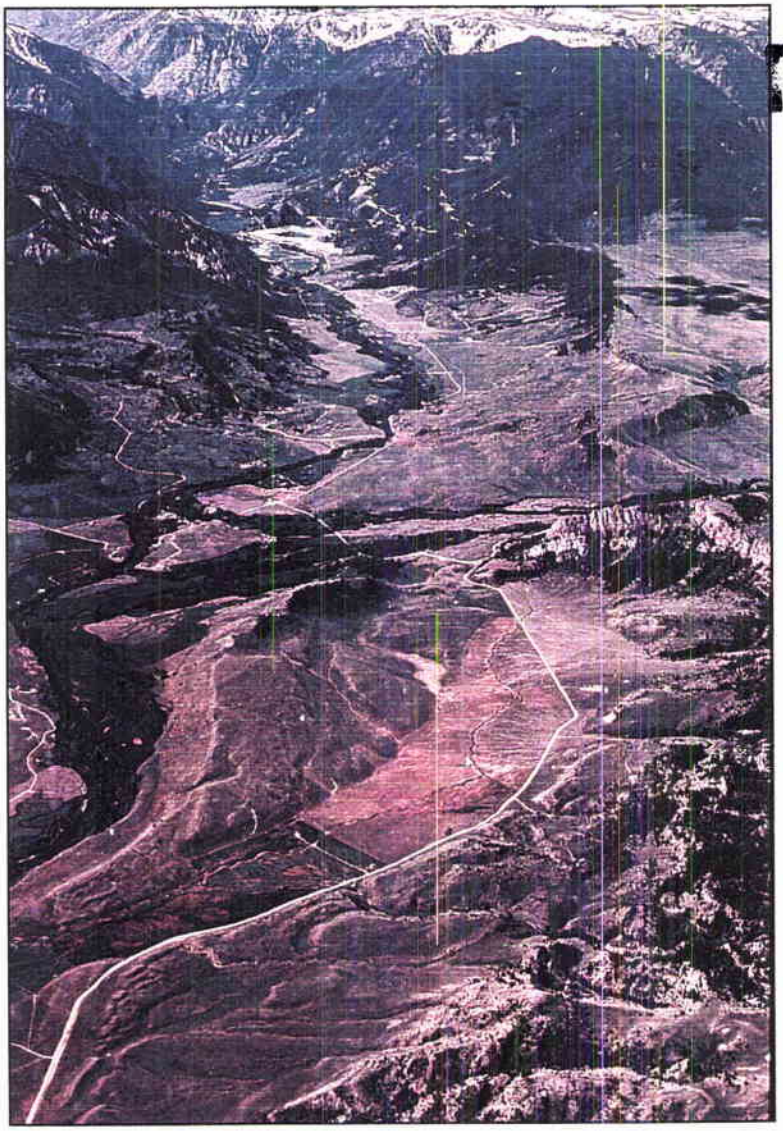
FINAL ENVIRONMENTAL IMPACT STATEMENT

Stillwater Mine Revised Waste Management Plan and Hertzler Tailings Impoundment



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QUALITY COUNCIL

Prepared by

Montana Department of Environmental Quality
and
U.S.D.A. Forest Service

October 1998

Custer National Forest
1310 Main St.
P.O. Box 50760
Billings, MT 59105

Montana Department of
Environmental Quality
P.O. Box 200901
Helena, MT 59620-0901

October 2, 1998

Re: Release of the final Environmental Impact Statement for the Stillwater Mine Revised Waste Management Plan and Hertzler Tailings Impoundment

Dear Reader:

The Stillwater Mining Company (SMC) proposed a revision to its operating permit #00118 and approved plan of operations for the Stillwater Mine located outside Nye, Montana, in Stillwater County. The Custer National Forest (CNF) and the Department of Environmental Quality (DEQ) released the draft Environmental Impact Statement (EIS) for the Stillwater Mine Revised Waste Management Plan and Hertzler Tailings Impoundment in March 1998. The agencies are now releasing the final EIS for this proposed action. A copy of this document is being sent to you for your review. You may also view the EIS on DEQ's web page at: http://www.deq.mt.us/eis.htm. This EIS covers the proposed revision and revisions to the Stillwater Mine's air quality permit as well as the Forest Service's biological assessment and evaluation for the proposed action.

We appreciate your continued interest in the analysis process concerning the development of this proposed project. Your involvement in the analysis process has aided us in the development of the final EIS. As a result of your input, we have included a more intensive investigation of tailings paste technology, including whole and slimes based paste backfill and landfill. We've expanded our rationale for dismissing the alternatives considered but dismissed, and revisited the issue of property values. Additional mitigations have been identified based on your comments and suggestions. The preferred alternative in the final EIS remains Alternative B, the proposed action.

Our decisions based on the analyses disclosed in the final EIS will be documented in a joint Record of Decision (ROD). Although the state must only wait 15 days before making a decision the Forest Service must wait 30 days from the date of the Federal Register notice on availability of the document, October 9, 1998. Therefore, the ROD should be published and released to the public within approximately one month.

If you have any questions or wish to obtain additional copies of this document, the previously released draft EIS, or summaries of either EIS, please contact the agency staff listed below:

Pat Pierson, Project Coordinator
Beartooth Ranger District
HC 49, Box 3420
Red Lodge, MT 59068
(406) 446-2103

Sincerely,

Mike Peterson
for Nancy Curriden, Forest Supervisor
Custer National Forest

Kathleen Johnson, Project Coordinator
Montana Department of Environmental Quality
P.O. Box 200901
Helena, MT 59620-0901
(406) 444-1760

Sincerely,

Mark Simonich

Mark Simonich, Director
Montana Department of Environmental Quality

Final Environmental Impact Statement

Stillwater Mine Revised Waste Management Plan and Hertzler Tailings Impoundment

October 1998

USDA Forest Service
Custer National Forest

Nancy T. Curriden, Forest Supervisor

Montana Department of
Environmental Quality

Mark Simonich, Director

COVER SHEET

Type of Statement: Final Environmental Impact Statement

Proposed Action: Revision of Stillwater Mining Company's Existing Waste Management Plan and the Construction and Operation of the Hertzler Tailings Impoundment

Lead Agencies: Montana Department of Environmental Quality
USDA Forest Service, Custer National Forest

Abstract: The Stillwater Mine Revised Waste Management Plan and Hertzler Tailings Impoundment Final Environmental Impact Statement describes the land, people, and resources potentially affected by the proposed action. The major federal and state action consists of the approval of all necessary permits to construct and operate the revised waste management plan. The proposed project would consist of four primary aspects: the construction and operation of a new tailings impoundment at the former Hertzler Ranch, the construction and operation of pipelines to transport tailings slurry and water between the mine and the Hertzler tailings impoundment, the construction and operation of a new waste rock storage facility, expansion of the Land Application Disposal system, and the removal of the limitation on daily production (currently 2,000 tons per day). The No Action Alternative, Proposed Action Alternative, and two additional action alternatives are analyzed in detail.

For Further Information, Please Contact:

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Preface

An Environmental Impact Statement (EIS) is not usually read like a book, from chapter one to the end. The best way to go about reading an EIS depends on your interests. You may be more interested in effects, whereas others might have more interest in the details of the proposed plan or be more concerned about what opportunities were made available for the public to be involved in the environmental analysis process. Many readers probably just want to know what is being proposed and how it will affect them.

This document follows the format established in the Montana Environmental Policy Act's regulations (ARM 17.4.601 to 17.4.636) and the National Environmental Policy Act's regulations (40 CFR 1500 to 1508). The following paragraphs outline information contained in the chapters and appendices so readers may find the parts of interest without having to read the entire document.

- *Summary:* contains a short, simple discussion to provide the reader and the decision makers with a sketch of the more important aspects of the EIS. The reader can obtain additional, more-detailed information from the actual text of the EIS.

- *Chapter 1 —Purpose and Need:* describes the proposed action, purpose of and need for the proposed action, history of the Stillwater Mine, decisions to be made by the agencies, agencies' roles and responsibilities, MEPA/NEPA process, and other permits required.

- *Chapter 2 —Public Participation, Issue Identification, and Alternative Development:* describes SMC's Proposed Action, the significant issues associated with the Proposed Action, and alternatives to that action, including the no action alternative. Action alternatives that at least partially meet the purpose and need were developed by the agencies in response to one or more of the key issues. Alternatives considered but dropped from detailed consideration are identified along with the rationale for not including them in the analysis. Reasonably foreseeable activities near the proposed project are identified. This chapter also provides a comparative analysis of the environmental effects of the primary alternatives to provide a clear basis of choice among options for the decision maker and public. The lead agencies' preferred alternative is identified.

- *Chapter 3 —Affected Environment:* describes the present condition of the environment that would be affected by implementation of the proposed action or any action alternative.

- *Chapter 4 —Environmental Consequences:* describes the probable direct, indirect, and cumulative effects to the human environment that would result from implementing the Proposed Action or alternatives. The discussion also addresses short-term uses versus long-term productivity, unavoidable impacts, and irreversible or irretrievable impacts. Resources without significant effects or issues are not discussed.

- *Chapter 5 —Consultation with Others:* identifies the agencies, companies, and organizations consulted as well as the cooperating agencies.

- *Chapter 6 —Preparers and Contributors:* identifies the people involved in the research, writing, and internal review of the draft EIS.

- *Chapter 7 —Distribution and Review of the Draft EIS:* lists the agencies, organizations, and individuals who received a copy of the draft EIS.

- *Chapter 8 —Glossary:* describes the technical terms, abbreviations, and acronyms used in the draft EIS.

- *Chapter 9 —References Cited:* lists the references cited in the draft EIS.

- *Index:* contains cross references and identifies the pages where key topics can be found.

- *Appendices:* contain technical and non-technical information that is important to full comprehension of the MEPA/NEPA analysis, but was too long to be included in the primary chapters.

Acronyms and Abbreviations used in this EIS

ABC	Anoxic Biotreatment Cell
ADT	Average Daily Traffic
APE	Area of Potential Effect
AQG	Ambient Air Quality Guidelines
AUM	Animal Unit Month
BACT	Best Available Control Technology
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	Cubic Feet per Second
CNF	Custer National Forest
COE	U.S. Army Corps of Engineers
CWA	Clean Water Act
DEQ	Montana Department of Environmental Quality
DHES	Montana Department of Health and Environmental Services
DNRC	Montana Department of Natural Resources and Conservation
DSL	Montana Department of State Lands
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FONSI	Finding of No Significant Impacts
gpm	Gallons per Minute
HDPE	High-density Polyethelene
KOP	Key Observation Point
LAD	Land Application Disposal
LOS	Level of Service
MDFWP	Montana Department of Fish, Wildlife, and Parks
MEPA	Montana Environmental Policy Act
MPDES	Montana Pollutant Discharge Elimination System
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOAA	National Oceanic and Atmospheric Administration
NRHP	National Register of Historic Places
PM_{10}	Respirable Particulate Matter less than 10 microns in aerodynamic diameter
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
ppm	Parts per Million
PSD	Prevention of Significant Deterioration
ROD	Record of Decision

SHPO	State Historic Preservation Office
TDS	Total Dissolved Solids
tpd	tons per day
tpy	tons per year
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VQO	Visual Quality Objective

Summary — Stillwater Mine Revised Waste Management Plan Draft Environmental Impact Statement

Introduction

The Montana Department of Environmental Quality (DEQ) and the USDA Forest Service, Custer National Forest (CNF) served as joint lead agencies for the preparation of an Environmental Impact Statement (EIS) in response to a proposal filed by Stillwater Mining Company to amend its operating permit (#00118). This Executive Summary summarizes the draft EIS.

The proposed amendment, which SMC submitted on April 29, 1996, requests authorization to make specific changes to SMC's mine waste management operation at the Stillwater Mine. The specific changes include:

- constructing and operating a new tailings impoundment on the Hertzler Ranch, which is about 7.8 miles northeast of the mine site;
- installing a system of pipelines along Stillwater County roads 419 and 420 connecting the new tailings impoundment to the mine's mill and tailing reclaim circuit;
- expanding the waste rock storage areas on the east side of the Stillwater River across from the mine;
- relocating the Land Application Disposal system (LAD) from its current location on the east side of the Stillwater River near the mine site to both the Stratton Ranch (1.5 miles northeast of the mine along Stillwater County Road 419) and the Hertzler Ranch; and
- removing the 2,000 tons per day (tpd) restriction on processing ore. (Having no restrictions on processing allows SMC to expand its processing of ore to match the capabilities of mining and milling equipment. The average rate is expected to be around 3,000 tpd, but it may peak as high as 5,000 tpd occasionally.)

These facilities would allow SMC to continue mining platinum group metals for about 30 more years. The Proposed Action would involve private lands owned by SMC, public rights-of-way administered by Stillwater County, and National Forest System lands administered by CNF. The sites are located in Stillwater County, approximately 35 miles southwest of Columbus, Montana (**Figure S–1**).

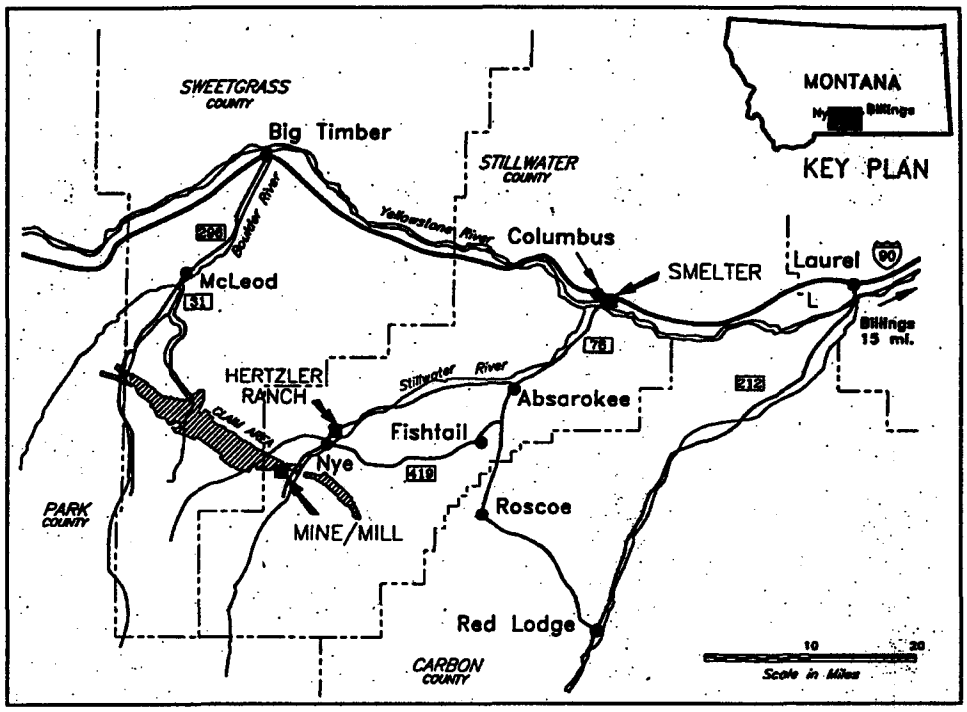


Figure S–1 Location of Stillwater Mine and Hertzler Ranch

This EIS was prepared to analyze and document the potential environmental consequences that may result from implementing the Proposed action or one of the alternatives. The EIS was prepared in accordance with the Montana Environmental Policy Act (MEPA) and the National Environmental Policy Act (NEPA) and the respective laws and regulations of the State of Montana and the USDA Forest Service.

MEPA contains the procedures that govern the decision-making process on state and private lands in Montana. If any action taken by a state agency may "significantly affect the quality of the human environment", this law requires the preparation of an EIS. NEPA governs the decision-making process for federal agencies. Some of the affected lands for this project are administered by the CNF and the Forest Supervisor will use the EIS for compliance with NEPA's rules and regulations.

Purpose and Need

The purpose of SMC's Proposed Action is to permit a flexible and integrated waste management plan providing for long-term management of the disposal of tailings, waste rock, and other wastes generated by the Stillwater Mine. SMC needs to implement the Proposed Action because its current tailings

impoundment will reach capacity in 2003. The Proposed Action would increase SMC's capacity for storing tailings and waste rock by almost 15 million tons and 17.5 million tons, respectively, and would allow the Stillwater Mine to operate for about another 30 years at an average production rate of 3,000 tons per day or as long as 50 years at an average production rate of 2,000 tons per day. The Proposed Action would also give SMC some flexibility in its operations it does not have currently.

History of the Project

SMC operates an underground platinum/palladium mine in Stillwater County, Montana (**Figure S–1**). Current permits allow SMC to produce ore at an average rate of 730,000 tons per year (tpy) or 2,000 tpd. At the mine's mill, SMC upgrades the ore by crushing, grinding, floating, and drying to a concentrate. This concentrate is then shipped by truck to a smelter and base metal refinery (BMR) in Columbus, Montana, for further upgrading. From the BMR, SMC ships the BMR product to Belgium for final refining.

SMC's original plan of operations was approved after completion of a Final Environmental Impact Statement (final EIS) in 1985. The current proposal, if approved, would be the tenth amendment to the original plan of operations and permit. The previous amendments are:

001 — Approved and permitted June 30, 1986. This amendment relocated mine and mill facilities. No increase in permit area or disturbed area resulted.

002 — Approved and permitted September 8, 1986. This amendment allowed excavation of a sand borrow area in the existing permit area. The disturbed area has been reclaimed.

003 — Approved and permitted January 8, 1987. This amendment allowed excavation of a second sand borrow area within the permit area and the disturbance has been reclaimed.

004 — Approved and permitted February 24, 1987. This amendment relocated the southern portion of the tailings impoundment toe dike to higher ground along Mountain View Creek on previously-disturbed land within the permit area.

005 — Approved and permitted March 2, 1989. This amendment was the first major amendment since the original permit was issued. It increased the permit area to 1,158 acres and permitted mining on the east side of the Stillwater River. The total allowable disturbance was increased by 72 acres.

006 — Approved and permitted July 21, 1989. This amendment allowed construction of a temporary sand slurry pipeline connecting the east and west sides of the mine area. No increase in permit area or disturbed area resulted.

007 — Approved and permitted November 15, 1990. This amendment allowed construction of the three Stillwater Valley Ranch percolation ponds and four monitoring wells. The permit area was increased 27 acres. The total allowable disturbance was increased by 7 acres.

008 — Approved and permitted on September 23, 1992. This amendment allowed production to increase from 1,000 tpd to 2,000 tpd. It also approved some expansion of support facilities, such as waste dumps, the mill, and the tailings impoundment.

009 — Approved and permitted February 28, 1996. This amendment allowed the construction of an underground connection between the east and west mining areas. No increase in permit area or disturbed area resulted.

Additionally, a minor amendment was approved to relocate the 5900 adit southward onto private land in order to reduce the visual effects due to development. The permit area was increased 48 acres and the total allowable disturbance was increased by 2 acres.

Currently, the total permit area is 1,340 acres and 255 acres are permitted for disturbance. However, only 120 acres have been disturbed by mining and exploration.

Decisions to be Made

The Director of the DEQ and the Supervisor of the CNF must make a decision on SMC's request to amend its permit. This decision will be documented in a Record of Decision (ROD). The process will lead to one of the following possible decisions:

1) approval of the proposed action amending the existing permit/plan of operations,

2) approval of an agency alternative to the proposed amendment,

3) approval of either the Proposed Action or an agency alternative subject to identified mitigation measures, or

4) denial of the proposed amendment (DEQ) or request for revision (CNF).

- DEQ can deny the proposed amendment. The authority for denial originates from the Montana Metal Mine Reclamation Act (MMRA) and Montana's water quality and air quality statutes. In addition, since 1982 DEQ and the courts have interpreted the Montana Environmental Policy Act (MEPA) as supplementing the basis upon which an operating permit under MMRA can be conditioned or denied. This means that DEQ may also deny or modify the mine operating permit under MMRA in order to avoid or mitigate an impact that would significantly degrade the human environment. The operator then has the option of revising the plan.

- The Forest Service is not granted the authority to deny a Plan of Operation or an amendment to a Plan of Operation (36 CFR 228, Sub-Part A). This finding is based on numerous court cases. If a proposed Plan of Operation or amendment to a Plan of Operation (amendment) is found to conflict with regulation, policy, or federal law, the Forest Service must notify the Operator or Claimant that a revision of the proposed Plan of Operation or amendment is required. The Operator or Claimant then has the option to either modify the Plan of Operation or amendment and resubmit it for approval or withdraw the Plan of Operation or amendment.

The proposal or an agency alternative, if approved, must comply with all applicable federal and state air and water quality laws and regulations.

Agencies' Roles and Responsibilities

The DEQ and Forest Service are the lead agencies for this Environmental Impact Statement (EIS). As discussed above, the Director of the DEQ and the Supervisor of the CNF are the officials responsible for making a decision on SMC's proposed amendment. A December 11, 1989, Memorandum of Understanding (MOU) between the State of Montana and the USDA Forest Service provides for the preparation of joint environmental analyses and the sharing of information, personnel, and funds.

MEPA/NEPA Process, including Tiering

NEPA and MEPA are Federal and State laws that direct the CNF and DEQ, respectively, to disclose the effects of proposed activities on Federal and State lands to the public and officials making decisions concerning the proposal.

The NEPA/MEPA process began when SMC proposed to amend its current operating permit/plan of operations. The agencies sought public input to help identify environmental issues and concerns through the process called "scoping."

Scoping activities for this project included mailing a scoping document to parties interested in or potentially affected by the proposal, holding a public meeting in Absarokee, Montana, on September 24, 1996, and receiving the public's responses.

In addition to public scoping, the agencies reviewed SMC's proposal for "completeness." The purpose of this review was to ensure the information contained in the proposal is adequate to complete the agencies' environmental analysis under MMRA and to identify additional information needed to complete an environmental analysis under MEPA. The environmental analysis phase of the NEPA/MEPA process began after the proposal was declared "complete" on January 28, 1997.

The regulations implementing NEPA and MEPA encourage tiering in EISs. Tiering is the process of referencing information presented in other previously-prepared NEPA/MEPA documents, such as EISs, to minimize repetition.. This EIS is specifically tiered to the documents identified in the following section.

Identification of Related Environmental Documents

Several EISs have been prepared for the Stillwater Mine. They include the EIS prepared for the original operating permit/plan of operations and EISs prepared in support of amendments to that permit/plan of operations. The EIS summarized here was specifically tiered to the following environmental documents:

- Final Environmental Impact Statement, Stillwater Project, Stillwater County, Montana. Prepared by the Montana Department of State Lands and USDA Forest Service, Custer National Forest in 1985.

- Preliminary Environmental Review/Environmental Assessment (PER/EA), Stillwater Project East Side Adit Development. Prepared by the Montana Department of State Lands and USDA Forest Service, Custer National Forest in 1989.

- Final Environmental Impact Statement, Stillwater Mine Expansion 2000 TPD, Application to Amend Plan of Operations and Permit No. 00118. Prepared by the Montana Department of State Lands, Montana Department of Health and Environmental Services, and USDA Forest Service in 1992.

- Final Environmental Impact Statement for the Stillwater Mining Company Underground Valley Crossing and Mine Plan. Application to Amend Plan of Operations, Permit No. 00118. Prepared by the Montana Department of Environmental Quality in 1996.

Public Participation

Scoping

The DEQ and the Forest Service consider public participation a crucial component in defining the scope of the environmental analyses presented in this EIS. The agencies first informed the public of SMC's proposal by mailing the project's Scoping Document to the public in August, 1996. News articles about SMC's proposal appeared in local and regional newspapers during the first week of September, 1996. A Notice of Intent to prepare an EIS was published in the Federal Register on September 19, 1996. A public scoping meeting was hosted by the DEQ and the Forest Service in Absarokee on September 24, 1996. Public field trips were hosted by SMC on November 14 and 15, 1996. Since that time, two newsletters have been distributed to the agencies' mailing lists. The first, in March, 1997, summarized the scoping process and identified the issues that had been defined in response to the public comments received. The second newsletter was issued in September, 1997, and it provided information on the process of preparing the EIS.

