF3	09/20/2002	Large Boulder	MM2048	+1024.1 mm	Riffle 1	64
SF3	09/20/2002	Large Boulder	MM2048	+1024.1 mm	Riffle 2	28
SF3	06/16/2003	Large Boulder	MM2048	+1024.1 mm	Riffle 1	6
SF3	06/16/2003	Large Boulder	MM2048	+1024.1 mm	Riffle 2	0
SF3	09/15/2003	Large Boulder	MM2048	+1024.1 mm	Riffle 1	2
SF3	09/15/2003	Large Boulder	MM2048	+1024.1 mm	Riffle 2	4
USF	09/21/2002	Large Boulder	MM2048	+1024.1 mm	Riffle 1	2
USF	09/21/2002	Large Boulder	MM2048	+1024.1 mm	Riffle 2	0
USF	06/16/2003	Large Boulder	MM2048	+1024.1 mm	Riffle 1	0
USF	06/16/2003	Large Boulder	MM2048	+1024.1 mm	Riffle 2	0
USF	09/20/2003	Large Boulder	MM2048	+1024.1 mm	Riffle 1	0
USF	09/20/2003	Large Boulder	MM2048	+1024.1 mm	Riffle 2	0
USF	09/20/2003	Large Boulder	MM2048	+1024.1 mm	Riffle 3	0

Wolman Pebble Count Analysis Traces



Wolman Pebble Count Sediment Structure



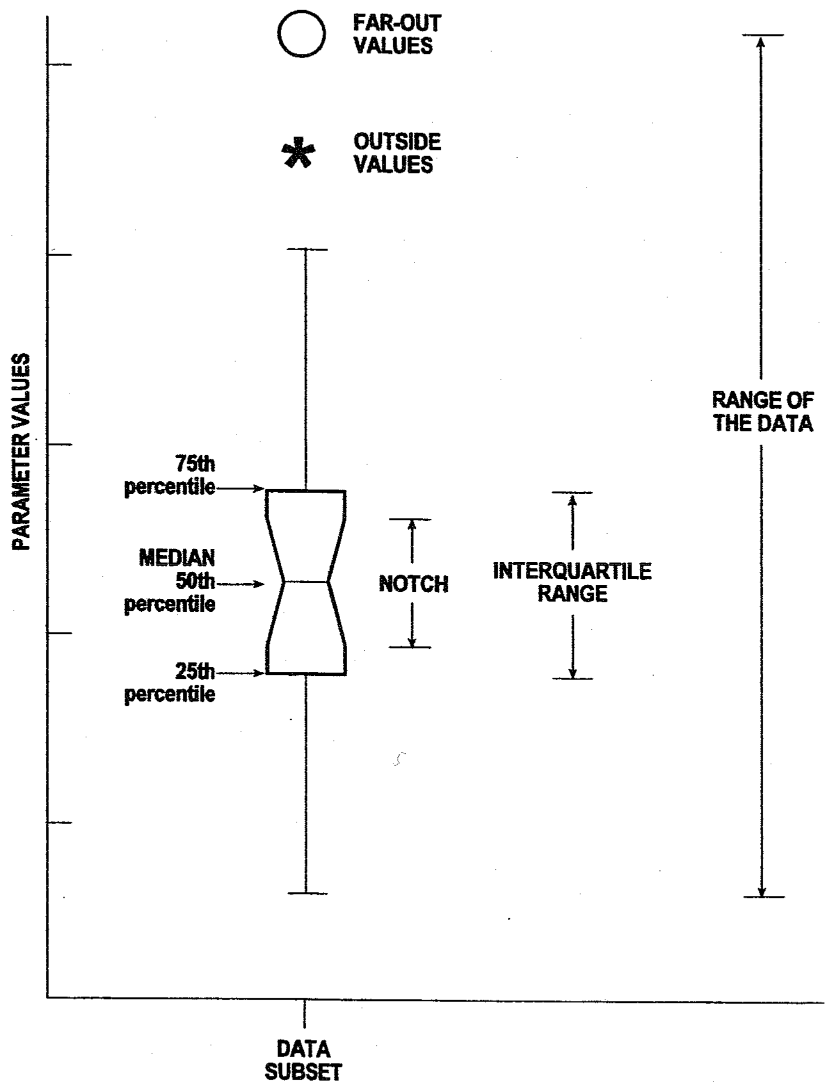
Macroinvertebrate Data and Data Runs

MICA CREEK MACROINVERTEBRATE CROSS-REFERENCE
TAXA BY HABITAT SUMMARY

TAXA	POOL	RIFFLE	HABITAT	TOTAL	CODE
Aeshna	1	-	P	1	P01
Ametor	1	-	P	1	P02
Constempellina	1	-	P	1	P03
Empididae	1	-	P	1	P04
Ephydridae	1	-	P	1	P05
Fossaria	1	-	P	1	P06
Haplotaxis	1	-	P	1	P07
Hexatoma	1	-	P	1	P08
Hydrobius	1	-	P	1	P09
Hydroporus	1	-	P	1	P10
Krenosmittia	1	-	P	1	P11
Nixe	1	-	P	1	P12
Odontomesa	1	-	P	1	P13
Onocosmoecus unicolor	1	-	P	1	P14
Ostracoda	1	-	P	1	P15
Paracladopelma	1	-	P	1	P16
Phryganeidae	1	-	P	1	P17
Planorbidae	1	-	P	1	P18
Visoka cataractae	1	-	P	1	P19
Cryptochironomus	2	-	P	2	P20
Helophorus	2	-	P	2	P21
Hesperoconopa	2	-	P	2	P22
Microtendipes	2	-	P	2	P23
Nemouridae	2	-	P	2	P24
Neophylax splendens	2	-	P	2	P25
Paramerina	2	-	P	2	P26
Paratendipes	2	-	P	2	P27
Physa	2	-	P	2	P28
Tipula	2	-	P	2	P29
Tricorythodes	2	-	P	2	P30
Ecclisomyia	3	-	P	3	P31
Helisoma	3	-	P	3	P32
Stenochironomus	3	-	P	3	P33
Branchiobdellida	4	-	P	4	P34
Cinygma	4	-	P	4	P35
Sigara grossolineata	4	-	P	4	P36
Lumbriculidae	5	-	P	5	P37
Radotanypus	6	-	P	6	P38
Paraleptophlebia bicornuta	7	-	P	7	P39
Ptilostomis	8	-	P	8	P40
Sialis	8	-	P	8	P41
Psychoglypha	14	-	P	14	P42
Uvarus	15	-	P	15	P43
Copepoda	20	-	P	20	P44
Sigara	25	-	P	25	P45
Psectrocladius	27	-	P	27	P46
Heterotrissocladius	36	-	P	36	P47

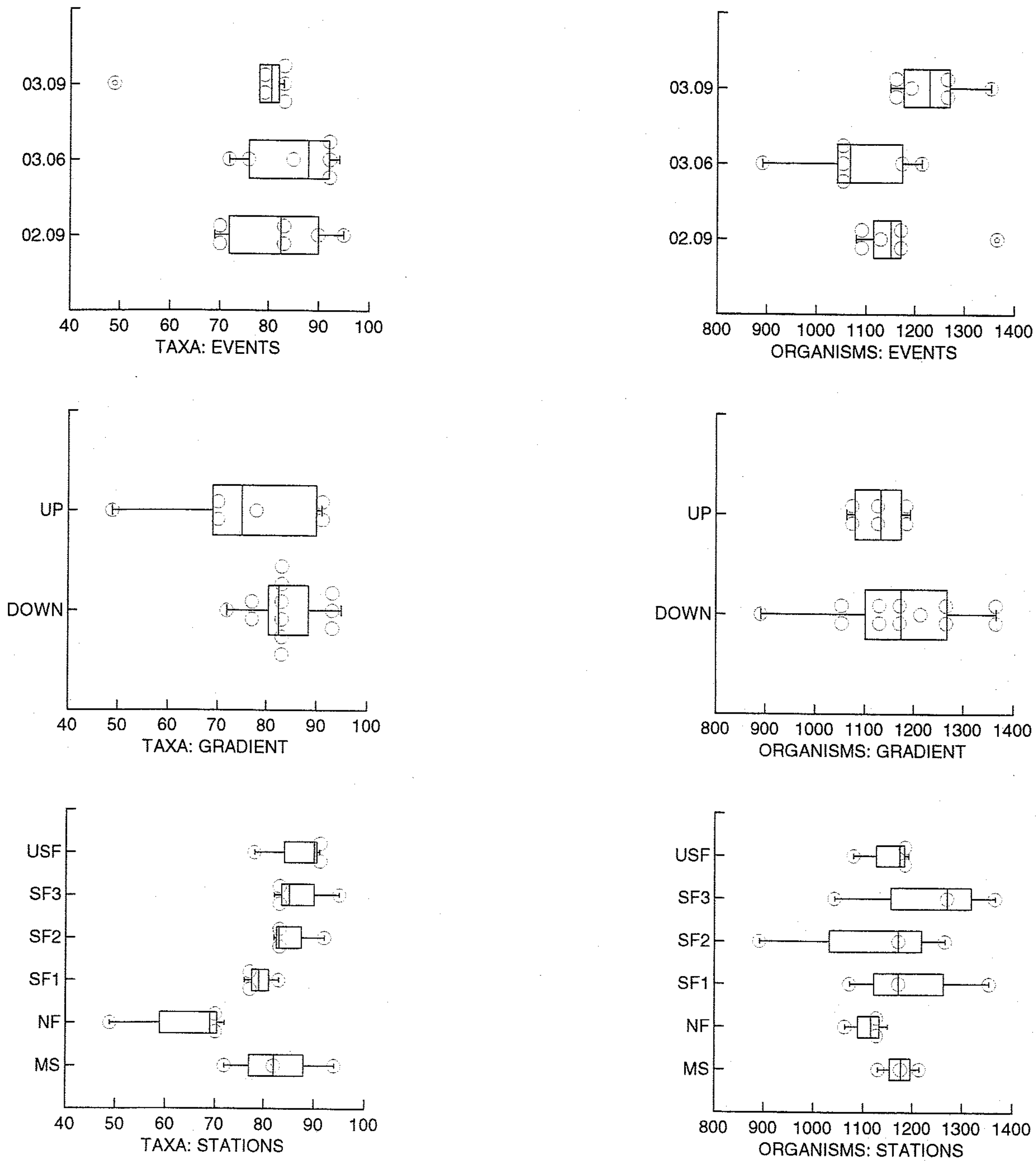
MICA CREEK MACROINVERTEBRATE CROSS-REFERENCE
TAXA BY HABITAT SUMMARY

TAXA	POOL	RIFFLE	HABITAT	TOTAL	CODE
Baetis tricaudatus	35	377	PR	412	PR092
Serratella tibialis	87	369	PR	456	PR093
Cinygmula	48	451	PR	499	PR094
Glossosoma	19	540	PR	559	PR095
Pericoma	264	324	PR	588	PR096
Acari	612	85	PR	697	PR097
Paraleptophlebia	280	462	PR	742	PR098
Hydropsyche	33	736	PR	769	PR099
Micrasema	193	589	PR	782	PR100
Heterlimnius	421	466	PR	887	PR101
Ephemerella	803	188	PR	991	PR102
Optioservus	2512	3162	PR	5674	PR103
Caudatella heterocaudata	-	1	R	1	R01
Dixa	-	1	R	1	R02
Dolichopodidae	-	1	R	1	R03
Gonomyia	-	1	R	1	R04
Heleniella	-	1	R	1	R05
Hydroptilidae	-	1	R	1	R06
Limnophora	-	1	R	1	R07
Limonia	-	1	R	1	R08
Meringodixa	-	1	R	1	R09
Oreogeton	-	1	R	1	R10
Rickera sorpta	-	1	R	1	R11
Sperchopsis	-	1	R	1	R12
Tropisternus	-	1	R	1	R13
Zapada oregonensis	-	1	R	1	R14
Caudatella edmundsi	-	2	R	2	R15
Cultus	-	2	R	2	R16
Eclipidrilus	-	2	R	2	R17
Hydraena	-	2	R	2	R18
Limnephilidae	-	2	R	2	R19
Hemerodromia	-	3	R	3	R20
Paraperla	-	3	R	3	R21
Tipulidae (pupa)	-	3	R	3	R22
Amiocentrus	-	4	R	4	R23
Cricotopus	-	4	R	4	R24
Cricotopus bicinctus	-	5	R	5	R25
Cryptolabis	-	5	R	5	R26
Hydrophilidae	-	5	R	5	R27
Ironodes	-	7	R	7	R28
Dicosmoecus gilvipes	-	8	R	8	R29
Doroneuria	-	8	R	8	R30
Megarcys	-	10	R	10	R31
Rhyacophila	-	15	R	15	R32
Wormaldia	-	24	R	24	R33
Drunella COLORadensis	-	55	R	55	R34



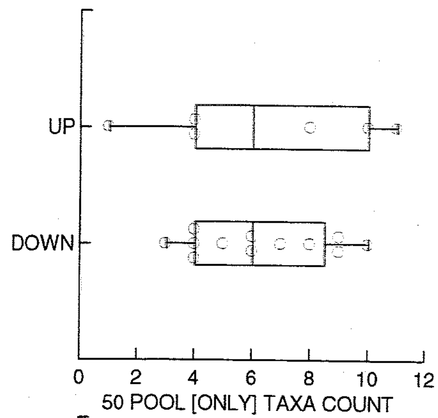
Components. A **BOX PLOT** identifies the **MEDIAN**, (50th percentile), the lower and upper quartiles (**25th and 75th PERCENTILES**), and the **RANGE** (extreme spread of the data). The edges of the box demarcate the 25th and 75th percentiles, and so represent the middle 50 percent (**INTERQUARTILE RANGE**) of the parameter values for the data subset. The line inside the box is the **MEDIAN**. The lines, or whiskers, extend outward from the box through the range of data, excluding outliers. Two outliers are defined, based on their distance from the nearest edge of the box, relative to the range of the box. **OUTSIDE VALUES** lie 1.5 to 3 interquartile ranges away from the nearest box edge, and **FAR-OUT VALUES** lie three or more interquartile ranges away form the nearest box edge. The **NOTCH** represents the approximate 95 percent confidence interval around the median.

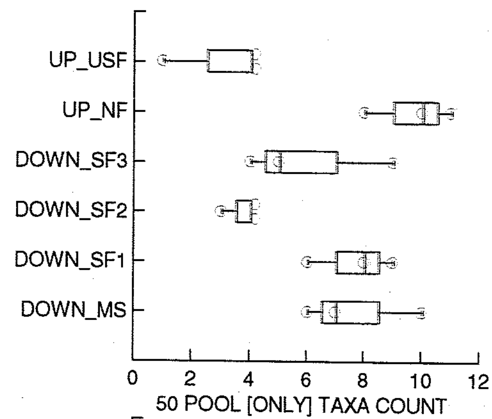
Interpretation. If notches from different subsets of data overlap completely, one can conclude with 95% confidence that the groups have been sampled from a common population. If notches do not overlap at all, one can conclude (with 95% confidence) that the groups represent different populations. Cases of partial overlap require explicit tests (e.g., t-Test, ANOVA, Mann-Whitney, or Kruskal-Wallis) to specify significance of differences among groups.

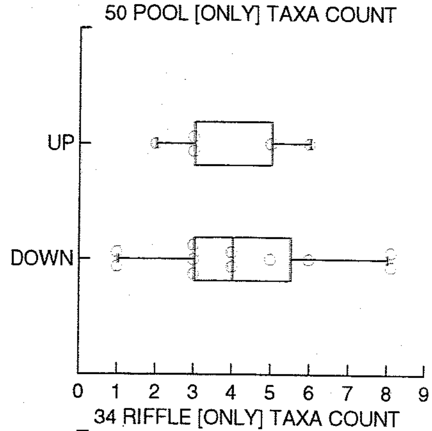


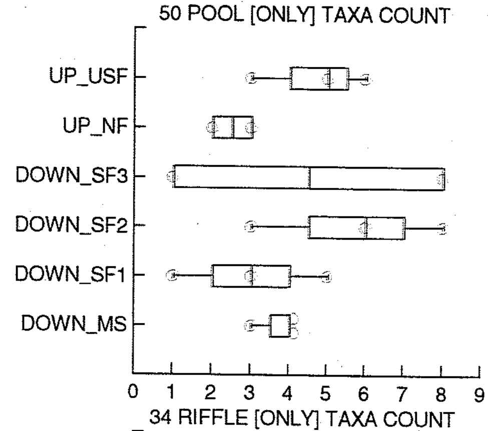
NONPARAMETRIC COMPARISONS

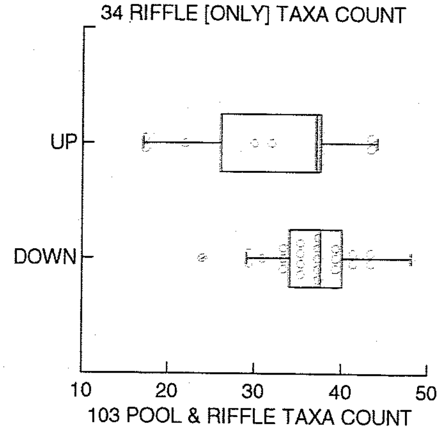
	TAXA COUNTS	ORGANISM COUNTS	
EVENTS	0.37	0.04	FALL03 > FALL02 > SUM03
GRADIENT	0.15	0.30	
STATIONS	0.12	0.76	

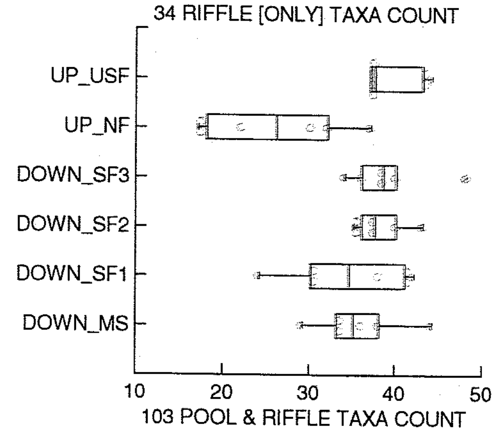






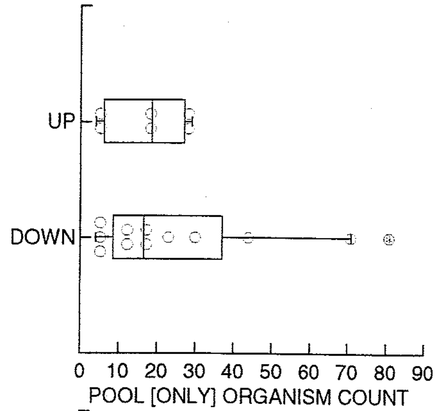


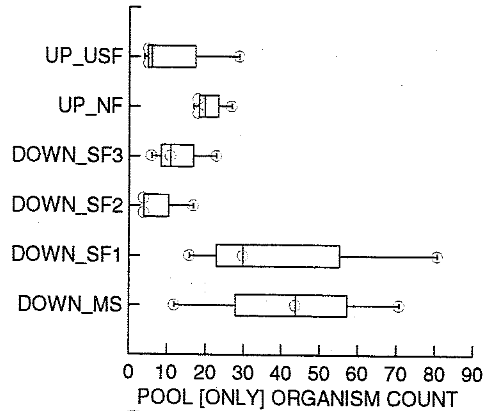


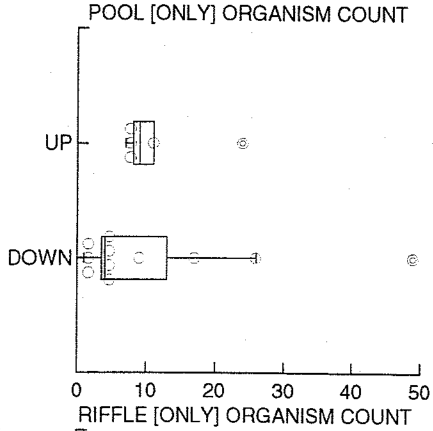


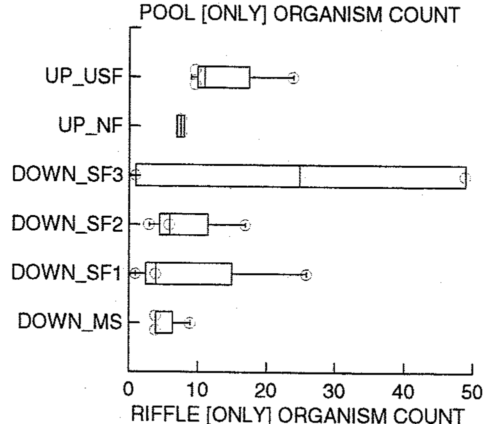
NONPARAMETRIC COMPARISONS

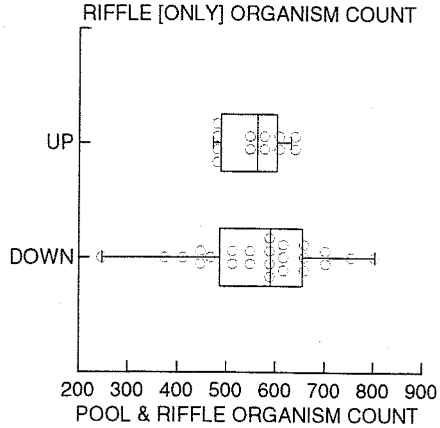
	GRADIENT	STATIONS
POOL TAXA COUNT	0.92 NS	**0.03** NF > SF1~MS > SF3 > SF2~USF
RIFFLE TAXA COUNT	0.77 NS	0.56 NS
POOL & RIFFLE TAXA COUNT	0.26 NS	**0.04** NF < MS~SF1~SF2~SF3~USF

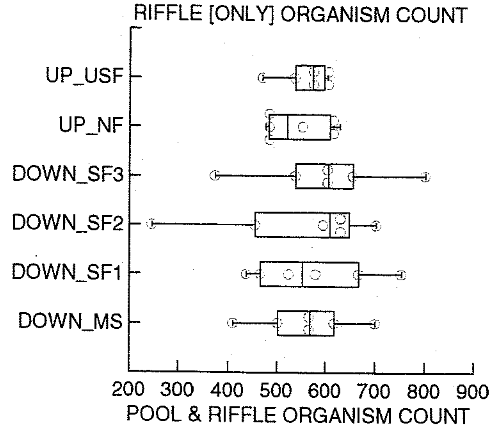












NONPARAMETRIC COMPARISONS

	GRADIENT		STATIONS	
POOL ORGANISM COUNT	0.78	NS	0.19	NS
RIFFLE ORGANISM COUNT	0.21	NS	0.78	NS
POOL & RIFFLE ORGANISM COUNT	0.42	NS	0.94	NS