DEQ and CNF reviewed and analyzed the comments they received during the scoping process. Public response to SMC's proposal included 52 letters and about 20 phone calls. Additionally, six people visited the Beartooth Ranger District's office in Red Lodge.

The agencies' process for identifying issues involved three overall steps. First, specific comments were arranged into groups of common concerns. Next, a primary issue statement was prepared for each group of comments. Finally, the issue statements were evaluated for applicability to this MEPA/NEPA analysis.

The analysis of comments initially identified 11 issues. Nine of these 11 issues were identified as key or significant issues. These issues were used to define the scope of the MEPA/NEPA analysis. Nine key issues were used to analyze environmental effects, prescribe mitigation measures, or both. Issues are "significant or key" because of the extent of their geographic distribution, the duration of their effects, or the intensity of interest or resource conflict. The determination of an issue's significance is different than and separate from any determination of the significance of an environmental consequence.

Review of Draft EIS

The draft EIS was available for public review and comment from March 20, 1998, through May 19, 1998. DEQ and CNF encouraged reviewers to submit written comments on the document during this period. In addition, DEQ and CNF held a public open house and hearing on the draft EIS on April 28, 1998, to

answer questions and provide the public with the opportunity to submit written and verbal comments in person.

Reviewers of the draft EIS submitted a variety of comments. Most of the comments were contained in 45 letters. However, eleven individuals provided verbal comments at the public hearing. Overall, the comments focused on the nine issues identified in the draft EIS (Section 2.2.1) and the MEPA/NEPA process. Appendix B contains a summary of the comments received on the draft EIS, and DEQ and CNF's responses to those comments.

The greatest number of comments focused on a wide range of water resources concerns. The main topic of concern centered around tailings paste technology. As a result of these and other comments raised on the draft EIS, additional information was added throughout the EIS. Additionally, 11 mitigations have been added as well as several new appendices.

Issue Statements for Key Issues

Issue statements have been developed from comments from the public and agencies to provide an understandable and measurable estimate of potential environmental consequences likely to occur if the Proposed Action or an alternative was permitted and implemented. The intent of the following issue statements is to clearly identify biological, physical, social, and economic resources that might be affected if one of the alternatives analyzed in the EIS is permitted and implemented.

Water Quality and Quantity

Implementation of SMC's proposed plans for long-term waste management might change the existing water quality and quantity around the existing and proposed new waste management facilities. These changes could result from proposed increases in the development of the sub-surface ore body. The current sediment load, chemical constituency, and function of area waters might be affected by construction and operation of the pipeline system adjacent to the Stillwater River, increased Land Application Disposal for waste water nitrates, pipeline construction crossing the West Fork of the Stillwater River, and construction and operation of the new tailings impoundment about 7.8 miles north of the current mine.

In response to these concerns, environmental effects will be estimated through analysis of sediment loads and water chemistry changes, past experiences and monitoring results collected since the mine began operating, and professional interpretation of site-specific conditions. Potential environmental consequences will be estimated for both surface and sub-surface water in the potentially-affected areas.

Wildlife

Mule deer populations in the Stillwater Valley have declined significantly since 1991. The number of fawns born during the spring of 1996 state-wide was the lowest on record, suggesting further declines are imminent. The area surrounding the proposed waste rock storage facility and tailings impoundment currently serves as important winter and spring range for mule deer. "Some mule deer within this seasonal population spend summers in Yellowstone National Park. Therefore, this mule deer population could have national significance" (Montana Department of Fish, Wildlife, and Parks, September 17 1996 letter to Randy Herzberg, Custer National Forest). Thus, potential effects to mule deer due to implementation of the Proposed Action are a concern.

To a lesser degree, the changes proposed by SMC might affect white-tailed deer and mountain lions that occupy the project area, the area between and including the existing mine, and the proposed impoundment site. The project area may also contain threatened, endangered, sensitive, or management indicator species.

Effects to wildlife will be estimated through identification of the type and location of existing wildlife uses within the potentially-affected habitats. Site-specific data collection, modeling, and professional interpretation also will be used.

Fisheries

SMC proposes to construct and operate 7.8 miles of pipeline adjacent to the Stillwater River and across the West Fork of the Stillwater River. The proposed tailings impoundment would be approximately 0.25 mile linear distance from the Stillwater River. The down-gradient distance from the tailings impoundment to the Stillwater River would be approximately 0.5 mile. Concerns related to the introduction of sediment and chemicals have been identified by the public. Currently, water from the Stillwater River provides high-quality habitat for trout in both the Stillwater and Yellowstone rivers.

Effects on fish will be estimated on the basis of data contained in the water quality and quantity section of the EIS and professional interpretation of site-specific conditions.

Air Quality

Air surrounding SMC's proposed tailings impoundment location currently is clean with low levels of particulates and odors. Particulate monitoring (PM10) in the area of SMC's mining facilities south of Nye has not indicated any infraction of state air quality standards. Implementation of SMC's proposed impoundment and waste rock storage will increase the amount of ground

disturbance and traffic in the project area, which might also increase PM10 in the project area.

Environmental effects will be estimated through comparison of existing air quality conditions with conditions predicted for the different alternatives.

Social/Economics

Many of the residents in the area adjacent to SMC's existing and proposed facilities have been drawn there because of the "high quality of life" afforded individuals in this mountainous setting. These individuals perceive the area to have a rural, quiet, non-industrial, and unhurried pace. Implementation of this project might change social and economic factors associated with this "high quality of life." For example, increased numbers of people might be hired and choose to live in the area. Increased demands to Stillwater County infrastructure might result if local populations increase. As a result, residents might experience a change in property values, taxation, housing costs, and the overall cost of living.

Potential social and economic effects will be estimated by comparison with data from the existing Hardrock Impact Plan.

Tailings Impoundment Stability

SMC proposes to use construction material consisting largely of glacial debris, including boulders, cobbles, sand, gravel, and large amounts of fine clay, to build a new tailings impoundment about 7.8 miles north of existing mine and milling facilities. Many comments received during scoping related to the use of this material for construction of the impoundment.

Site-specific engineering studies and field data will be used to determine the suitability of this glacial material for construction and the risk of failure. Engineers from the Forest Service, DEQ, and the third- party contractor will review construction plans for the proposed action and alternatives for adequacy.

Aesthetics

The area surrounding SMC's proposed impoundment location currently is characterized by substantial modifications for agricultural and other uses. Approval of this proposal might increase traffic, industrial activities, and refuse, as expressed in many scoping comments.

The severity of these impacts will be estimated on the basis of past experience with construction and operation of this type of impoundment.

Transportation

SMC's proposal includes construction of a pipeline corridor with several pipelines along the roads (Stillwater County roads 419 and 420) between the proposed tailings impoundment site near Nye and the existing mine and mill. Implementation of this action might disrupt traffic flow on these roads.

Changes in traffic flow patterns will be determined for each alternative based on data from the Montana Department of Transportation (MDOT).

Reclamation

About 319 acres of additional disturbance would result if SMC's proposal is approved. Although most of this total (251 acres) would involve areas not disturbed by previous activities, some (68 acres) would involve areas disturbed by previous activities (redisturbance), such as chromium mining. Many commentors doubted SMC's ability to reclaim disturbed areas to required levels of stability and utility. Reclamation potential will be determined by comparing soil data, such as productivity, depth, structure, and location with planned disturbance size, slopes, and location. State reclamation standards will be addressed.

Alternatives

The process of developing alternatives to SMC's proposal involved four steps. First, the DEQ and CNF conducted project scoping to identify the key issues of concern. This scoping involved both internal agency and public concerns. It also considered environmental and project-design elements.

The second step consisted of formulating alternatives to the proposal. Each alternative had to at least partially meet the purpose and need for the project. Typically, driving issues are identified that help the agencies define what changes need to be made to avoid, eliminate, reduce, minimize, or mitigate impacts that would result from implementing the Proposed Action. DEQ and CNF had identified water quality and quantity, tailings impoundment stability, and reclamation as the potential driving issues for this EIS. However, as the Proposed Action was analyzed, no significant impacts were identified that could be further reduced by other alternatives, siting locations, or mitigations relative to these issues. Nevertheless, both MEPA and NEPA require a reasonable range of alternatives that meet the purpose and need. DEQ and CNF looked at alternate locations for various facilities, modifying the size and storage capacity of the proposed and existing impoundments, timing of construction, and operational changes. The agencies also considered alternatives that would avoid building an impoundment at the Hertzler Ranch. The four alternatives being considered do show a range of impacts relative to all nine issues.

The third step involved screening the potential alternatives for reasonableness. The MEPA/NEPA process requires that alternatives evaluated in detail be reasonable. The regulations for implementing NEPA provide a discussion of the need for reasonable alternatives in the NEPA process (40 CFR 1500.1(e) and 1502.14). Also, CEQ's 40 Most Asked Questions about NEPA (Question 2a) state, in part, that "reasonable alternatives include those that are practical or feasible from the technical and economic standpoint and using common sense..." (CEQ 1981).

Based on this direction, the agencies focused their screening alternatives on technical, environmental, and economic feasibility. Technical considerations included the feasibility of constructing and operating the facilities. Environmental considerations included the potential for significant impacts and the feasibility of successfully mitigating the impacts of the alternative. Economic considerations included potential costs and benefits of implementing the alternative.

Finally, unreasonable alternatives were dropped from detailed consideration. If an alternative did not pass the technical, environmental, and economic screening for feasibility, it was not considered any further in the analysis.

Several alternatives were considered in this MEPA/NEPA analysis. They include a No Action alternative, SMC's Proposed Action, two modifications of SMC's Proposed Action, and a variety of alternatives considered but dropped from detailed evaluation. Each of these alternatives is briefly described below.

Alternative A — No Action

The No Action alternative is defined as the Stillwater Mining operation as currently permitted by DEQ and CNF (Permit #00118). This alternative was included to define the existing baseline conditions for comparison with the other alternatives considered in this analysis. Thus, this alternative reflects the existing conditions of the Stillwater Mine. Selection of this alternative would mean no additional changes would be allowed at this time at the Stillwater Mine, beyond those already permitted by DEQ and CNF through previous permitting processes and decisions. Previous analyses and decisions were documented in the 1985, 1992, and 1996 final EISs and their associated Records of Decision and the 1989 Environmental Assessment and its associated Decision Notice.

Implementation of this alternative would not meet the purpose of and need for the project. For example, under this alternative, SMC's need for additional capacity for storage of tailings necessary for production to continue beyond 2003 would not be met. Also, the operational flexibility and long-term planning sought by SMC in managing wastes would not be met. Although the No Action alternative would not meet the purpose of and need for the project, its inclusion

in the analysis is required by MEPA (ARM 17.4.601 to 17.4.636) and NEPA (40 CFR 1502.14(d)).

Alternative B — Proposed Action

SMC's proposal to change its mine waste management operation includes plans for waste rock and tailings production, management, and disposal as well as water management and disposal. The proposed changes are summarized below. **Figure S–2** shows the overall locations of the primary facilities comprising the Proposed Action alternative. The application to amend Hard Rock Operating Permit #00118 (SMC 1996) contains detailed discussions of these aspects and facilities.

In addition to changing SMC's mine waste management operation, implementation of the Proposed Action would remove the limitation on daily production (currently 2,000 tpd). If selected, SMC's Hard Rock Operating Permit (#0118) would be based on an approved "footprint" of surface disturbance, not a rate of production. SMC would be able to alter daily levels of production to respond to changing conditions in the market. The amendment discusses levels of production ranging up to 5,000 tpd. The proposed amendment (Proposed Action) and all information related to this EIS are on file with the DEQ and CNF (Beartooth District Office) for public review.

Waste Rock Production and Management

Currently, SMC is permitted to store waste rock in four areas. They are the embankment of the existing tailings impoundment, a temporary storage area above the tailings impoundment, a permanent storage area near the west mine portal, and a permanent visual screening berm on the east side of the Stillwater River. SMC proposes to expand the visual berm on the east side of the river (which was previously permitted but not yet constructed) into a permanent east side storage site for storage of an additional 17.5 million tons. The storage site would be constructed in three stages and would occupy about 80 acres. The facilities currently occupying this site would be relocated. The LAD irrigators would be relocated to Stratton and Hertzler Ranch sites (this is discussed under Water Management). Soil stockpiles, sedimentation/percolation ponds, and water monitoring facilities would be relocated. Additional monitoring wells would be added, as needed.

Tailings Management

To provide for additional capacity for tailings, SMC would construct a new impoundment at the former Hertzler Ranch. SMC would operate the new tailings impoundment in concert with the existing impoundment to maximize

operational flexibility. The Hertzler impoundment would occupy about 163 acres and be able to store approximately 15 million tons of tailings. The embankment would be constructed in three stages several years apart.

Tailings would be pumped to the Hertzler impoundment through two buried 7.8-mile long pipelines. Both pipelines would be double walled, constructed of 8-inch steel pipe lined with an inner sleeve of HDPE. The pipelines would be located in the rights-of-way for Stillwater County roads 419 and 420. Additionally, process water would be reclaimed from the impoundment and returned to the mill via another pipeline within the same right-of-way. Where possible, SMC proposes to bury the pipelines below the frost line. However, in some instances where the pipeline may not be buried below the frost line, such as within the roadway, SMC will insulate the pipeline to prevent freezing using the same technology currently being used on Alaskan pipelines.

Water Management and Disposal

As discussed under the No Action alternative, SMC handles two primary waste water streams at the Stillwater Mine. One stream is adit water, which is groundwater intercepted by the mine workings. The second stream is process and tailings water, which is the water used in the milling and concentrating circuits and pumping of the tailings. Under this alternative, SMC would continue to handle the water in these waste water streams differently.

Adit water from the mine workings is discharged at over 1,000 gallons per minute (gpm). SMC treats, and would continue to treat, the adit water before it uses or disposes of it. Treatment is primarily by clarification to remove fine particulates. Following treatment, the water would be used for irrigating reclaimed areas, crop and pasture land; stabilizing soils; controlling dust; and adding to the mill process as make-up water. During the winter, excess water is disposed of in sedimentation/percolation ponds. During the growing season, SMC would use an LAD system to irrigate agricultural and reclaimed lands.

SMC proposes to add LAD systems at Stratton and Hertzler Ranches. A pipeline buried with the tailings pipelines would transport the adit water to these sites. A new LAD storage pond, which could contain up to 80 million gallons of water, would be constructed at Hertzler Ranch. During the winter, excess adit water would be routed to percolation ponds and the LAD storage pond.

Tailings/process water includes water used within the milling and concentrating circuits, which contains low levels of reagents from the milling process. Although the reagents pose no hazard to human health or the environment, SMC handles the water containing these reagents separately from adit water. Process waters can also be used to slurry tailings to the Hertzler impoundment. In the

tailings impoundments, water is either evaporated or reclaimed and pumped back to the mill for reuse.

To facilitate reclaiming tailings water, SMC would construct a reclaimed water pipeline between the mill and the Hertzler tailings impoundment. This 10-inch steel pipeline would be constructed and buried in the same rights-of-way as the tailings slurry pipelines. The pipeline would return tailings water from the Hertzler impoundment back to a process water head tank above the concentrator for reuse in the milling and flotation circuits.

Removal of Production Limit

In 1992, SMC received approval for an amendment to their Plan of Operations and Permit No. 00118 (DSL, DHES, and Forest Service 1992). That permit amendment allowed SMC to increase production to a maximum level of 2,000 tpd or 730,000 tpy. SMC now proposes to have that limit on production removed. The permit would be based on an approved "footprint" of surface disturbance, not a rate of production. SMC would be able to alter daily levels of production to respond to changing conditions in the market, as described under the Proposed Action.

Roads and Traffic

SMC does not propose any modifications to existing or previously-approved permit-related roads. Stillwater County roads 419 and 420 may be upgraded to allow for installation of the buried pipelines within their rights-of-way. SMC would negotiate an agreement with Stillwater County for these upgrades. The agreement would constitute an amendment to SMC's Hardrock Impact Plan for Stillwater County.

Workforce

Projections suggest that implementation of the Proposed Action would increase employment at the mine to approximately 700 workers. Forty to 45 percent of the additional workers (some combination of permanent employees and contractors) are expected to be local residents. This increase would trigger a revision to SMC's Hardrock Impact Plan.

Alternative C — Modified Centerline Expansion and Hertzler Tailings Impoundment

Under this alternative, SMC would expand the existing tailings impoundment and construct a new impoundment at Hertzler Ranch. SMC also would then later

construct a waste rock storage facility on the east side of the Stillwater River and develop additional facilities for LAD. A system of pipelines would be constructed to transport tailings and reclaim water. Pipelines would be constructed in the rights of way of Stillwater County roads 419 and 420 for a distance of 7.8 miles. The pipelines would carry slurried tailings water and adit water from the mill and mine to the Hertzler tailings impoundment and the land application system, respectively. Other pipelines would carry reclaim water back to the mill. The LAD system would include four center pivot irrigators at Hertzler Ranch and two irrigators at Stratton Ranch. **Figure S–3** shows the distribution of the primary facilities comprising this alternative. The primary facilities are described below.

Implementation of this alternative would result in a smaller impoundment at Hertzler Ranch than would be constructed under the Proposed Action (Alternative B). This smaller impoundment would be 29 feet shorter than the Proposed Action's impoundment and less visible. Finally, the areal extent of surface disturbance would involve about 129 acres, 34 acres less than what would be involved under the Proposed Action.

Selection and implementation of this alternative also would remove the limitation on daily production (currently at 2,000 tpd). The permit would be based on an approved "footprint" of surface disturbance, not a rate of production. SMC would be able to alter daily levels of production to respond to changing conditions in the market, as described under the Proposed Action.

Alternative D — Modified Centerline Expansion and East Side Tailings Impoundment

Under this alternative, SMC would expand the existing tailings impoundment and construct a new impoundment on the east side of the Stillwater River. SMC also would develop additional facilities for LAD at Stratton Ranch. Pipelines to transport tailings water, adit water and reclaim water would be suspended across the river or attached to the bridge. Pipelines would be constructed to carry adit water to the Stratton Ranch for LAD as described in the Proposed Action. **Figure S–3** shows the distribution of the primary facilities comprising this alternative. The primary facilities are described below.

This alternative would not fully meet the purpose of and need for the project. It would only allow the placement of 15.9 million tons of waste rock and 13.3 million tons of tailings. Furthermore, the life of the project would be shortened from 30 years to 23 years.

Implementation of this alternative would result in no development at Hertzler Ranch. All new facilities would be concentrated in the general vicinity of the

Stillwater Mine and Stratton Ranch. This alternative would eliminate concerns about the facilities at Hertzler Ranch, including effects on the local aesthetics, surface water, groundwater, aquatic resources, and property values.

Selection and implementation of this alternative also would remove the limitation on daily production (currently at 2,000 tpd). The permit would be based on an approved "footprint" of surface disturbance, not a rate of production. SMC would be able to alter daily levels of production to respond to changing conditions in the market, as described under the Proposed Action.

Agency Mitigations

DEQ and CNF's decisions on the previous environmental analyses (1985 through 1996) required SMC to implement a variety of mitigation measures. Many of these measures are ongoing or annual requirements. Consequently, SMC must continue to implement them, regardless of the decision made on this analysis. A summary of the mitigation measures required in the previous decisions is included as **Appendix C**.

Through the analysis of environmental consequences, DEQ and CNF identified additional mitigation measures relative to this proposed action or the action alternatives discussed in this EIS. These measures are:

1) The agencies would require testing and monitoring of the permeability of the clay liner or compacted base on which the HDPE liner would be placed. If this testing showed that the material does not meet the minimum permeability requirement of 1x10-6 cm/sec, then additional clay material would need to be brought in to reduce the permeability. The actual cost of obtaining this material would vary depending upon how much material was needed and how far it had to be hauled to get to the site, because this affects the cost of purchasing the material and the amount of work involved in transporting the material to and placing the material at the site. SMC could also investigate other options of achieving the desired permeability. There are too many variables to determine what this cost might entail. If the monitoring showed that required permeabilities were obtained, SMC would noot incur costs for obtaining the additional clay material. No less restrictive method of protecting ground water has been identified.

2) SMC would be required to monitor ground water at the Hertzler Ranch to determine effects of seepage from the impoundment. The agencies would require an additional mitigation measure based on the results of the ground water monitoring. If ground water monitoring at the Hertzler Ranch indicated that nitrates or other

contaminants were migrating at concentrations that would cause increases above the trigger level in the Stillwater River, SMC would be required to conduct biological monitoring of periphyton and macroinvertebrates above and below the site twice a year. This mitigation measure, if implemented, would require SMC pay for additional monitoring and testing. This type of monitoring and testing costs approximately $30,000 per year. The number of years of testing required would depend upon when ground water monitoring indicated biological monitoring was necessary. The additional monitoring would be required to comply with both MMRA and the Montana Clean Water Act.

3) If monitoring at Hertzler Ranch showed that groundwater quality exceeded nondegradation standards outside of the mixing zone then SMC would be required to identify, collect baseline data prior to construction of the pipeline and Hertzler impoundment from, and monitor nearby down-gradient residential wells that could potentially be affected by seepage from the Hertzler impoundment. SMC would be required to pay for the collection and testing of water samples. Typical collection and laboratory costs for a single sample range between $35.00 and $330.00 for nitrates and a full range of the constituents specified in SMC's ground water monitoring plan respectively. The total cost would depend upon the number of wells being sampled. This sampling would ensure that down-gradient water users would be identified and help determine if their water supplies became contaminated as a result of the Hertzler impoundment. If that occurred, then SMC would provide replacement water sources as required under MMRA. No less restrictive means of ensuring long term compliance is available.

4) SMC would be required to purchase a 250 kW backup generator to ensure pipeline leak detection sensor function and operation during power failures or partial power outages. This would cost SMC approximately $50,000 to purchase and $32.00 per hour to operate; it would take about 4 hours of pumping to vacate the tailings pipeline. However, if a power outage resulted in undetected leaks or ruptures of the pipeline, the cost of fines, penalties, and repairs could potentially exceed that amount. SMC proposes to construct an underground water storage reservoir at the 6400 foot level, however, it may not be constructed immediately and it would take time for it to fill up with enough water to provide sufficient volume to flush the pipelines by gravity feed alone. There may also be times during mine life when there was insufficient volume of water in the storage reservoir. Therefore, there is no less restrictive means of ensuring that the pipelines could be flushed in the event of a rupture during a

power failure although a smaller generator would be sufficient to supply enough power to keep the leak detection system function.

5) If, after 2 years, agency review of pipeline monitoring data resulted in a decision to continue the monitoring of the tailings pipelines every six months and the water pipelines annually, there would be a continuing cost of monitoring the pipelines more frequently than SMC might want to specify. If the agency determined that pipeline monitoring frequency could be reduced, costs to SMC would be reduced slightly. No less restrictive means of ensuring pipeline failure does not occur has been identified.

6) SMC, DEQ, and CNF would re-evaluate paste technology applicability for use at the Stillwater Mine after 5 years of operations. There would be some costs for engineering studies. If the evaluation resulted in implementation of paste technology, there might be increases in construction and operational costs over more traditional mining and waste storage methods proposed under Alternative B. Those costs cannot be estimated at this time. No less restrictive means of providing a denser, and thus potentially smaller impoundment, which also retains less water and can be reclaimed in a shorter period of time has been identified. However, DEQ will make this evaluation again when paste technology is re-evaluated.

7) SMC would be required to work with the Stillwater Valley Bighorn Management Committee to explore options for mitigating indirect impacts to bighorn sheep. The company's main involvement would be attending meetings, developing mitigations, and implementing those mitigations. SMC currently works with the committee as required in their operating permit so no additional costs would be incurred for attending the meetings. No costs of mitigation implementation can be determined at this time because the plans have not be developed; the costs are not expected to be substantial. Furthermore, whether less restrictive means are available will be evaluated before a mitigation is imposed.

8) The agencies would require SMC to replace creeping meadow foxtail with a more palatable native species in the reclamation seed mix for the LADs. There would be virtually no difference in costs to SMC for implementing this mitigation measure.

9) SMC currently has a dust abatement program for the existing impoundment. As mitigation, the agencies would require that program be extended to the Hertzler or east side impoundments, depending upon the alternative implemented. The dust abatement program would be implemented whenever one of the impoundments

was not in use as well as when both were inactive. This mitigation would result in a slight increase in operating costs to keep both surfaces wet. This mitigation would be required under the air quality permit to comply with the Montana Air Quality Act.

10) During final design development of the Hertzler tailings impoundment, SMC would be required to conduct stability modeling and analyses on the Colorado Shale Unit for deep foundation failures. The agencies would also require that a professional engineering geologist or geotechnical engineer would observe the excavation of the Hertzler Ranch impoundment foundation and borrow areas to determine if any geomorphological features were exposed that would indicate ancient mass failure. If such features were observed or if the modeling indicated a potential for mass failure, then SMC would be required to develop a plan for a detailed bedrock drilling program and analysis. The plan would be subject to agency review and approval prior to implementation. Necessary changes to the design of the impoundment would be developed, reviewed and approved by the agencies, and implemented to resolve any problems identified by the drilling and bedrock analysis. There would be a slight increased cost for running the additional stability modeling during final design ($2,000 to $5,000). Since SMC typically has a professional engineer on hand during construction for quality control purposes, there would be no additional cost for the engineer to look for signs of mass failure. The costs associated with drilling and bedrock analysis and any resulting engineering designs and construction changes cannot be determined at this time. This mitigation would confirm that the shale bedrock and glacial till had not been affected by past mass movement and that the glacial till would provide a suitable foundation for the impoundment. This requirement would be required under MMRA and no less restrictive means of ensuring that the impoundment would not be subject to mass failure has been identified.

11) The agencies would require SMC to develop incentives for employee carpooling. This requirement is based on the need for minimizing the potential for accidents on road segments in need of resurfacing. Incentives could have varying costs to SMC depending upon what SMC included in their plan and how many employees take advantage of the incentives. These costs cannot be estimated at this time. This analysis of restriction would be reevaluated when a plan is submitted to the agencies. The need for this stipulation may be eliminated through the Hard Rock Impact Plan.

12) The agencies would require SMC to extend the first lift of the proposed Hertzler tailings impoundment to the full footprint so that the outer slopes can be reclaimed once and not redisturbed during

construction of the second lift. This could increase construction costs of the embankment of the first lift by approximately $1.2 million, but it would eliminate the need to reclaim that portion of the embankment a second time under alternatives B and C (there would be no impoundment at Hertzler Ranch under Alternative D). The cost for stage two would be reduced by $1.2 and so there would be no net increase in cost of constructing the impoundment Interim revegetation of the first left as planned under Alternative B would mitigate visual impacts and provide for slope stabilization, but the slope would be redisturbed when the second lift was constructed and require revegetation for a second time. There are no other ways to provide for final revegetation of the outer slope of the first lift and eliminate redisturbance of the slope. SMC could investigate modifying the final design so that there is no net increase in volume of borrow needed to build the first lift out to the final footprint, it is anticipated that this would reduce the height of the first lift which would be made upp in the second lift; this could reduce the up front capital needed to construct the first lift. This mitigation is more restrictive than that proposed under Alternative B.

13) SMC specified in its revision application that the outer slopes of the Hertzler impoundment and east side waste rock storage site would be reclaimed with a mosaic of vegetation and rock. SMC did not specify how long the soiled and vegetated slopes would be. The agencies would require a mitigation measure to specify that revegetated slopes would not exceed 150 feet in length before being intercepted by a rocky zone. This rocky zone or armor would be placed asymmetrically across the slope. This would not result in any additional costs to SMC and is an extension of a mitigation for the existing required under the 1992 ROD on the 2,000 tpd EIS. This mitigation would be necessary to ensure successful reclamation of these slopes, to reduce erosion, and comply with MMRA.

14) SMC would be required to have a professional archeologist present during construction of the pipeline and the embankments for the first lift of the Hertzler impoundment when construction of these facilities approaches identified and potential cultural sites. The archeologist would be responsible for identifying any cultural material that might be exposed during construction. This would result in additional costs of paying for those services. Current rates for a professional archeologist range between $25.00 and $50.00 an hour; SMC would also need to cover lodging and meals for the person hired for this purpose. The total cost would depend upon on how long construction took and on any needed mitigations. This restriction would be required to comply with the various federal laws pertaining to cultural,

historic, and archeological resources. No less restrictive means of protecting archeological resources has been identified.

Alternatives Considered But Eliminated

Several potential alternatives were considered for this analysis, but were dropped from detailed study for various reasons. The alternatives are listed below along with the main reason they were excluded from further consideration.

Eighteen Tailings Facilities Sites First Identified in 1985

Most of these sites were eliminated due to the same geotechnical or hydrogeological concerns identified during the 1985 evaluation. Although three were reevaluated during this analysis, they also were eliminated for the reasons indicated below:

- Tailings Impoundment at Stratton Ranch. Much of the area is geotechnically unstable and shallow groundwater is present.

- Tailings Impoundment at Beartooth Ranch in conjunction with an East Side Tailings Impoundment. This option had serious environmental concerns associated with it and too many technical challenges.

- Tailings Impoundment at Horseman Flats in conjunction with an East Stillwater Tailings Impoundment. The primary concern with the Horseman Flats site is associated with the risk involved in pumping the tailings long distances under high pressure. The potential for accidental discharge of tailings is very likely over the operational life of the facility.

Another five potential alternatives were identified as part of this analysis, but were eliminated as described below.

- Tailings impoundment in the Nye Creek drainage. Compared to the other alternatives available, technical, environmental, and economical concerns rendered this alternative unreasonable. The accessibility to the site during winter would be restricted and any closure of the access road would prohibit operational access to the tailings impoundment and water reclaim system. To develop the required impoundment capacity, the required dam would be almost twice as high as required at either the Beartooth or Horseman Flats sites. This increases the risk of failure and the consequences of a failure. The potential for accidental discharge of tailings from the tailings transport pipeline also would be very likely over the operational life of the facility.

- Dispose of tailings in the abandoned Benbow Mine. This alternative was determined to be unreasonable because implementation would be technically unfeasible. This alternative would require pumping tailings from the Stillwater Mine up the Nye Creek drainage and over the 8,800-foot high drainage divide, a vertical gain in elevation of more than 3,500 feet. the pipeline would have to be placed on the surface rather than be buried. During the course of operation, there would be a high probability that at some point, the pipeline would fail resulting in discharge of tailings to the environment. At this time, it is unknown if there is sufficient volume to dispose of the tailings in existing underground mine workings because the extent and condition of the underground workings is undefined.

- Convert the tailings to paste and landfill or backfill the paste (slimes or whole tailings paste). The agencies determined implementation of total tailings paste backfill and landfill at the Stillwater Mine is not reasonable at this time. This technology has only recently been implemented in a full-scale, operational mode in other underground mines and critical issues remain unresolved. Implementation of a total tailings paste backfill system also would not eliminate the need for additional aboveground storage for tailings. Construction of an overall paste backfill system would generate a comparatively large amount of new disturbances. Finally, the addition of the paste backfill system would require a substantial financial investment.

- Use of a thicker or second liner at the Hertzler Tailings Impoundment. No substantive decrease in the potential for seepage to reach groundwater could be demonstrated.

- Use the centerline method to expand the existing impoundment along with a new impoundment at Hertzler Ranch. The toe of the existing impoundment would be pushed farther into the PMF flood plain, which was not acceptable to the agencies.

Affected Environment

The project area is in Stillwater County, Montana, in the upper reaches of the Stillwater River valley. The surrounding area is mountainous, relatively sparsely populated and noted for its scenic beauty and recreational opportunities. The Absaroka-Beartooth Wilderness lies about 1.5 miles south of the project area. Yellowstone National Park lies approximately 25 miles to the south.

Surface water features in the project area are dominated by the Stillwater River. All drainages from project area lands enter the Stillwater River. Surface water quality in the Stillwater River Basin is generally good to excellent, reflecting the relatively undeveloped state of the area. Groundwater resources comprise two major aquifers; the unconsolidated alluvium/alluvial fan deposits of the

Stillwater valley, and the fractured bedrock system. Groundwater in the bedrock is mainly confined to openings, such as joints, faults, and shear zones. Groundwater samples from monitoring wells show the water is generally of good quality.

Thirteen vegetation types, as well as, disturbed lands that are barren have been identified in the project area. They include stony grasslands, sagebrush shrublands, skunkbush shrublands, drainage bottomlands, riparian woodlands, ravine aspen-chokecherry, open forest/meadow understory, open forest/rocky understory, douglas-fir forest, subalpine forest, revegetated chrome mining tailings, cultivated haylands, and disturbed lands.

The Stillwater valley supports a wide variety of wildlife. Three big-game species occur regularly in the project area: mule deer, white-tailed deer, and bighorn sheep. Black bear, mountain lions, and upland game birds also frequent the project area and its surrounding environment. The U.S. Fish and Wildlife Service has identified four threatened or endangered species that may occur in or near the project area. They are the bald eagle, peregrine falcon, grizzly bear, and black-footed ferret. The Stillwater River and the West Fork Stillwater River are considered substantial fishery resources by the Montana Department of Fish, Wildlife, and Parks.

Air quality in the project area is very good. Monitoring stations show the annual average of particulate matter is approximately 25 percent or less than the ambient standard. The major sources of particulate and gaseous emissions consist of mining activities, vehicle traffic (mining and residential), and residential wood burning.

Stillwater County had a civilian labor force in 1996 of 4,135 individuals, with an unemployment rate of about 6.2 percent. The major employer categories in the county (in order of decreasing employment) are mining, retail trade, government, manufacturing, and services. As of December 1997, SMC employed 620 people, or about 16 percent of the Stillwater County labor force. This level of employment represents about a 35 percent increase over the 460-employee level projected in SMC's Amended Hard Rock Impact Plan of 1988. SMC's 1996 property tax liability, including the smelter in Columbus and gross proceeds tax, was approximately $1.8 million. Community services are addressed by SMC's Amended Hard Rock Impact Plan in the jurisdictions of Stillwater County, the town of Columbus, the Absarokee Rural Fire District, and school districts in Absarokee, Columbus, Fishtail, and Nye.

The Woodbine Campground and trailhead are heavily used during the summer and fall months. These facilities are approximately 1.5 miles south of the SMC mine. The lowest elevation access point to the Absaroka-Beartooth Wilderness is located approximately 3.5 miles south of the mine and is a major point of access to the wilderness area.

Twenty-eight cultural resources have been recorded in the project area. Only seven are partially in or near the area of potential effect and only four of these are considered eligible for the National Register of Historic Places.

Summary Comparison of Alternatives and Environmental Consequences

The alternatives considered in detail and the likely environmental consequences of each alternative are summarized in **Table S–1** and **Table S–2**, respectively. The Proposed Action would disturb approximately 251 new acres for mine-related structures in areas previously used for mining and agriculture, the most of any of the alternatives, and Alternative D would disturb the fewest number of acres.

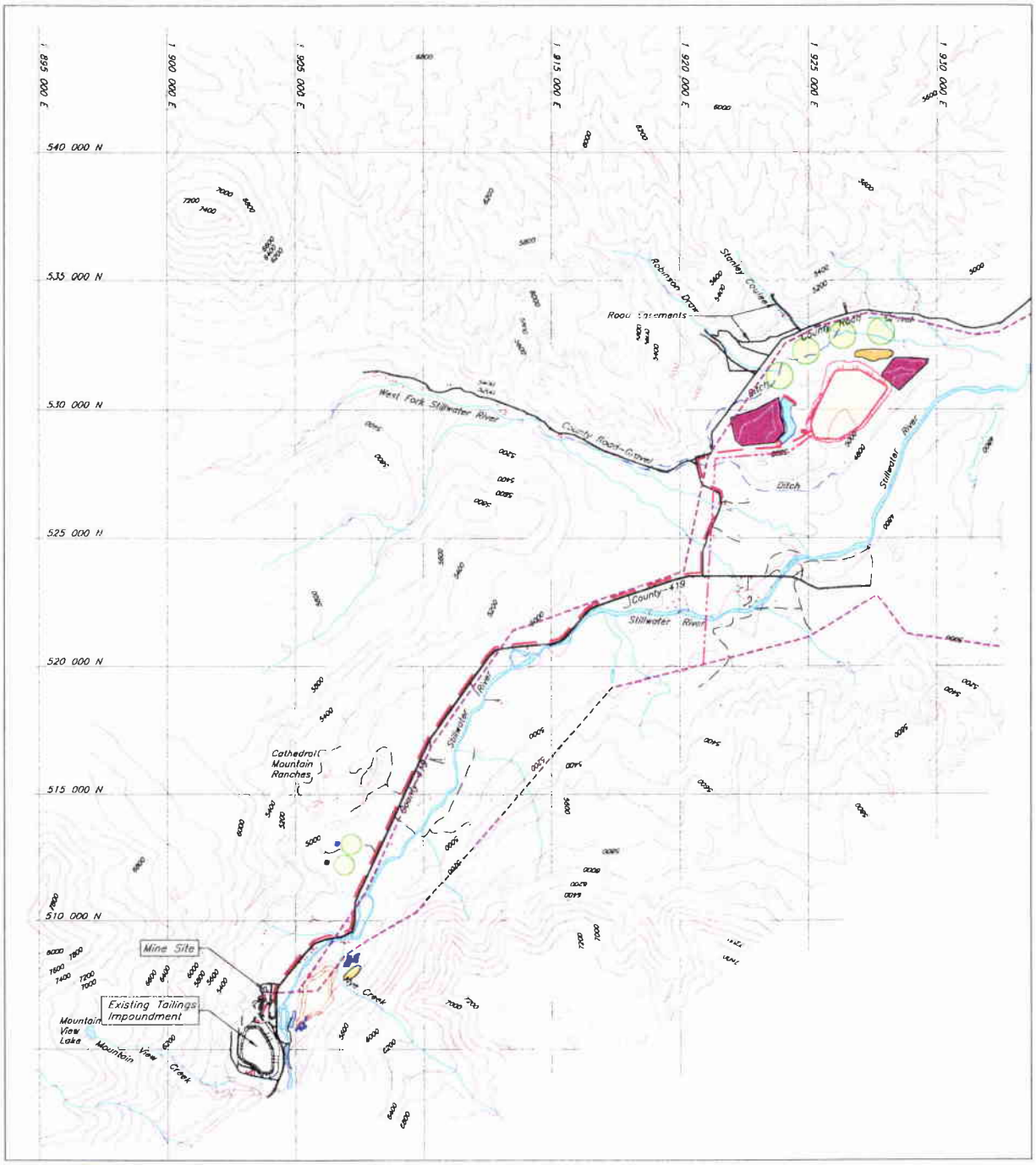
Groundwater quality would be affected by localized increases in nitrates under alternatives B and C, but Alternative D would increase nitrates only at the Stratton Ranch location. Surface water quantities would experience a short-term increase in runoff: the most for Alternative B, less under Alternative C, and least under Alternative D. Surface water quality would experience minor degradation in certain parameters, but no standards would be violated. This situation would be essentially the same for alternatives B and C, but with slightly less effect under Alternative D. Nitrate levels in the Stillwater River would increase similarly under all alternatives, but would not violate any standard. There would be a slight increase in runoff from waste rock from all alternatives. Approximately 1.5 acres of wetlands (Waters of the U.S.) would be affected by the pipeline route under Alternatives B and C, but Alternative D would affect less than one acre because of shorter pipelines. Effects to Waters of the U.S. would be mitigated through in-kind reclamation.

Air quality would experience slight increases in particulate matter, especially during construction phases under all alternatives. Alternative C would have lower dust levels during construction of the smaller impoundment at Hertzler Ranch, and Alternative D would concentrate dust generation at the mine site. Vegetation communities would be changed from the current mixture of native and introduced (agricultural) species to a different community after reclamation . Alterantive B would affect the largest acreage, and Alternative D the least acreage. Wildlife habitat would be affected during the life of the mine, with the greatest acreage affected under Alternative B, and the fewest under Alternative C. Alternatives C and D would also affect about eight acres of bighorn sheep range. Fish reproduction in the Stillwater River could be affected from increases in sedimentation over the short-term. This phenomenon would be the same for alternatives B and C, but slightly less under Alternative D.

Social and economic effects would include approximately 424 new residents, including 34 new school students, 45 new jobs created, and a continuation of tax payments by SMC for an additional 30 years. The socioeconomic effects would be the same for all action alternatives. Visual intrusion by new facilities would not violate visual quality objectives on National Forest system lands. Construction noise would be created at all locations under all action alternatives. Transportation increases from the project would increase the average daily trips on Stillwater County roads 419 and 420 from 803 to 906, regardless of the selected action alternative. Construction of the pipeline corridors would disrupt traffic on the roads in the short-term. Pipeline construction would be similar for alternatives B and C, but greatly reduced under Alternative D. No direct effects would occur to cultural resources, regardless of the action alternative selected.

Preferred Alternative

The agencies' preferred alternative is Alternative B, the Proposed Action, with the variety of mitigations listed in the final EIS. Alternative B would result in the construction of a second tailings impoundment at the Hertzler Ranch site, construction of a 7.8-mile long pipeline corridor along Stillwater County roads 419 and 420 between the mill and the new impoundment, construction of a waste rock storage facility on the east side of the river across from the mill, additional LAD sites at the Stratton and Hertzler ranch sites, and removal of the production cap.



LEGEND

- Proposed Pipeline Alignment
- Approximate Location of Overhead Power Line
- Approximate Location of Proposed Overhead Power Line
- Road
- Land Application Disposal Site
- Borrow Area
- Topsoil Stockpile
- Land Application Disposal Storage Pond
- Waste Rock Storage Area
- Hertzler Tailings Impoundment
- Sediment / Percolation Pond

Stillwater Mine
Revised Waste Management Plan
and Hertzler Tailings Impoundment
Draft Environmental Impact Statement

TOPOGRAPHY AND MINE SITE DETAILS ORIGINATED FROM INFORMATION SUPPLIED BY STILLWATER MINING COMPANY

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SCALE (FT)

Alternative B
Location of Primary Facilities Comprising the Proposed Action
Figure S-2

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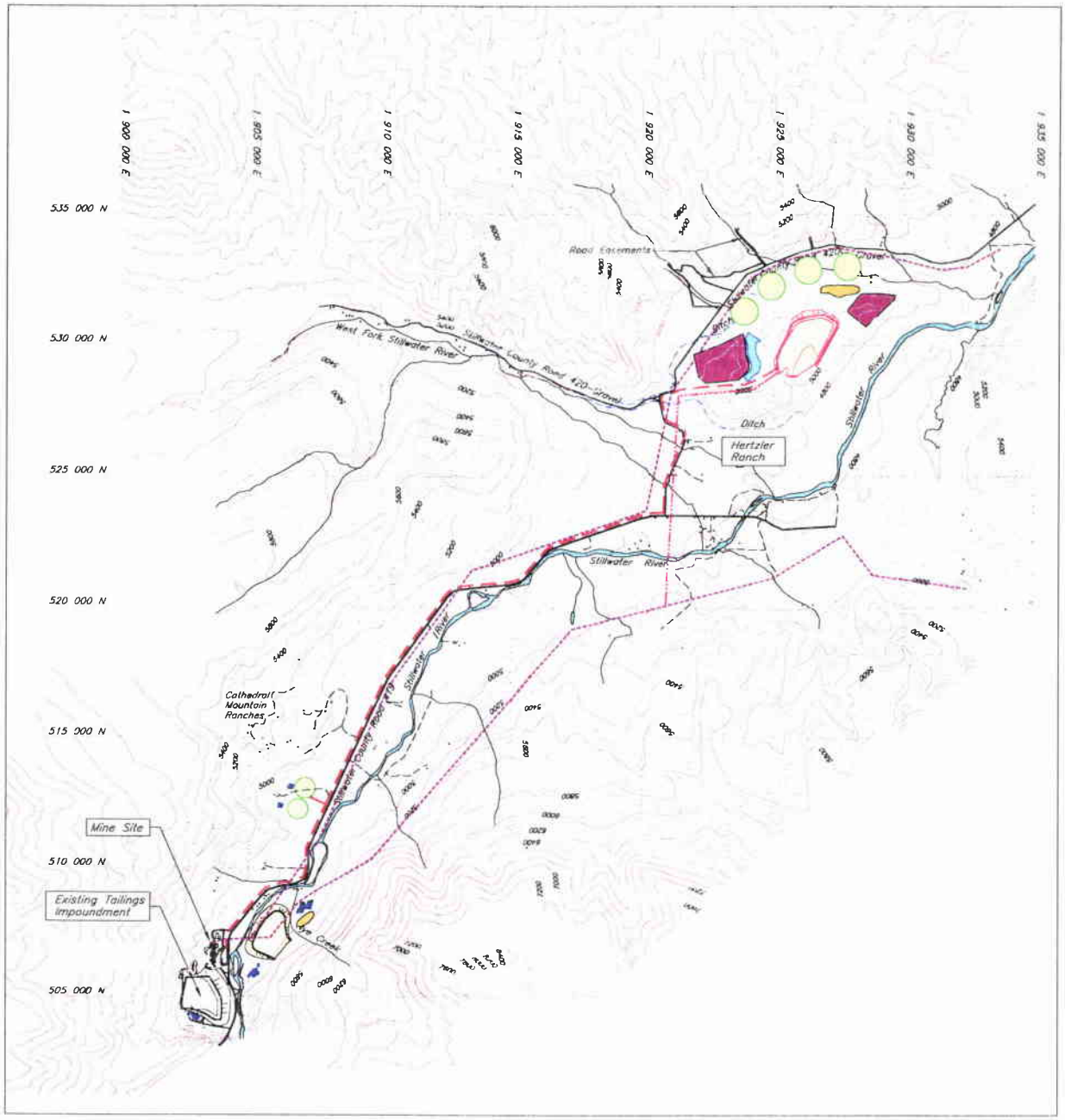

LEGEND

- Proposed Pipeline Alignment
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- Sediment / Percolation Pond

Stillwater Mine
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TOPOGRAPHY AND MINE SITE DETAILS ORIGINATED FROM INFORMATION SUPPLIED BY STILLWATER MINING COMPANY

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SCALE (FT)

Location of Primary Facilities Comprising Alternative C - Modified Centerline Expansion and Hertzler Tailings Impoundment
Figure S-3