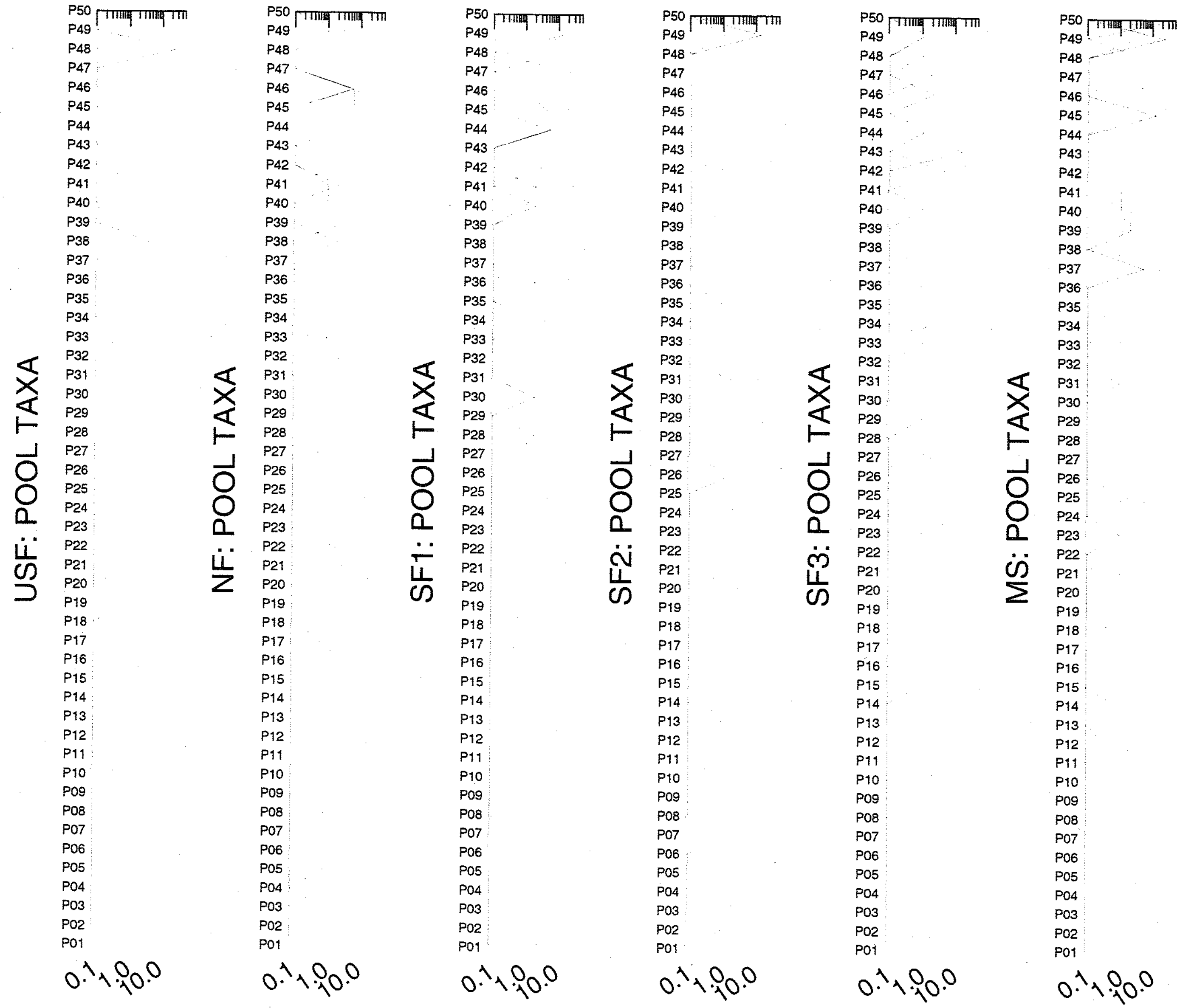


Figure ___.

POOL-ONLY TAXA: COUNT PER SAMPLE LOCATION – EVENT

X-AXIS = COUNTS/SAMPLE
Y-AXIS = TAXA CODE [Table ___]
EVENT CODING:

____ **FALL 2002** ___ SUMMER 2003 ___ **FALL 2003**

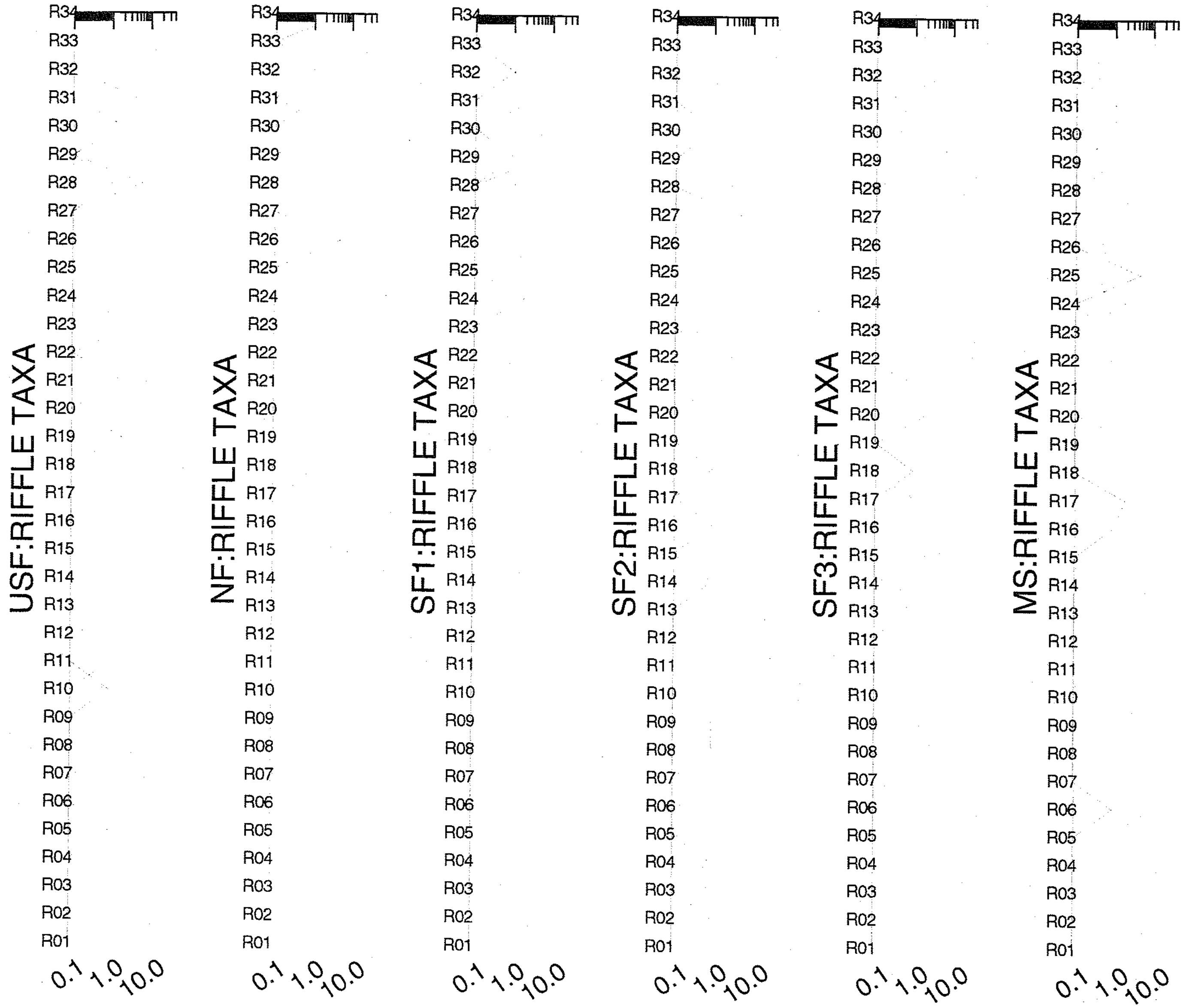


Figure ___.
RIFFLE-ONLY TAXA: COUNT PER SAMPLE LOCATION – EVENT

X-AXIS = COUNTS/SAMPLE
Y-AXIS = TAXA CODE [Table ___]
EVENT CODING:

____ **FALL 2002** ____ SUMMER 2003 ____ **FALL 2003**

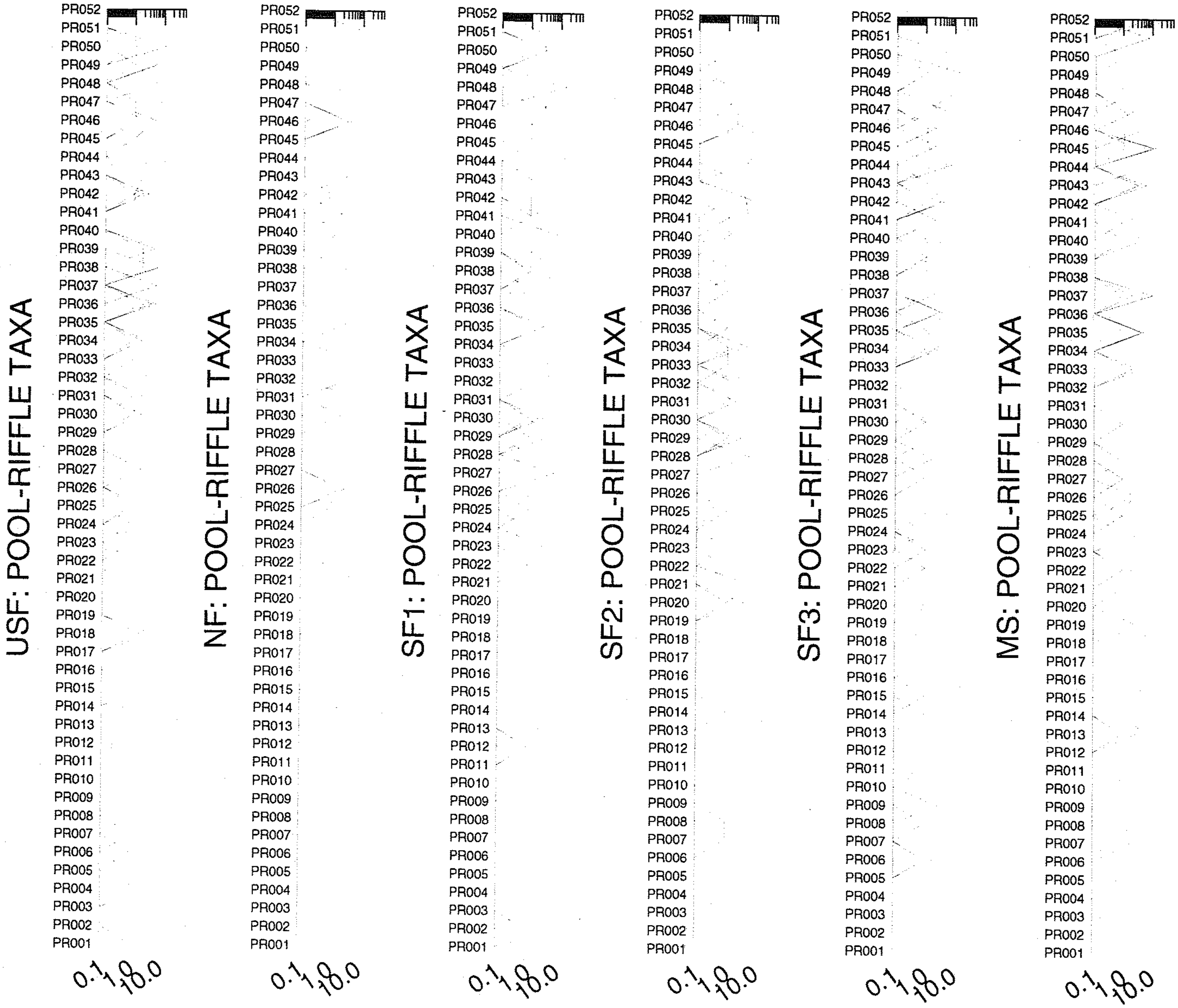


Figure ___A.

POOL-RIFFLE TAXA: COUNT PER SAMPLE LOCATION – EVENT

X-AXIS = COUNTS/SAMPLE
Y-AXIS = TAXA CODE [Table ___]
EVENT CODING:

____ **FALL 2002** ___ SUMMER 2003 ___ **FALL 2003**

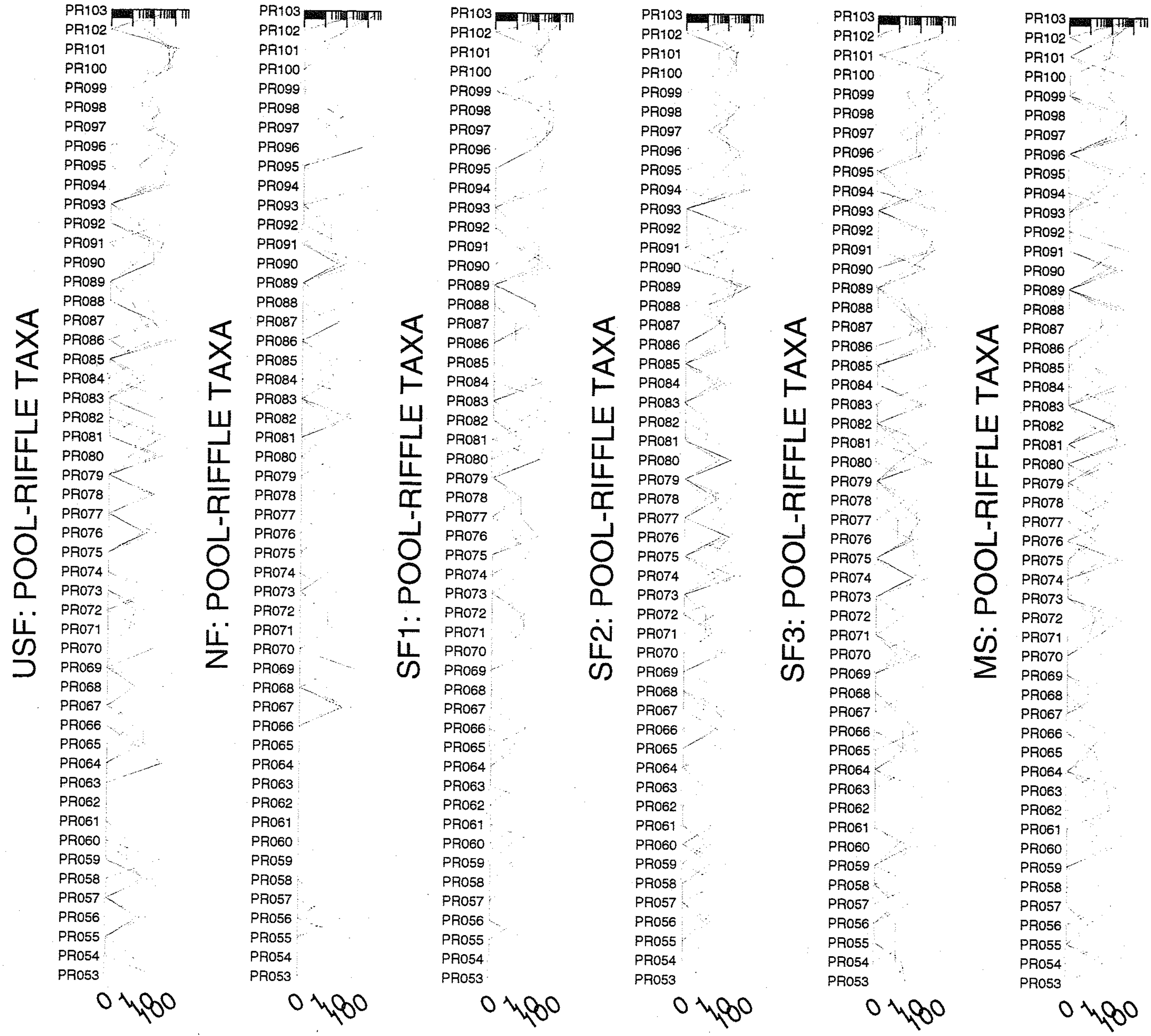


Figure ___B

POOL-RIFFLE TAXA: COUNT PER SAMPLE LOCATION – EVENT

X-AXIS = COUNTS/SAMPLE
Y-AXIS = TAXA CODE [Table ___]
EVENT CODING:

____ **FALL 2002** ___ SUMMER 2003 ___ **FALL 2003**

MICA CREEK MACROINVERTEBRATE TAXA
ANCILLARY TAXA DOCUMENTATION

N	Taxa	DEQ	HAB	FFG	CLNGR	SENS	SED_S	TOL	SED_T	BI	FSBI
75	Centroptilum	22	-	CG	yes	-	-	yes	-	8	-
20	Copepoda	441	-	CG	-	-	-	-	-	6	-
75	Corixidae	136	-	PP	yes	-	-	-	-	9	-
36	Heterotrissocladius	907	-	CG	-	-	-	-	-	4	-
39	Macropelopia sp.	358	-	EP	-	-	-	-	-	6	-
27	Psectrocladius	392	-	CG	-	-	-	yes	-	8	-
14	Psychoglypha	220	-	CG	-	-	-	-	-	3	3
22	Sigara		-	PH	-	-	-	-	-	9	-
1	Aeshna	932	-	EP	-	-	-	-	-	8	-
1	Ametor		-	OM	*	-	-	-	-	5	-
1	Constempellina	331	-	CG	yes	-	-	-	-	4	-
1	Empididae	305	-	EP	-	-	-	-	-	5	-
1	Ephydridae		-	CG	*	-	-	-	-	6	-
1	Fossaria		-	SC	*	-	-	-	-	6	-
1	Haplotaxis***		-	PR	*	-	-	-	-	5	-
1	Hexatoma		-	EP	-	-	-	-	-	4	-
1	Hydrobius sp.		-	PP	-	-	-	-	-	8	-
1	Hydroporus	807	-	PP	-	-	-	-	-	11	-
1	Krenosmittia	903	-	CG	-	-	-	-	-	11	-
1	Nixe	783	-	CG	yes	-	-	-	-	7	-
1	Odontomesa		-	CF	-	-	-	-	-	7	-
1	Ostracoda		-	CG	-	-	-	-	-	6	-
1	Paracladopelma	1117	-	UN	-	-	-	-	-	7	-
1	Phryganeidae		-	OM	*	-	-	-	-	4	-
1	Planorbidae		-	UN	*	-	-	-	-	7	-
1	Stictotarsus	995	-	*	-	-	-	-	-	7	-
1	Visoka cataractae	87	-	DS	yes	-	-	-	-	2	5
2	Cryptochironomus	340	-	EP	-	-	-	-	-	8	-
2	Helophorus sp.	654	-	MS	-	-	-	-	-	11	-
2	Hesperoconopa		-	UN	-	-	-	-	-	3	-
2	Microtendipes		-	CG	yes	-	-	-	-	5	-
2	Nemouridae	81	-	DS	yes	-	-	-	-	5	-
2	Neophylax splendens	228	-	CG	-	-	-	-	-	4	-
2	Paramerina		-	PR	*	-	-	-	-	6	-
2	Paratendipes	380	-	CG	-	-	-	-	-	6	-
2	Physa		-	UN	*	-	-	-	-	9	-
2	Tipula		-	DS	-	-	-	-	yes	6	3
2	Tricorythodes		-	CF	-	-	-	-	-	8	4
3	Ecclisomyia sp.	207	-	PP	yes	-	-	-	-	3	8
3	Helisoma		-	SC	*	-	-	-	-	6	-
3	Stenochironomus		-	CG	-	-	-	-	-	5	-
4	Branchiobdellida	465	-	UN	*	-	-	-	-	6	-
4	Ptilostomis		-	OM	*	-	-	-	-	3	-
5	Lepidostoma (turret case)		-	SH	*	-	-	-	-	2	-
5	Lumbriculidae		-	CG	*	-	-	-	-	6	5
6	Radotanypus		-	PR	*	-	-	-	-	4	-
7	Paraleptophlebia bicornuta		-	CG	yes	-	-	-	-	8	5
7	Sigara grossolineata	142	-	PH	-	-	-	-	-	9	-

N	Taxa	DEQ	HAB	FFG	CLNGR	SENS	SED_S	TOL	SED_T	BI	FSBI
8	Cricotopus/Orthocladius	333	-	DS	-	-	-	-	-	7	-
8	Sialis		28	PP	-	-	-	yes	-	8	1
704	Acari	453	-	PA	-	-	-	-	-	6	-
19	Agapetus	171	-	CG	yes	-	-	-	-	5	-
259	Ameletus	13	21	CG	-	-	-	-	-	4	4
167	Antocha	284	-	CG	yes	-	-	-	yes	7	6
44	Apatania	212	-	CG	yes	-	-	-	-	3	7
428	Baetis tricaudatus	20	-	CG	yes	-	-	-	-	7	5
16	Brillia	322	-	DS	-	-	-	-	-	6	-
75	Capniidea	100	-	DS	yes	-	-	-	-	4	-
396	Ceratopogoninae	770	-	EP	-	-	-	-	-	6	-
41	Chelifera	306	-	EP	-	-	-	-	-	6	2
517	Cinygmula	26	15	CG	yes	-	-	-	-	5	6
126	Cladotanytarsus	329	-	CG	yes	-	-	yes	-	7	-
328	Cleptelmis	259	-	CG	yes	-	-	-	-	6	2
54	Corynoneura	332	-	DS	-	-	-	-	-	5	-
97	Cricotopus (Crictopus)	333	-	DS	yes	-	-	-	-	7	-
48	Cricotopus (Isocladius)	336	-	DS	yes	-	-	-	-	7	-
331	Cricotopus (Nostococladius)	337	-	DS	-	-	-	-	-	3	-
21	Dicranota	285	-	EP	-	-	-	-	-	5	2
247	Diphetor hageni	679	-	CG	yes	-	-	-	-	5	-
45	Drunella doddsi	43	-	CG	yes	-	-	-	-	3	7
343	Drunella grandis	51	-	CG	-	-	-	-	-	6	7
364	Elmidae	253	-	CG	yes	-	-	-	-	5	-
204	Epeorus longimanus	31	-	SC	yes	-	-	-	-	4	6
998	Ephemerella	49	-	CG	-	-	-	-	-	6	4
69	Eukiefferiella devonica gr.	349	-	CG	-	-	-	-	-	4	-
60	Eukiefferiella pseudomontana gr.	351	-	CG	-	-	-	-	-	8	-
79	Ferrissia		-	CG	*	-	-	yes	yes	8	-
18	Glossosomatidae	170	-	CG	yes	-	-	-	-	11	-
583	Glossosoma	173	33	CG	yes	-	yes	-	-	5	6
22	Heptagenia	34	16	CG	yes	-	-	-	-	7	2
984	Heterlimnius	262	-	CG	yes	-	-	-	-	3	5
798	Hydropsyche	198	34	CF	yes	-	-	yes	-	6	5
310	Hydroptila	182	-	PH	yes	-	-	yes	-	8	5
28	Isoperla	127	-	EP	yes	-	-	-	-	4	2
25	Lara avara	264	-	XS	-	-	-	-	-	4	2
54	Larsia	355	-	EP	-	-	-	-	-	6	-
98	Lepidostoma	237	-	DS	*	-	-	-	-	5	5
93	Limnophila	283	-	EP	-	-	-	-	-	3	2
121	Lopescladius	357	-	CG	-	-	-	-	-	4	-
41	Malenka	83	-	DS	yes	-	-	-	-	6	2
24	Margaritifera falcata	426	-	CF	*	yes	-	-	-	6	-
62	Micropsectra		-	CG	-	-	-	-	-	7	-
861	Micrasema	236	-	MS	yes	-	-	-	-	4	4
47	Nais		-	CG	*	-	-	-	-	8	-
44	Narpus	265	8	CG	yes	-	-	-	-	4	5
37	Nematoda	417	-	OM	-	-	-	-	-	6	-
164	Oligochaeta	418	-	CG	-	-	-	yes	yes	6	-

N	Taxa	DEQ	HAB	FFG	CLNGR	SENS	SED_S	TOL	SED_T	BI	FSBI
5771	Optioservus	267	-	CG	yes	-	-	yes	-	7	3
269	Oreodytes	252	-	PP	-	-	-	-	-	7	-
26	Orthocladius	369	-	CG	-	-	-	-	-	6	-
14	Pacifastacus	475	-	UN	-	-	-	-	-	6	-
82	Pagastia	373	-	CG	-	-	-	-	-	6	-
80	Paratanytarsus		-	CG	-	-	-	-	-	6	-
846	Paraleptophlebia	63	-	DS	yes	-	-	-	-	6	2
673	Pericoma	299	-	CG	-	-	-	-	-	5	5
64	Perlodidae	114	-	EP	yes	-	-	-	-	4	-
23	Physidae	432	-	SC	-	-	-	-	-	9	-
40	Pisidiidae	424	-	CG	-	-	-	-	-	8	-
26	Polycentropus	185	38	PP	-	-	-	-	-	6	-
227	Polypedilum sp.	386	3	CG	yes	-	-	-	-	6	-
51	Rheocricotopus	400	-	CG	-	-	-	-	-	5	-
67	Rheotanytarsus	401	-	CG	yes	-	-	-	-	6	-
22	Rhithrogena	35	17	CG	yes	-	-	-	-	6	6
17	Rhyacophila Betteni Gr.	157	-	EP	yes	-	-	-	-	4	6
26	Rhyacophila Brunnea Gr.	158	-	EP	yes	-	-	-	-	6	5
39	Rhyacophila narvae	166	-	EP	yes	-	-	-	-	4	-
462	Serratella tibialis	54	-	CG	-	-	-	-	-	5	5
321	Simulium	303	12	CF	yes	-	-	-	-	7	3
31	Skwala	126	-	EP	yes	-	-	-	-	6	5
150	Stempellinella	403	-	CG	-	-	-	-	-	4	-
16	Suwallia	577	-	EP	-	-	-	-	-	4	-
194	Sweltsa	134	-	EP	*	-	-	-	-	5	4
10	Synorthocladius	407	-	CG	-	yes	-	-	-	6	-
31	Tabanidae	318	-	PP	-	-	-	-	-	8	-
301	Tanytarsus	408	5	CG	yes	-	-	-	-	8	-
263	Thienemannimyia	410	6	EP	-	-	-	-	-	6	-
75	Tubificidae		-	CG	*	-	-	-	-	6	-
133	Tvetenia	411	7	CG	-	-	-	-	-	5	-
131	Zaitzevia	271	9	CG	yes	-	-	yes	-	7	5
286	Zapada cinctipes	89	-	DS	yes	-	-	-	-	5	3
2	Lepidostoma (sand case larvae)		-	DS	-	-	-	-	-	5	5
2	Onocosmoecus unicolor	527	-	DS	-	-	-	-	-	5	-
3	Despaxia augusta	94	-	DS	yes	-	-	-	-	3	-
3	Perlidae	104	-	EP	yes	-	-	-	-	4	-
4	Lepidostoma (panel case larvae)		-	DS	-	-	-	-	-	5	5
4	Limnophyes	2016	-	CG	*	-	-	-	-	8	-
4	Rhyacophila verrula	169	-	MS	yes	-	-	-	-	2	-
4	Symposiocladius		-	CG	*	-	-	-	-	4	-
5	Eukiefferiella Brehmi Gr.	346	-	CG	-	-	-	-	-	4	-
5	Margaritifera		-	CF	*	-	-	-	-	6	-
5	Neophylax rickeri	227	-	CG	yes	-	-	-	-	6	-
5	Sphaeriidae		30	CF	*	-	-	-	-	6	-
5	Thienemanniella	908	-	CG	-	-	-	-	-	6	-
6	Ephemerella inermis	52	-	-	CG	-	-	-	-	7	4
6	Neophylax occidentalis	226	-	CG	yes	-	-	-	-	3	-
6	Procladius	390	-	EP	-	-	-	yes	-	9	-
6	Rhabdomastix	615	-	UN	-	-	-	-	-	3	-

N	Taxa	DEQ	HAB	FFG	CLNGR	SENS	SED_S	TOL	SED_T	BI	FSBI
7	Cinygma	25	-	CG	yes	-	-	-	-	4	2
7	Glutops	316	-	PP	-	-	-	-	-	3	-
7	Maruina	298	-	CG	yes	-	-	-	-	5	-
8	Psychoda		-	CG	-	-	-	-	-	10	-
9	Parametriocnemus	377	-	CG	-	-	-	-	-	5	-
9	Parapsyche almota		-	CF	yes	-	-	-	-	5	-
9	Rhyacophila Angelita Gr.	156	-	EP	yes	-	-	-	-	5	-
18	Cricotopus		-	DS	-	-	-	-	-	7	-
10	Dicosmoecus gilvipes	205	41	CG	-	-	-	-	-	5	-
15	Ironodes	715	-	UN	yes	-	-	-	-	3	-
10	Megarcys	121	-	EP	yes	-	-	-	-	2	8
14	Rhyacophila	153	-	PP	yes	-	-	-	-	4	5
24	Wormaldia	189	-	CF	-	-	-	-	-	4	2
1	Caudatella heterocaudata	41	-	CG	yes	-	-	-	-	4	-
1	Dixa		-	CG	-	-	-	-	-	4	-
1	Dolichopodidae	698	-	EP	-	-	-	-	-	8	-
1	Hydroptilidae		-	PH	yes	-	-	-	-	8	-
1	Limnophora	646	-	PP	-	-	-	-	-	8	-
1	Limonia		-	MS	-	-	-	-	-	8	-
1	Meringodixa		-	CG	-	-	-	-	-	3	-
1	Oreogeton		-	PR	*	-	-	-	-	6	-
1	Rickera sorpta	665	-	EP	yes	-	-	-	-	3	-
1	Sperchopsis	730	-	**	yes	-	-	-	-	11	-
1	Tropisternus	746	-	PP	-	-	-	-	-	8	-
1	Zapada oregonensis		-	DS	yes	-	-	-	-	3	6
2	Caudatella edmundsi	39	-	CG	yes	-	-	-	-	4	8
2	Cultus sp.		-	EP	yes	-	-	-	-	3	7
2	Eclipidrilus		-	CG	*	-	-	-	-	5	-
2	Hydraena		-	UN	yes	-	-	-	-	11	-
2	Lepidostoma (turrent case)		-	DS	-	-	-	-	-	5	5
2	Limnephilidae		-	DS	-	-	-	-	-	11	-
3	Paraperla	133	-	UN	*	-	-	-	-	3	-
4	Amiocentrus	232	-	CG	-	-	-	-	-	6	-
4	Gonomyia	751	-	UN	-	-	-	-	-	11	-
4	Hemerodromia	308	-	PR	-	-	-	-	-	8	5
5	Cricotopus bicinctus		-	CG	*	-	-	-	-	7	-
5	Cryptolabis		-	UN	-	-	-	-	-	7	-
5	Hydrophilidae (early instar larva)	276	-	PB	-	-	-	-	-	8	-
9	Doroneuria	110	-	EP	yes	-	-	-	-	3	7

MICA CREEK AGGREGATE MEASURE: STATION COMPARISONS
TAXA AND INDIVIDUAL COUNTS

BY COUNT OF TAXA							
	P-VALUE[1]	MS	NF	SF1	SF2	SF3	USF
BIOTIC INDEX	*0.02*	VAR	LESS	VAR	LESS	VAR	VAR
CLINGER							
FUNCTIONAL FOOD GROUP	*0.98*	--	--	--	--	--	--
FSBI	*0.91*	--	--	--	--	--	--
SED_SENS	*0.60*	--	--	--	--	--	--
SENSITIVE	*0.14*	--	--	--	--	--	--
SED_TOL	*0.06*	--	--	--	--	--	--
TOLERANT	0.93	--	--	--	--	--	--

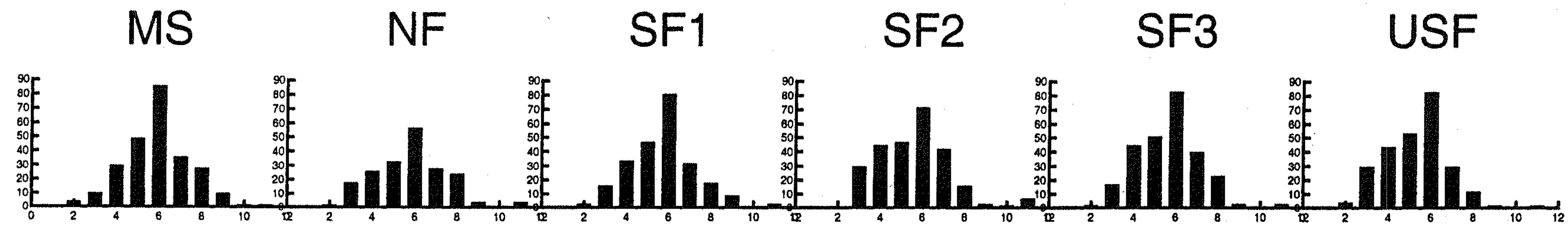
BY COUNT OF INDIVIDUALS							
	P-VALUE[1]	MS	NF	SF1	SF2	SF3	USF
BIOTIC INDEX	*<0.001*	VAR	VAR	VAR	LEAST	VAR	VAR
CLINGER							
FUNCTIONAL FOOD GROUP	*<0.001*	VAR	MOST	VAR	VAR	VAR	VAR
FSBI	*<0.001*	VAR	MOST	VAR	VAR	VAR	VAR
SED_SENS	<0.001	HI	LO	LO	HI	LO	+/-
SENSITIVE	*0.03*	HI	LO	HI	HI	LO	LO
SED_TOL	<0.001	HI	LO	LO	HI	HI	LO
TOLERANT	<0.001	HI	HI	HI	LO	LO	LO

P-VALUE[1]
Cell contains probability of Pearson Chi^2 statistic. By convention, a value less than 0.05 is considered to indicate that differences between observed and expected cell counts in one or more locations. An italicized p-value indicates that results are considered less reliable given unacceptably low counts [n < 5] in one or more cells of the contingency table.

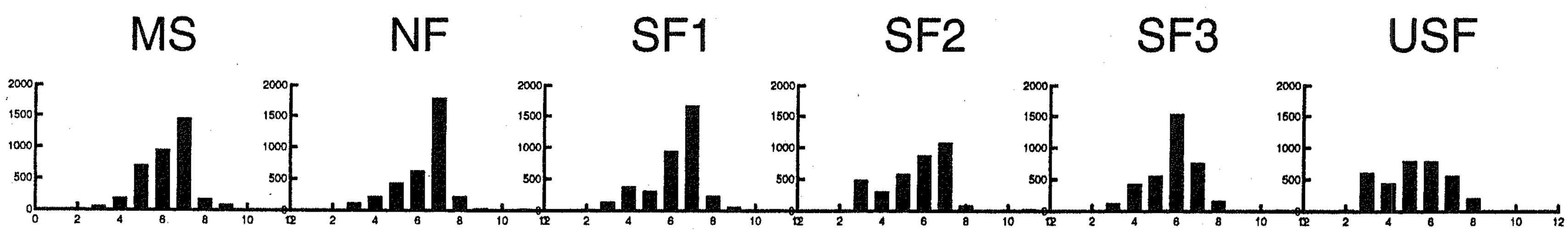
LOCATION RESULTS CELLS: CODE INTERPRETATION

HI	Observed Counts exceed Expected Counts
LO	Observed Counts are less than Expected
VAR	Observed-Expected differences variable among the multiple category levels
LEAST	Location with narrowest discrepancies between Observed-Expected counts over multiple category levels.
MOST	Location with widest discrepancies between Observed-Expected counts over multiple category levels.
LESS	Locations with narrower discrepancies between Observed-Expected counts over multiple category levels.

BIO-INDEX: TAXA

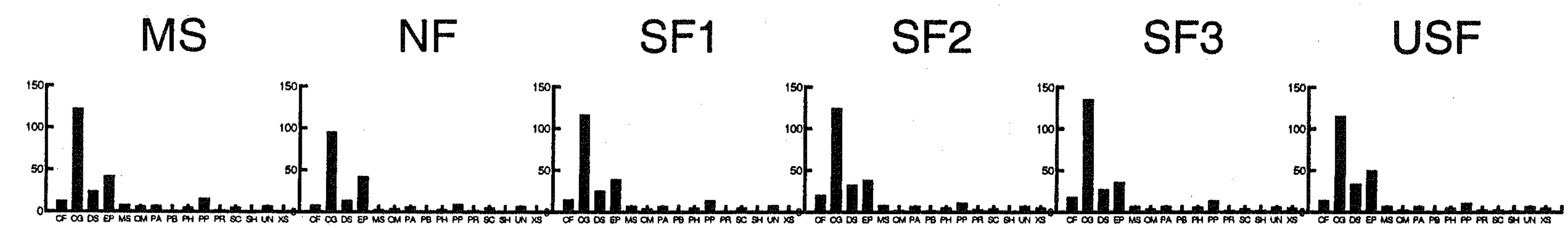


BIO-INDEX: ORGANISMS

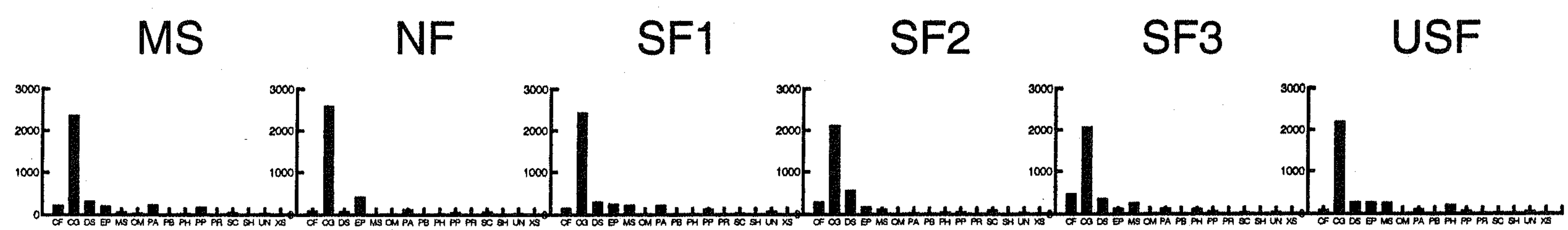


BIOTIC-INDEX LEVELS [X-axis] :	**2 -> 11**	
	TAXA	ORGANISMS
STATISTICAL COMPARISON [P χ^2]:	0.02	<0.001

FFG: TAXA



FFG: ORGANISMS

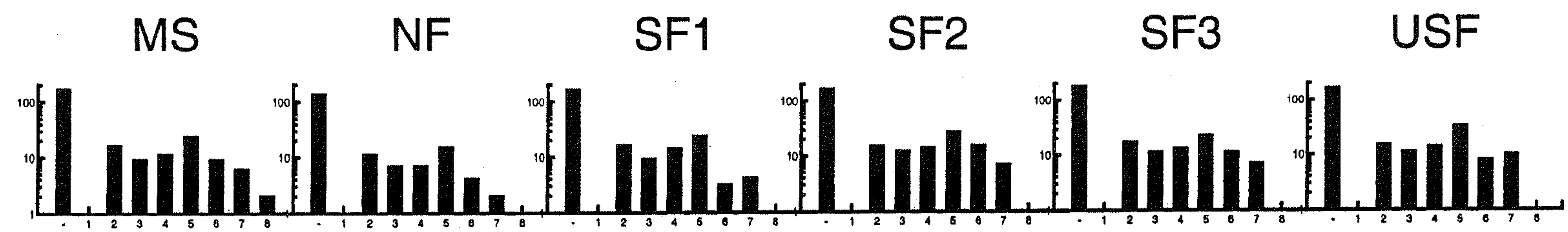


FUNCTIONAL FEEDING GROUPS [X-axis] : **CF CG DS EP MS OM PA PB PH PP PR SC SH UN XS**

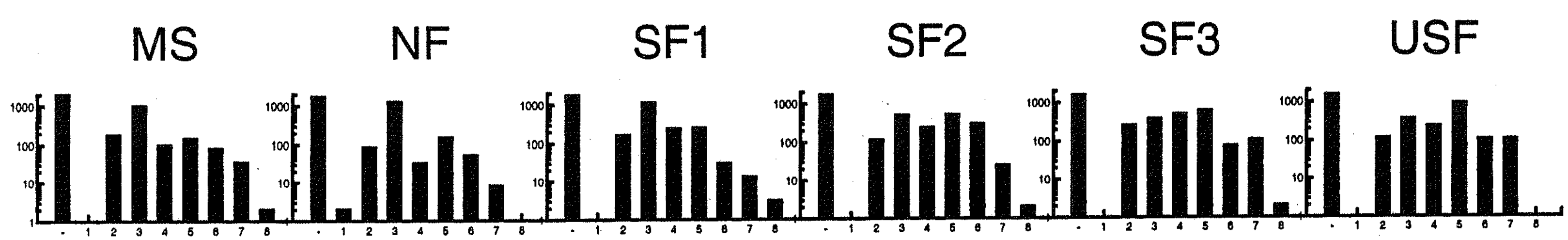
Group names defined in Section 4 text

	TAXA	ORGANISMS
STATISTICAL COMPARISON [P χ^2]:	0.98	<0.001

FSBI: TAXA

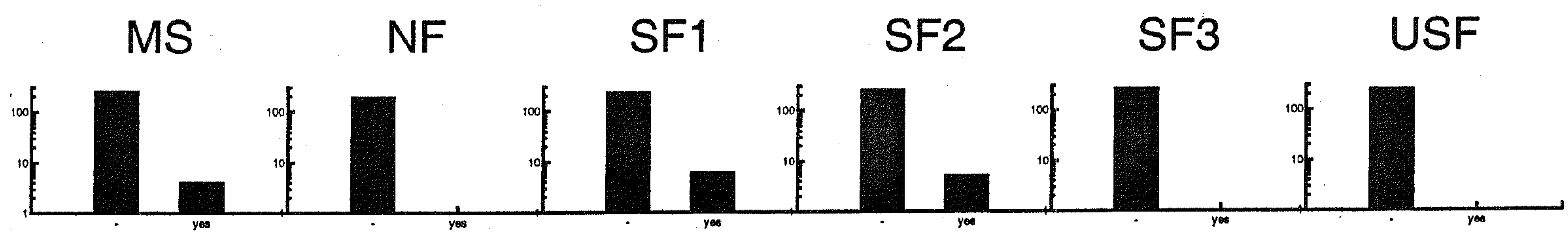


FSBI: ORGANISMS

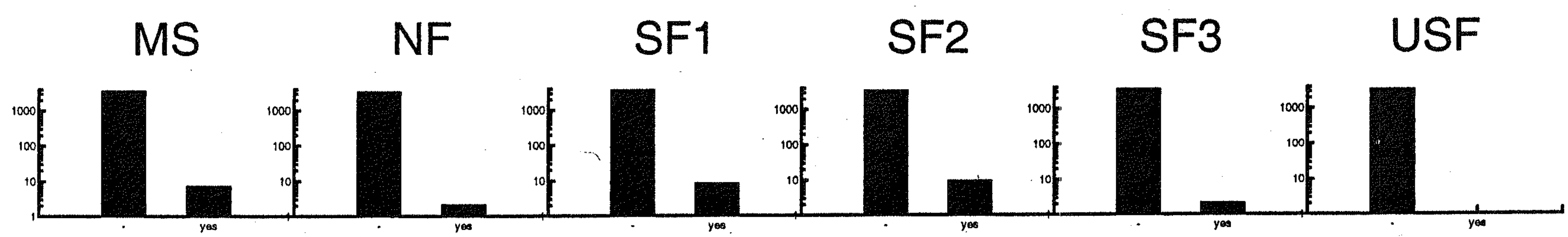


FINE SEDIMENT BIOTIC-INDEX LEVELS [X-axis] :	**-** [*UNASSIGNED*] **-> 8**	
	<u>TAXA</u>	<u>ORGANISMS</u>
STATISTICAL COMPARISON [P χ^2]:	0,91	<0.001