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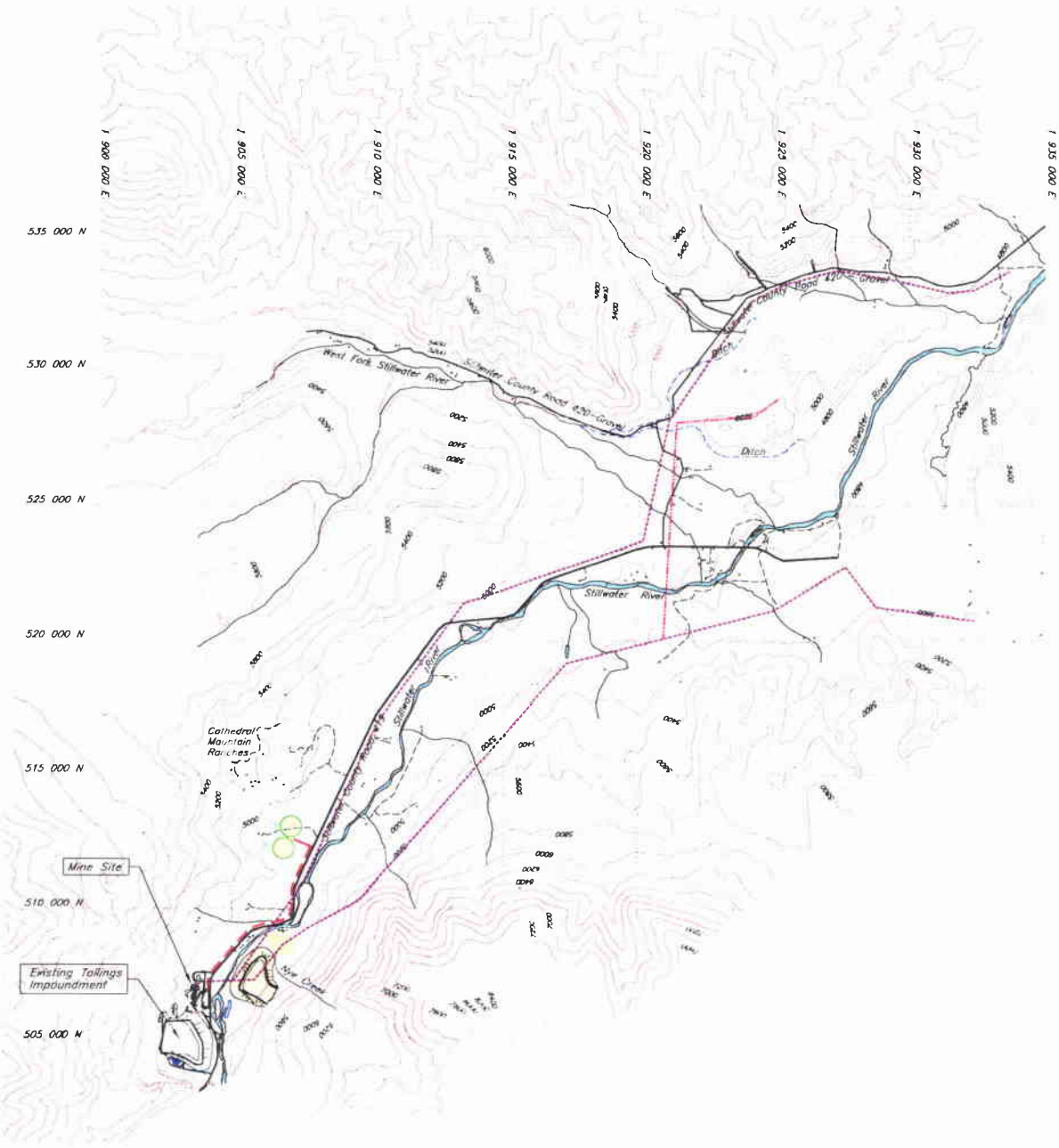

LEGEND

- Proposed Pipeline Alignment
- Approximate Location of Overhead Power Line
- Approximate Location of Proposed Overhead Power Line
- Road
- Land Application Disposal Site
- Borrow Area
- Topsoil Stockpile
- Land Application Disposal Storage Pond
- Waste Rock Storage Area
- Tailings Impoundment

Stillwater Mine
Revised Waste Management Plan
and Hertzler Tailings Impoundment
Draft Environmental Impact Statement

TOPOGRAPHY AND MINE SITE DETAILS ORIGINATED FROM INFORMATION SUPPLIED BY STILLWATER MINING COMPANY

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Location of Primary Facilities Comprising Alternative D - Modified Centerline Expansion and East Side Tailings Impoundment
Figure S-4

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Table S–1 Comparison of Alternatives Considered in Detail

Parameter	Alternative A	Alternative B	Alternative C	Alternative D
Waste Rock Production and Management				
Capacity (tons)				
Temp. & Permanent Storage Areas[1]	1,630,000	1,630,000	1,630,000	1,630,000
Completion of Existing Impoundment[1]	1,755,000	1,755,000	1,755,000	1,755,000
Expansion of Existing Impoundment	na[2]	na	2,660,000	2,660,000
East Side Visual Berm[1]	386,000	na	na	na
East Side Storage Site	na	17,886,000	15,226,000	na
East Stillwater Impoundment	na	na	na	9,840,000
Total	3,771,002	21,271,000	21,271,000	15,885,000
Areal Extent of Coverage (acres)				
Temp. & Permanent Storage Areas	18	18	18	18
Complete Existing Impoundment Embankment	15	15	15	15
Expansion of Existing Embankment	na	na	8	8
East Side Visual Berm	12	na	na	na
East Side Storage Site	na	80	80	na
East Stillwater Impoundment	na	na	na	72
Total	45	113	121	113
Tailings Production and Management				
Capacity (tons)				
Existing Impoundment (present day)	1,900,000	1,900,000	1,900,000	1,900,000
Existing Impoundment (additional)	1,600,000	1,600,000	1,600,000	1,600,000
Expansion of Existing Impoundment	na	na	4,850,000	4,850,000
Hertzler Ranch Impoundment	na	15,000,000	10,150,000	na
East Stillwater Impoundment	na	na	na	4,940,000
Total Capacity	3,500,000	18,500,000	18,500,000	13,290,000
Areal Extent of Coverage (acres)				
Existing Impoundment	45	45	45	45
Expansion of Existing Impoundment	na	na	8	8
Hertzler Ranch Impoundment	na	163	129	na
East Stillwater Impoundment	na	na	na	72
Total	45	208	182	125
Final Crest Elevations (feet)				
Existing Impoundment	5,111	5,111	5,175	5,175
Hertzler Ranch Impoundment	na	5,036	5,007	na
East Stillwater Impoundment	na	na	na	5,085
Water Management and Disposal				
LADs (acres)	24	104	104	40
LAD storage ponds (acres)	2	17	17	2
Tailings/Process water	evaporate/reuse	evaporate/reuse	evaporate/reuse	evaporate/reuse
Power Requirements (MW)	12	16	16	16
Roads and Traffic	no change	additional traffic	additional traffic	additional traffic
Workforce (# employees)	655	700	700	700
Monitoring	no change	program would expand	program would expand	program would expand
Reclamation	no change	revise accepted plan	revise accepted plan	revise accepted plan
Currently-permitted disturbance (acres)	255	255	255	255
Existing Non-SMC disturbance[2] (acres)	0	172	172	84
New SMC disturbance (acres)	0	251	217	1
Total disturbance (acres)	255	678	644	340
Bonding	no change	increase	increase	increase

Notes:

1. Placement of waste rock in the temporary and permanent storage areas, embankment to complete the existing tailings impoundment, and east side visual berm has been permitted by DEQ and CNF. No waste rock has been placed in the east side visual berm.. If an alternative with the east side storage site or East Stillwater impoundment is selected, the east side visual berm would not be constructed. Instead, its capacity would be absorbed into the east side storage site or East Stillwater impoundment.
2. Existing non-SMC disturbance includes 80 acres of pastureland at Hertzler Ranch and portions of the east side where chrome tailings were previously deposited. Neither of these locations has a cover of native species.

Table S–2 Summary Comparison of Impacts by Alternative

Issue or Resource	Indicator Units	Alternative			
		A — No Action	B — Proposed Action	C — Modified Expansion and Hertzler	D — Modified Expansion and East Side Impoundment
Purpose and Need		Does not meet Purpose and Need	Does meet Purpose and Need	Does meet Purpose and Need	Partially meets Purpose and Need
Physical Size	Acres	255	678	644	340
Water Resources	Groundwater Quantity	Aquifers are localized and highly variable. Overall mine discharges may reach 1,061 gpm.	Recharge as much as 2,000 gpm at Stratton and Hertzler Ranch by LAD in summer. Overall mine discharges may reach 1,342 gpm at an average production rate of 3,000 tpd.	Same as B, but effects at Hertzler Ranch delayed.	Recharge only at Stratton Ranch. Overall mine discharges may reach 1,277 gpm at an average production rate of 3,000 tpd.
	Groundwater Quality	Generally good. No change would occur.	Localized increase in nitrates near LADs at Stratton and Hertzler Ranches and the waste rock storage facility (approx. loading of 13.6 lbs/day).	Same as B, but effects at Hertzler Ranch delayed.	Localized increase in nitrates near LADs at Stratton Ranch and east side tailings impoundment. Loading of nitrates from east side tailings impoundment would be less than the 13.6 lbs/day that would occur with waste rock facility.
	Tailings Pollutant From Pipeline Accident	Not applicable.	No long-term effects, but short-term effects from increased sediment would be primarily contained within the borrow ditch.	Same effects as B, but slightly shorter period than B.	Slightly higher risk than B due to exposed pipelines suspended over the Stillwater River.
	Surface Water Quantity	No change.	Small, short-term increase in runoff	Slightly less risk than B	Least runoff
	Surface Water Quality	Good to excellent. No change.	Minor change due to increased water discharges	Same as B	Slightly better than B due to a lower increase in water discharges
	Tailings Pollutant from Impoundment Failure	Only tailings from existing impoundment would possibly reach the river.	Same as A, only tailings from existing impoundment would reach the river if it failed Hertzler is ≥½ mile upgradient from Stillwater River.	Greater risk than B because more tailings would possibly reach the river if the modified, existing tailings impoundment failed	Greater risk than B or C. All tailings from two impoundments would reach the river if the impoundments failed

Table S–2 Summary Comparison of Impacts by Alternative, Con't.

Issue or Resource	Indicator Units	Alternative: A — No Action	B — Proposed Action	C — Modified Expansion and Hertzler	D — Modified Expansion and East Side Impoundment
Water Resources	Nitrates in Stillwater River	No change	Remain below Std. (an increase of 0.02 to 0.05 mg/L)	Same as B	Same as B
	Sedimentation	247 TDS mean adit water and 1,500 TDS mean process water. No change.	Sediment from pipeline construction would be contained within the borrow ditch. Sediment from Hertzler would have to travel about ½ mile to reach the river. No more than small, short-term increases during construction.	Modification of the existing impoundment would occur less than ¼ mile from the river. However, most sediment from this construction should be captured by SMC's stormwater containment system.	Same as C for the existing impoundment. Sediment would be generate from construction of the new impoundment less than ¼ mile from the river. However, most sediment from this construction should be captured by a new stormwater containment system.
	Heavy Metals	Some metals (cadmium, copper, lead, and zinc) have exceeded standards. on one or more occasions (from natural sources). No change.	Same as A.	Same as B.	Same as B.
	Water Wells	No effect.	No effect.	Same as B.	Same as B.
	Waters of the U.S.	None.	1.5 acres affected. Permitted under Nationwide Permits.	Same as B. Permitted under Nationwide Permits.	Less than 1 acre affected. Permitted under Nationwide Permits.

Table S–2 Summary Comparison of Impacts by Alternative, Con't.

Issue or Resource	Indicator Units	Alternative: A — No Action	B — Proposed Action	C — Modified Expansion and Hertzler	D — Modified Expansion and East Side Impoundment
Wildlife	General Habitats Affected (acres)	No change from approved.	678 acres	644 — affects at Hertzler delayed up to 10 years.	340
	Winter Range Affected (acres)	No change from approved	678 acres of mule deer winter range affected (255 acres previously-permitted disturbance, 251 acres new disturbance, 68 acres previously disturbed, and 104 acres under LADs). No bighorn sheep habitat directly affected, but potential indirect effects to bighorn sheep from competition for forage from mule deer displacement.	644 acres of mule deer winter range affected (255 acres previously-permitted disturbance, 217 acres new disturbance, 68 acres previously disturbed, and 104 acres under LADs). 8 acres of bighorn sheep habitat directly affected. Same indirect effects to bighorn sheep as B.	340 acres of mule deer winter range affected (255 acres previously-permitted disturbance, 1 acre new disturbance, 60 acres previously disturbed, and 24 acres under LADs). 8 acres of bighorn sheep habitat affected. Same indirect effects to bighorn as B.
	T&E Impacts	No effect.	No effect.	Same as B.	Same as B.
Fisheries	Change in Stream Flow	No change.	No change.	Same as B.	Same as B.
	Increased Sedimentation	No change	No change.	Same as B	Same as B.
	Increased Nutrients	No change	No change	Same as B	Same as B
Air Quality	Criteria Pollutants Above Standards	None. (from 7 percent to 30 percent of NAAQS).	None.	Same as B slightly less dust.	Similar to B, but increased potential for dust with two impoundments in a high-wind area.
Social Economics	Population	No change (7,653 persons in the county).	456 new residents.	Same as B.	Same as B.
	Employment	No change (3,879 persons employed in the county).	45 additional people (a combination of permanent employees and contractors).	Same as B.	Same as B.
	Property Values	Would continue to increase.	Same as A, but some individual properties may loose value	Same as B, but delayed in time at Hertzler.	Similar to B. Any adverse effects are concentrated at the current mine site and new impoundment site.

Table S–2 Summary Comparison of Impacts by Alternative, Con't.

Issue or Resource	Indicator Units	Alternative			
		A — No Action	B — Proposed Action	C — Modified Expansion and Hertzler	D — Modified Expansion and East Side Impoundment
Social Economics	Proximity of Residences to Mine Facilities	22 within 1 mile and 109 within 5 miles of existing impoundment	Same number of residences in proximity to existing impoundment. 33 within 1 mile and 158 within 5 miles of Hertzler	Same as B, but delayed activity at Hertzler.	Same as A, but increased amount of activity at existing mine site.
	New Students	No change (957 students).	34 new elementary students.	Same as B.	Same as B.
Tailings Impoundment Stability	Exceed Safety Factor of 1.0	Yes	Yes	Yes	Yes
	Risk of Failure and Consequences	No change.	Somewhat higher risk than A due because two impoundments would exist. Only failure of existing impoundment could discharge tailings directly into the Stillwater River.	Higher risk than B because existing impoundment would be expanded above the original design elevation. Only failure of existing impoundment could discharge tailings directly into the Stillwater River.	Risk about the same as B because existing impoundment would be expanded above the original design elevation. Failure of existing impoundment and new impoundment could discharge tailings directly into the Stillwater River.
Visual Quality	Meets Visual Quality Objectives for National Forest System lands.	Yes, no change.	Yes	Yes	Yes
Noise	Increased Noise Levels.	Yes, if production increases.	Yes, slightly at new locations.	Less than B, but effects at Hertzler Ranch delayed.	No noise effects at Hertzler, increased noise at mine site and east side, which would affect a larger number of residences because more homes exist around the mine site.
Lights and Lighting	Changes in the amount of lighting.	No change.	Minor additions of shaded lights.	Same as B, but effects at Hertzler Ranch delayed.	No lights at Hertzler Ranch, but increased lights at mine site and east side
Transportation	ADTs on County Road 419.	803	906	Same as B.	Same as B.

Table S–2 Summary Comparison of Impacts by Alternative, Con't.

Issue or Resource	Indicator Units	Alternative: A — No Action	B — Proposed Action	C — Modified Expansion and Hertzler	D — Modified Expansion and East Side Impoundment
Reclamation Potential	Sufficient Topsoil for Reclamation	Yes, 4,000 cubic yards	Yes, 142,500 cubic yards	Same as B, but disturbance delayed up to 10 years.	Cubic yards would be different, source would be the same.
	Suitable Revegetation Plan	Yes	Yes	Same as B.	Same as B.
	Microclimate	High winds drive dust and blast revegetation.	Less winds to affect revegetation at Hertzler.	Same as B, but delayed revegetation due to construction delay.	Same as A, but two impoundments and revegetation efforts would be subject to high winds.
	Vegetation Disturbance (acres)				
	Currently-permitted disturb.	255	255	255	255
	Existing non-SMC disturb.[1]	0	172	172	84
	New SMC Disturbance	0	251	217[2]	1
	Total disturbance	255	678	644	340
Cultural Resources	Sites Affected	None	None	Same as B.	Same as B.

Note:
1. Existing non-SMC disturbance includes 80 acres of pastureland at Hertzler Ranch and portions of the east side where chrome tailings were previously deposited. Neither of these locations has a cover of native species.
2. Disturbance at Hertzler Ranch would be delayed up to 10 years relative to Alternative B.

Abbreviations in Table:

ADT	Average Daily Trips
APE	Area of Potential Effect
BMP	Best Management Practice
KOP	Key Observation Point
LAD	Land Application Disposal
T&E	Threatened and Endangered Species

Contents

Chapter 1.0 — Purpose and Need . . . . . 1 – 1
1.1 Purpose and Need . . . . . 1 – 1
1.1.1 Supply and Demand for Platinum/Palladium . . . . . 1 – 2
1.2 History of Project . . . . . 1 – 3
1.3 Decisions to be Made . . . . . 1 – 5
1.4 Agencies' Roles and Responsibilities . . . . . 1 – 6
1.4.1 Montana Department of Environmental Quality . . . . . 1 – 6
1.4.1.1 Montana Metal Mine Reclamation Act . . . . . 1 – 6
1.4.1.2 Montana Environmental Policy Act . . . . . 1 – 7
1.4.1.3 Water Quality Statutes . . . . . 1 – 8
1.4.1.4 Air Quality Statutes . . . . . 1 – 8
1.4.2 USDA Forest Service, Custer National Forest . . . . . 1 – 9
1.4.2.1 Custer National Forest Lands and Resource Management Plan . . . . . 1 – 9
1.4.2.2 Organic Administration Act of 1897 . . . . . 1 – 9
1.4.2.3 36 CFR 228, Subpart A — Locatable Minerals . . . . . 1 – 10
1.4.2.4 National Environmental Policy Act . . . . . 1 – 10
1.5 Permits and Approvals Required from Other Agencies . . . . . 1 – 10
1.6 MEPA/NEPA Process, including Tiering . . . . . 1 – 12
1.6.1 Identification of Related Environmental Documents . . . . . 1 – 12

Chapter 2.0 — Public Participation, Issue Identification, and Alternative Development . . . . . 2 – 1
2.1 Public Participation . . . . . 2 – 1
2.1.1 Scoping . . . . . 2 – 1
2.1.2 Review of Draft EIS . . . . . 2 – 2
2.2 Issue Identification and Issue Statements . . . . . 2 – 3
2.2.1 Issue Statements for Key Issues . . . . . 2 – 4
2.2.1.1 Water Quality and Quantity . . . . . 2 – 4
2.2.1.2 Wildlife . . . . . 2 – 4
2.2.1.3 Fisheries . . . . . 2 – 5
2.2.1.4 Air Quality . . . . . 2 – 5
2.2.1.5 Social/Economics . . . . . 2 – 6
2.2.1.6 Tailings Impoundment Stability . . . . . 2 – 6
2.2.1.7 Aesthetics . . . . . 2 – 6
2.2.1.8 Transportation . . . . . 2 – 6
2.2.1.9 Reclamation . . . . . 2 – 7
2.2.2 Issues Not Considered Further . . . . . 2 – 7
2.2.2.1 Human Health and Safety . . . . . 2 – 7
2.2.2.2 Utilities . . . . . 2 – 8
2.3 Process Used to Develop Alternatives . . . . . 2 – 8
2.4 Alternatives Descriptions . . . . . 2 – 9
2.4.1 Alternative A — No Action . . . . . 2 – 10
2.4.1.1 Waste Rock Production and Management . . . . . 2 – 11
2.4.1.2 Tailings Production and Management . . . . . 2 – 11
2.4.1.3 Water Management and Disposal . . . . . 2 – 14
2.4.1.4 Power Requirements . . . . . 2 – 16

Contents Con't

2.4.1.5 Roads and Traffic ..... 2 – 16
2.4.1.6 Workforce Requirements/Socioeconomics ..... 2 – 16
2.4.1.7 Monitoring ..... 2 – 16
2.4.1.8 Reclamation ..... 2 – 18
2.4.1.9 Bonding ..... 2 – 18
2.4.2 Alternative B — Proposed Action ..... 2 – 18
2.4.2.1 Waste Rock Production and Management ..... 2 – 21
2.4.2.2 Tailings Production and Management ..... 2 – 23
2.4.2.3 Water Management and Disposal ..... 2 – 29
2.4.2.4 Power Requirements ..... 2 – 31
2.4.2.5 Roads and Traffic ..... 2 – 31
2.4.2.6 Workforce Requirement/Socioeconomics ..... 2 – 32
2.4.2.7 Monitoring ..... 2 – 33
2.4.2.8 Reclamation ..... 2 – 35
2.4.2.9 Bonding ..... 2 – 37
2.4.3 Alternative C — Modified Centerline Expansion and Hertzler Tailings Impoundment ..... 2 – 38
2.4.3.1 Waste Rock Production and Management ..... 2 – 38
2.4.3.2 Tailings Production and Management ..... 2 – 41
2.4.3.3 Water Management and Disposal ..... 2 – 44
2.4.3.4 Power Requirements ..... 2 – 44
2.4.3.5 Roads and Traffic ..... 2 – 44
2.4.3.6 Workforce Requirements/Socioeconomics ..... 2 – 45
2.4.3.7 Monitoring ..... 2 – 45
2.4.3.8 Reclamation ..... 2 – 45
2.4.3.9 Bonding ..... 2 – 45
2.4.4 Alternative D — Modified Centerline Expansion and East Side Tailings Impoundment ..... 2 – 46
2.4.4.1 Waste Rock Production and Management ..... 2 – 46
2.4.4.2 Tailings Production and Management ..... 2 – 46
2.4.4.3 Water Management and Disposal ..... 2 – 51
2.4.4.4 Power Requirements ..... 2 – 51
2.4.4.5 Roads and Traffic ..... 2 – 51
2.4.4.6 Workforce Requirements/Socioeconomics ..... 2 – 52
2.4.4.7 Monitoring ..... 2 – 52
2.4.4.8 Reclamation ..... 2 – 52
2.4.4.9 Bonding ..... 2 – 52
2.4.5 Agency Mitigations ..... 2 – 53
2.5 Alternatives Considered but Eliminated (& rationale) ..... 2 – 57
2.5.1 1985 Tailings Facilities Sites ..... 2 – 58
2.5.2 1997 Alternatives Considered but Eliminated ..... 2 – 63
2.6 Reasonably Foreseeable Projects ..... 2 – 76
2.6.1 Custer National Forest Projects ..... 2 – 77
2.6.2 Other Projects ..... 2 – 77
2.7 Projects Not Considered Reasonably Foreseeable at This Time ..... 2 – 79

Contents Con't

2.7.1 Future Mine Expansion . . . . . 2 – 79
2.7.2 Stillwater River Corridor Zoning Petition . . . . . 2 – 80
2.8 Summary of Alternatives and Environmental Consequences . . . . . 2 – 80
2.9 Preferred Alternative . . . . . 2 – 81

Chapter 3.0 — Affected Environment . . . . . 3 – 1
3.1 Water Resources . . . . . 3 – 1
3.1.1 Surface Water Quantity . . . . . 3 – 1
3.1.1.1 Stillwater Mine Site . . . . . 3 – 2
3.1.1.2 Stratton Ranch . . . . . 3 – 7
3.1.1.3 Hertzler Ranch . . . . . 3 – 7
3.1.2 Surface Water Quality . . . . . 3 – 8
3.1.2.1 Stillwater Mine Site . . . . . 3 – 8
3.1.2.2 Stratton Ranch . . . . . 3 – 13
3.1.2.3 Hertzler Ranch . . . . . 3 – 13
3.1.3 Groundwater . . . . . 3 – 14
3.1.3.1 Stillwater Mine Site . . . . . 3 – 14
3.1.3.2 Stratton Ranch . . . . . 3 – 22
3.1.3.3 Hertzler Ranch . . . . . 3 – 23
3.1.4 Wetlands . . . . . 3 – 26
3.2 Wildlife . . . . . 3 – 27
3.2.1 High-Interest Species . . . . . 3 – 27
3.2.1.1 . . . . . 3 – 27
3.2.1.2 Stratton Ranch . . . . . 3 – 31
3.2.1.3 Hertzler Ranch . . . . . 3 – 31
3.2.2 Threatened, Endangered, and Sensitive Species . . . . . 3 – 32
3.2.2.1 Bald Eagle (Threatened Designation) . . . . . 3 – 32
3.2.2.2 Peregrine Falcon (Threatened Designation) . . . . . 3 – 33
3.2.2.3 Black-footed Ferret (Endangered Designation) . . . . . 3 – 33
3.2.2.4 Grizzly Bear (Threatened Designation) . . . . . 3 – 33
3.2.2.5 Sensitive Species . . . . . 3 – 34
3.3 Fisheries . . . . . 3 – 34
3.3.1 Stillwater Mine Site, Stratton and Hertzler Ranches . . . . . 3 – 34
3.3.1.1 Fish . . . . . 3 – 35
3.3.1.2 Aquatic Macroinvertebrates . . . . . 3 – 36
3.3.1.3 Periphyton . . . . . 3 – 38
3.4 Air Quality . . . . . 3 – 39
3.5 Socioeconomics . . . . . 3 – 40
3.5.1 Population . . . . . 3 – 40
3.5.2 Labor and Employment . . . . . 3 – 41
3.5.2.1 Civilian Labor Force . . . . . 3 – 41
3.5.2.2 Stillwater Mine Employment . . . . . 3 – 42
3.5.3 Local Economy . . . . . 3 – 42
3.5.4 Property Tax Base . . . . . 3 – 43
3.5.5 Property Values . . . . . 3 – 44

Contents Con't

3.5.6 Housing ..... 3 – 45
3.5.7 Community Services ..... 3 – 46
3.5.7.1 Hard Rock Impact Plan ..... 3 – 46
3.5.7.2 Water Supply ..... 3 – 47
3.5.7.3 Sewer Systems ..... 3 – 47
3.5.7.4 Solid Waste ..... 3 – 48
3.5.7.5 Educational System ..... 3 – 48
3.5.7.6 Hospitals and Clinics ..... 3 – 48
3.5.7.7 Fire Protection ..... 3 – 49
3.5.7.8 Law Enforcement ..... 3 – 50
3.6 Tailings Impoundment Stability ..... 3 – 50
3.6.1 Area Geology and Seismicity ..... 3 – 50
3.6.1.1 Stillwater Mine Site ..... 3 – 50
3.6.1.2 Stratton Ranch Area ..... 3 – 53
3.6.1.3 Hertzler Ranch Area ..... 3 – 53
3.7 Aesthetics ..... 3 – 54
3.7.1 Visual Resources ..... 3 – 54
3.7.1.1 Stillwater Mine Site ..... 3 – 57
3.7.1.2 Stratton Ranch ..... 3 – 57
3.7.1.3 Hertzler Ranch ..... 3 – 58
3.7.2 Noise ..... 3 – 58
3.7.2.1 Stillwater Mine Site ..... 3 – 58
3.7.2.2 Hertzler Ranch ..... 3 – 59
3.8 Transportation ..... 3 – 59
3.9 Reclamation ..... 3 – 61
3.9.1 Soils ..... 3 – 61
3.9.1.1 Stillwater Mine Site ..... 3 – 61
3.9.1.2 Stratton Ranch ..... 3 – 61
3.9.1.3 Hertzler Ranch ..... 3 – 61
3.9.2 Vegetation ..... 3 – 63
3.9.2.1 Noxious Weeds ..... 3 – 63
3.9.2.2 Stillwater Mine Site ..... 3 – 64
3.9.2.3 Hertzler Ranch ..... 3 – 64
3.9.2.4 Pipeline Route ..... 3 – 65
3.10 Cultural Resources ..... 3 – 65
3.10.1 Overview ..... 3 – 65
3.10.2 Previous Investigations ..... 3 – 67
3.10.3 Criteria for Evaluation ..... 3 – 68
3.10.4 Known Resources ..... 3 – 69
3.10.5 Ethnography ..... 3 – 69

Chapter 4.0 — Environmental Consequences ..... 4 – 1
4.1 Water Quality and Quantity ..... 4 – 2
4.1.1 Direct and Indirect Effects ..... 4 – 2
4.1.1.1 Alternative A — No Action ..... 4 – 2

Contents Con't

4.1.1.2 Alternative B — Proposed Action . . . . . 4 – 2
4.1.1.3 Alternative C — Modified Centerline Expansion and Hertzler Tailings Impoundment . . . . . 4 – 10
4.1.1.4 Alternative D — Modified Centerline Expansion and East Side Tailings Impoundment . . . . . 4 – 12
4.1.2 Wetlands . . . . . 4 – 14
4.1.2.1 Direct and Indirect Effects . . . . . 4 – 14
4.1.3 Cumulative Impacts to Water Resources . . . . . 4 – 15
4.1.4 Water Quality and Quantity Mitigation . . . . . 4 – 16
4.2 Effects on Wildlife . . . . . 4 – 18
4.2.1 Direct and Indirect Effects . . . . . 4 – 18
4.2.1.1 Alternative A — No Action . . . . . 4 – 18
4.2.1.2 Alternative B — Proposed Action . . . . . 4 – 18
4.2.1.3 Alternative C — Modified Centerline Expansion and Hertzler Tailings Impoundment . . . . . 4 – 22
4.2.1.4 Alternative D - Modified Centerline Expansion and East Side Tailings Impoundment . . . . . 4 – 23
4.2.2 Cumulative Impacts on Wildlife Species . . . . . 4 – 24
4.2.3 Mitigation for Wildlife . . . . . 4 – 25
4.3 Effects on Fisheries . . . . . 4 – 25
4.3.1 Direct and Indirect Effects . . . . . 4 – 25
4.3.1.1 Alternative A — No Action . . . . . 4 – 25
4.3.1.2 Alternative B — Proposed Action . . . . . 4 – 26
4.3.1.3 Alternative C — Modified Centerline Expansion and Hertzler Tailings Impoundment . . . . . 4 – 28
4.3.1.4 Alternative D — Modified Centerline Expansion and East Side Tailings Impoundment . . . . . 4 – 29
4.3.2 Cumulative Effects on Fisheries . . . . . 4 – 29
4.3.3 Mitigation . . . . . 4 – 30
4.4 Air Quality Effects . . . . . 4 – 30
4.4.1 Direct and Indirect Effects . . . . . 4 – 30
4.4.1.1 Alternative A — No Action . . . . . 4 – 30
4.4.1.2 Alternative B — Proposed Action . . . . . 4 – 30
4.4.1.3 Alternative C — Modified Centerline Expansion and Hertzler Tailings Impoundment . . . . . 4 – 32
4.4.1.4 Alternative D — Modified Centerline Expansion and East Side Tailings Impoundment . . . . . 4 – 33
4.4.2 Cumulative Effects on Air Quality . . . . . 4 – 33
4.4.3 Mitigation Measures . . . . . 4 – 34
4.5 Social and Economic Effects . . . . . 4 – 34
4.5.1 Direct and Indirect Effects . . . . . 4 – 34
4.5.1.1 Alternative A — No Action . . . . . 4 – 34
4.5.1.2 All Action Alternatives — Alternatives B, C, and D . . . . . 4 – 34
4.5.2 Cumulative Effects on Socioeconomics . . . . . 4 – 43
4.6 Tailings Impoundment Stability . . . . . 4 – 43

Contents Con't

4.6.1 Direct and Indirect Effects ..... 4 – 43
4.6.1.1 Alternative A — No Action ..... 4 – 43
4.6.1.2 Alternative B — Proposed Action ..... 4 – 44
4.6.1.3 Alternative C — Modified Centerline Expansion and Hertzler Tailings Impoundment ..... 4 – 45
4.6.1.4 Alternative D — Modified Centerline Expansion and East Side Tailings Impoundment ..... 4 – 46
4.6.2 Cumulative Effects ..... 4 – 48
4.6.3 Mitigation Measures ..... 4 – 48
4.7 Effects on Aesthetics ..... 4 – 49
4.7.1 Visual Resources ..... 4 – 49
4.7.1.1 Direct and Indirect Effects ..... 4 – 49
4.7.1.2 Cumulative Effects ..... 4 – 66
4.7.1.3 Mitigation Measures ..... 4 – 66
4.7.2 Noise Effects ..... 4 – 67
4.7.2.1 Direct and Indirect Effects ..... 4 – 67
4.7.2.2 Cumulative Noise Effects ..... 4 – 70
4.7.2.3 Mitigation Measures ..... 4 – 70
4.7.3 Lights and Lighting Effects ..... 4 – 70
4.7.3.1 Direct and Indirect Effects ..... 4 – 70
4.7.3.2 Cumulative Effects ..... 4 – 71
4.7.3.3 Mitigation Measures ..... 4 – 71
4.8 Effects on Transportation ..... 4 – 71
4.8.1 Direct and Indirect Effects ..... 4 – 71
4.8.1.1 Alternative A — No Action ..... 4 – 71
4.8.1.2 Alternative B — Proposed Action ..... 4 – 72
4.8.1.3 Alternative C — Modified Centerline Expansion and Hertzler Tailings Impoundment ..... 4 – 74
4.8.1.4 Alternative D — Modified Centerline Expansion and East Side Tailings Impoundment ..... 4 – 74
4.8.2 Cumulative Effects ..... 4 – 74
4.8.3 Mitigation Measures ..... 4 – 74
4.9 Effects on Reclamation Potential ..... 4 – 75
4.9.1 Soils ..... 4 – 75
4.9.1.1 Direct and Indirect Effects ..... 4 – 75
4.9.1.2 Cumulative Impacts ..... 4 – 77
4.9.2 Vegetation ..... 4 – 79
4.9.2.1 Direct and Indirect Effects ..... 4 – 79
4.9.2.2 Cumulative Effects on Vegetation ..... 4 – 83
4.9.3 Reclamation Mitigation ..... 4 – 84
4.10 Effects on Cultural Resources ..... 4 – 87
4.10.1 Direct and Indirect Effects ..... 4 – 87
4.10.1.1 Alternative A — No Action ..... 4 – 87
4.10.1.2 Alternative B — Proposed Action ..... 4 – 87

Contents Con't

4.10.1.3 Alternative C — Modified Centerline Expansion and Hertzler Tailings Impoundment . . . . . 4 – 89
4.10.1.4 Alternative D — Modified Centerline Expansion and East Side Tailings Impoundment . . . . . 4 – 89
4.10.2 Cumulative Effects . . . . . 4 – 89
4.10.3 Mitigation Measures . . . . . 4 – 90
4.11 Unavoidable Adverse Effects . . . . . 4 – 90
4.12 Relationship Between Short-term Uses of Man's Environment and the Maintenance and Enhancement of Long-term Productivity . . . . . 4 – 91
4.13 Irreversible and Irretrievable Losses . . . . . 4 – 92
4.14 Effects of Environmental Justice in Minority Populations and Low-Income Populations . . . . . 4 – 93
4.15 Evaluation of Restrictions on Private Property . . . . . 4 – 93
4.15.1 Alternative A — No Action . . . . . 4 – 94
4.15.2 Alternative B — Proposed Action . . . . . 4 – 95
4.15.3 Alternative C — Modified Centerline Expansion and Hertzler Tailings Impoundment . . . . . 4 – 95
4.15.4 Alternative D — Modified Centerline Expansion and East Side Tailings Impoundment . . . . . 4 – 95
4.15.5 Mitigation Measures . . . . . 4 – 96

Chapter 5.0 — Consultation with Others . . . . . 5 – 1

Chapter 6.0 — Preparers and Contributors . . . . . 6 – 1

Chapter 7.0 — Distribution and Review of the Final EIS . . . . . 7 – 1

Chapter 8.0 — Glossary . . . . . 8 – 1

Chapter 9.0 — References Cited . . . . . 9 – 1

Index . . . . . I – 1

Tables

Table 1–1 Permits, Licenses, and Approvals Required for the Stillwater Amendment 11
Table 2–1 Key Issues Addressed by the Alternatives Considered in Detail 10
Table 2–2 Results of Reevaluation of 1985 Tailings Facilities Sites 59
Table 2–3 Comparison of Alternatives Considered in Detail 82
Table 2–4 Summary Comparison of Impacts by Alternative 83
Table 3–1 Water Quality of Surface Water Sites near the Stillwater Mine 10
Table 3–2 Acid-Base Evaluation Waste: Rock and Tailings (March 22, 1996) 13
Table 3–3 Surface Water Discharge Water Quality 16
Table 3–4 Alluvial Monitoring Wells Associated with Percolation Ponds 18
Table 3–5 Alluvial Monitoring Wells Downgradient of the Tailings Impoundment 20
Table 3–6 Alluvial Sites Associated with Land Application Disposal (LAD) 21
Table 3–7 Macroinvertebrate Bioassessment Metrics for Stations in the Stillwater River 37
Table 3–8 Stillwater Mine and Hertzler Ranch PM_{10} Data[1] 40
Table 3–9 Employment Distribution by Industry, Stillwater County, 1996 41
Table 3–10 Labor Income by Major Industry, 1996 43
Table 3–11 Farm Statistics, 1987 and 1992 43
Table 3–12 Distribution of Elementary and High School Students, Stillwater County 49
Table 3–14 Average Daily Totals (ADT) of Traffic, 1994–1996 60
Table 3–15 Vegetation Categories and Types in the Stillwater Mine Project Area 63
Table 3–16 Known Cultural Resources near the Proposed Pipeline Corridor and Tailings Impoundment 70
Table 4–1 SMC PM_{10} Annual Emission for Maximum Operating Scenario 32
Table 4–2 SMC Gaseous Annual Emissions for Maximum Operating Scenario 33
Table 4–3 SMC's Population Effects 35
Table 4–4 SMC Employment 36
Table 4–5 Distribution of Impact Employees and Population 38
Table 4–6 Distribution of SMC Elementary and High School Students 40
Table 4–7 Quantity of Soils for East Side Waste Rock Storage Site Reclamation 76
Table 4–8 Soil and Embankment Fill Quantities for the Hertzler Tailings Impoundment 78
Table 4–9 Significant Cultural Resources Within the Project Area 87

Figures

Figure 1–1 Location of Stillwater Mine and Hertzler Ranch 3
Figure 2–1 Waste Rock Storage Areas 12
Figure 2–2 Location of Primary Facilities Comprising the Proposed Action 19
Figure 2–3 Plan and Section of the East Side Waste Storage Site 22
Figure 2–4 Reclamation of the East Side Waste Storage Site 24
Figure 2–5 Hertzler Tailings Impoundment Typical Cross Section of the Embankment 26
Figure 2–6 Hertzler Tailings Impoundment Plan 28
Figure 2–7 Location of Primary Facilities Comprising Alternative C — Modified Centerline Expansion and Hertzler Tailings Impoundment 39
Figure 2–8 Modified Centerline Expansion of the Existing Tailings Impoundment 42
Figure 2–9 Plan and Section of the Hertzler Tailings Impoundment Under Alternative C 43
Figure 2–10 Location of Primary Facilities Comprising Alternative D — Modified Centerline Expansion and East Side Tailings Impoundment 47
Figure 2–11 Plan and Section of the East SideTailings Impoundment 50
Figure 2–12 Location of Reasonably Foreseeable Projects 78
Figure 3–1 Water Resources Present in the Project Area (Part 1) 3
Figure 3–2 Water Resources Present in the Project Area (Part 2) 5
Figure 3–3 Deer Winter Range Complex in the Upper Stillwater Valley 29
Figure 3–4 Geologic Faults in and Near the Project Area 51
Figure 3–5 Geology of Hertzler Ranch 55
Figure 3–6 Geological Cross-Sections for Hertzler Ranch 56
Figure 3–7 Distribution of Soils at Hertzler Ranch 62
Figure 4–1 Location of Key Observation Points for Visual Analysis 47
Figure 4–2a View to the east from KOP 1 west of County Road 419, Fall 1997. 51
Figure 4–2b Simulation of East Side Waste Rock Facility (Alternatives B and C) from KOP 1 after reclamation, 2027. 51
Figure 4–2c Simulation of East Side Tailings Impoundment (Alternative D) from KOP 1 after reclamation, 2027. 51
Figure 4–3a View to the south from KOP 2 in Cathedral Mountain Ranch, Fall 1997. 53
Figure 4–3b Simulation of LAD at Stratton Ranch and East Side Waste Rock Area (Alternatives B and C) from KOP 2 after reclamation, 2027. 53
Figure 4–3c Simulation of LAD at Stratton Ranch and East Side Tailings Impoundment (Alternative D) from KOP 2 after reclamation, 2027. 53
Figure 4–4a View to the south from KOP 3 located 1.2 miles south of Nye, Fall 1997. 55
Figure 4–4b Simulation of East Side Waste Rock Area (Alternatives B and C) from KOP 3 after Reclamation, 2027. 55
Figure 4–5a View to the south from KOP 4 located 1.6 miles south of Moraine Fishing Access, Fall 1997. 59
Figure 4–5b Simulation of the Proposed Hertzler Tailings Impoundment (Alternative B) from KOP 4 after reclamation, 2027. 59
Figure 4–6a View to the northwest from KOP 5 located 4 miles east of Nye, Fall 1997. 61
Figure 4–6b Simulation of Hertzler Tailings Impoundment (Alternative B) from KOP 5 after reclamation, 2027. (Under Alternative C, the impoundment would not be discernable). 61

Figures Con't

Figure 4–7a View to the southwest from KOP 6 located 0.3 mile south of Moraine Fishing Access, Fall 1997. 63

Figure 4–7b Cross Section of Terrain Between KOP 6 and Hertzler Ranch showing the intervening topography. 63

Figure 4–8 Hertzler Tailings Impoundment Modified Cross Section of the Embankment 68

Appendices

Appendix A Synopses of Environmental Documents
Appendix B Response to Draft Environmental Impact Statement
Appendix C Previously-required Mitigations
Appendix D Water Balance Calculations
Appendix E Preliminary Determination of the Air Quality Permit Application
Appendix F Biological Assessment
Appendix G Biological Evaluation
Appendix H Alternatives Eliminated from Detailed Consideration Background Report

Chapter 1.0 — Purpose and Need

Chapter 1.0 — Purpose and Need ..... 1 – 1
1.1 Purpose and Need ..... 1 – 1
1.2 History of Project ..... 1 – 2
1.3 Decisions to be Made ..... 1 – 5
1.4 Agencies' Roles and Responsibilities ..... 1 – 6
1.5 Permits and Approvals Required from Other Agencies ..... 1 – 10
1.6 MEPA/NEPA Process, including Tiering ..... 1 – 12

Chapter 1.0 — Purpose and Need

On April 29, 1996, Stillwater Mining Company (SMC) submitted an application to the Montana Department of Environmental Quality (DEQ) and the Custer National Forest (CNF) to amend its operating permit (#00118). In its application, SMC proposes to change its mine waste management operation. The changes include:

- constructing and operating a new tailings impoundment about 7.8 miles northeast of the mine site, which also is 2 miles northeast of Nye, Montana;
- installing a system of pipelines along Stillwater County roads 419 and 420 connecting the new tailings impoundment to the mine's mill and tailing reclaim circuit;
- expanding the waste rock storage area on the east side of the Stillwater River across from the mine;
- relocating the Land Application Disposal system (LAD) from the east side of the Stillwater River to the Stratton Ranch (1.5 miles northeast of the mine along Stillwater County Road 419), Hertzler Ranch, or both; and
- removing the 2,000 tons per day (tpd) restriction on ore production. (Having no restrictions on processing allows SMC to expand its ore production to match the capabilities of mining and milling equipment. The average rate is expected to be around 3,000 tpd, but it may peak as high as 5,000 tpd occasionally.)

The new tailings impoundment would be on the former Hertzler Ranch, which is owned by SMC. The pipelines would be located in the right-of-way of the county roads and the waste rock storage area would be primarily on patented mining claims. With implementation of the amendment, the areal extent of new disturbance created by SMC's activities would increase by 251 acres and the permit area would increase by 1,112 acres. If the amendment is approved, the permit area would encompass a total of 2,452 acres and permitted disturbance would increase from 255 acres to 678 acres.

1.1 Purpose and Need

The purpose of SMC's proposed action is to permit a flexible and integrated waste management plan to provide for the long-term management and disposal of tailings, waste rock, and other wastes generated by the Stillwater Mine. SMC needs to implement the proposed action because its current tailings impoundment will reach its capacity in 2003. The proposed action would increase SMC's capacity for storing tailings and waste rock by almost 15 million tons and 17.5 million tons, respectively, and would allow the Stillwater Mine to operate for

about another 30 years at an average production rate of 3,000 tons per day or as long as 50 years at an average production rate of 2,000 tons per day. The proposed action also would give SMC some flexibility in its operations to respond to changing market values for its product, which it does not have currently (this flexibility is discussed in more detail in the description of the Proposed Action Alternative presented in **Chapter 2**).

1.1.1 Supply and Demand for Platinum/Palladium

Platinum and palladium (platinum group metals) are important to industrial and defense technology. Additionally, the United States Government has classified them as *Strategic Metals*. Platinum is used primarily as a catalyst in pollution control devices. Palladium is used primarily in space age electronics micro-circuitry, as a catalyst in the chemical industry, and in dental alloys.

Demand for platinum and palladium is growing. Platinum has a worldwide demand of about 4.7 million troy ounces annually (Engineering and Mining Journal 1996). As the European countries implement the use of automotive catalytic converters, the demand for platinum is expected to increase substantially. Worldwide demand for palladium is about 5.9 million troy ounces annually. The U.S. demand for both metals is about one-half of the total worldwide demand.

Historically, the Republic of South Africa and Russia have supplied the worldwide demand for platinum and palladium. The Stillwater Complex, which is the primary source of platinum group metals (PGM) ore at the Stillwater Mine, holds the only significant primary source of platinum and palladium outside South Africa and Russia. SMC's mining claims extend for more than 27 miles along the Stillwater Complex. As of December 31, 1997, proven and probable reserves of ore at the Stillwater Mine were estimated at almost 18 million tons (Gilbert 1998, pers. comm.). Data also suggest at least another 19 million tons of mineable ore exist at the Stillwater Mine (Gilbert 1998, pers. comm.).

Currently, the Stillwater Mine can supply about five percent of World's annual demand for PGM, but only a portion of the U.S. demand (about 6 percent of the total amount of PGM the U.S. imported in 1997). Sources of the platinum imported during 1997 were South Africa (60 percent), Russia (10 percent), the United Kingdom (10 percent), Germany (5 percent) and other countries (15 percent). Sources of imported palladium in 1997 were Russia (47 percent), South Africa (22 percent), the United Kingdom (10 percent), Belgium (8 percent), and other countries (13 percent). The current political situations in South Africa and Russia and the increasing demand for these strategic metals suggest demand for Stillwater ore may increase.

1.2 History of Project

SMC operates an underground platinum/palladium mine in Stillwater County, Montana (**Figure 1–1**). Current permits allow SMC to produce ore at an average rate of 730,000 tons per year (tpy) or 2,000 tpd. At the mine's mill, SMC upgrades the ore by crushing, grinding, floating, and drying to a concentrate. This concentrate is then shipped by truck to a smelter and base metal refinery (BMR) in Columbus, Montana, for further upgrading. From the BMR, SMC ships the BMR product to Belgium for final refining.

Every 100 tons of ore fed to the mill generates 99 tons of tailings. These tailings are pumped from the mill to an underground sand plant where the sand component is separated from the slimes (the smallest fraction of tailings). About 58 percent of the tailings are used as backfill in mined out stopes. The slimes and whatever sands cannot be used as backfill are pumped to the tailings impoundment. This impoundment was designed to hold 3.5 million tons of tails when lined to the 5111-foot level. At present rates of production, the impoundment will reach its design capacity in 2003.