SENSITIVITY: TAXA



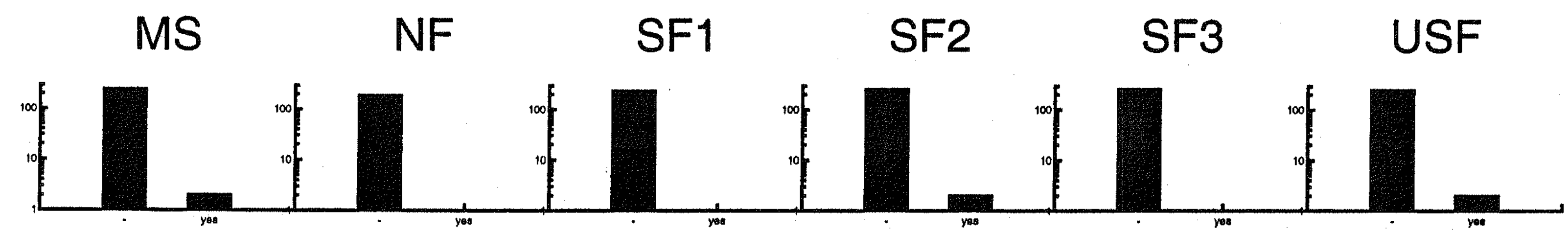
SENSITIVITY: ORGANISMS



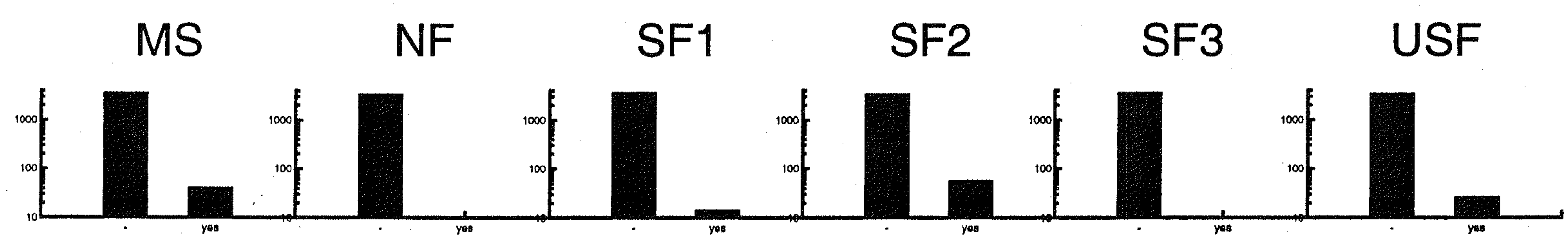
SENSITIVITY LEVELS [X-axis] : - [*UNASSIGNED*] -> **YES**

	TAXA	ORGANISMS
STATISTICAL COMPARISON [P χ^2]:	0.14	0.03

SEDIMENT SENSITIVITY: TAXA

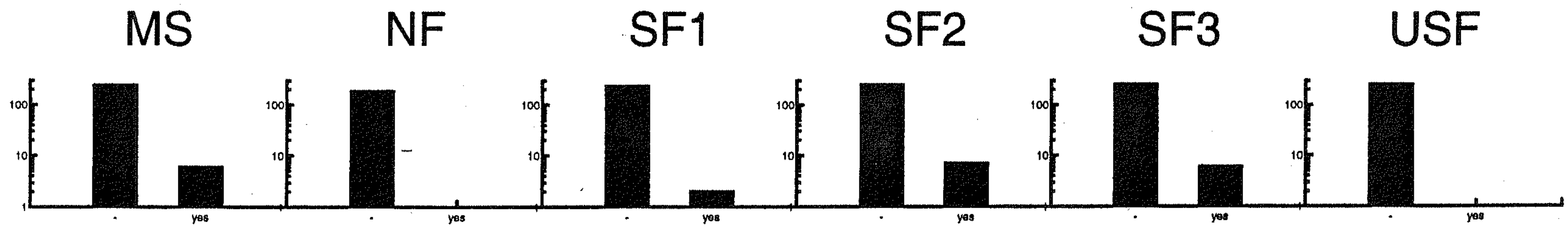


SEDIMENT SENSITIVITY: ORGANISMS

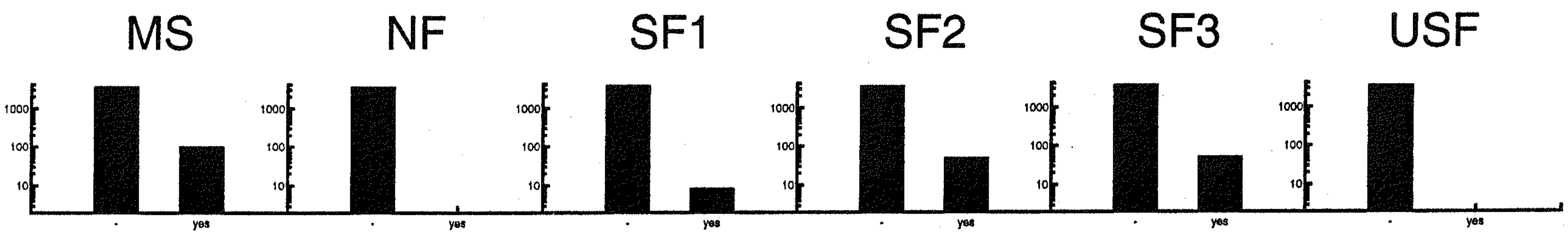


SEDIMENT SENSITVITY LEVELS [X-axis] :	- [*UNASSIGNED*] -> **YES**	
	<u>TAXA</u>	<u>ORGANISMS</u>
STATISTICAL COMPARISON [P χ^2] :	0.60	<0.001

SEDIMENT TOLERANCE: TAXA

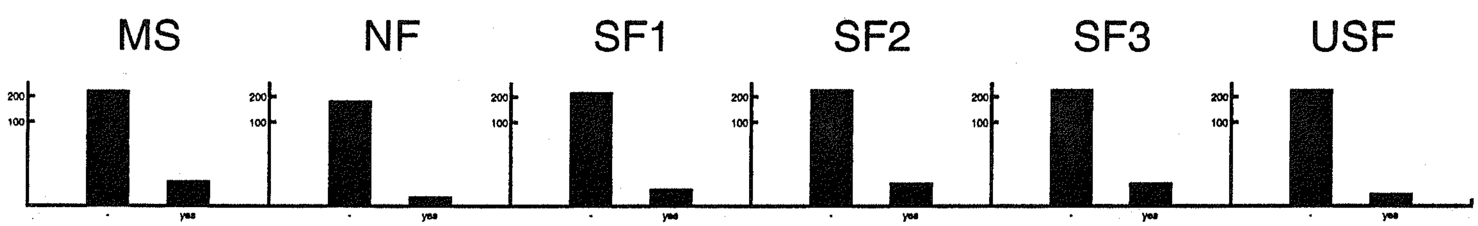


SEDIMENT TOLERANCE: ORGANISMS

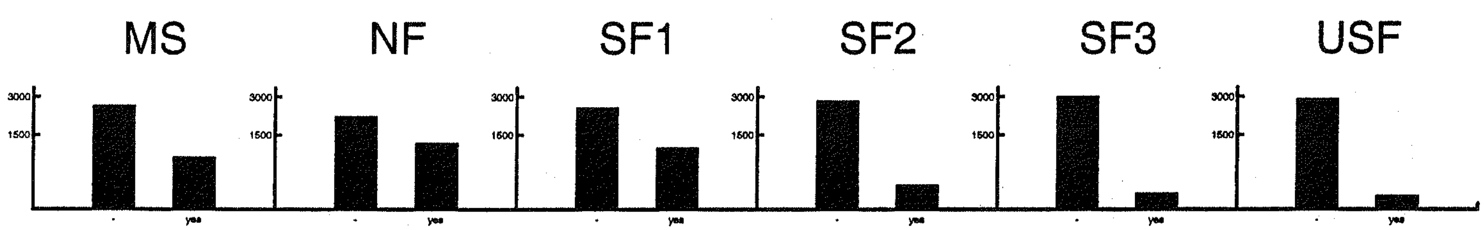


SEDIMENT TOLERANCE LEVELS [X-axis] :	**- [*UNASSIGNED*] -> YES**	
	<u>TAXA</u>	<u>ORGANISMS</u>
STATISTICAL COMPARISON [P χ^2]:	0.06	<0.001

TOLERANCE: TAXA



TOLERANCE: ORGANISMS



TOLERANCE LEVELS [X-axis] : - [*UNASSIGNED*] -> **YES**

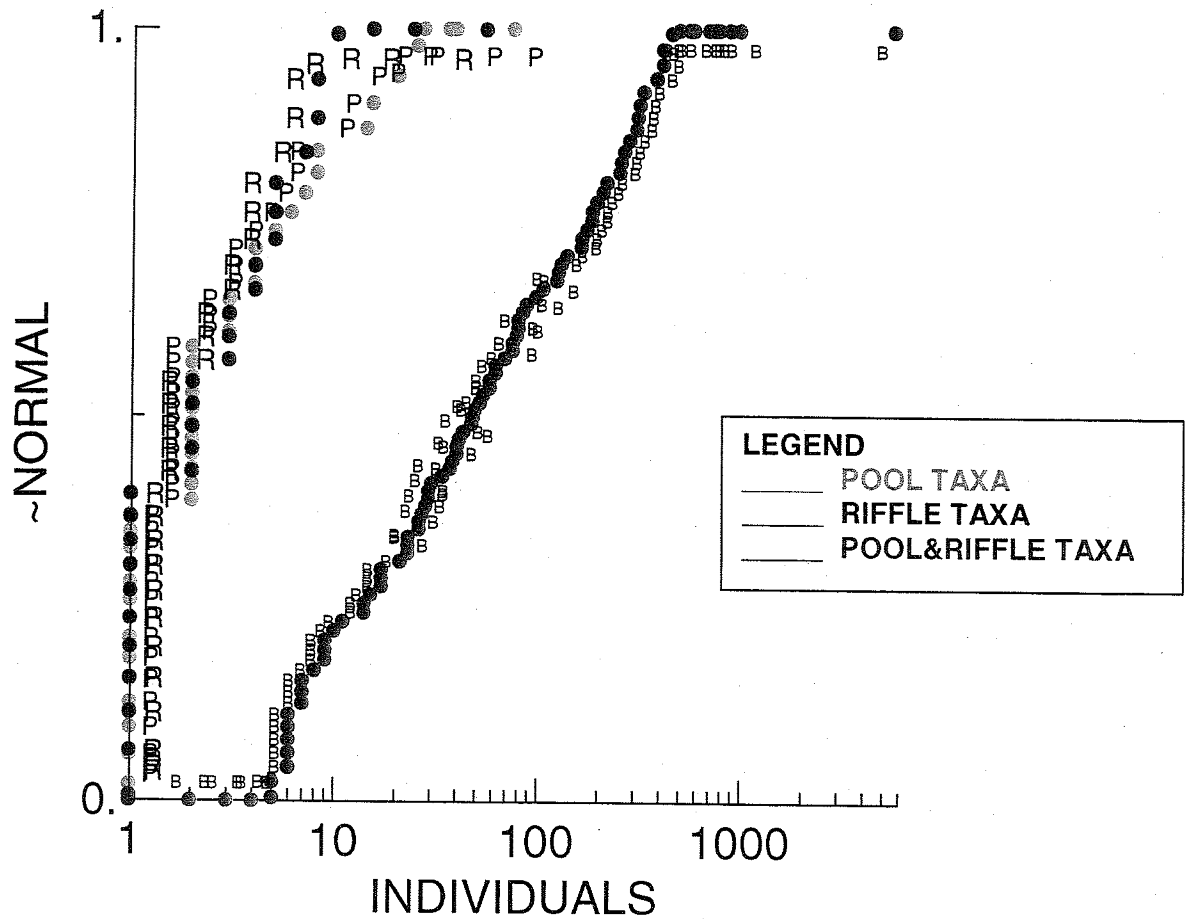
	TAXA	ORGANISMS
STATISTICAL COMPARISON [P χ^2]:	0.93	<0.001

MICA CREEK MACROINVERTEBRATE COUNTS PER EVENT
103 POOL&RIFFLE SPECIES

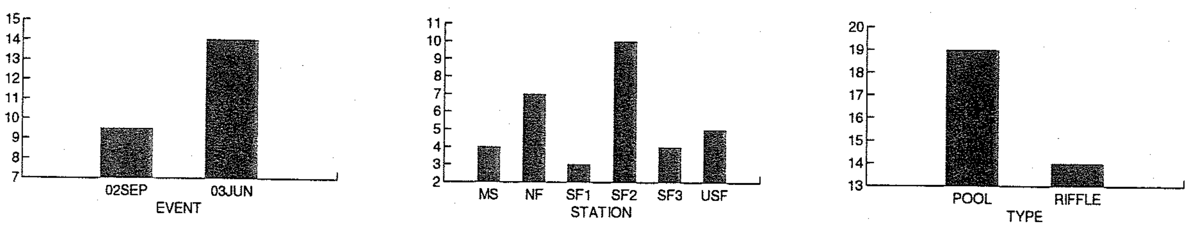
Taxa	MS_R1	MS_R2	MS_R3	NF_P1	NF_P2	NF_P3	NF_R1	NF_R2	NF_R3	SF1_P1	SF1_P2	SF1_P3	SF1_R1	SF1_R2	SF1_R3	SF2_P1	SF2_P2	SF2_P3	SF2_R1	SF2_R2	SF2_R3	SF3_P1	SF3_P2	SF3_P3	SF3_R1	SF3_R2	SF3_R3	USF_P1	USF_P2	USF_P3	USF_R1	USF_R2	USF_R3	Grand Total
Acari	6	3	12	27	6	64	1		2	48	71	43	6	2	23	6	2	3	3	1	1	70	14	10	1	2	6	37	18	8	11	2	3	697
Agapetus		2						1						1						6						2						1		14
Ameletus	2	5			6			3		1	2	2	2	3	3	1	3	15	3	1	4	8	30	2		9	1	8	15	14		11		185
Antocha		1					3		2				2			1	2	23	46	11	4	6	2	5	28	20	6							163
Apatania							3						2		1					4		1							7		2	6		26
Baetis tricaudatus	4	7					1	4	2				3	39	1	1	5		38	122	20	4	22		20	61	11		3		8	34	2	412
Brillia					1			1			5				1	3	2				1		1											15
Capniidae			1							4		54				2		3						7										75
Ceratopogoninae	1	1	5	83	12	13	4	5	5	62		32	2		10	16		9			2	8		16			3	16	1	11	9	2	2	384
Chelifera	1		4	3			4					1	1		1			2	3			1		2	2			2		4	5	1	1	38
Cinygmula	25		2	3			111	1					24		4	1		16	55		96	10		1	37		10	5	1	10	28	2	56	499
Cladotanytarsus		4					2				4		9	6		9	4		6	12		3	24	1	1		8		16			15		124
Cleptelmis	13	17	56			6			2	2	2	1	37	4	11	3			12		6	22	7		56	28	47	28		10	33		7	411
Corynoneura			5			1		1		2	1	4				6								1	3		2	2					2	52
Cricotopus (Crictopus)									12			4			4	26		4			3			10	6		2			5			2	84
Cricotopus (Isocladius)		7																																48
Cricotopus (Nostococladius)										1						13	47	106	85	46	26	1						1	5					331
Despaxia augusta																													2			1		3
Dicranota		1	1				2				1	1	3	2													1	1			1		2	17
Diphetor hageni	1	6	3		1		2	23					2	13	2		7	2		25		1	4		1	9	11		36			22		184
Drunella doddsi							3												1				4	1	2	17			1		6	5	1	41
Drunella grandis	3	10	16		2		5		6	1	2		15	6	4	8	5	6	7	4	3	17	42	6	5	22	12	10	53	8	3	19	4	311
Elmidae	15	50					50						46							13		12			20	14		7			30			257
Epeorus longimanus		24						43						11			1			74			3			21						11		195
Ephemerella	10		6	64		11	4		7	45		68	7		23	148		126	32		2	83		224	28		65	7		13	1		3	991
Ephemerella inermis		1			2																											3		6
Eukiefferiella Brehmi																	1									3								4
Eukiefferiella devonica	7		13									1	19	1					1		2	1	1	1	5	4	5	1	6					69
Eukiefferiella pseudomontana	12	2	21						2										8			1			4	2	1					3		58
Ferrissia			7												1			4			1	3		14										79
Glossosoma	305		32				15						14		14			5	38		50	2			11			2		2	38		23	559
Glossosomatidae							5						2				2			4						4								17
Glutops																								1				1		1	1	2		6
Heptageniidae		4			2								1																					7
Heterlimnius	7	19		5	5		7	5	1	9	16	8	8	32	34	3	26	23	6	39	20	10	12	33	11			40	109	107	47	157	73	887
Hydropsyche	10		6				34	6		1			29	5	17		1	2	131	27	43	20	3	2	306	66	11	1		3	14	3	28	769
Hydroptila			1	1						1						3		20	7			31		53	2		12	48		115	1		11	306
Isoperla					1					1				1								1	2				1	5	11		2			27
Lara avara																5	1			2	1	2		3	1	1		1		2	3		1	23
Larsia		4				30				3	1	6					3						6	1										54
Lepidostoma		1		2	1					1	1			1		8	1					5						46	7		2	3		98
Lepidostoma (panel case larvae)			2															1												1				4
Lepidostoma (sand case larvae)																														1			1	2
Lepidostoma (turret case)																														5			2	7
Limnophila			1	5	11	12		11	27			1				3	1		1	3	8			1	2			1						88
Limnophyes						1									1																			2
Lopescladius					52		5	44						2			2			1														106
Malenka														15						2			4			12			5					40
Margaritifera falcata	1	1			2		2				1	1		3	1	1	1	5		1	1			2								1		29
Maruina																1			4		1					1								7
Micrasema	3	9	31				1			4		17	69	4	91	3	2	10	50	8	19	24		11	68	10	112	53	30	33	43	7	64	782
Micropsectra							2						1		1	11		2				8			1			1			34		1	62
Nais						31			7			2																						47

Taxa	MS_R1	MS_R2	MS_R3	NF_P1	NF_P2	NF_P3	NF_R1	NF_R2	NF_R3	SF1_P1	SF1_P2	SF1_P3	SF1_R1	SF1_R2	SF1_R3	SF2_P1
Narpus			1							1		3		7	3	
Nematoda	1	12				3		1				1			1	
Neophylax occidentalis														2		
Neophylax rickeri		1														
Oligochaeta	5	2					3			3	7		4			52
Optioservus	140	199	209	171	197	380	253	275	378	83	226	228	267	268	355	74
Oreodytes		9		1	25	3				6	37	17		2		7
Orthocladius										1				1		
Pacifastacus		1	1							7						
Pagastia	2	1	2				3		3			1	2	1		2
Paraleptophlebia	69	3	45	1	7	1	24	4		9	11	49	31		45	10
Parametriocnemus	2												1		1	
Parapsyche almota													3			
Paratanytarsus	4															
Pericoma	2			50	1	59	12		5	4		5	9		21	11
Perlidae					1			1								
Perlodidae			1		1		10	4					2		2	
Physidae			4			3			3		2				3	
Pisidiidae		2	1		8	11		1							1	
Polycentropus		1								1						
Polypedilum					1			3		6		2			24	4
Procladius		1								1						
Psychoda	1															7
Rhabdomastix					1		1							2	1	
Rheocricotopus							1			1		2	1		1	
Rheotanytarsus			4											1	2	
Rhithrogena	2						7						4			
Rhyacophila Angelita		2						2						1		
Rhyacophila Betteni								6								
Rhyacophila Brunnea																
Rhyacophila narvae									1						1	
Rhyacophila verrula		1												2		
Serratella tibialis		51			4			42						20		
Simulium	10	96	35					27	2				7	28	8	
Skwala			6				3						1	1	1	
Sphaeriidae				2												1
Stempellinella		1			6			4			8			1		
Stictotarus													1			
Suwallia		2			2			3								
Sweltsa	3		1				7	2	1	1	1	2	12	7	14	
Symposiocladius																
Synorthocladius		1		1							1	1				
Tabanidae			1	2	1					8	2			2		1
Tanytarsus		2		55	47	2		7		150	6					
Thienemanniella								1								
Thienemannimyia	3	2	14	2	78		11	4	20		30		2	2	2	
Tubificidae			10									24				
Tvetenia	19	5	55				1	8	2				2	1	3	1
Zaitzevia	3	6	2		1		4	12	2		1		4	27	3	1
Zapada cinctipes	11		3				4					1	13		16	4
Grand Total	703	580	620	478	485	631	610	555	492	468	439	582	670	527	756	457

Taxa	SF2_P2	SF2_P3	SF2_R1	SF2_R2	SF2_R3	SF3_P1	SF3_P2	SF3_P3	SF3_R1	SF3_R2	SF3_R3	USF_P1	USF_P2	USF_P3	USF_R1	USF_R2	USF_R3	Grand Total
Narpus	1			1			7		1			1	1	11	3	1		43
Nematoda						1					2			1	1			37
Neophylax occidentalis	1									3								6
Neophylax rickeri				1						1			2					5
Oligochaeta			2	1		16			6			3						164
Optioservus	62	121	90	76	179	96	49	98	80	16	154	50	51	77	47	132	44	5674
Oreodytes	16	3		2			24	1		1	1	2	28	7			2	266
Orthocladius				5		7				2						11		34
Pacifastacus						1		1						2				14
Pagastia	1		6	2		3			8	12	2	2	2	5	6	3		80
Paraleptophlebia	3	54	17	4	23	30	3	12	24	1	124	14	6	19	5	3	40	742
Parametriocnemus	1					1		1					1					9
Parapsyche almota			1			2					1				1		1	9
Paratanytarsus									3			39			34			80
Pericoma		48	14		26	11		20	9		6	23		32	97		123	588
Perlidae																1		3
Perlodidae	11	1	1	2	2		1	1						4	3		8	58
Physidae		1						1					1					23
Pisidiidae		2		1			2	4		1				1		2	1	40
Polycentropus	1	1				2	1							6				26
Polypedilum	1			1		1	4	22			3	3	25	43		12		218
Procladius																		6
Psychoda																		8
Rhabdomastix																		5
Rheocricotopus		1			1	1		3	1		3	4		20			6	49
Rheotanytarsus					5			8					9	9		19	5	62
Rhithrogena					1					2					1			21
Rhyacophila Angelita				1						1						1		9
Rhyacophila Betteni	1			1	2		2			2					2	1		17
Rhyacophila Brunnea				2					3	4			2		6	2	4	23
Rhyacophila narvae		4	1		6	3			1		4		1	1	2	1	3	29
Rhyacophila verrula							1											4
Serratella tibialis	1			23			71			189			10			44		456
Simulium	1	1	3	23	10	2	1		3	26	1		2		1	7	1	317
Skwala		2									1			2		10		30
Sphaeriidae			1			1			1									6
Stempellinella	14			15			19			18			42			11		139
Stictotarus																		2
Suwallia																		11
Sweltsa	6	5	13	19	12	1	6	4	5	7	3		4	5	6	7	18	174
Symposiocladius						2		1							1			4
Synorthocladius		1				1						1			2			10
Tabanidae		1				1	1											28
Tanytarsus													5			3		281
Thienemanniella		1									1		1					4
Thienemannimyia	2		1	3			1			3			16		3	13		252
Tubificidae		10						20										75
Tvetenia			3	2	1					3	2	5			9		2	130
Zaitzevia	5	2		31	2		1			8					1	6	1	126
Zapada cinctipes		4	15	2	13	2		1	38		23	1	4	1	16	4	33	209
Grand Total	247	650	705	624	597	540	375	606	804	608	658	472	539	599	569	605	581	20308