SMC's original plan of operations was approved after completion of a Final Environmental Impact Statement (final EIS) in 1985. The current proposal, if approved, would be the tenth amendment to the original plan of operations and permit. The previous amendments are:

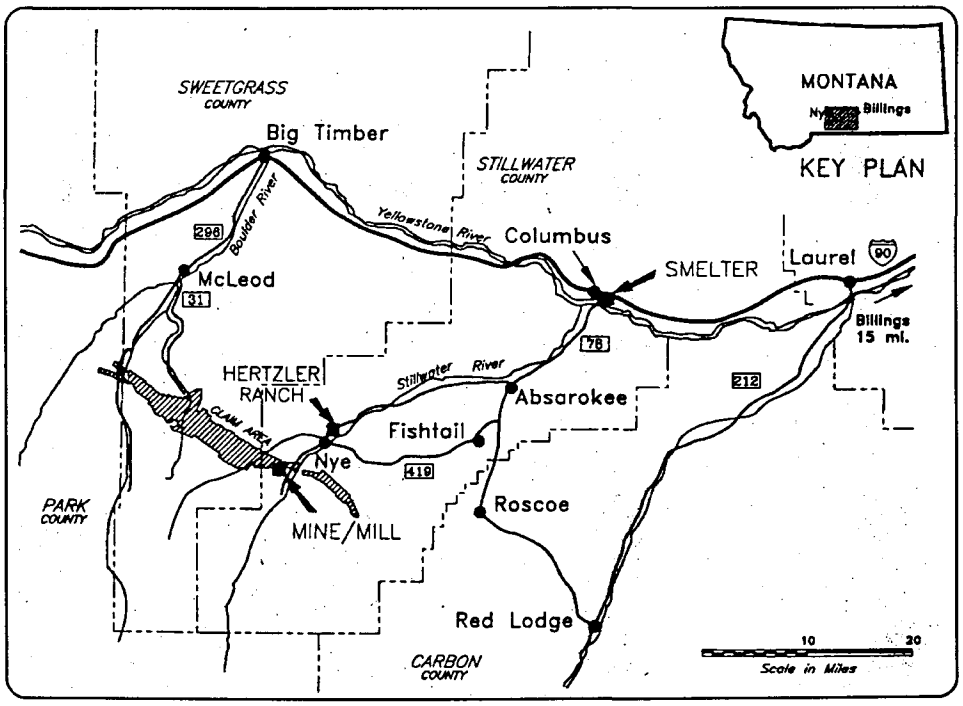


Figure 1–1 Location of Stillwater Mine and Hertzler Ranch

001 — Approved and permitted June 30, 1986. This amendment relocated mine and mill facilities. No increase in permit area or disturbed area resulted.

002 — Approved and permitted September 8, 1986. This amendment allowed excavation of a sand borrow area in the existing permit area. The disturbed area has been reclaimed.

003 — Approved and permitted January 8, 1987. This amendment allowed excavation of a second sand borrow area within the permit area and the disturbance has been reclaimed.

004 — Approved and permitted February 24, 1987. This amendment relocated the southern portion of the tailings impoundment toe dike to higher ground along Mountain View Creek on previously-disturbed land within the permit area.

005 — Approved and permitted March 2, 1989. This amendment was the first major amendment since the original permit was issued. It increased the permit area to 1,158 acres and permitted mining on the east side of the Stillwater River. The total allowable disturbance was increased by 72 acres.

006 — Approved and permitted July 21, 1989. This amendment allowed construction of a temporary sand slurry pipeline connecting the east and west sides of the mine area. No increase in permit area or disturbed area resulted.

007 — Approved and permitted November 15, 1990. This amendment allowed construction of the three Stillwater Valley Ranch percolation ponds and four monitoring wells. The permit area was increased 27 acres. The total allowable disturbance was increased by 7 acres.

008 — Approved and permitted on September 23, 1992. This amendment allowed production to increase from 1,000 tpd to 2,000 tpd. It also approved some expansion of support facilities, such as waste dumps, the mill, and the tailings impoundment.

009 — Approved and permitted February 28, 1996. This amendment allowed the construction of an underground connection between the east and west mining areas. No increase in permit area or disturbed area resulted.

Additionally, a minor amendment was approved to relocate the 5900 adit southward onto private land in order to reduce the visual effects due to

development. The permit area was increased 48 acres and the total allowable disturbance was increased by 2 acres.

Currently, the total permit area is 1,340 acres and 255 acres are permitted for disturbance. However, only 120 acres have been disturbed by mining and exploration.

1.3 Decisions to be Made

The Director of the DEQ and the Supervisor of the CNF must make a decision on SMC's request to amend its permit. This decision will be documented in a Record of Decision (ROD). The process will lead to one of the following possible decisions:

1) approval of the proposed action amending the existing permit/plan of operations,

2) approval of an agency alternative to the proposed amendment,

3) approval of either the Proposed Action or an agency alternative subject to identified mitigation measures, or

4) denial of the proposed amendment (DEQ) or request for revision (CNF).

   - DEQ can deny the proposed amendment. The authority for denial originates from the Montana Metal Mine Reclamation Act (MMRA) and Montana's water quality and air quality statutes. In addition, since 1982 DEQ and the courts have interpreted the Montana Environmental Policy Act (MEPA) as supplementing the basis upon which an operating permit under MMRA can be conditioned or denied. This means that DEQ may also deny or modify the mine operating permit under MMRA in order to avoid or mitigate an impact that would significantly degrade the human environment. The operator then has the option of revising the plan.

   - The Forest Service is not granted the authority to deny a Plan of Operation or an amendment to a Plan of Operation (36 CFR 228, Subpart A). This finding is based on numerous court cases. If a proposed Plan of Operation or amendment to a Plan of Operation (amendment) is found to conflict with regulation, policy, or federal law, the Forest Service must notify the operator or claimant that a revision of the proposed Plan of Operation or amendment is required. The operator or claimant then has the option to either modify the Plan

of Operation or amendment and resubmit it for approval or withdraw the Plan of Operation or amendment.

The proposal or an agency alternative, if approved, must comply with all applicable federal and state air and water quality laws and regulations.

1.4 Agencies' Roles and Responsibilities

The DEQ and Forest Service are the lead agencies for this Environmental Impact Statement (EIS). As discussed above, the Director of the DEQ and the Supervisor of the CNF are the officials responsible for making a decision on SMC's proposed amendment. A December 11, 1989, Memorandum of Understanding (MOU) between the State of Montana and the USDA Forest Service provides for the preparation of joint environmental analyses and the sharing of information, personnel, and funds. Each agency's role and responsibilities are described below.

1.4.1 Montana Department of Environmental Quality

DEQ oversees mining within the State of Montana. The DEQ's responsibilities originate from several acts and their implementing regulations. They are the Montana Metal Mine Reclamation Act (MMRA), Montana Environmental Policy Act (MEPA), Public Water Supply Act, Air Quality Act, and Water Quality Act (WQA). These are summarized below.

1.4.1.1 Montana Metal Mine Reclamation Act

DEQ administers the MMRA, under which SMC has applied for an amendment to its operating permit (#00118). The MMRA's purpose is to ensure the usefulness, productivity, and scenic values of all lands and surface waters involved in mining and exploration receive the greatest reasonable degree of protection and the lands are reclaimed to beneficial uses. The act and its rules set forth the steps to be taken in the issuance of an operating permit for and the reclamation of the applicant's proposed mine expansion.

A finding that the mining or reclamation plans would violate laws administered by the DEQ would be grounds for DEQ to deny the permit amendment. A permit also may be denied if a person or any firm or business association of which that person was a principal or controlling member has forfeited a bond or failed to reclaim an operation within two years after completion or abandonment of operations on any segment of a permit area, unless otherwise specified by the DEQ. SMC has not forfeited any bonds under the MMRA and has not failed in its reclamation obligations.

The DEQ also determines reclamation bonding under MMRA. Reclamation bonds are determined by computing costs to the State of Montana and CNF for reclaiming a site should the operator default. The State of Montana is required to review the amounts of bonds for all active and permitted mines at least every five years. If a bond is determined to be insufficient, the company is required to submit the additional amount. SMC's current bond for the Stillwater Mine is $3,174,000.

If this amendment is approved, the additional bond would be calculated using the specifications, stipulations, and mitigation measures of the approved amendment. The bond would include such costs as long-term maintenance of management practices, such as percolation ponds and diversion ditches, demolition of buildings and other structures, earth movement and soil replacement, seedbed preparation and revegetation. Bond must be submitted before the proposed amendment could be permitted.

A newly-approved hardrock operating permit or revisions to an approved permit cannot be implemented until several other associated permits and plans have been approved. This includes any new or revised water discharge or air quality permits regulated by DEQ and other permits or approvals required by other state or federal agencies, such as a 404 dredge and fill permit from the U.S. Army Corps of Engineers and a revised Hard Rock Impact Plan that has been approved by the Hard Rock Impact Board and the affected local governments.[1]

1.4.1.2 Montana Environmental Policy Act

Procedures governing state decision-making processes on state, federal, and private lands in Montana are defined in administrative rules implementing MEPA. If any action taken by a state agency may "significantly affect the quality of the human environment," this law requires the preparation of an EIS. The DEQ has determined that an EIS is appropriate for this project. This EIS has several purposes:

- It serves to ensure the agency uses the natural and social sciences and environmental design arts in planning and decision-making;
- It assists in the evaluation of reasonable alternatives and the development of conditions, stipulations, or modifications to be made part of a proposed action;

[1] *The proposed action triggers a revision in SMC's Hard Rock Impact Plan because the proposed employment level of 700 workers would exceed 15 percent of the employment level of 525 workers projected in its 1988 plan amendment.*

- It ensures the fullest appropriate opportunity for public review and comment on proposed actions, including alternatives and planned mitigation; and

- It examines and documents the effects of a proposed action on the quality of the human environment and provides the basis for public review and comment.

1.4.1.3 Water Quality Statutes

The DEQ is responsible for administering several water quality statutes, including the Public Water Supply Act and the WQA. The DEQ also administers several sections of the federal Clean Water Act pursuant to an agreement between the State of Montana and the Environmental Protection Agency (EPA). The State of Montana, through the DEQ, has been delegated authority for administering the Nonpoint Source Pollution Program, National Pollution Discharge Elimination System (NPDES), and Water Quality Standards.

The WQA provides a regulatory framework for protecting, maintaining, and improving the quality of water for beneficial uses. Pursuant to the WQA, the DEQ has developed water quality classifications and standards and a permit system to control discharges into state water. Mining operations must comply with Montana's regulations and standards for surface and ground waters. SMC currently holds a Montana Pollution Discharge Elimination System (MPDES) permit (MT–0024716) for discharge of excess adit water into the Stillwater River. This permit was revised on July 6, 1998 as part of the required 5-year permit review/renewal process.

DEQ also administers two other water-related permits SMC will need to obtain for the proposed project. They include the storm water discharge general permit and short-term exemption from Montana's surface water quality standards (3A authorization). Together, these permits will protect state waters from degradation associated with the construction of components of SMC's proposed project.

1.4.1.4 Air Quality Statutes

DEQ administers the Clean Air Act of Montana. A facility must obtain an air quality permit prior to construction or change in operation unless a permit is not required pursuant to Administrative Rules of Montana (ARM) 17.8.705. The owner or operator of a new or altered source for which an air quality permit is required shall install on the new or altered source the maximum air pollution control capability that is technically practicable and economically feasible, except that Best Available Control Technology (BACT) shall apply. The applicant must also demonstrate that the project would not violate Montana or Federal Ambient Air Quality Standards.

SMC operates the Stillwater Mine under an air quality permit issued by the State of Montana on April 17, 1997 (Air Quality Permit #2459–07). This permit limits SMC's mining and processing of ore to 730,000 tons per year and a maximum of 3,500 tons per day. Currently, SMC has applied for an alteration to its permit that would increase the rate of mining and processing of ore to 1,825,000 tons per year and a maximum of 5,000 tons per day (see **Appendix E**).

1.4.2 USDA Forest Service, Custer National Forest

The CNF administers SMC's current plan of operations, which correlates to the State's operating permit, and any amendments or revisions to the approved plan under the Forest Service's authority to regulate all activities and uses of National Forest System lands. Additionally, the Forest Service's policy is to encourage the exploration, development, and production of mineral resources on National Forest System lands open to mineral entry as directed by Congress via the 1970 Minerals Policy Act. The following sections summarize the primary direction for the CNF's regulation of SMC's Stillwater Mine.

1.4.2.1 Custer National Forest Lands and Resource Management Plan

According to its 1986 Land and Resource Management Plan, the CNF must consider how other resources and impacts from mining would be mitigated to the extent possible through standard operating procedures. Additionally, the CNF can prescribe mitigation measures to the Plan of Operations as necessary to manage key surface resources. Mineral development will not be precluded by these resource concerns within legal constraints. Efforts will be made to avoid or mitigate resource conflicts. If the responsible official determines that conflicts cannot be adequately mitigated, she/he will resolve the conflict in accordance with the management goal and, if necessary, in consultation with affected parties (Forest Service 1986a, page 58).

The area under consideration for SMC's proposal falls within Management Area E, which emphasizes the exploration, development, and production of mineral resources (Forest Service 1986a). The CNF's Land and Resource Management Plan (Forest Plan) did not analyze site-specific actions, such as SMC's current proposal. However, as an integrated management plan, it evaluated various alternatives for managing the Forest as a whole for a 10- to 15-year period. The Record of Decision (ROD) for the Forest Plan clearly states a site-specific project, such as SMC's current proposal, must undergo additional analysis under the National Environmental Policy Act (NEPA). This EIS documents this analysis.

1.4.2.2 Organic Administration Act of 1897

In 1891, Congress granted the President the authority to establish forest reserves (national forests) from the existing public domain lands. In the Organic Administration Act of 1897, Congress designated the purposes for the establishment of national forests and provided for their protection and management. These purposes were to improve and protect the forest within the national forests, or for the purpose of securing favorable water flows, and to furnish a continuous supply of timber for the use and needs of the citizens of the United States. However, it was not the purpose or intent of these provisions to authorize the inclusion of lands more valuable for their minerals or for agricultural purposes than for forest purposes (16 USC § 475). Thus, the Organic Administration Act does not allow the CNF to unreasonably circumscribe or prohibit reasonably necessary activities under the Mining Law of 1872 that are otherwise lawful.

1.4.2.3 36 CFR 228, Subpart A — Locatable Minerals

These regulations set forth the rules and procedures through which use of the surface of National Forest System lands can occur in connection with operations authorized by the United States' mining laws. These laws confer a statutory right to enter public lands to search for minerals. Because the Forest Service must abide by the mining laws, it developed its regulations for locatable minerals to ensure mining-related activities are conducted in a manner that minimizes adverse environmental effects on National Forest System's surface resources.

1.4.2.4 National Environmental Policy Act

The National Environmental Policy Act of 1969 (NEPA) declares a national environmental policy and promotes consideration of environmental concerns by federal agencies. Procedures and regulations issued by the Council on Environmental Quality (CEQ), as authorized under NEPA, direct implementation of NEPA by federal agencies. The CEQ's regulations are promulgated at 40 CFR Parts 1500–1508. Additionally, the Forest Service's regulations pertaining to implementation of NEPA and CEQ regulations are contained in Chapter 20 of the Forest Service Handbook 1909.15 (Environmental Policy and Procedures). To meet its requirements under NEPA and its Forest Plan, the CNF has prepared this EIS in cooperation with DEQ.

1.5 Permits and Approvals Required from Other Agencies

In addition to approvals by the DEQ and CNF, several additional secondary permits, approvals, and consultations with other federal, state, and local agencies must be obtained before SMC could implement the changes proposed for its mine waste management operation. These additional permits, approvals, and consultations are identified and described in **Table 1–1**.

Table 1–1 Permits, Licenses, and Approvals Required for the Stillwater Amendment

Permit, License, or Approval	Purpose
U.S. Fish and Wildlife Service (UFWS)	
Biological Opinion (Endangered Species Act 50 CFR 402)	To ensure actions taken by federal agencies would not jeopardize the continued existence of threatened and endangered species or result in the destruction or modification of critical habitat. The CNF must consult with the FWS who issues its Biological Opinion following review of a Biological Assessment submitted by the CNF.
USDA Forest Service	
Plan of Operation	To ensure design, operation, closure, monitoring, and bonding of mining operations result in adequate reclamation for post-mining use. Coordinate with DEQ and other appropriate agencies.
U.S. Army Corps of Engineers	
Section 404 Nationwide Permit (Clean Water Act)	To control the discharge of dredged or fill material into waters of the U.S., including wetlands.
Department of Environmental Quality (DEQ)	
401 Certification (Montana Water Quality Act)	To certify that any activity requiring a Federal license or permit that may result in any discharge into State waters would not cause or contribute to a violation of State surface water quality standards.
Montana Pollution Discharge Elimination System (MPDES) Permit	To authorize SMC to discharge water from the Stillwater Mine's adits to the Stillwater River and groundwater adjacent to the Stillwater River. SMC's current MPDES permit (MT–0024716) is in the renewal process.
DEQ Hardrock Mining Permit (Metal Mine Reclamation Act)	To ensure design, operation, closure, monitoring, and bonding of mining operations result in adequate reclamation for post-mining use. Coordinate with the CNF and other appropriate agencies.
Storm Water Discharge General Permit	To prevent the degradation of state waters from pollutants, such as sediment, industrial chemicals or materials, heavy metals, and petroleum products.
Short-term Exemption from Montana's Surface Water Quality Standards (3A Authorization)	To allow for short-term increases in surface water turbidity during construction. Montana Department of Fish, Wildlife, and Parks (MDFWP) is consulted on this authorization.
State Historic Preservation Office	
Historic Resources Consultation (National Historic Preservation Act)	To obtain joint approval by land-managing agencies and concurrence by the State Historic Preservation Office (SHPO) before agency approval; reviewed by the Advisory Council on Historic Preservation
Stillwater County and Hard Rock Impact Board	
Hard Rock Impact Plan	To identify and mitigate future financial impacts in Stillwater County associated with the Stillwater Mine.
Stillwater Conservation District	
310 Permit (Montana Natural Streambed and Land Preservation Act	To protect and preserve streams and rivers in their natural or existing state. Application processed in consultation with the MDFWP.
Stillwater County Road Department	
Application to Perform Construction Work in a Right-of-way	To permit construction of the pipeline along County roads 419 and 420.
Stillwater County Sanitarian	
Floodplain Development Permit	To restrict floodplain areas to uses that will not be seriously damaged or present a hazard to life if flooded.

Note: More information on the permits, licenses, and approvals identified on this table is contained in previous permitting documents, including the 1985, 1992, and 1996 final EISs and the 1989 EA (see **Appendix A** for additional descriptions of these documents).

1.6 MEPA/NEPA Process, including Tiering

The National Environmental Policy Act (NEPA) and Montana Environmental Policy Act (MEPA) are Federal and State laws that direct the CNF and DEQ, respectively, to disclose the effects of proposed activities on Federal and State lands to the public and officials making decisions concerning the proposal.

The NEPA/MEPA process began when SMC proposed to amend its current operating permit/plan of operations. The agencies sought public input to help identify environmental issues and concerns through the process called "scoping." Scoping activities for this project included mailing a scoping document to parties interested in or potentially affected by the proposal, holding a public meeting in Absarokee, Montana, on September 24, 1996, and receiving the public's responses.

In addition to public scoping, the agencies reviewed SMC's proposal for "completeness." The purpose of this review was to ensure the information contained in the proposal is adequate to complete the agencies' environmental analysis under MMRA and to identify additional information needed to complete an environmental analysis under MEPA. The environmental analysis phase of the NEPA/MEPA process began after the proposal was declared "complete" on January 28, 1997.

The regulations implementing NEPA and MEPA encourage tiering in EISs. Tiering is the process of referencing information presented in other previously-prepared NEPA/MEPA documents, such as EISs, to minimize repetition. This EIS is specifically tiered to the documents identified in the following section.

1.6.1 Identification of Related Environmental Documents

Several environmental analyses have been prepared for the Stillwater Mine. They include the EIS prepared for the original operating permit/plan of operations and EISs and an environmental assessment (EA) prepared in support of amendments to that permit/plan of operations. This EIS is specifically tiered to the following environmental documents:

- Final Environmental Impact Statement, Stillwater Project, Stillwater County, Montana. Prepared by the Montana Department of State Lands and USDA Forest Service, Custer National Forest in 1985.

- Preliminary Environmental Review/Environmental Assessment (PER/EA), Stillwater Project East Side Adit Development. Prepared by the Montana

Department of State Lands and USDA Forest Service, Custer National Forest in 1989.

- Final Environmental Impact Statement, Stillwater Mine Expansion 2000 TPD, Application to Amend Plan of Operations and Permit No. 00118. Prepared by the Montana Department of State Lands, Montana Department of Health and Environmental Services, and USDA Forest Service in 1992.

- Final Environmental Impact Statement for the Stillwater Mining Company Underground Valley Crossing and Mine Plan. Application to Amend Plan of Operations, Permit No. 00118. Prepared by the Montana Department of Environmental Quality in 1996.

Appendix A contains a synopsis of each of these four documents. The documents are available for review at DEQ's offices in Helena and the Beartooth Ranger District's office in Red Lodge.

Chapter 2.0 — Public Participation, Issue Identification, and Alternative Development

Chapter 2.0 — Public Participation, Issue Identification, and Alternative Development ..... 2 – 1
2.1 Public Participation ..... 2 – 1
2.2 Issue Identification and Issue Statements ..... 2 – 3
2.3 Process Used to Develop Alternatives ..... 2 – 8
2.4 Alternatives Descriptions ..... 2 – 9
2.5 Alternatives Considered but Eliminated (& rationale) ..... 2 – 59
2.6 Reasonably Foreseeable Projects ..... 2 – 78
2.7 Projects Not Considered Reasonably Foreseeable at This Time ..... 2 – 82
2.8 Summary of Alternatives and Environmental Consequences ..... 2 – 83
2.9 Preferred Alternative ..... 2 – 84

Chapter 2.0 — Public Participation, Issue Identification, and Alternative Development

This chapter covers five primary topics. First, it describes the process used to obtain the public's concerns and identifies the issues raised by the public. Then, it describes the process used to develop the alternatives considered in this analysis. Third, it describes the project alternatives analyzed in detail. The specific features of these alternatives are fully described. Fourth, it identifies each alternative dropped from detailed consideration and briefly describes the reasoning for the exclusion. Finally, it summarily presents, in comparative form, the components and environmental effects of the alternatives analyzed in detail and identifies the agencies' preferred alternative.

2.1 Public Participation

2.1.1 Scoping

DEQ and CNF consider public participation a crucial component in defining the scope of the environmental analysis presented in this EIS. Consequently, the agencies worked to ensure the public was informed about SMC's proposal and the opportunities available for participating in the environmental process.

The agencies first informed the public of SMC's proposal when they mailed the project's Scoping Document to potentially interested or affected persons on August 27, 1996. This document described SMC's proposal, the agencies' responsibilities, and the permitting and environmental impact analysis process. It also requested scoping comments by October 31, 1996.

After release of the Scoping Document, additional public notices and activities occurred. News articles about SMC's proposal appeared in local and regional newspapers during the week of September 1, 1996. A Notice of Intent to prepare an EIS was published in the Federal Register on September 19, 1996. Subsequently, the DEQ and CNF held a public scoping meeting in Absarokee on September 24, 1996.

As a result of the September 24 scoping meeting, SMC offered to host public field trips to provide information to interested individuals. Two field trips were held on November 14 and 15, 1996. Fifty individuals attended these trips.

Finally, DEQ and CNF have been keeping the public informed of the analysis' status through periodic newsletters. Two newsletters have been distributed to

date. The first newsletter, issued in March 1997, summarized the results of public scoping. It also identified the issues DEQ and CNF defined in response to comments received during the scoping period. The second newsletter, issued in September 1997, described the results of DEQ and CNF's selection of the third-party contractor and presented the team responsible for assisting in the preparation of the EIS.

2.1.2 Review of Draft EIS

In mid-March 1998, the draft EIS was distributed to the public. The distribution list included the agencies, companies, organizations, and individuals that had expressed an interest in the project during scoping. It also included several agencies and elected officials to whom DEQ and CNF commonly send EISs.

The draft EIS was available for public review and comment from March 20, 1998, through May 19, 1998. DEQ and CNF encouraged reviewers to submit written comments on the document during this period. In addition, DEQ and CNF held a public open house and hearing on the draft EIS on April 28, 1998, to answer questions and provide the public with the opportunity to submit written and verbal comments in person.

Reviewers of the draft EIS submitted a variety of comments. Most of the comments were contained in 45 letters. However, eleven individuals provided verbal comments at the public hearing. Overall, the comments focused on the nine issues identified in the draft EIS (**Section 2.2.1**) and the MEPA/NEPA process. **Appendix B** contains a summary of the comments received on the draft EIS, and DEQ and CNF's responses to those comments.

Those comments and responses resulted in numerous changes throughout the document. Quite a few of those changes were editorial in nature—spelling errors, making numbers consistent throughout the document, correcting titles or adding missing features on figures, and so on. Additional acronyms were added to the glossary and preface. Chapter 1 had only minor corrections. In Chapter 2, additional information was added to the issues not considered further and the description of reasonable alternatives was provided along with regulatory citations throughout the chapter. A description of an experimental paste backfill that SMC has recently initiated has been included as well as a brief description of SMC's recently renewed MPDES permit and additional information on some proposed facilities such as the pipeline system, power requirements and monitoring are provided. Estimated reclamation bond amounts for each action alternative have been calculated and included. Twelve new agency mitigations are described. The discussion on paste backfill and landfill in the alternatives considered but dismissed section and the rationale for dismissing some alternatives has been expanded. The zoning petition has been added as a project considered not reasonably foreseeable because the agencies do not know what

the outcome of the petition would be. **Table 2–4** has been expanded to more fully show the differences between the environmental consequences of implementing alternatives A through D.

In Chapter 3, additional information focused primarily on water resources including precipitation data, flow data for Stillwater River and several springs, surface and ground water quality data, the recently revised MPDES permit, water rights, characteristics of the deposited materials at the Hertzler Ranch. Other changes included better defining civilian labor force numbers, identifying the maximum credible earthquake, and clarifying which cultural sites were in closest proximity to proposed facilities and incorporating the results of SHPO evaluation of identified cultural sites.

The greatest amount of changes in Chapter 4 occurred in Water Resources including analyses relative to MPDES permit limitations (loading rates, mixing zones), clarification on the HELP model, additional modeling of surface and ground water quality impacts (LAD, impoundment and waste rock storage site seepage), impacts on flows, impacts on persons with water rights, and impacts from a potential pipeline rupture. Other changes include a discussion on indirect impacts to bighorn sheep, information on the diffuser for discharging water into the Stillwater River, information regarding the proposed zoning petition, and a new section on regulatory restrictions on the use private property (the applicant's private property).

Several new appendices, in addition to that containing the comments and responses, have been included to provide additional details not included elsewhere. These include a listing of previously permitted mitigation, water balance calculations, the biological evaluation in addition to the biological assessment, and a technical appendix containing information on paste and cost calculations for various alternatives considered as well as those dismissed.

2.2 Issue Identification and Issue Statements

DEQ and CNF reviewed and analyzed the comments they received during the scoping process. Public response to SMC's proposal included 52 letters and about 20 phone calls. Additionally, six people visited the Beartooth Ranger District's office in Red Lodge.

The agencies' process for identifying issues involved three overall steps. First, specific comments were arranged into groups of common concerns. Next, a primary issue statement was prepared for each group of comments. Finally, the issue statements were evaluated for applicability to this MEPA/NEPA analysis.

The analysis of comments initially identified 11 issues. Nine of these 11 issues were identified as key or significant issues. NEPA and MEPA direct agencies to

focus the analysis on significant issues and to dismiss nonsignificant issues (40 CFR 1500.4 (b), (c), and (g) and ARM 17.4.615 (2) (b) and (c)). These issues were used to define the scope of this MEPA/NEPA analysis. Nine key issues were used to analyze environmental effects, prescribe mitigation measures, or both. Issues are "significant or key" because of the extent of their geographic distribution, the duration of their effects, or the intensity of interest or resource conflict. The determination of an issue's significance is different than and separate from any determination of the significance of an environmental consequence.

2.2.1 Issue Statements for Key Issues

Issue statements have been developed from public and agency comments to provide an understandable and measurable estimate of potential environmental consequences likely to occur if the Proposed Action or an alternative was permitted and implemented. The intent of the following issue statements is to clearly identify biological, physical, social, and economic resources that might be affected if one of the action alternatives analyzed in this EIS is permitted and implemented.

2.2.1.1 Water Quality and Quantity

Implementation of SMC's proposed plans for long-term waste management might change the existing water quality and quantity around the existing and proposed new waste management facilities. These changes could result from proposed increases in the development of the sub-surface ore body. The current sediment load, chemical constituency, and function of area waters might be affected by construction and operation of the pipeline system adjacent to the Stillwater River, increased Land Application Disposal for waste water nitrates, pipeline construction crossing the West Fork of the Stillwater River, and construction and operation of the new tailings impoundment about 7.8 miles northeast of the current mine.

In response to these concerns, environmental effects will be estimated through analysis of sediment loads and water chemistry changes, past experiences and monitoring results collected since the mine began operating, and professional interpretation of site-specific conditions. Potential environmental consequences will be estimated for both surface and sub-surface water in the potentially-affected areas.

2.2.1.2 Wildlife

Mule deer populations in the Stillwater Valley have declined significantly since 1991. The number of fawns born during the spring of 1996 state-wide was the lowest on record, suggesting further declines are imminent. The area

surrounding the proposed waste rock storage facility and tailings impoundment currently serves as important winter and spring range for mule deer. "Some mule deer within this seasonal population spend summers in Yellowstone National Park. Therefore, this mule deer population could have national significance" (Montana Department of Fish, Wildlife, and Parks, September 17, 1996, letter to Randy Herzberg, Custer National Forest). Thus, potential effects to mule deer due to implementation of the Proposed Action are a concern.

To a lesser degree, the changes proposed by SMC might affect white-tailed deer and mountain lions that occupy the project area, the area between and including the existing mine, and the proposed impoundment site. The project area may also contain threatened, endangered, sensitive, or management indicator species.

Effects to wildlife will be estimated through identification of the type and location of existing wildlife uses within the potentially-affected habitats. Site-specific data collection, modeling, and professional interpretation also will be used.

2.2.1.3 Fisheries

SMC proposes to construct and operate 7.8 miles of pipeline adjacent to the Stillwater River and across the West Fork of the Stillwater River. The proposed tailings impoundment would be approximately 0.25 mile linear distance from the Stillwater River; however, the down-gradient distance from the tailings impoundment to the Stillwater River (the route surface or ground water would have to travel to reach the river) would be approximately 0.5 mile. Concerns related to the introduction of sediment and chemicals have been identified by the public. Currently, water from the Stillwater River provides high-quality habitat for trout in both the Stillwater and Yellowstone rivers.

Effects on fish will be estimated on the basis of data contained in the water quality and quantity section of the EIS and professional interpretation of site-specific conditions.

2.2.1.4 Air Quality

Air surrounding SMC's proposed tailings impoundment location currently is clean with low levels of particulates and odors. Particulate monitoring (PM_{10}) in the area of SMC's mining facilities south of Nye has not indicated any infraction of state air quality standards. Implementation of SMC's proposed impoundment and waste rock storage will increase the amount of ground disturbance and traffic in the project area, which might also increase PM_{10} in the project area.

Environmental effects will be estimated through comparison of existing air quality conditions with conditions predicted for the different alternatives.

2.2.1.5 Social/Economics

Many of the residents in the area adjacent to SMC's existing and proposed facilities have been drawn there because of the "high quality of life" afforded individuals in this mountainous setting. These individuals perceive the area to have a rural, quiet, non-industrial, and unhurried pace. Implementation of this project might change social and economic factors associated with this "high quality of life." For example, increased numbers of people might be hired and choose to live in the area. Increased demands to Stillwater County infrastructure might result if local populations increase. As a result, residents might experience a change in property values, taxation, housing costs, and the overall cost of living.

Potential social and economic effects will be estimated by comparison with data from the existing Hardrock Impact Plan.

2.2.1.6 Tailings Impoundment Stability

SMC proposes to use construction material consisting largely of glacial debris, including boulders, cobbles, sand, gravel, and large amounts of fine clay, to build a new tailings impoundment about 7.8 miles northeast of existing mine and milling facilities. Many comments received during scoping related to the use of this material for construction of the impoundment.

Site-specific engineering studies and field data will be used to determine the suitability of this glacial material for construction and the risk of failure. Engineers from the Forest Service, DEQ, and the third- party contractor will review construction plans for the proposed action and alternatives for adequacy.

2.2.1.7 Aesthetics

The area surrounding SMC's proposed impoundment location currently is characterized by substantial modifications for agricultural and other uses. Approval of this proposal might increase traffic, industrial activities, and refuse, as expressed in many scoping comments.

The severity of these impacts will be estimated on the basis of past experience with construction and operation of this type of impoundment.

2.2.1.8 Transportation

SMC's proposal includes construction of a pipeline corridor with several pipelines along the roads (Stillwater County roads 419 and 420) between the proposed tailings impoundment site near Nye and the existing mine and mill. Implementation of this action might disrupt traffic flow on these roads.

Changes in traffic flow patterns will be determined for each alternative based on data from the Montana Department of Transportation (MDOT).

2.2.1.9 Reclamation

About 423 acres of additional disturbance would be added to SMC's currently-permitted disturbance (255 acres), if this proposal is approved. Although most of this total (251 acres) would involve areas not disturbed by previous activities, some (172 acres) would involve areas disturbed by previous activities (redisturbance), such as chromium mining and the previously-interseeded LAD sites. Many commentors doubted SMC's ability to reclaim disturbed areas to required levels of stability and utility. Reclamation potential will be determined by comparing soil data, such as productivity, depth, structure, and location with planned disturbance size, slopes, and location. State reclamation standards will be addressed.

2.2.2 Issues Not Considered Further

Two issues were originally considered by DEQ and CNF, but were dismissed because there were no impacts or only minimal, short-term impacts. These issues are briefly described below, as well as the reason for their dismissal. Because they were dismissed and this document focuses on key issues, these issues are not discussed any further in chapters 3 and 4.

2.2.2.1 Human Health and Safety

Under SMC's proposal, the new tailings impoundment would be operated in conjunction with the existing impoundment. People commenting on the proposed action were concerned about the possible escape of chemical constituents in tailings impoundment waters. They were also concerned about possible negative effects of breathing or coming in contact with such constituents.

Long-term monitoring (1980 to 1997) of air quality for particulate matter, lead and sulfates, has not shown any concentrations of materials considered harmful or injurious to health. Wind-blown dust still can be an irritant on occasion, but generally it is not considered an impact on human health. Additionally, the effects of any of the alternatives would not be significantly different from one another, which is another reason for not carrying the issue through detailed analysis.

Water quality monitoring also has been conducted since 1980. The potential for water quality impacts of tailings escaping is addressed by the quality of the decant water sampled at surface monitoring site SMC–4 at the mill site and by

the geochemical characterization of the tailings. These tests indicate the ore body is non-acid generating. The tailings have an acid-base potential of 76 tons of calcium carbonate ($CaCO_3$) per 1000 tons soil, or essentially no potential to form acid (SMC 1997e). Toxicity Characteristic Leaching Procedure (TCLP) tests also show that constituents of the tailings have a low possibility of mobilizing metals and that many constituents are below the detection limits and all constituents of the tailings are at levels below the standards. Finally, the effects of any of the alternatives would not be substantially different from one another, which is another reason for not carrying the issue through detailed analysis.

2.2.2.2 Utilities

Implementation of the proposal may require an additional 12 megawatts of electrical power currently available from Montana Power Company. Development of the proposed impoundment would include a one-mile extension of the existing three-phase power line from a point near the junction of Stillwater County roads 419 and 420. This extension would provide about 500 horsepower for operation of the new impoundment site.

The extension of utilities for the project would have potential effects only where actual powerline extensions would occur (see **Section 2.4.2.4** for a description non-disturbing upgrades of existing power lines). These effects would be construction oriented (short term) and would create minor land use changes. The power demands for the expansion are well within the capabilities of Montana Power Company to provide. Because these potential effects would be similar for all action alternatives and were considered minor, they were not carried through the full analysis.

2.3 Process Used to Develop Alternatives

The process of developing alternatives to SMC's proposal involved four steps. First, the DEQ and CNF conducted project scoping to identify the key issues of concern. This scoping involved both internal agency and public concerns. It also considered environmental and project-design elements.

The second step consisted of formulating alternatives to the proposal. Each alternative had to at least partially meet the purpose and need for the project. Typically, driving issues are identified that help the agencies define what changes need to be made to avoid, eliminate, reduce, minimize, or mitigate impacts that would result from implementing the Proposed Action. DEQ and CNF had identified water quality and quantity, tailings impoundment stability, and reclamation as the potential driving issues for this EIS. However, as the Proposed Action was analyzed, no significant impacts were identified that could

be further reduced by other alternatives, siting locations, or mitigations relative to these issues. Nevertheless, both MEPA and NEPA require a reasonable range of alternatives that meet the purpose and need. DEQ and CNF looked at alternate locations for various facilities, modifying the size and storage capacity of the proposed and existing impoundments, timing of construction, and operational changes. The agencies also considered alternatives that would avoid building an impoundment at the Hertzler Ranch. The four alternatives being considered do show a range of impacts relative to all nine issues.

The third step involved screening the potential alternatives for reasonableness. The MEPA/NEPA process requires that alternatives evaluated in detail be reasonable. The regulations for implementing NEPA provide a discussion of the need for reasonable alternatives in the NEPA process (40 CFR 1500.1(e) and 1502.14). Also, CEQ's 40 Most Asked Questions about NEPA (Question 2a) state, in part, that "reasonable alternatives include those that are practical or feasible from the technical and economic standpoint and using common sense..." (CEQ 1981).

Based on this direction, the agencies focused their screening alternatives on technical, environmental, and economic feasibility. Technical considerations included the feasibility of constructing and operating the facilities. Environmental considerations included the potential for significant impacts and the feasibility of successfully mitigating the impacts of the alternative. Economic considerations included potential costs and benefits of implementing the alternative.

Finally, unreasonable alternatives were dropped from detailed consideration. If an alternative did not pass the technical, environmental, and economic screening for feasibility, it was not considered any further in the analysis. **Section 2.5** summarizes these alternatives and explains why they were not considered further.

2.4 Alternatives Descriptions

Several alternatives were considered in this MEPA/NEPA analysis. They include a No Action alternative, SMC's Proposed Action, two modifications of SMC's Proposed Action, and a variety of alternatives considered but dropped from detailed evaluation. Each of these alternatives is described below.

The following sections describe the four alternatives evaluated in detail. The descriptions focus on waste rock production and management, tailings production and management, and water management and disposal, as appropriate. All nine key issues are addressed in each of the action alternatives in **Chapter 4**. However, three of these key issues (Water Quality/Quantity, Tailings Impoundment Stability, and Reclamation) were used as the basis of alternative development in order to provide discreet differences in environmental

consequences, thereby providing a clear choice for decision makers, as directed by 40 CFR 1502.14 and MEPA (see **Table 2–1**). Since agency mitigations were not incorporated into the alternatives, **Table 2–1** also shows which issues are addressed by one or more agency mitigations.

Table 2–1 Key Issues Addressed by the Alternatives Considered in Detail

Issue	Alternative A	Alternative B	Alternative C	Alternative D	Agency Mitigations
1. Water Quality and Quantity		✓	✓[1]	✓[1]	
2. Wildlife		✓	✓	✓	✓
3. Fisheries		✓	✓	✓	
4. Air Quality		✓	✓	✓	✓
5. Social/Economics		✓	✓	✓	
6. Tailings Impoundment Stability		✓	✓[1]	✓[1]	✓
7. Aesthetics		✓	✓	✓	✓
8. Transportation		✓	✓	✓	✓
9. Reclamation		✓	✓[1]	✓[1]	✓

Notes:
1. This issue was specifically used in the development of this alternative.

2.4.1 Alternative A — No Action

The No Action alternative is defined as the Stillwater Mining operation as currently permitted by DEQ and CNF (Permit #00118). This alternative was included to define the existing baseline conditions for comparison with the other alternatives considered in this analysis. Thus, this alternative reflects the existing conditions of the Stillwater Mine. Selection of this alternative would mean no additional changes would be allowed at this time at the Stillwater Mine, beyond those already permitted by DEQ and CNF through previous permitting processes and decisions. Previous analyses and decisions were documented in the 1985, 1992, and 1996 final EISs and their associated Records of Decision and the 1989 Environmental Assessment and its associated Decision Notice (see **Appendix A** for additional descriptions of these documents). The various mitigations and stipulations required as a result of these agency decisions and approvals are listed in **Appendix C**.

Implementation of this alternative would not meet the purpose of and need for the project as described in **Chapter 1**. For example, under this alternative, SMC's need for additional capacity for storage of tailings necessary for production to continue beyond 2003 would not be met. Also, the operational flexibility and long-term planning sought by SMC in managing wastes would not

be met. Although the No Action alternative would not meet the purpose of and need for the project, its inclusion in the analysis is required by MEPA (ARM 17.4.601 to 17.4.636) and NEPA (40 CFR 1502.14(d)).

2.4.1.1 Waste Rock Production and Management

Mining at the Stillwater Mine generates waste rock. The volume of waste rock produced varies from year to year. Largely, the volume generated depends on the amount of development being conducted and the mine's overall economics.

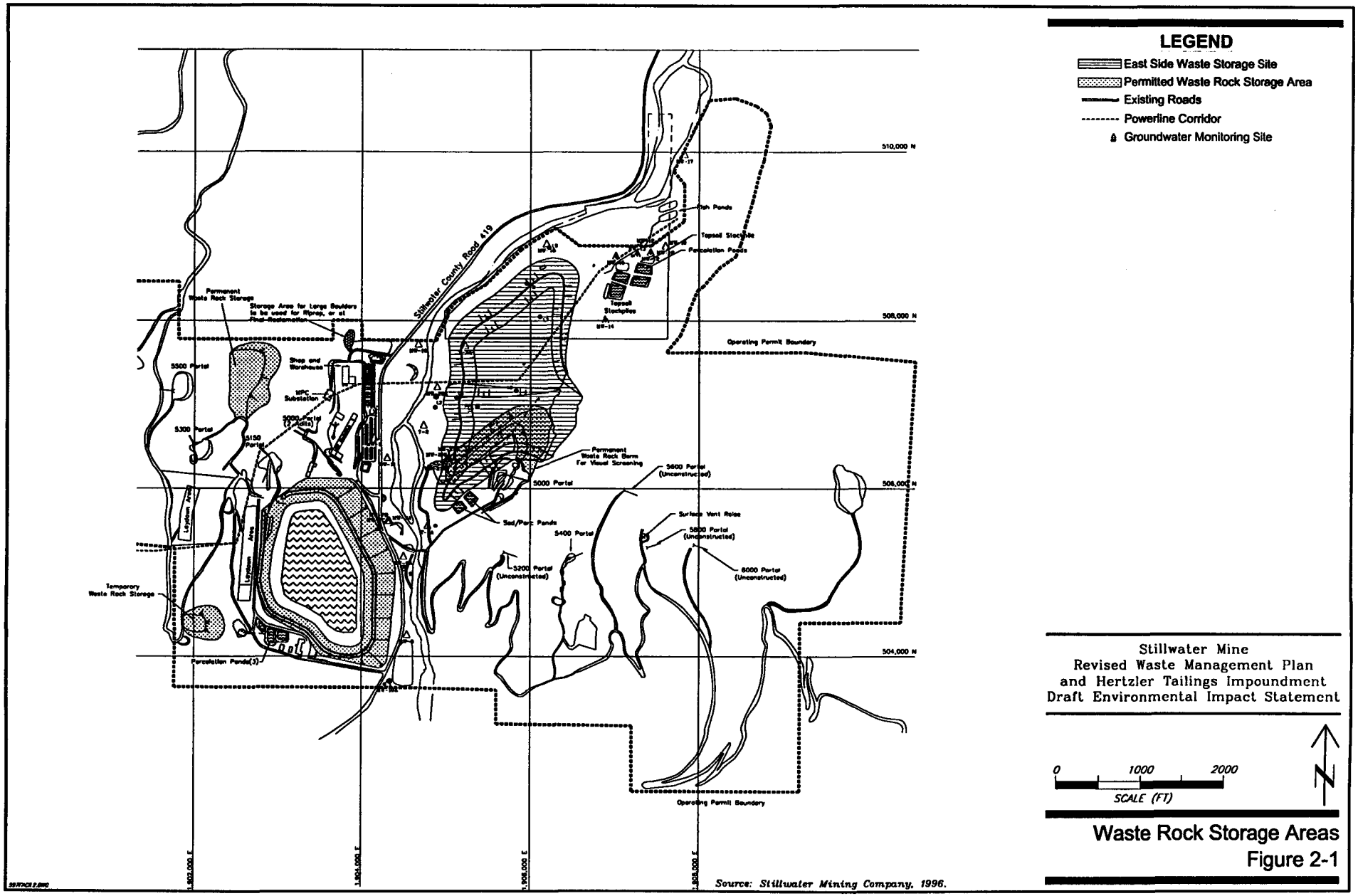
SMC disposes of waste rock both underground and aboveground. The volume of waste rock that remains underground depends upon access to SMC's facilities for handling waste and the quantity of ore produced in mining. Currently, about 20 percent of the waste rock produced in the mine remains underground and is primarily used for backfilling mined out stopes. Although some of the other 80 percent is used to construct facilities, such as portal pads and roads, most is used to construct the embankment of the existing tailings impoundment on the west side of the Stillwater River.

Currently, SMC is permitted to place mine waste rock in four areas. They are the embankment for existing tailings impoundment, a temporary storage area above the tailings impoundment, a permanent storage area near the 5300 west portal, and the permanent visual berm on the east site of the Stillwater River (**Figure 2–1**). Together, these areas can hold an additional 3,771,000 tons of waste rock.

2.4.1.2 Tailings Production and Management

The processing of ore in SMC's mill and concentrator produces tailings. For every 100 tons of ore fed to the mill, 99 tons of tailings are generated. These tailings are pumped from the concentrator to an underground sand plant where they are separated by cyclones into a coarse fraction (sandfill) and a fine fraction (slimes). The sandfill is used underground as backfill in the mine and the slimes are pumped into the existing tailings impoundment. About 58 percent of the tailings are used as backfill in mined out stopes. The slimes fraction, which represents about 42 percent of the total tailings, is pumped to the tailings impoundment. At times however, the entire bulk of the tailings stream may be pumped to the tailings impoundment.

The capacity of the existing tailings impoundment is limited. This impoundment, which occupies about 60 acres, has an engineered capacity of 3.5 million tons of tailings. At present rates of production, the impoundment will reach its capacity in 2003. Thus, SMC would have to stop production of platinum and palladium in 2003 under this alternative.



Stillwater Mine
Revised Waste Management Plan
and Hertzler Tailings Impoundment
Draft Environmental Impact Statement

0 1000 2000
SCALE (FT)

N

Waste Rock Storage Areas
Figure 2-1

Experimental Paste Backfill

On April 30, 1998, SMC submitted requests to DEQ and CNF for approvals to construct and operate a cemented backfill plant at the Stillwater Mine. The purpose of this plant is to allow SMC to evaluate the use of paste backfill at the Stillwater Mine. In particular, SMC is trying to determine if paste backfill made from either whole tailings or the sand fraction of the tailings can provide the compressive strength needed to support SMC's method of mining at the mine, which involves backfilling mined out stopes. The backfilled stopes serve two purposes: to provide a footing for the next stoping effort and to provide internal support (ground control) and assistance in the prevention of subsidence.