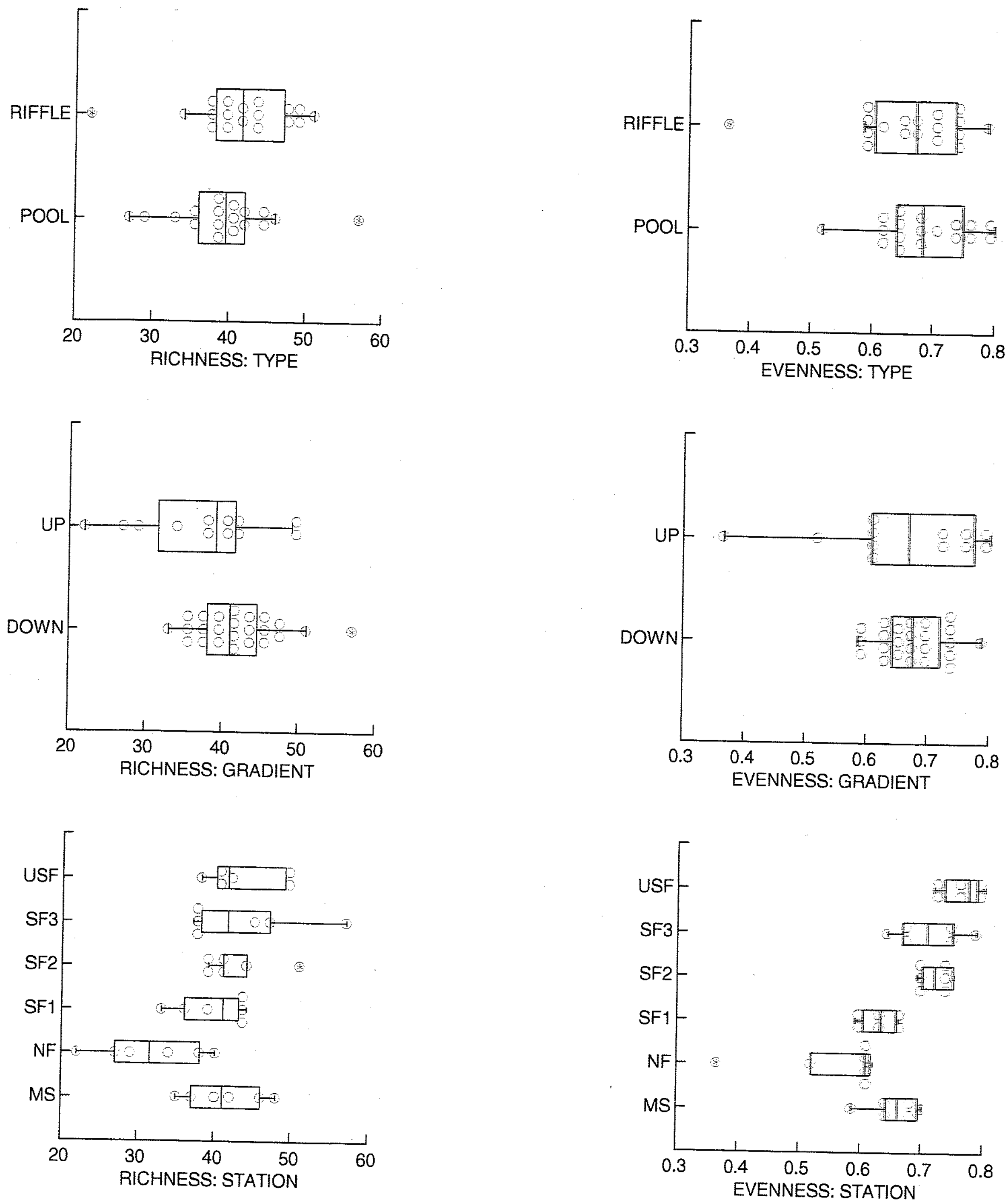


DISTRIBUTION OF INDIVIDUAL COUNTS/TAXA: BY HABITAT



SINGLE OCCURRENCE TAXA DISTRIBUTION

	EVENT	STATION	TYPE
$P[\chi^2]$	0.38	0.30	0.38



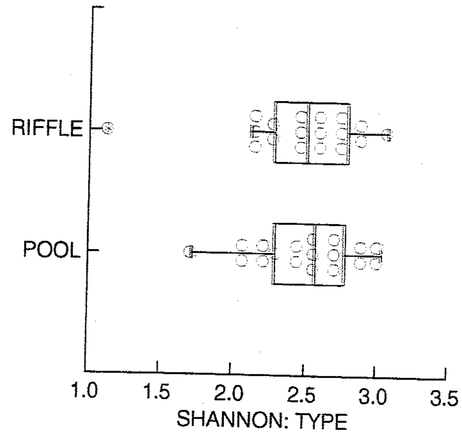
TAXA RICHNESS/STATION

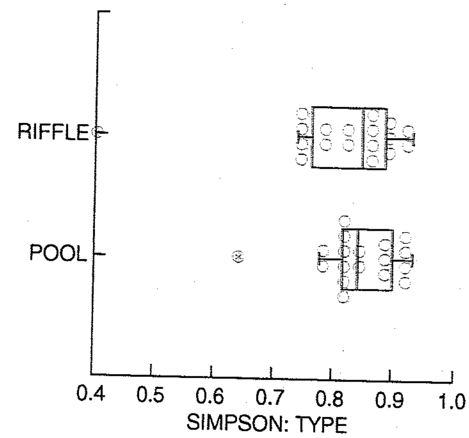
TYPE	NS	[0.24]
GRADIENT	NS	[0.15]
STATION	NS	[0.06]

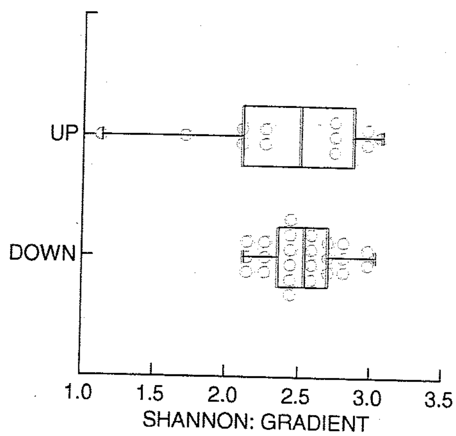
TAXA EVENNESS/STATION

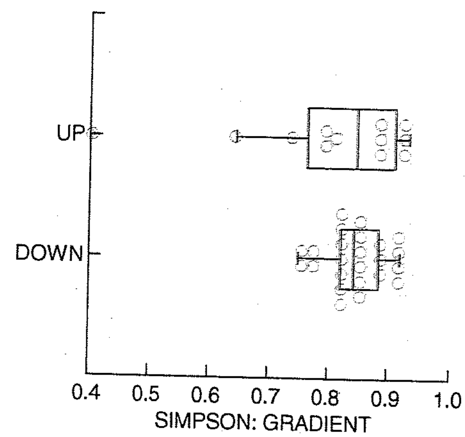
TYPE	NS	[0.56]
GRADIENT	NS	[0.96]
STATION	<0.001	

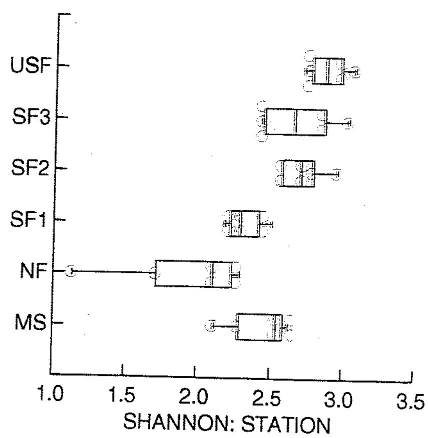
NF~SF1~MS < SF2~SF3~USF

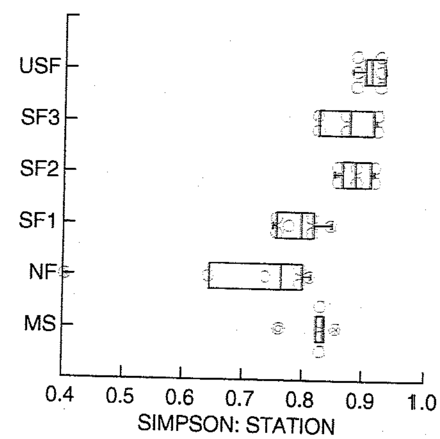












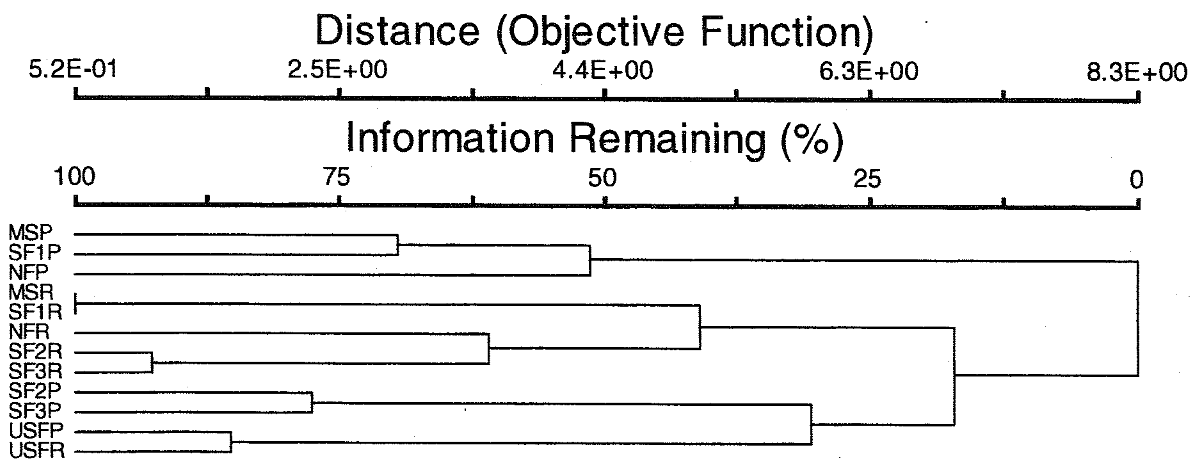
SHANNON DIVERSITY/STATION

TYPE NS [0.80]
GRADIENT NS [0.76]
STATION <0.001
NF < SF1~MS < SF2~SF3~USF

SIMPSON DIVERSITY/STATION

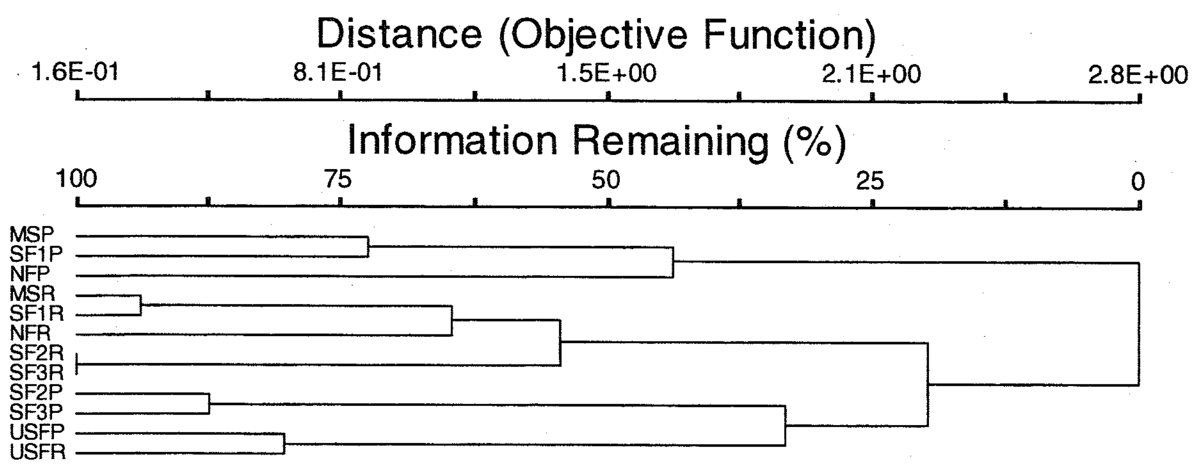
TYPE: NS [0.54]
GRADIENT: NS [0.89]
STATION: <0.001
NF < SF1~MS < SF2~SF3~USF

MREW187



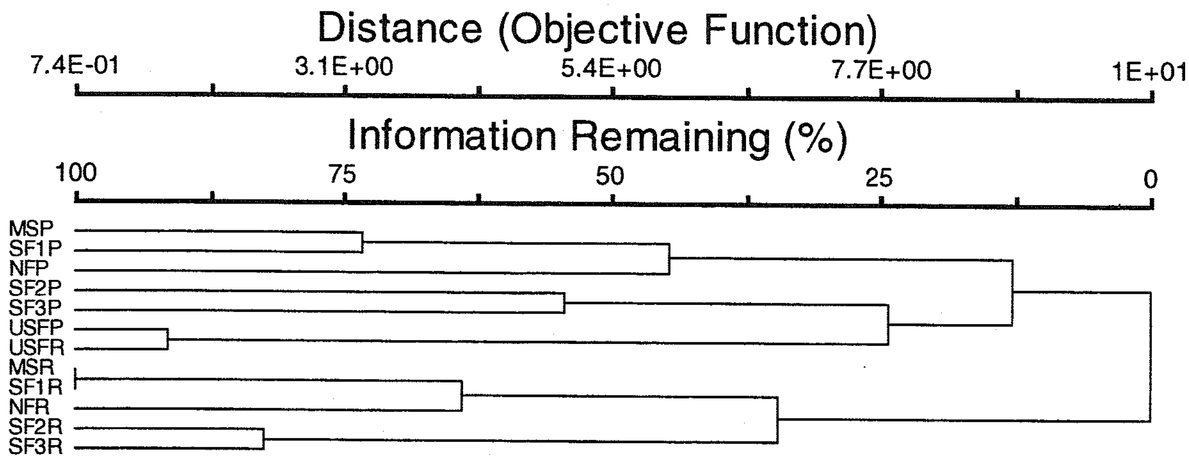
SAMPLES	12: CUMULATIVE OVER 3 EVENTS
STATIONS	6 STATIONS/RIFFLE & POOL
TAXA	187
RELATIVIZATION	MAX SPP COUNT
DISTANCE MEASURE	EUCLIDEAN RELATIVE
CLUSTERING LINKAGE	WARD'S LINKAGE

MSB187



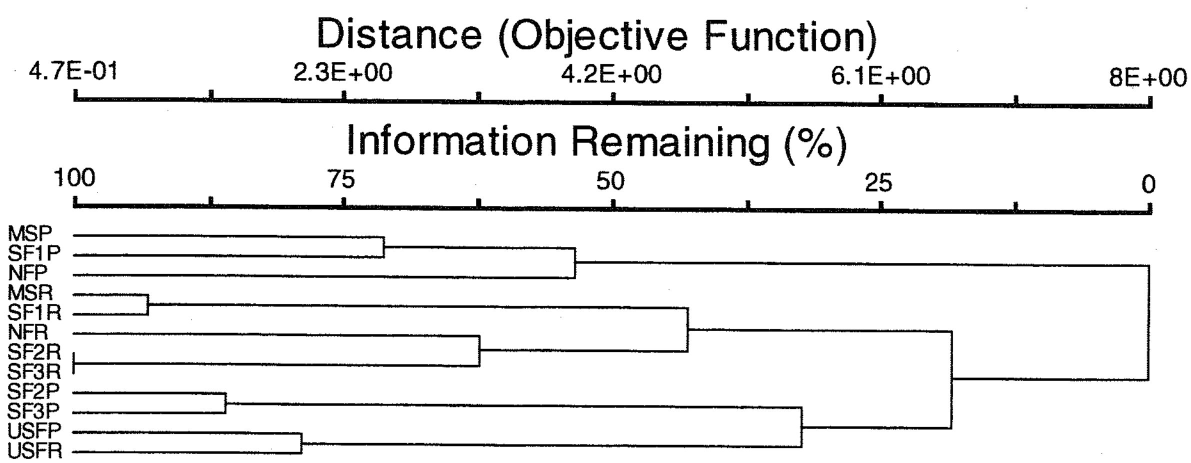
SAMPLES	12: CUMULATIVE OVER 3 EVENTS
STATIONS	6 STATIOINS/RIFFLE & POOL
TAXA	187
RELATIVIZATION	MAX SPP COUNT
DISTANCE MEASURE	SORENSON
CLUSTERING LINKAGE	FLEXIBLE BETA

TREW187



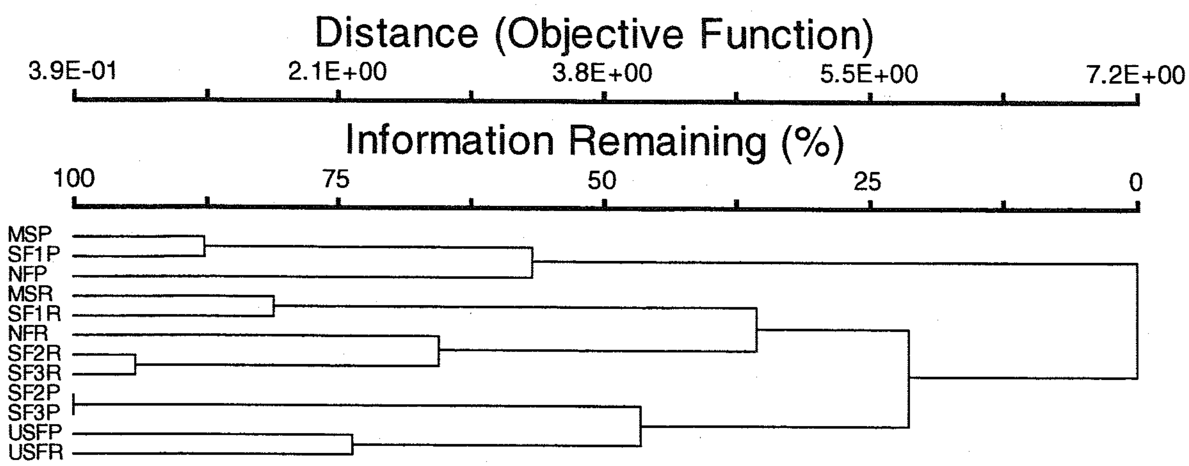
SAMPLES	12: CUMULATIVE OVER 3 EVENTS
STATIONS	6 STATIOINS/RIFFLE & POOL
TAXA	187
RELATIVIZATION	TOTAL SPP COUNT
DISTANCE MEASURE	RELATIVE EUCLIDEAN
CLUSTERING LINKAGE	WARD'S

M154REW



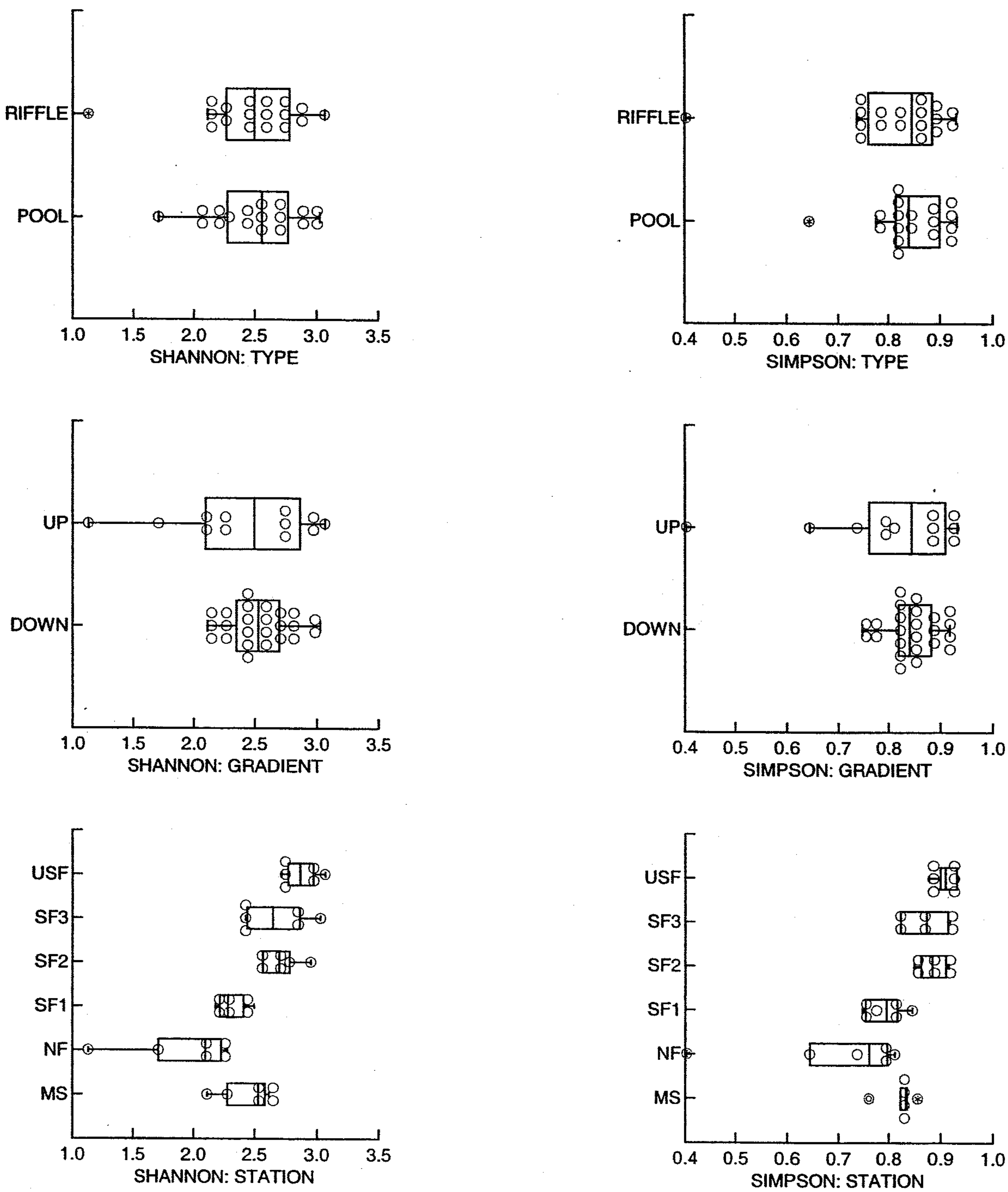
SAMPLES	12: CUMULATIVE OVER 3 EVENTS
STATIONS	6 STATIOINS/RIFFLE & POOL
TAXA	154 [NOT SINGLE OCCURRENCES]
RELATIVIZATION	MAXIMUM SPP COUNT
DISTANCE MEASURE	RELATIVE EUCLIDEAN
CLUSTERING LINKAGE	WARD'S

M104REW



SAMPLES	12: CUMULATIVE OVER 3 EVENTS
STATIONS	6 STATIOINS/RIFFLE & POOL
TAXA	104 [OCCURRING AT >2 STATIONS]
RELATIVIZATION	MAXIMUM SPP COUNT
DISTANCE MEASURE	RELATIVE EUCLIDEAN
CLUSTERING LINKAGE	WARD'S

Macroinvartebrate Diversity and Eveness by Station

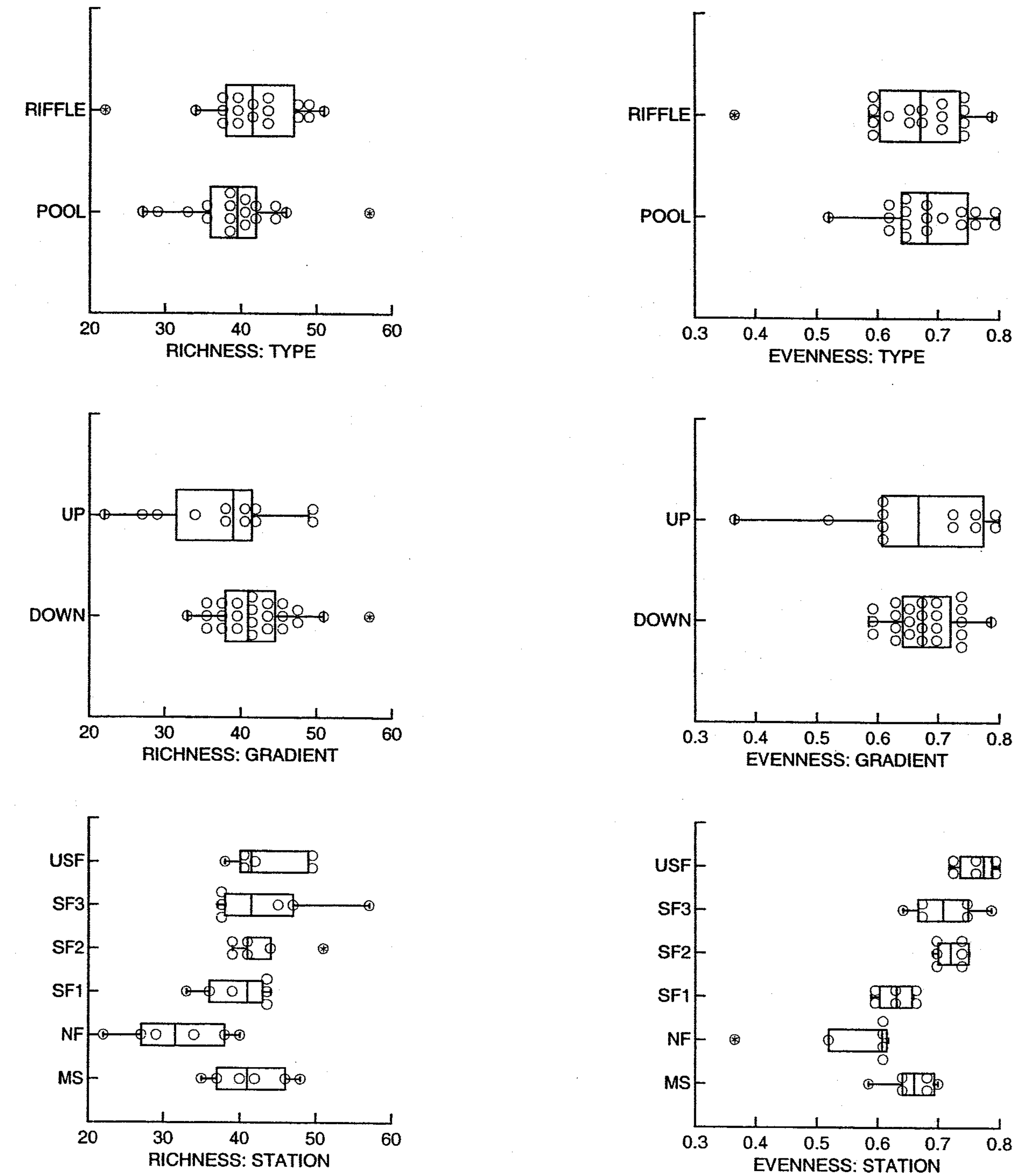


SHANNON DIVERSITY/STATION

TYPE NS [0.80]
GRADIENT NS [0.76]
STATION <0.001
NF < SF1~MS < SF2~SF3~USF

SIMPSON DIVERSITY/STATION

TYPE: NS [0.54]
GRADIENT: NS [0.89]
STATION: <0.001
NF < SF1~MS < SF2~SF3~USF



TAXA RICHNESS/STATION

TYPE	NS	[0.24]
GRADIENT	NS	[0.15]
STATION	NS	[0.06]

TAXA EVENNESS/STATION

TYPE	NS	[0.56]
GRADIENT	NS	[0.96]
STATION	<0.001	

NF~SF1~MS < SF2~SF3~USF

MICA CREEK CLUSTER ANALYSES
RELATIVIZATION COMPARISONS: SUMMARY STATISTICS

FILE N[1]	S187	S187MAX	S187TC	S154	S154MAX	S104	S104MAX
%EMPTY	59.8%	59.8%	59.8%	53.0%	53.0%	37.2%	37.2%
RELATIVIZATION	NONE	SPP MAX	SPP TOTAL	NONE	SPP MAX	NONE	SPP MAX
SAMPLE COUNT	12	12	12	12	12	12	12
SAMPLE CV	12%	15%	23%	12%	14%	13%	13%
SAMPLE OUTLIER	SF1R	NFP	NFP	SF1R	NFP	SF1R	NFP
Z-MAX	2.48	2.2	2.04	2.48	2.16	2.40	2.32
SPP COUNT	187	187	187	154	154	104	104
SPP CV	397%	54%	0%	356%	47%	294%	36%
SPP OUTLIER	5	1	0	3	1	4	2
Z-MAX	2.54	2.02	NA	-2.39	2.16	-2.17	+2.10

FILE N[1]	D97	D97MAX	D97TC
%EMPTY	56.7	56.7	56.7
RELATIVIZATION	NONE	SPP MAX	SPP TOTAL
SAMPLE COUNT	6	6	6
SAMPLE CV	13	19	25
SAMPLE OUTLIER	NONE	NONE	NONE
SPP COUNT	97	97	97
SPP CV	328.6	44	0
SPP OUTLIER	3	1	NONE

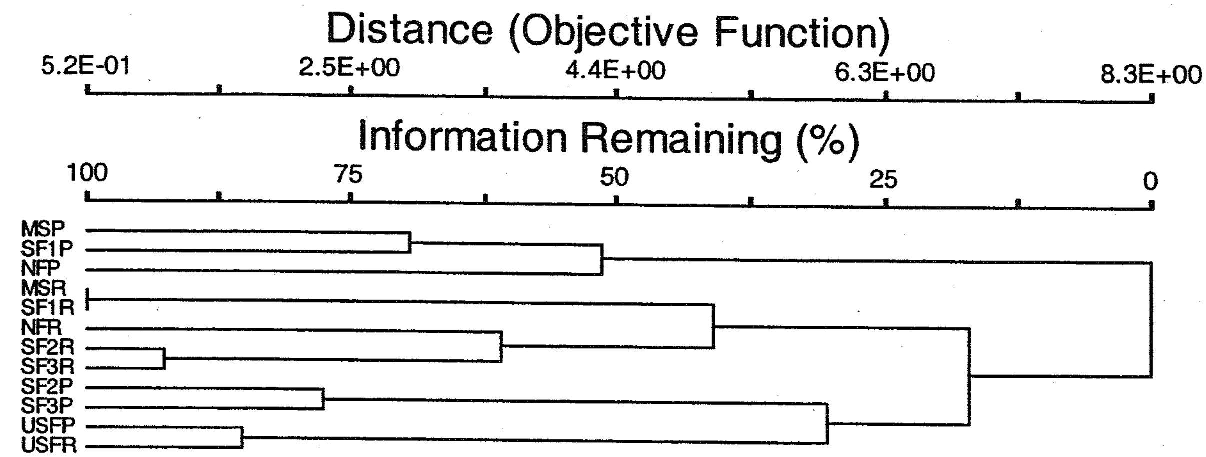
FILE N[1]	
S187	INCLUDES ALL 187 TAXA DETECTED: 50POOL, 34RIFFLE AND 103POOL-RIFFLE
S154	EXCLUDES 33 SINGLE OCCURRENCE TAXA
S104	EXCLUDES 83 TAXA OCCURRING IN 2 OR FEWER LOCATIONS
D97	INCLUDES ALL 97 TAXA DETECTED IN 3 FIELD DUPLICATE SETS

MICA CREEK CLUSTER ANALYSES
LOCATION*HABITAT CLUSTER PER CLUSTER ALGORITHM

STATION*HABITAT	MREW187	MSB187	TREW187	M154REW	RE-W155R2
MSP	1	1	1	1	1
SF1P	1	1	1	1	1
NFP	1	1	1	1	1
MSR	2	2	3	2	2
SF1R	2	2	3	2	2
NFR	2	2	3	2	2
SF2R	2	2	3	2	2
SF3R	2	2	3	2	2
SF2P	2	3	2	3	3
SF3P	3	3	3	3	3
USFP	3	3	2	3	3
USFR	3	3	2	3	3

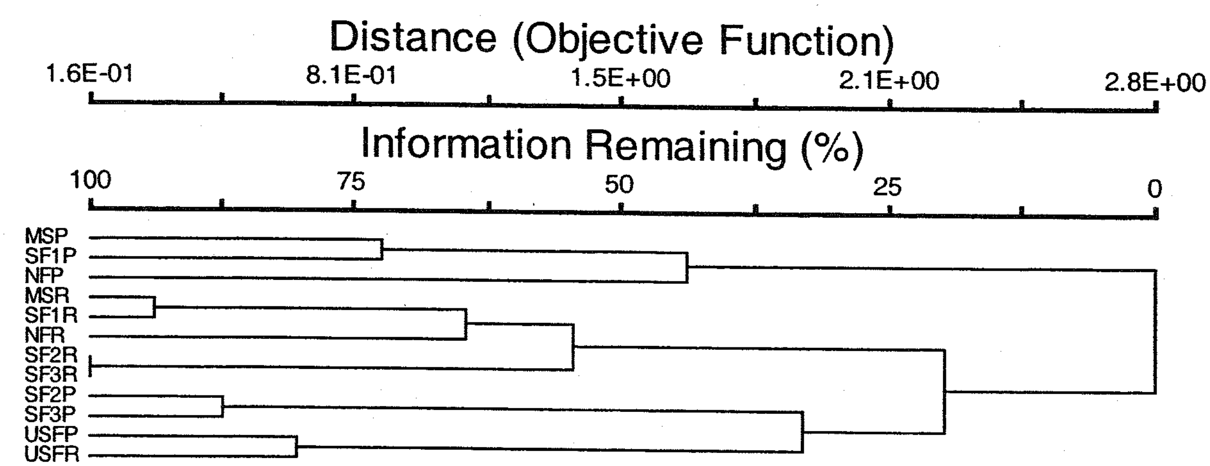
DUPLICATE PAIRS	D6MAX
NF11	2
NF12	2
USF31	1
USF32	1
NF21	3
NF22	3

MREW187



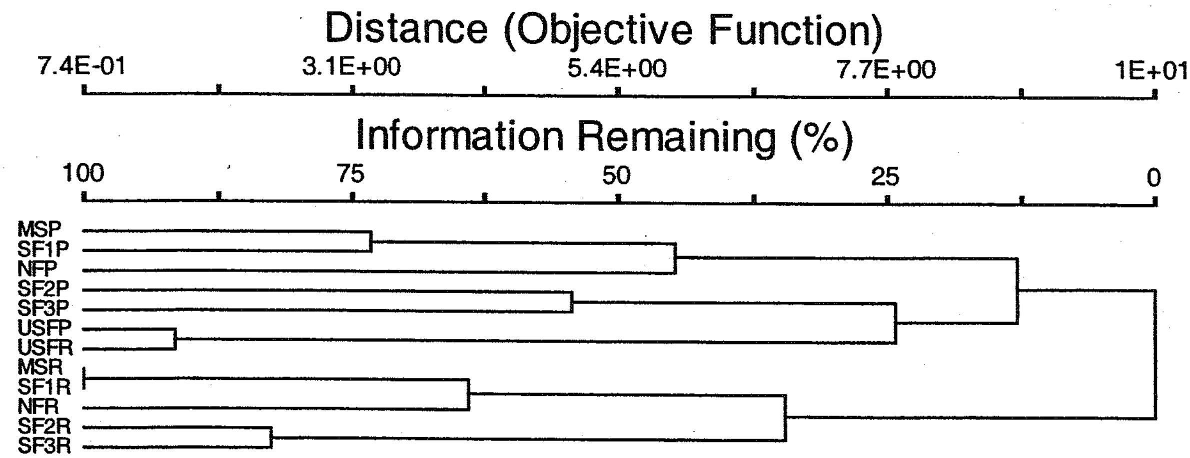
SAMPLES	12: CUMULATIVE OVER 3 EVENTS
STATIONS	6 STATIONS/RIFFLE & POOL
TAXA	187
RELATIVIZATION	MAX SPP COUNT
DISTANCE MEASURE	EUCLIDEAN RELATIVE
CLUSTERING LINKAGE	WARD'S LINKAGE

MSB187



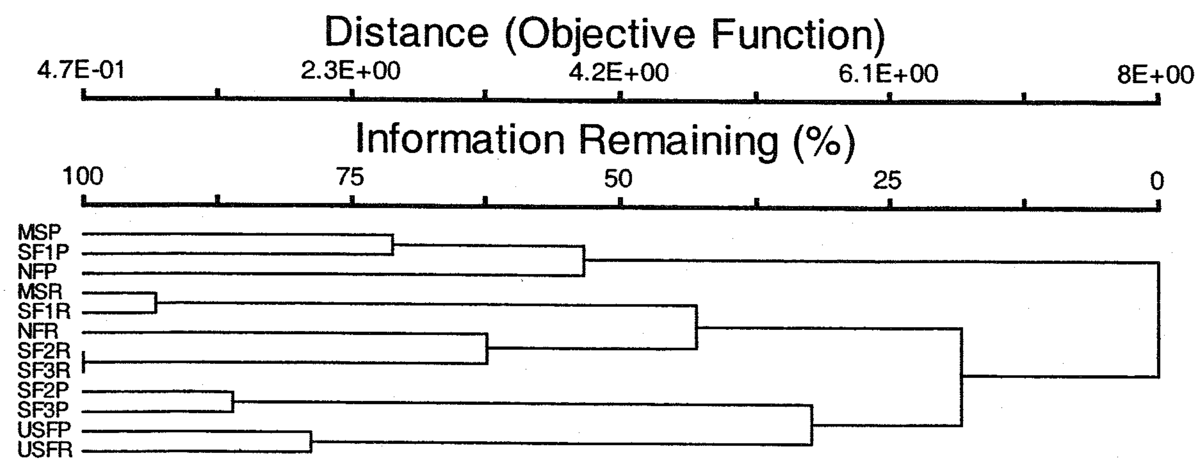
SAMPLES	12: CUMULATIVE OVER 3 EVENTS
STATIONS	6 STATIOINS/RIFFLE & POOL
TAXA	187
RELATIVIZATION	MAX SPP COUNT
DISTANCE MEASURE	SORENSON
CLUSTERING LINKAGE	FLEXIBLE BETA

TREW187



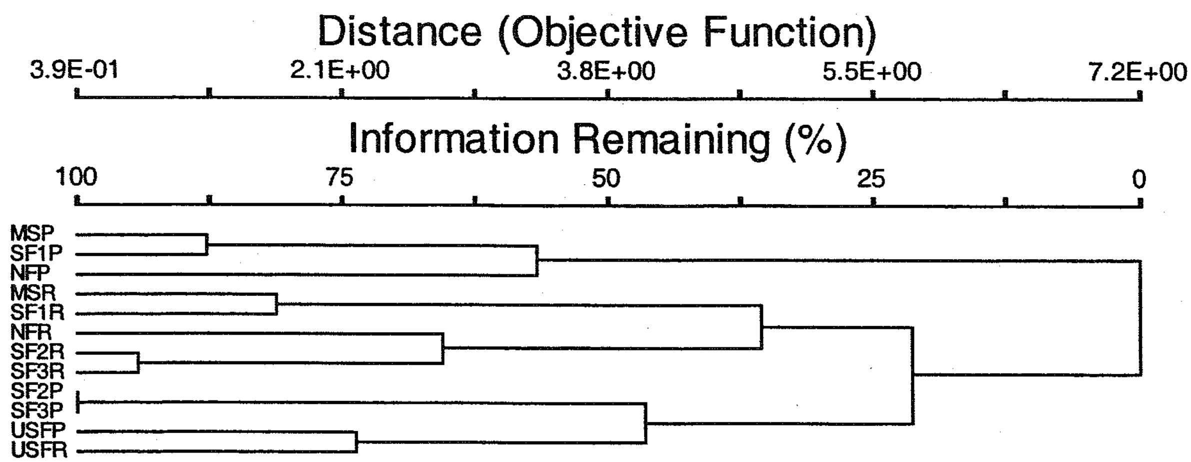
SAMPLES	12: CUMULATIVE OVER 3 EVENTS
STATIONS	6 STATIOINS/RIFFLE & POOL
TAXA	187
RELATIVIZATION	TOTAL SPP COUNT
DISTANCE MEASURE	RELATIVE EUCLIDEAN
CLUSTERING LINKAGE	WARD'S

M154REW

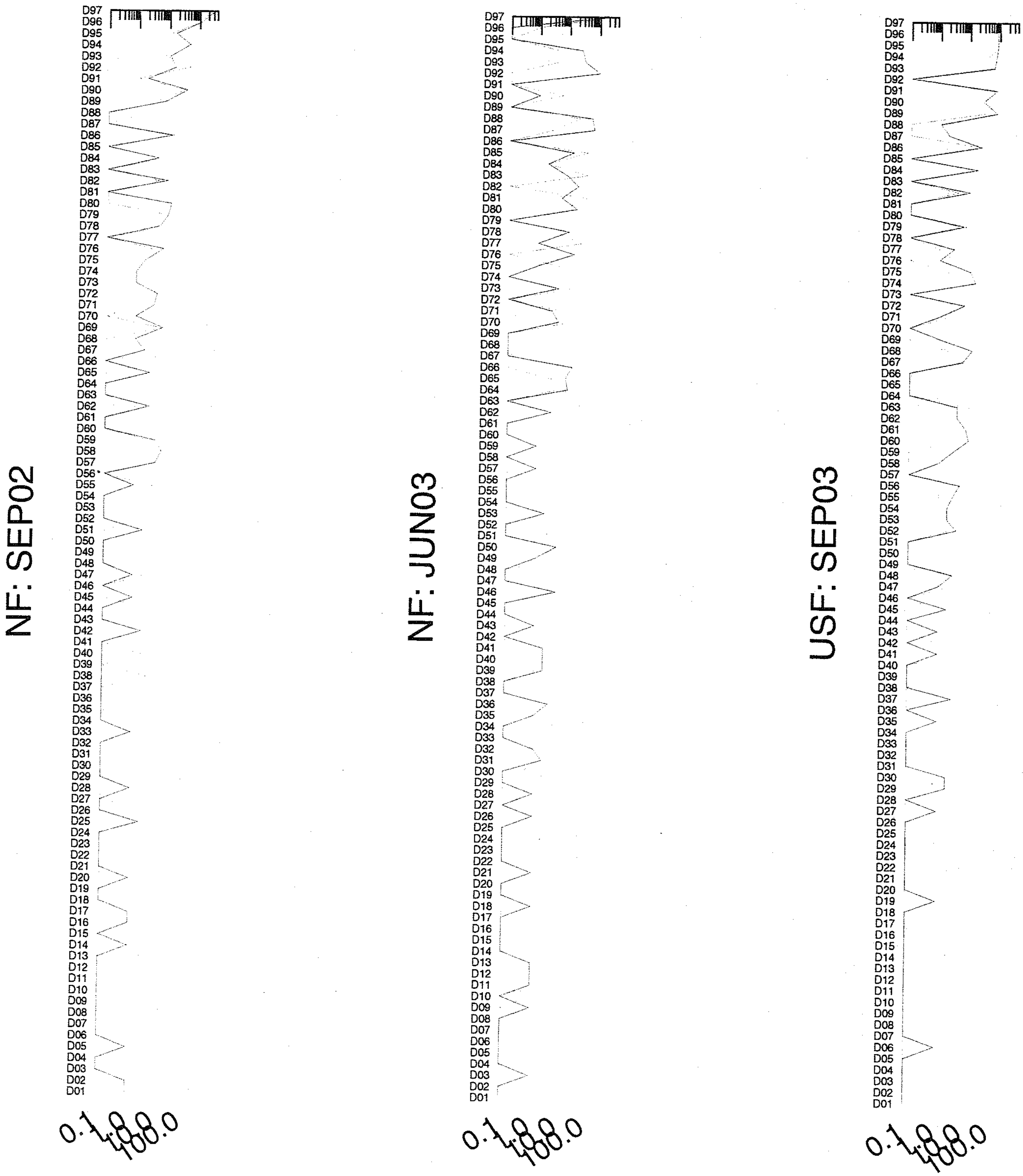


SAMPLES	12: CUMULATIVE OVER 3 EVENTS
STATIONS	6 STATIOINS/RIFFLE & POOL
TAXA	154 [NOT SINGLE OCCURRENCES]
RELATIVIZATION	MAXIMUM SPP COUNT
DISTANCE MEASURE	RELATIVE EUCLIDEAN
CLUSTERING LINKAGE	WARD'S

M104REW

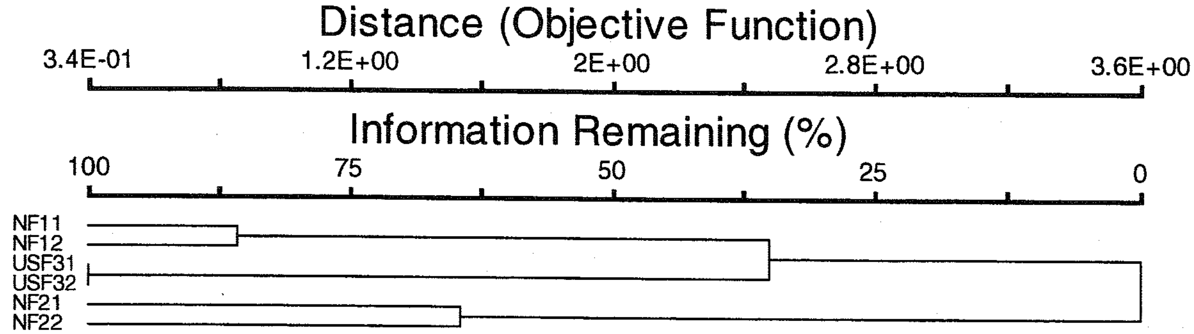


SAMPLES	12: CUMULATIVE OVER 3 EVENTS
STATIONS	6 STATIOINS/RIFFLE & POOL
TAXA	104 [OCCURRING AT >2 STATIONS]
RELATIVIZATION	MAXIMUM SPP COUNT
DISTANCE MEASURE	RELATIVE EUCLIDEAN
CLUSTERING LINKAGE	WARD'S



DUPLICATE SPECIES TRACES: LOG10[COUNT+0.1]
____ ORIGINAL SAMPLE ____ DUPLICATE

D6MAX



SAMPLES	6: 3 DUPLICATE PAIRS
STATIONS	2 UNIQUE
TAXA	97
RELATIVIZATION	MAX SPP COUNT
DISTANCE MEASURE	EUCLIDEAN RELATIVE
CLUSTERING LINKAGE	WARD'S LINKAGE

1995 Stream Habitat Index Values

1995 Survey SHI Scores.

Reach level SHI scores for the 1995 BURP habitat measures as described in the Framework (ID DEQ 2002). The values in **bold**, adjacent to the habitat measure, represent the value for the habitat measure within the specific reach. Values that are underlined represent the mean for the NMR ecoregion metric as described in Appendix 1.

REACH SF MICA. Scoring criteria for the Northern and Middle Rockies Ecoregion SHI.

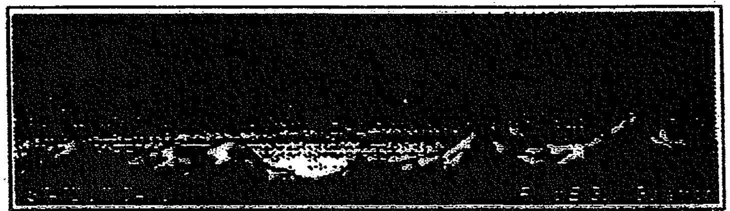
	Score										
Habitat Measure	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Instream Cover	0	1-2	3-4	5-6	7-8	9-10	**11-12**	13-14	15-16	17-18	19-20
Large Organic Debris (#s)	0	1-3	**4-7**	8-12	13-17	18-26	27-36	37-48	49-60	61-73	>73
Percent fines <2.5mm	**≥40**	35-39.9	30-34.9	25-29.9	20-24.9	15-19.9	10-14.9	7-9.9	5-6.9	3-4.9	<3
Embeddedness	0	1-2	3-4	5-6	7-8	9-10	**11-12**	13-14	15-16	17-18	19-20
Wolman size classes	1-3	4				5	6	7	8	9	**10**
Channel shape	0-1	2-3	4	5	6	7	8	**9**	10-11	12-13	14-15
% Bank vegetation cover	<30	30-39.9	40-49.9	50-59.9	**60-69.9**	70-79.9	80-84.9		85-89.9	90-94.9	95-100
% Canopy cover	<10	**10-19.9**	20-24.9	25-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	≥90
Disruptive pressures	0	1	2	3	4	5	6	7	8	**9**	10
Zone of influence	0	1	2	**3**	4	5	6	7	8	9	10

REACH NF MICA. Scoring criteria for the Northern and Middle Rockies Ecoregion SHI.

	Score										
Habitat Measure	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Instream Cover	0	1-2	3-4	5-6	7-8	9-10	**11-12**	13-14	15-16	17-18	19-20
Large Organic Debris (#s)	0	1-3	**4-7**	8-12	13-17	18-26	27-36	37-48	49-60	61-73	>73
Percent fines <2.5mm	≥40	35-39.9	**30-34.9**	25-29.9	20-24.9	15-19.9	10-14.9	7-9.9	5-6.9	3-4.9	<3
Embeddedness	0	1-2	3-4	5-6	7-8	9-10	11-12	**13-14**	15-16	17-18	19-20
Wolman size classes	1-3	4				5	6	7	8	9	**10**
Channel shape	0-1	2-3	4	**5**	6	7	8	9	10-11	12-13	14-15
% Bank vegetation cover	<30	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-84.9		85-89.9	90-94.9	**95-100**
% Canopy cover	**<10**	10-19.9	20-24.9	25-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	≥90
Disruptive pressures	0	1	2	3	4	5	6	**7**	8	9	10
Zone of influence	0	1	2	**3**	4	5	6	7	8	9	10

Appendix O

Water Intake and Treatment System Surveys



TRANSPORTATION DEPARTMENT

DISTRICT 1 • 600 W. PRAIRIE • COEUR D'ALENE, ID • 83815-8764 • (208) 772-1200

RECEIVED
SEP 25 2003
I.T.D. DIV. OF HIGHWAYS
COEUR D'ALENE, IDAHO

July 10, 2003

Mica Bay Property Owner"

Subject: U.S. 95 Bellgrove to Mica Highway Construction Project
Water Intake Survey for Mica Bay Sediment Impact Assessment

Dear Sir/Madam:

An impact assessment of Mica Bay in Lake Coeur d'Alene is currently being conducted by the Idaho Transportation Department (ITD) pursuant to an agreement with the Idaho Department of Environmental Quality (DEQ). As part of the assessment, we are conducting a survey of property owners on Mica Bay to seek information needed to evaluate the effects that the U.S. 95 Bellgrove to Mica construction project may have had on water intake and/or treatment systems.

Please fill in the information and check the appropriate spaces in the enclosed sheet and return it to ITD District 1 in the enclosed self-addressed, stamped envelope. Please return this sheet by August 1, 2003. Your help and cooperation will be much appreciated and are essential to an objective evaluation of impacts that may have occurred.

For those who indicate on the enclosed sheet that their water system may have been adversely affected by the U.S. 95 construction project, we will arrange to meet with you to obtain further information that will be needed for the Mica Bay assessment. We will contact you to set up a time that is convenient.

If you have any questions, please do not hesitate to call Andrea Storjohann at ITD in Coeur d'Alene at (208) 772-1208.

Sincerely,

Idaho Transportation Department, District 1

Andrea Paroni Storjohann, P.E.
Assistant District Engineer

Post-it® Fax Note 7671

To Steve Miller	Date 10/07/03 # of pages 3
Co./Dept.	From A. Storjohann
Phone #	Co.
Fax #	Phone #
	Fax #

Water Intake/Affected

Mica Bay Water Intake and Treatment System Survey Related to U.S. 95 Bellgrove to Mica Highway Construction Project

Today's Date: 9/22/03

Lot Number and/or Street Address:

① Left message voice mail 10/8/03 4:25 pm

Property Owner
Name: Bruce R. Barany
Address: North 2424 Division St. Spokane, Wash. 99207
Phone: 509 444 4298 voice #

Current Resident (if different than property owner above)
Name:
Address: Same
Phone:

Do you reside at the Mica Bay property on a year-round or seasonal basis?

Year round ✓ Seasonal ✓

If seasonal, please indicate which months you are normally at the property.
Ap. May June July Aug Sept Parts of Oct - Nov

Do you have a water intake and/or water treatment system that uses water withdrawn directly from Mica Bay (this would not include well water)? Yes ✓ No ____

If you answered "yes" to the above question, do you believe that your water intake and/or water treatment system has been affected by sediment and/or turbid conditions in Mica Bay since the Fall of 2001 that you consider out of the ordinary for the system you have compared to previous years? Yes ✓ No ____

If you answered "yes" to the above question, a representative of the Idaho Transportation Department will contact you to schedule a convenient time to meet with you to obtain further information that will be needed for the Mica Bay assessment. If you have any preferences, please identify what day of the week, month, and time of day typically is best for you.

Please use voice mail to get name + phone # of representative and I'll return call

Thanks

B R Barany

RECEIVED

AUG 1 2003

I.T.D. DIV OF HIGHWAYS
COEUR D'ALENE, IDAHO

Mica Bay Water Intake and Treatment System Survey Related to U.S. 95 Bellgrove to Mica Highway Construction Project

Today's Date: 7/31/03

Lot Number and/or Street Address:
4570 Mica Shore Road
Coeur d'Alene, Idaho

Property Owner
Name: Richard McKernan
Address: P.O. Box 2052 Coeur d'Alene, Idaho 83816
Phone: 8 765-9068 or 665-5301

Current Resident (if different than property owner above)
Name:
Address:
Phone:

Do you reside at the Mica Bay property on a year-round or seasonal basis?

Year round ✓ Seasonal ____

If seasonal, please indicate which months you are normally at the property.

Do you have a water intake and/or water treatment system that uses water withdrawn directly from Mica Bay (this would not include well water)? Yes ✓ No ____

If you answered "yes" to the above question, do you believe that your water intake and/or water treatment system has been affected by sediment and/or turbid conditions in Mica Bay since the Fall of 2001 that you consider out of the ordinary for the system you have compared to previous years? Yes ✓ No ____

If you answered "yes" to the above question, a representative of the Idaho Transportation Department will contact you to schedule a convenient time to meet with you to obtain further information that will be needed for the Mica Bay assessment. If you have any preferences, please identify what day of the week, month, and time of day typically is best for you.

Mica Bay Water Intake and Treatment System Survey Related to U.S. 95 Bellgrove to Mica Highway Construction Project

RECEIVED
JUL 31 2003
I.T.D. DIV OF HIGHWAYS
COEUR D'ALENE, IDAHO

Today's Date: 7-30-03

Lot Number and/or Street Address:
5124 MICA SHORE ROAD

Property Owner
Name: JAMES S. YATES
Address: MARINE RT. MICA BAY CDA. ID. 83814
Phone: 667-8272

Current Resident (if different than property owner above)
Name:
Address:
Phone:

Do you reside at the Mica Bay property on a year-round or seasonal basis?

Year round ✓ Seasonal ____

If seasonal, please indicate which months you are normally at the property.

Do you have a water intake and/or water treatment system that uses water withdrawn directly from Mica Bay (this would not include well water)? Yes ✓ No ____

If you answered "yes" to the above question, do you believe that your water intake and/or water treatment system has been affected by sediment and/or turbid conditions in Mica Bay since the Fall of 2001 that you consider out of the ordinary for the system you have compared to previous years? Yes ✓ No ____

If you answered "yes" to the above question, a representative of the Idaho Transportation Department will contact you to schedule a convenient time to meet with you to obtain further information that will be needed for the Mica Bay assessment. If you have any preferences, please identify what day of the week, month, and time of day typically is best for you.

MON. TUES. THURS ARE BEST DAYS

RECEIVED

JUL 3 0 2003

.T.D. DIV OF HIGHWAYS
COEUR D'ALENE, IDAHO

Mica Bay Water Intake and Treatment System Survey Related to U.S. 95 Bellgrove to Mica Highway Construction Project

Today's Date: 28 July 03

Lot Number and/or Street Address:

Property Owner
Name: Orland B. Scott M.D.
Address: 8565 S. Red Hog Drive, Coeur d'Alene, Idaho 83814
Phone: 208-765-2835

Current Resident (if different than property owner above)
Name:
Address:
Phone:

Do you reside at the Mica Bay property on a year-round or seasonal basis?

Year round X Seasonal ____

If seasonal, please indicate which months you are normally at the property.

Do you have a water intake and/or water treatment system that uses water withdrawn directly from Mica Bay (this would not include well water)? Yes X No ____

If you answered "yes" to the above question, do you believe that your water intake and/or water treatment system has been affected by sediment and/or turbid conditions in Mica Bay since the Fall of 2001 that you consider out of the ordinary for the system you have compared to previous years? Yes X No ____

If you answered "yes" to the above question, a representative of the Idaho Transportation Department will contact you to schedule a convenient time to meet with you to obtain further information that will be needed for the Mica Bay assessment. If you have any preferences, please identify what day of the week, month, and time of day typically is best for you.

Mica Bay Water Intake and Treatment System Survey Related to U.S. 95 Bellgrove to Mica Highway Construction Project

Today's Date: 7/21/03

RECEIVED
JUL 22 2003
I.T.D. DIV OF HIGHWAYS
COEUR D'ALENE, IDAHO

Lot Number and/or Street Address:
4579 W. Lyondale Dr.

Property Owner (Molly)
Name: Magdalene B. Isalaky
Address: 47 Mica Bay
Phone: (208) 664 2006

Current Resident (if different than property owner above)
Name:
Address:
Phone:

Do you reside at the Mica Bay property on a year-round or seasonal basis?

Year round ✓ Seasonal ____

If seasonal, please indicate which months you are normally at the property.

Do you have a water intake and/or water treatment system that uses water withdrawn directly from Mica Bay (this would not include well water)? Yes ✓ No ____

If you answered "yes" to the above question, do you believe that your water intake and/or water treatment system has been affected by sediment and/or turbid conditions in Mica Bay since the Fall of 2001 that you consider out of the ordinary for the system you have compared to previous years? Yes ✓ No ____

If you answered "yes" to the above question, a representative of the Idaho Transportation Department will contact you to schedule a convenient time to meet with you to obtain further information that will be needed for the Mica Bay assessment. If you have any preferences, please identify what day of the week, month, and time of day typically is best for you.

I am part of White Sands Estates, Inc., where 5 households share a common water system. On June 30, 2003, our pump, in the bay, was replaced by North Idaho Pump. When the pump was pulled from its casing, it was full of mu[d]. The original pump, installed in 1974, was replaced for the first time in May, 1999. At that time, there was no mud in the casing nor was there evidence of silt accumulation on the casing. This causes us to believe we are affected by the current mud flow into Mica Bay.

Contact person for White Sands: Molly Isalaky (208) 664 2006
Best time to meet with the majority of homeowners: Friday afternoons

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I.T.D. DIV OF HIGHWAYS
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Mica Bay Water Intake and Treatment System Survey Related to U.S. 95 Bellgrove to Mica Highway Construction Project

Today's Date: 7/14/03

Lot Number and/or Street Address:
5128 Mica Shore Rd.
Coeur d'Alene, ID 83814

Property Owner
Name: DAN BLAIR
Address: MARINE ROUTE, MICA BAY, CDA, ID 83814
Phone: 208-765-9352

Current Resident (if different than property owner above)
Name:
Address:
Phone:

Do you reside at the Mica Bay property on a year-round or seasonal basis?

Year round ✓ Seasonal ____

If seasonal, please indicate which months you are normally at the property.

Do you have a water intake and/or water treatment system that uses water withdrawn directly from Mica Bay (this would not include well water)? Yes ✓ No ____

If you answered "yes" to the above question, do you believe that your water intake and/or water treatment system has been affected by sediment and/or turbid conditions in Mica Bay since the Fall of 2001 that you consider out of the ordinary for the system you have compared to previous years? Yes ✓ No ____

If you answered "yes" to the above question, a representative of the Idaho Transportation Department will contact you to schedule a convenient time to meet with you to obtain further information that will be needed for the Mica Bay assessment. If you have any preferences, please identify what day of the week, month, and time of day typically is best for you.

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Mica Bay Water Intake and Treatment System Survey Related to U.S. 95 Bellgrove to Mica Highway Construction Project

Today's Date: 7-13-03

Lot Number and/or Street Address:
3678 Mica Shore Rd
Coeur d'Alene, Idaho

Property Owner
Name: Joan E. Simpson
Address: Mica Bay - Marine Rt Hcll
Phone: 208-664-9442

Current Resident (if different than property owner above)
Name:
Address: Same
Phone:

Do you reside at the Mica Bay property on a year-round or seasonal basis?

Year round X Seasonal ____

If seasonal, please indicate which months you are normally at the property.

Do you have a water intake and/or water treatment system that uses water withdrawn directly from Mica Bay (this would not include well water)? Yes X No ____

If you answered "yes" to the above question, do you believe that your water intake and/or water treatment system has been affected by sediment and/or turbid conditions in Mica Bay since the Fall of 2001 that you consider out of the ordinary for the system you have compared to previous years? Yes X No ____

If you answered "yes" to the above question, a representative of the Idaho Transportation Department will contact you to schedule a convenient time to meet with you to obtain further information that will be needed for the Mica Bay assessment. If you have any preferences, please identify what day of the week, month, and time of day typically is best for you.

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Mica Bay Water Intake and Treatment System Survey Related to U.S. 95 Bellgrove to Mica Highway Construction Project

Today's Date: 7-12-03

Lot Number and/or Street Address: MICA BAY, MARINE RT. CdA - MAILING ADDRESS
8555 RED HOG DRIVE

Property Owner
Name: JOHN AND CAROLINE GRIFFIN
Address: MICA BAY, COEUR d'ALENE, ID. 83814
Phone: 208-667-4095

Current Resident (if different than property owner above)
Name:
Address: SAME
Phone:

Do you reside at the Mica Bay property on a year-round or seasonal basis?

Year round X Seasonal ____

If seasonal, please indicate which months you are normally at the property.

Do you have a water intake and/or water treatment system that uses water withdrawn directly from Mica Bay (this would not include well water)? Yes X No ____

If you answered "yes" to the above question, do you believe that your water intake and/or water treatment system has been affected by sediment and/or turbid conditions in Mica Bay since the Fall of 2001 that you consider out of the ordinary for the system you have compared to previous years? Yes X No ____

If you answered "yes" to the above question, a representative of the Idaho Transportation Department will contact you to schedule a convenient time to meet with you to obtain further information that will be needed for the Mica Bay assessment. If you have any preferences, please identify what day of the week, month, and time of day typically is best for you.

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I.T.D. DIV OF HIGHWAYS
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Mica Bay Water Intake and Treatment System Survey Related to U.S. 95 Bellgrove to Mica Highway Construction Project

Today's Date: 7/29/03

Lot Number and/or Street Address:

Property Owner
Name: KMPZ Properties
Address: 83 LaVerne Ave Mill Valley CA
Phone: 415 389 - 9947

Current Resident (if different than property owner above)
Name:
Address:
Phone:

Do you reside at the Mica Bay property on a year-round or seasonal basis?

Year round ____ Seasonal ✓

If seasonal, please indicate which months you are normally at the property. May - Sept

Do you have a water intake and/or water treatment system that uses water withdrawn directly from Mica Bay (this would not include well water)? Yes ✓ No ____

If you answered "yes" to the above question, do you believe that your water intake and/or water treatment system has been affected by sediment and/or turbid conditions in Mica Bay since the Fall of 2001 that you consider out of the ordinary for the system you have compared to previous years? Yes ✓ No ____

If you answered "yes" to the above question, a representative of the Idaho Transportation Department will contact you to schedule a convenient time to meet with you to obtain further information that will be needed for the Mica Bay assessment. If you have any preferences, please identify what day of the week, month, and time of day typically is best for you.

contact:
Perrin Zanck
509-922-8581

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I.T.D. DIV. OF HIGHWAYS
COEUR D'ALENE, IDAHO

Mica Bay Water Intake and Treatment System Survey Related to U.S. 95 Bellgrove to Mica Highway Construction Project

Today's Date: 7-21-03

Lot Number and/or Street Address:
4673 Lyondale Dr
Coeur D'alene ID

Property Owner
Name: Elizabeth Stroschein Ries Trustee Stroschein Trusts
Address: S829 S. Lacey Lane, Spokane, WA 99223-6610
Phone: 509-448-5851 Summer home: 208-667-8086

Current Resident (if different than property owner above)
Name:
Address:
Phone:

Do you reside at the Mica Bay property on a year-round or seasonal basis?

Year round ____ Seasonal X

If seasonal, please indicate which months you are normally at the property.

April - Oct

Do you have a water intake and/or water treatment system that uses water withdrawn directly from Mica Bay (this would not include well water)? Yes X No ____

If you answered "yes" to the above question, do you believe that your water intake and/or water treatment system has been affected by sediment and/or turbid conditions in Mica Bay since the Fall of 2001 that you consider out of the ordinary for the system you have compared to previous years? Yes X No ____

If you answered "yes" to the above question, a representative of the Idaho Transportation Department will contact you to schedule a convenient time to meet with you to obtain further information that will be needed for the Mica Bay assessment. If you have any preferences, please identify what day of the week, month, and time of day typically is best for you.

I am part of White Sands Estates, Inc. Five households share a common water system.

On June 30, 2003 our pump, in the lake, was replaced by North Idaho Pump. When the pump was pulled the casing around the pump was full of mud.

The original pump, installed in 1974, was replaced for the first time in May of 1999. At that time there was no mud observed in the casing nor was there

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Mica Bay Water Intake and Treatment System Survey Related to U.S. 95 Bellgrove to Mica Highway Construction Project

Today's Date: 7/24/03

Lot Number and/or Street Address:
4575 W Lyondale Lane
Coeur d'Alene, Idaho Mica Bay

Property Owner
Name: Lawrence & Gladys Peretti, Managers Peretti Family LLC
Address: 4575 Lyondale Lane, Couerd'Alene, Idaho
Phone: 208-667-0185

Current Resident (if different than property owner above)
Name: Lawrence + Gladys Peretti
Address: 4708 S. Schafer Dr., Spokane, WA, 99206
Phone: 509-926-5694

Do you reside at the Mica Bay property on a year-round or seasonal basis?

Year round ___ Seasonal ✓ April Though October - part time

If seasonal, please indicate which months you are normally at the property.

Do you have a water intake and/or water treatment system that uses water withdrawn directly from Mica Bay (this would not include well water)? Yes X No ___

If you answered "yes" to the above question, do you believe that your water intake and/or water treatment system has been affected by sediment and/or turbid conditions in Mica Bay since the Fall of 2001 that you consider out of the ordinary for the system you have compared to previous years? Yes X No ___ see addendum

If you answered "yes" to the above question, a representative of the Idaho Transportation Department will contact you to schedule a convenient time to meet with you to obtain further information that will be needed for the Mica Bay assessment. If you have any preferences, please identify what day of the week, month, and time of day typically is best for you.

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Mica Bay Water Intake and Treatment System Survey Related to U.S. 95 Bellgrove to Mica Highway Construction Project

Today's Date: 7-14-03

Lot Number and/or Street Address:

8236 S. DEER RUN DR

Property Owner
Name: GLEN CLONINGER
Address: 8236 S. DEER RUN DR. CDA. 83814
Phone: 208-664-0555

Current Resident (if different than property owner above)
Name:
Address:
Phone:

Do you reside at the Mica Bay property on a year-round or seasonal basis?

Year round ___ Seasonal ✓

If seasonal, please indicate which months you are normally at the property.

MAY - SEPT

Do you have a water intake and/or water treatment system that uses water withdrawn directly from Mica Bay (this would not include well water)? Yes ✓ No ___

If you answered "yes" to the above question, do you believe that your water intake and/or water treatment system has been affected by sediment and/or turbid conditions in Mica Bay since the Fall of 2001 that you consider out of the ordinary for the system you have compared to previous years? Yes ✓ No ___

If you answered "yes" to the above question, a representative of the Idaho Transportation Department will contact you to schedule a convenient time to meet with you to obtain further information that will be needed for the Mica Bay assessment. If you have any preferences, please identify what day of the week, month, and time of day typically is best for you.

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Mica Bay Water Intake and Treatment System Survey Related to U.S. 95 Bellgrove to Mica Highway Construction Project

Today's Date: Aug. 11, 03

Lot Number and/or Street Address:

Property Owner
Name:
Address:
Phone:

Current Resident (if different than property owner above)
Name:
Address:
Phone:

Do you reside at the Mica Bay property on a year-round or seasonal basis?

Year round ____ Seasonal ✓

If seasonal, please indicate which months you are normally at the property.

March to November

Do you have a water intake and/or water treatment system that uses water withdrawn directly from Mica Bay (this would not include well water)? Yes ✓ No ____

If you answered "yes" to the above question, do you believe that your water intake and/or water treatment system has been affected by sediment and/or turbid conditions in Mica Bay since the Fall of 2001 that you consider out of the ordinary for the system you have compared to previous years? Yes ✓ No ____

If you answered "yes" to the above question, a representative of the Idaho Transportation Department will contact you to schedule a convenient time to meet with you to obtain further information that will be needed for the Mica Bay assessment. If you have any preferences, please identify what day of the week, month, and time of day typically is best for you.

Mica Bay Water Intake and Treatment System Survey Related to U.S. 95 Bellgrove to Mica Highway Construction Project

Today's Date: August 26, 03

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COEUR D'ALENE, IDAHO

Lot Number and/or Street Address:

Deer Run
15-49N-4W

Property Owner
Name: Flahavin Investments LLC et Al
Address: 34714 Schaefer Branch Road Spokane, Wa 99206
Phone: 509-924-1819

Current Resident (if different than property owner above)
Name:
Address:
Phone:

Do you reside at the Mica Bay property on a year-round or seasonal basis?

Year round ____ Seasonal X

If seasonal, please indicate which months you are normally at the property.
May, June, July, August and part of Sept.

Do you have a water intake and/or water treatment system that uses water withdrawn directly from Mica Bay (this would not include well water)? Yes X No ____

If you answered "yes" to the above question, do you believe that your water intake and/or water treatment system has been affected by sediment and/or turbid conditions in Mica Bay since the Fall of 2001 that you consider out of the ordinary for the system you have compared to previous years? Yes X No ____

If you answered "yes" to the above question, a representative of the Idaho Transportation Department will contact you to schedule a convenient time to meet with you to obtain further information that will be needed for the Mica Bay assessment. If you have any preferences, please identify what day of the week, month, and time of day typically is best for you.

No Water Intake

Mica Bay Water Intake and Treatment System Survey Related to U.S. 95 Bellgrove to Mica Highway Construction Project

Today's Date: 8/1/03

Lot Number and/or Street Address:
3650 W. Lutherhaven Rd

Property Owner
Name: Kevin & Sue Schwahn
Address: 3650 W. Lutherhaven Rd.
Phone: 667-3121

Current Resident (if different than property owner above)
Name:
Address:
Phone:

Do you reside at the Mica Bay property on a year-round or seasonal basis?

Year round X Seasonal ____

If seasonal, please indicate which months you are normally at the property.

Do you have a water intake and/or water treatment system that uses water withdrawn directly from Mica Bay (this would not include well water)? Yes ____ No X

If you answered "yes" to the above question, do you believe that your water intake and/or water treatment system has been affected by sediment and/or turbid conditions in Mica Bay since the Fall of 2001 that you consider out of the ordinary for the system you have compared to previous years? Yes ____ No ____

If you answered "yes" to the above question, a representative of the Idaho Transportation Department will contact you to schedule a convenient time to meet with you to obtain further information that will be needed for the Mica Bay assessment. If you have any preferences, please identify what day of the week, month, and time of day typically is best for you.

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Mica Bay Water Intake and Treatment System Survey Related to U.S. 95 Bellgrove to Mica Highway Construction Project

Today's Date: 12 July 03

Lot Number and/or Street Address:
SOUTH 7770 SWAN CT.

Property Owner
Name: WM SWANN
Address: S
Phone:

Current Resident (if different than property owner above)
Name:
Address:
Phone:

Do you reside at the Mica Bay property on a year-round or seasonal basis?

Year round YES Seasonal ____

If seasonal, please indicate which months you are normally at the property.

Do you have a water intake and/or water treatment system that uses water withdrawn directly from Mica Bay (this would not include well water)? Yes ____ No ✓

If you answered "yes" to the above question, do you believe that your water intake and/or water treatment system has been affected by sediment and/or turbid conditions in Mica Bay since the Fall of 2001 that you consider out of the ordinary for the system you have compared to previous years? Yes ____ No ____

If you answered "yes" to the above question, a representative of the Idaho Transportation Department will contact you to schedule a convenient time to meet with you to obtain further information that will be needed for the Mica Bay assessment. If you have any preferences, please identify what day of the week, month, and time of day typically is best for you.

NOTE:
WE HAVE A LAKE PUMP FOR WATERING OUR LAWN & SHRUBERY & CARS

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Mica Bay Water Intake and Treatment System Survey Related to U.S. 95 Bellgrove to Mica Highway Construction Project

Today's Date: 7/12/03

Lot Number and/or Street Address:

Property Owner
Name: Jerry L. Hanson
Address: 9295 S Falling Pines Rd Coeur d'Alene, Id 83814
Phone: 208 765-6142

Current Resident (if different than property owner above)
Name:
Address:
Phone:

Do you reside at the Mica Bay property on a year-round or seasonal basis?

Year round X Seasonal ____

If seasonal, please indicate which months you are normally at the property.

Do you have a water intake and/or water treatment system that uses water withdrawn directly from Mica Bay (this would not include well water)? Yes ____ No X

If you answered "yes" to the above question, do you believe that your water intake and/or water treatment system has been affected by sediment and/or turbid conditions in Mica Bay since the Fall of 2001 that you consider out of the ordinary for the system you have compared to previous years? Yes ____ No ____

If you answered "yes" to the above question, a representative of the Idaho Transportation Department will contact you to schedule a convenient time to meet with you to obtain further information that will be needed for the Mica Bay assessment. If you have any preferences, please identify what day of the week, month, and time of day typically is best for you.

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Mica Bay Water Intake and Treatment System Survey Related to U.S. 95 Bellgrove to Mica Highway Construction Project

Today's Date: 17 July 03

Lot Number and/or Street Address:
1008 Swann Court

Property Owner
Name: R.C. Colburn
Address: 4093 Fairway Dr. Lewiston, ID 83501
Phone: 208 7439784

Current Resident (if different than property owner above)
Name:
Address:
Phone:

Do you reside at the Mica Bay property on a year-round or seasonal basis?

Year round ____ Seasonal ✓

If seasonal, please indicate which months you are normally at the property.
April thru Oct.

Do you have a water intake and/or water treatment system that uses water withdrawn directly from Mica Bay (this would not include well water)? Yes ____ No ✓

If you answered "yes" to the above question, do you believe that your water intake and/or water treatment system has been affected by sediment and/or turbid conditions in Mica Bay since the Fall of 2001 that you consider out of the ordinary for the system you have compared to previous years? Yes ____ No ____

If you answered "yes" to the above question, a representative of the Idaho Transportation Department will contact you to schedule a convenient time to meet with you to obtain further information that will be needed for the Mica Bay assessment. If you have any preferences, please identify what day of the week, month, and time of day typically is best for you.

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Mica Bay Water Intake and Treatment System Survey Related to U.S. 95 Bellgrove to Mica Highway Construction Project

Today's Date: 7/12/03

Lot Number and/or Street Address:

Property Owner Jack and Barbara Dawson
Name:
Address: 9337 S. Tall Pines Rd
Phone: 6677654

Current Resident (if different than property owner above)
Name:
Address:
Phone:

Do you reside at the Mica Bay property on a year-round or seasonal basis?

Year round X Seasonal ____

If seasonal, please indicate which months you are normally at the property.

Do you have a water intake and/or water treatment system that uses water withdrawn directly from Mica Bay (this would not include well water)? Yes ____ No X

If you answered "yes" to the above question, do you believe that your water intake and/or water treatment system has been affected by sediment and/or turbid conditions in Mica Bay since the Fall of 2001 that you consider out of the ordinary for the system you have compared to previous years? Yes ____ No ____

If you answered "yes" to the above question, a representative of the Idaho Transportation Department will contact you to schedule a convenient time to meet with you to obtain further information that will be needed for the Mica Bay assessment. If you have any preferences, please identify what day of the week, month, and time of day typically is best for you.

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Mica Bay Water Intake and Treatment System Survey Related to U.S. 95 Bellgrove to Mica Highway Construction Project

Today's Date: JULY 17, 2003

Lot Number and/or Street Address:

49N04W-16-2100

Property Owner
Name: CHARLES BUTTS
Address: 714 W PROVIDENCE AVE, SPOKANE WA 99205
Phone: 509-325-3016

Current Resident (if different than property owner above)
Name:
Address:
Phone:

Do you reside at the Mica Bay property on a year-round or seasonal basis?

Year round ____ Seasonal X

If seasonal, please indicate which months you are normally at the property.
APRIL – OCTOBER

Do you have a water intake and/or water treatment system that uses water withdrawn directly from Mica Bay (this would not include well water)? Yes ____ No X

If you answered "yes" to the above question, do you believe that your water intake and/or water treatment system has been affected by sediment and/or turbid conditions in Mica Bay since the Fall of 2001 that you consider out of the ordinary for the system you have compared to previous years? Yes ____ No ____

If you answered "yes" to the above question, a representative of the Idaho Transportation Department will contact you to schedule a convenient time to meet with you to obtain further information that will be needed for the Mica Bay assessment. If you have any preferences, please identify what day of the week, month, and time of day typically is best for you.

Mica Bay Water Intake and Treatment System Survey Related to U.S. 95 Bellgrove to Mica Highway Construction Project

Today's Date: 7-19-03

Lot Number and/or Street Address:

Property Owner
Name: Louise Shaddutt
Address: POB 399 Cda, Id. 83816
Phone:

Current Resident (if different than property owner above)
Name:
Address:
Phone:

Do you reside at the Mica Bay property on a year-round or seasonal basis?

Year round ✓ Seasonal ____

If seasonal, please indicate which months you are normally at the property.

Do you have a water intake and/or water treatment system that uses water withdrawn directly from Mica Bay (this would not include well water)? Yes ____ No t at this time

If you answered "yes" to the above question, do you believe that your water intake and/or water treatment system has been affected by sediment and/or turbid conditions in Mica Bay since the Fall of 2001 that you consider out of the ordinary for the system you have compared to previous years? Yes ____ No ____

If you answered "yes" to the above question, a representative of the Idaho Transportation Department will contact you to schedule a convenient time to meet with you to obtain further information that will be needed for the Mica Bay assessment. If you have any preferences, please identify what day of the week, month, and time of day typically is best for you.

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Mica Bay Water Intake and Treatment System Survey Related to U.S. 95 Bellgrove to Mica Highway Construction Project

Today's Date: 24 July 2003

Lot Number and/or Street Address:

Property Owner
Name: Leona Tucker / Marcia Skinner
Address: HC 11 Box 43 CdA
Phone: 676-1099

Current Resident (if different than property owner above)
Name: Marcia Skinner
Address: HC11 Box 43 CdA
Phone: 676-1093

Do you reside at the Mica Bay property on a year-round or seasonal basis?

Year round X Seasonal ____

If seasonal, please indicate which months you are normally at the property.

Do you have a water intake and/or water treatment system that uses water withdrawn directly from Mica Bay (this would not include well water)? Yes ____ No X

If you answered "yes" to the above question, do you believe that your water intake and/or water treatment system has been affected by sediment and/or turbid conditions in Mica Bay since the Fall of 2001 that you consider out of the ordinary for the system you have compared to previous years? Yes ____ No ____

If you answered "yes" to the above question, a representative of the Idaho Transportation Department will contact you to schedule a convenient time to meet with you to obtain further information that will be needed for the Mica Bay assessment. If you have any preferences, please identify what day of the week, month, and time of day typically is best for you.

Water Intake/Not Affected

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Mica Bay Water Intake and Treatment System Survey Related to U.S. 95 Bellgrove to Mica Highway Construction Project

Today's Date: 7/15/03

Lot Number and/or Street Address:
4713 West Lyondale Dr.
Mica Bay, Lake Coeur d'Arlene

Property Owner
Name: Allan G. Roy
Address: 4308 S. Conklin Rd.
Phone: Greenacres Wa. 99016

Current Resident (if different than property owner above)
Name:
Address:
Phone:

Do you reside at the Mica Bay property on a year-round or seasonal basis?

Year round ____ Seasonal ✓

If seasonal, please indicate which months you are normally at the property. June thru October.

Do you have a water intake and/or water treatment system that uses water withdrawn directly from Mica Bay (this would not include well water)? Yes ✓ No ____

If you answered "yes" to the above question, do you believe that your water intake and/or water treatment system has been affected by sediment and/or turbid conditions in Mica Bay since the Fall of 2001 that you consider out of the ordinary for the system you have compared to previous years? Yes ____ No ✓

If you answered "yes" to the above question, a representative of the Idaho Transportation Department will contact you to schedule a convenient time to meet with you to obtain further information that will be needed for the Mica Bay assessment. If you have any preferences, please identify what day of the week, month, and time of day typically is best for you.

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Mica Bay Water Intake and Treatment System Survey Related to U.S. 95 Bellgrove to Mica Highway Construction Project

Today's Date: ________________

Lot Number and/or Street Address:

Property Owner
Name: Calvin & Roberta Elliott
Address: Marine Rt. Mica Bay. Coeur d'Alene Id 83814
Phone: 664-6479

Current Resident (if different than property owner above)
Name:
Address:
Phone:

Do you reside at the Mica Bay property on a year-round or seasonal basis?

Year round X Seasonal ____

If seasonal, please indicate which months you are normally at the property.

Do you have a water intake and/or water treatment system that uses water withdrawn directly from Mica Bay (this would not include well water)? Yes X No ____

If you answered "yes" to the above question, do you believe that your water intake and/or water treatment system has been affected by sediment and/or turbid conditions in Mica Bay since the Fall of 2001 that you consider out of the ordinary for the system you have compared to previous years? Yes ____ No X

If you answered "yes" to the above question, a representative of the Idaho Transportation Department will contact you to schedule a convenient time to meet with you to obtain further information that will be needed for the Mica Bay assessment. If you have any preferences, please identify what day of the week, month, and time of day typically is best for you.

While we have not been personally affected - we have seen the "rivers" of mud moving through the bay on days with heavy rainfall.

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Mica Bay Water Intake and Treatment System Survey Related to U.S. 95 Bellgrove to Mica Highway Construction Project

Today's Date: 7/14/03

Lot Number and/or Street Address:

Property Owner
Name: Robert Clark
Address: End of Red Hog Road
Phone: 509 ? 2165515

Current Resident (if different than property owner above)
Name:
Address:
Phone:

Do you reside at the Mica Bay property on a year-round or seasonal basis?

Year round ____ Seasonal X

If seasonal, please indicate which months you are normally at the property.

Do you have a water intake and/or water treatment system that uses water withdrawn directly from Mica Bay (this would not include well water)? Yes X No ____

If you answered "yes" to the above question, do you believe that your water intake and/or water treatment system has been affected by sediment and/or turbid conditions in Mica Bay since the Fall of 2001 that you consider out of the ordinary for the system you have compared to previous years? Yes ____ No X

If you answered "yes" to the above question, a representative of the Idaho Transportation Department will contact you to schedule a convenient time to meet with you to obtain further information that will be needed for the Mica Bay assessment. If you have any preferences, please identify what day of the week, month, and time of day typically is best for you.

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Mica Bay Water Intake and Treatment System Survey Related to U.S. 95 Bellgrove to Mica Highway Construction Project

Today's Date: 7.16.03

Lot Number and/or Street Address:

3969 W Scot Ave Dr.
Coeur d'Alene, Idaho

Property Owner
Name: Charles R. Nipp
Address: 2025 S Riverwood Dr. CdA, Idaho 83814
Phone: 208-765-9463

Current Resident (if different than property owner above)
Name:
Address:
Phone:

Do you reside at the Mica Bay property on a year-round or seasonal basis?

Year round ____ Seasonal ✓

If seasonal, please indicate which months you are normally at the property.
April thru October

Do you have a water intake and/or water treatment system that uses water withdrawn directly from Mica Bay (this would not include well water)? Yes ✓ No ____

If you answered "yes" to the above question, do you believe that your water intake and/or water treatment system has been affected by sediment and/or turbid conditions in Mica Bay since the Fall of 2001 that you consider out of the ordinary for the system you have compared to previous years? Yes ____ No ✓

If you answered "yes" to the above question, a representative of the Idaho Transportation Department will contact you to schedule a convenient time to meet with you to obtain further information that will be needed for the Mica Bay assessment. If you have any preferences, please identify what day of the week, month, and time of day typically is best for you.

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Mica Bay Water Intake and Treatment System Survey Related to U.S. 95 Bellgrove to Mica Highway Construction Project

Today's Date: 7-14-03

Lot Number and/or Street Address:

8241 S. Deer Run Drive

Property Owner
Name: Doug + Janie Salvadalena
Address: 8246 S. Deer Run Drive
Phone: (208) 666-1323

Current Resident (if different than property owner above)
Name:
Address:
Phone:

Do you reside at the Mica Bay property on a year-round or seasonal basis?

Year round ___ Seasonal X

If seasonal, please indicate which months you are normally at the property.
June through September

Do you have a water intake and/or water treatment system that uses water withdrawn directly from Mica Bay (this would not include well water)? Yes X No ___

If you answered "yes" to the above question, do you believe that your water intake and/or water treatment system has been affected by sediment and/or turbid conditions in Mica Bay since the Fall of 2001 that you consider out of the ordinary for the system you have compared to previous years? Yes ~~X~~ No X

If you answered "yes" to the above question, a representative of the Idaho Transportation Department will contact you to schedule a convenient time to meet with you to obtain further information that will be needed for the Mica Bay assessment. If you have any preferences, please identify what day of the week, month, and time of day typically is best for you.

~~[illegible]~~

Mica Bay Water Intake and Treatment System Survey Related to U.S. 95 Bellgrove to Mica Highway Construction Project

Today's Date: 7/23/03

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COEUR D'ALENE, IDAHO

Lot Number and/or Street Address:
4550 mica Shore Rd.

Property Owner
Name: Edward A. Leach
Address: P.O. Box 2088
Phone: 765-6193

Current Resident (if different than property owner above)
Name:
Address:
Phone:

Do you reside at the Mica Bay property on a year-round or seasonal basis?

Year round ✓ Seasonal ___

If seasonal, please indicate which months you are normally at the property.

Do you have a water intake and/or water treatment system that uses water withdrawn directly from Mica Bay (this would not include well water)? Yes ✓ No ___

If you answered "yes" to the above question, do you believe that your water intake and/or water treatment system has been affected by sediment and/or turbid conditions in Mica Bay since the Fall of 2001 that you consider out of the ordinary for the system you have compared to previous years? Yes ___ No ___ Unknown (See Below)

If you answered "yes" to the above question, a representative of the Idaho Transportation Department will contact you to schedule a convenient time to meet with you to obtain further information that will be needed for the Mica Bay assessment. If you have any preferences, please identify what day of the week, month, and time of day typically is best for you.

Our system includes a filtration system (3 houses). We have seen substantial runoff in the bay and must conclude there has to be an impact on the system.

APPENDIX P

GIS Biological Survey Database

APPENDIX Q

Mica Bay Underwater Video July 2002