The plant is considered a full-scale plant for that portion of the mine that it can reasonably supply with cemented paste backfill. The portion of the mine expected to receive backfill from the plant includes the area underneath the Stillwater valley, which is constrained by the need for lateral pumping. Pumping with gravity aids the distribution of backfill whereas pumping laterally is very limited due to friction between the tailings and the pipe. Considering the characteristics of the paste SMC would make and the 1,700-foot hydraulic head that would exist between the paste plant and the ultimate location for placing the experimental paste, the paste tailings are expected to spread laterally up to a maximum of 5,280 to about 8,000 feet (Gilbert 1998b, pers. comm.).

The plant will occupy an area of about approximately 200 feet by 200 feet at the 5150 west side portal area. Major pieces of equipment include a high density "deep well" thickener 50 feet tall and 35 feet in diameter; a belt filter 10 feet wide and 95 feet long; a cement silo 50 feet tall with a capacity of 200 tons, and a building with the dimensions of 65 feet by 125 feet by 50 feet tall (only the belt filter, paste mixer, distribution pumps, and control systems will be contained in the building). The plant will require about 1.5 megawatts of electricity to operate.

SMC intends to create two kinds of paste backfill at the cement plant. They are a low-compressive-strength backfill (30 psi) made from whole tailings and a high-compressive-strength backfill (300 psi) made from a 2:1 ratio of the coarse fraction to whole tailings. In the second case, the whole tailings will be cycloned with the finer fraction from that process rejected to the tailings pond.

Creation of the low-compressive-strength backfill will involve sending the whole tailings to the thickener. The overflow goes to the tailings pond and the underflow (approximately 72 percent solids) goes to the belt filter for additional dewatering. The product, which would be about 78 to 82 percent solids, would then be mixed with cement, conditioned to optimum moisture, conveyed to a positive displacement pump, and pumped to underground work areas.

Creation of the high-compressive-strength backfill will involve dividing the whole tailings so about one-third is sent to the thickener and two-thirds are sent

to the cyclone. The overflows (fine fractions) from both these processes are sent to the tailings pond. The underflows (coarse fraction) go to the belt thickener, are then mixed with cement, and pumped underground to backfill areas.

Although results of the tests will not be available until later in 1999, a preliminary comparison of SMC's current sand backfilling with the experimental cement "paste" backfilling has been made. Slurried tailings, fine tailings paste, and whole tailings paste would have average dry densities of 70 pcf, 80 pcf, and 100 pcf, respectively. Thus, 100 pounds of slurried tailings, fine tailings paste, and whole tailings paste would occupy about 1.4 cubic feet, 1.25 cubic feet, and 1 cubic foot, respectively. The volume differences are a function of material density.

2.4.1.3 Water Management and Disposal

SMC handles two waste water streams at the Stillwater Mine. One stream is adit water, which is groundwater intercepted by the mine workings. The second stream is process and tailings water, which has been used in the milling and concentrating circuits and for slurrying tailings. Because the water in these streams is handled differently, they are discussed separately.

Adit Water

Mining and development of the mine's underground workings have intercepted, and will continue to intercept, groundwater. Inflows of groundwater increase with lateral development of the mine until an area is dewatered. SMC also seals abandoned workings to reduce inflows. Currently, discharges of adit water from all areas of the mine total about 1,000 gallons per minute (gpm). The Stillwater Mine Expansion 2000 TPD EIS (DSL, DHES, and Forest Service 1992) estimates these discharges may increase to as much as 2,020 gpm as SMC develops the mine further.

The adit water picks up suspended particulate matter and nitrogen compounds (nitrates) as it moves through the underground mine workings. The particulate matter also may contain low concentrations of metals that are present in the mineralized rocks. Residues of the blasting compounds used in the mining process are the source of the nitrates.

SMC has the option to discharge adit water directly into the Stillwater River without treatment under its MPDES permit. However, this is not the routing SMC prefers to use. SMC treats, and will continue to treat, the adit water before it uses or disposes of it. This treatment, which occurs on both the east and west sides of the operation, consists of clarification to remove fine particulates (slimes). Following clarification, SMC uses the treated water for irrigating reclaimed areas, pasture, and cropland; stabilizing soils; controlling dust; and

adding to the mill process as make-up water. Most of the excess water is routed to the percolation ponds for disposal during the winter. During the growing season, SMC uses a Land Application Disposal (LAD) system to irrigate reclaimed areas, pasture, and cropland (hay fields) with clarified adit water.

SMC recently renewed its MPDES permit. In its renewal, SMC proposed to use an Anoxic Biotreatment Cell (ABC) system to remove nitrates from adit water. The ABC is a porous, media-filled, attached-growth denitrification reactor. Denitrification is a biologically-enhanced process in which nitrate is converted to nitrogen gas. The pilot project conducted during 1996 suggests SMC's ABC lowers concentrations of nitrates to 3 to 4 mg/L, a reduction ranging from 60 to 99 percent, while maintaining concentrations of phosphate below 0.1 mg/L. As a result of the tests, SMC's ABC was enlarged during 1997 to handle flows up to 500 gpm. Additional information on the ABC is available in DEQ's MPDES files.

During the growing season (generally April through October), excess adit water is routed to two east-side LAD pivots. SMC's records on its newest east side LAD pivot suggest volatilization, vegetation, and soils under the LAD pivots remove more than 80 percent of the nitrates dissolved in the adit water. Due to this effectiveness, application of adit water using the LAD pivots qualifies as secondary treatment for removing nutrients.

Tailings and Process Water

Process water includes water used within the mill and concentrating circuits. This water contains reagents SMC uses to separate metal concentrate from the ore. The reagents, which are mainly long-chain alcohols and organic compounds that readily breakdown in water, are used in small quantities. Consequently, they are highly diluted in the tailings water. However, some inorganic constituents, such as sulfate, may remain at high concentrations. The reagents used in milling are fully described in the 1985 Final EIS for the Stillwater Mine (DSL and Forest Service 1985, pgs VI–12 through VI–15). Although the reagents, at the concentrations present in the tailings water, pose no hazard to human health, SMC handles the water containing these reagents separately from adit water.

In addition to being used in the milling and concentrating circuits, process water also is used to transport tailings to the existing tailings impoundment through the slurry pipelines. In the impoundment, the tailings water either evaporates or is reclaimed and pumped back to the mill for reuse in the milling and concentrating circuits.

2.4.1.4 Power Requirements

Montana Power Company's power line servicing the mine is capable of providing up to 18 megawatts of power. Currently, the mine requires about 12 megawatts to mine and process 2,000 tpd of ore. Thus, no changes to the electrical utilities would occur with this alternative.

2.4.1.5 Roads and Traffic

Stillwater County roads 419 and 420 provide access to the Stillwater Mine. No changes would occur to these facilities under the No Action alternative. Thus, they would continue to experience the same level of use by SMC's employees and vendors in the future as they do now.

2.4.1.6 Workforce Requirements/Socioeconomics

Under this alternative, SMC's workforce demands would remain unchanged. As of December 31,1997, mineral development employment (employees and contractors) at the Stillwater Mine was 655 people (SMC 1998). Thus, employment at the mine would continue to be 655 workers until production at the mine shuts down.

2.4.1.7 Monitoring

Tailings and Waste Rock

Sampling of the ore body conducted for more than 20 years has shown no capacity for acid generation. Once each year, SMC combines samples from all mine waste rock storage sites for laboratory analysis to verify the lack of acid-generating potential of the materials. The tailings, which are sampled separately, also are tested for acid-generating potential. This sampling program would continue for the life of the mine as analyzed by the SMC 2,000 tpd EIS and as prescribed by the associated ROD.

Water Quality

SMC's MPDES permit (MT–0024716) requires monitoring of four authorized outfalls, five monitoring wells below percolation pond outfalls, and two surface water monitoring sites. Acute Whole Effluent Toxicity testing is required quarterly when SMC uses Outfall 001, alternating species each quarter of use. A Toxicity Reduction Evaluation and Toxicity Identification Evaluation will follow acute toxicity outcomes of Whole Effluent Toxicity testing. The permit also directs SMC to develop a biomonitoring program that includes periphyton sampling. To meet this requirement, SMC has begun annual, early fall, benthic and periphyton sampling on two to four sites along the Stillwater River.

Outfall 001 is a diffuser unit that discharges directly to the Stillwater River east of the current tailings impoundment. The diffuser is a 50-foot, 6-inch diameter pipe anchored by concrete blocks with three, one-inch diameter spigots located at 0.5-foot intervals. It is located in a reach of the channel that is 80 feet wide during low flow conditions.

Outfalls 002, 003, and 004 are three series of percolation ponds. Outfall 002 is located south of the east side waste storage site (proposed as part of Alternative B) on the east side of the river. Outfall 003 is northeast in the Stillwater Valley Ranch area. Outfall 004 is south of the current tailings impoundment on the west side of the river.

Sampling of Outfall 001 includes daily flow measurements and weekly sampling for metals and nutrients. Additionally, use of this outfall initiates a monthly nutrient sampling requirement of the upstream and downstream surface water stations at the mine site (SMC–1A and SMC–11). Monitoring of flow and nutrients occurs at the inlets of outfalls 002, 003 and 004 weekly during discharges. The five monitoring wells are monitored tri-annually for salinity and nitrogen compounds. The surface water stations are sampled quarterly regardless of use of Outfall 001.

SMC may directly discharge adit waters to the MPDES outfalls, if permit limits are met. Treatment for sediments is provided by a clarifier and reduction of nitrate concentrations is achieved with the ABC system. The MPDES permit restricts direct discharge to Outfall 001 to 2,000 gpm, with as much as 1,005 gpm being derived from clarifier and/or ABC pre-treatment. No flow limitations exist on the percolation ponds, as long as effluent limitations are met.

Stormwater containment measures and sampling would continue to follow SMC's Stormwater Pollution Prevention Plan, which has been approved by, and is on file with, the DEQ and CNF. In the event of a stormwater discharge to surface waters, SMC would sample and report the discharge as required by its approved stormwater MPDES permit. Ambient surface water and groundwater are monitored through the mine-wide water resources monitoring plan. SMC's operating permit (#00118) includes requirements for annual reporting and tri-annual monitoring of eight river or creek stations, one spring, 15 alluvial wells, two adit discharge sites and one mill decant water site. In addition, SMC monitors five wells 3 to 12 times per year and two springs twice per year. Water levels are acquired from three piezometers monthly. The requirements for SMC's water monitoring plan were provided in the 1985 and 1992 RODs for the 1985 Final Environmental Impact Statement, Stillwater Project and 1992 Final Environmental Impact Statement, Stillwater Mine Expansion 2000 Tons Per Day, respectively.

2.4.1.8 Reclamation

Reclamation of the existing tailings impoundment would occur concurrently to the extent practical. Reclamation is concurrent when a disturbance is reclaimed as soon as practical. For example, a lower lift of an embankment would be reclaimed as soon as it was constructed and at the same time as the next lift was being built.

The embankments would be reclaimed concurrently as lifts are completed. SMC would be continually adding tailings from the mill over the life of the mine. Consequently, final reclamation of the existing impoundment's surface would not occur until SMC stops tailings production and the impoundment is dewatered. All reclamation would be completed according to plans in the existing permit.

2.4.1.9 Bonding

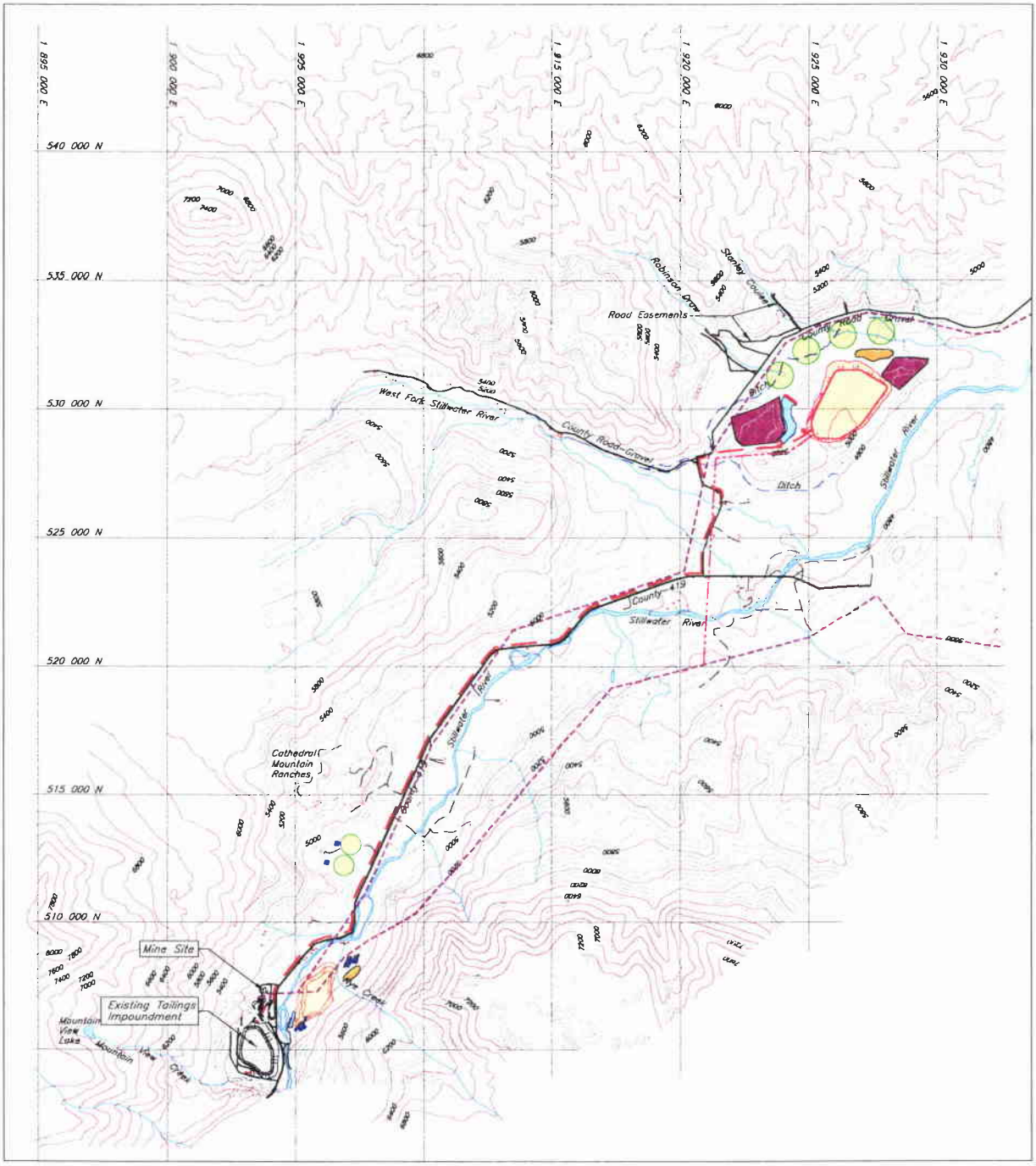
Reclamation bonds are determined by the agencies and are held by DEQ (the CNF may require additional bonds if it decides the state's bond is insufficient). The bonds are determined by computing costs to the state and CNF for reclaiming a site should the operator default. The state is required to review the bond at least every five years. If a bond is determined to be insufficient, it is recalculated and the company is required to submit the additional amount. SMC's current bond for the Stillwater Mine is $3,174,000.

If this alternative is selected, the bond would probably remain the same as it is now and be periodically adjusted for inflation. The bond includes costs for long-term maintenance of water management practices, such as percolation ponds and diversion ditches; demolition of buildings and other facilities; earth movement and soil replacement; seedbed preparation; and revegetation.

2.4.2 Alternative B — Proposed Action

SMC's proposal to change its mine waste management operation includes plans for waste rock and tailings production, management, and disposal as well as water management and disposal. The proposed changes are summarized below. **Figure 2–2** shows the overall locations of the primary facilities comprising the Proposed Action alternative. The application to amend Hard Rock Operating Permit #00118 (SMC 1996b) contains detailed discussions of these aspects and facilities.

In addition to changing SMC's mine waste management operation, implementation of the Proposed Action would remove the limitation on daily production (currently 2,000 tpd). If selected, SMC's Hard Rock Operating



LEGEND

- Proposed Pipeline Alignment
- Approximate Location of Overhead Power Line
- Approximate Location of Proposed Overhead Power Line
- Road
- Land Application Disposal Site
- Borrow Area
- Topsoil Stockpile
- Land Application Disposal Storage Pond
- Waste Rock Storage Area
- Hertzler Tailings Impoundment
- Sediment / Percolation Pond

Stillwater Mine
Revised Waste Management Plan
and Hertzler Tailings Impoundment
Draft Environmental Impact Statement

TOPOGRAPHY AND MINE SITE DETAILS ORIGINATED FROM INFORMATION SUPPLIED BY STILLWATER MINING COMPANY

0 2000 4000 10000
SCALE (FT)

N

Alternative B
Location of Primary Facilities Comprising the Proposed Action
Figure 2-2

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Permit (#00118) would be based on an approved "footprint" of surface disturbance, not a rate of production. SMC would be able to alter daily levels of production to respond to changing conditions in the market. The amendment discusses levels of production ranging up to 5,000 tpd, but an average of 3,000 tpd was used for preliminary design and analysis purposes. The proposed amendment (Proposed Action) and all information related to this EIS are on file with the DEQ and CNF (Beartooth District Office) for public review.

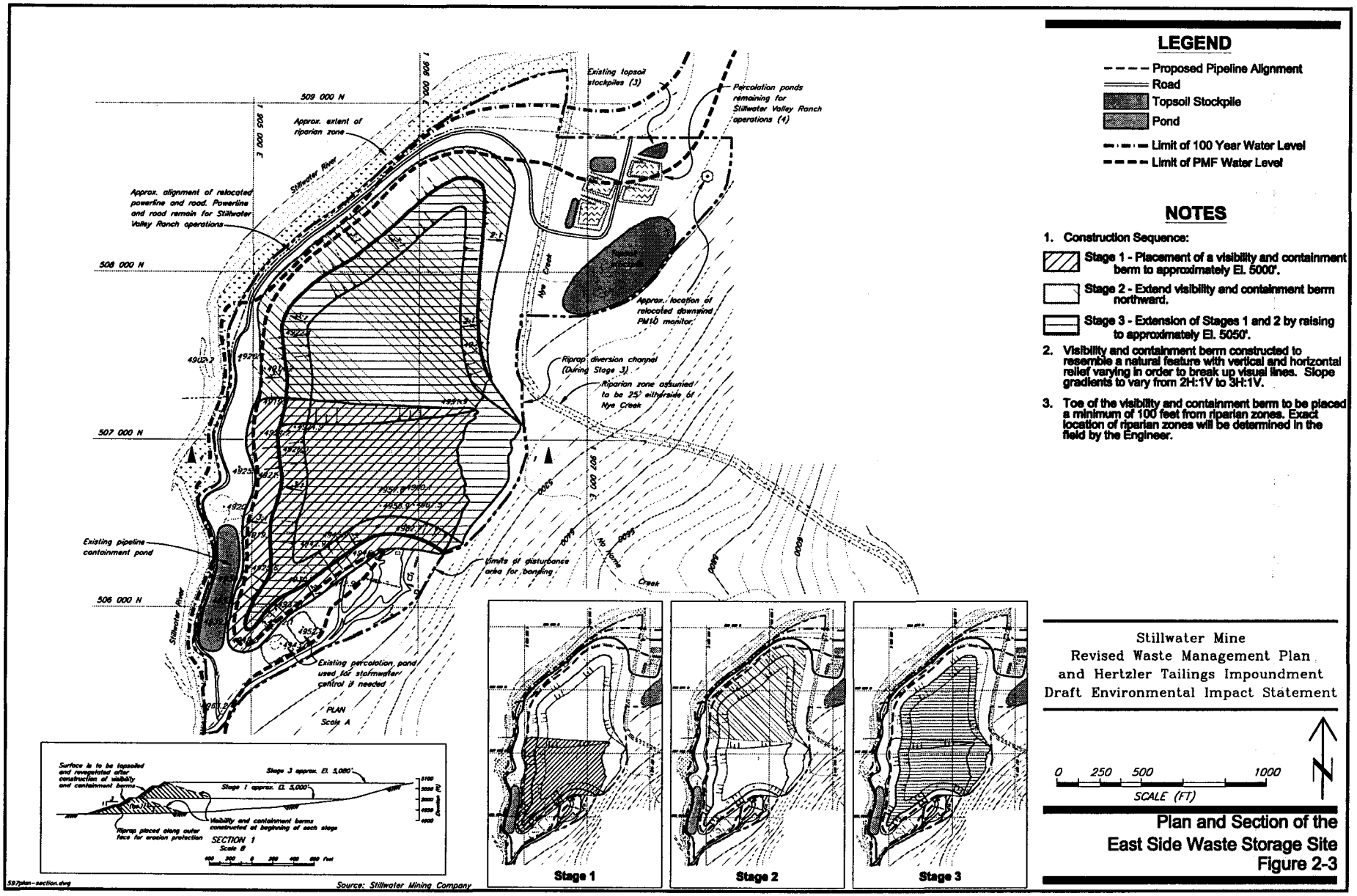
2.4.2.1 Waste Rock Production and Management

As is discussed under the No Action alternative, SMC is permitted to place mine waste rock in four areas (**Figure 2–1**). Together, these areas are capable of holding an additional 3,771,000 tons of waste rock. SMC needs additional capacity because this capacity is insufficient for the long term (17.5 million tons over 20 to 30 years).

SMC proposes to expand the visual berm on the east side of the Stillwater River into an east side waste storage site to obtain the additional capacity it needs for waste rock (**Figure 2–3**). This expansion would increase the storage site's areal extent to about 80 acres from the currently-permitted disturbance of 12 acres.

SMC would use trucks to haul the waste rock to the east side waste storage site. The trucks would use the existing access road and Stillwater River bridge located across Stillwater County Road 419 from the office/mill access. Because operational traffic patterns mandate that through traffic on Stillwater County Road 419 has the right-of-way, the haul trucks would yield right of way to traffic on County Road 419. After crossing the road, trucks would simply drive up ramps to access dumping points. No conveyors or lifts would be needed to place the waste rock (Gilbert 1998d, pers. comm.).

SMC may elect to use the 4400 level (under the river) connection between the west and east mining areas to move some of the trucks hauling waste rock without crossing County Road 419. In February 1996, DEQ approved and permitted the construction and operation of this under-the-river connection for this type of use (DEQ 1996). Some limited potential exists for waste rock from below the 5500 level to be hauled through the 4400 level connection, when it is completed at a future date. However, waste rock from higher levels would be transported aboveground and across County Road 419, which is the most efficient means to move the rock. To transport rock from these upper levels through the 4400 level connection, SMC would have to haul this rock out from the upper portals (no


LEGEND
Proposed Pipeline Alignment
Road
Topsoil Stockpile
Pond
Limit of 100 Year Water Level
Limit of PMF Water Level
NOTES
1. Construction Sequence:
Stage 1 - Placement of a visibility and containment berm to approximately El. 5000'.
Stage 2 - Extend visibility and containment berm northward.
Stage 3 - Extension of Stages 1 and 2 by raising to approximately El. 5050'.
2. Visibility and containment berm constructed to resemble a natural feature with vertical and horizontal relief varying in order to break up visual lines. Slope gradients to vary from 2H:1V to 3H:1V.
3. Toe of the visibility and containment berm to be placed a minimum of 100 feet from riparian zones. Exact location of riparian zones will be determined in the field by the Engineer.
509 000 N
508 000 N
507 000 N
506 000 N
905 000 E
907 000 E
Approx. extent of riparian zone
Stillwater River
Approx. alignment of relocated powerline and road. Powerline and road remain for Stillwater Valley Ranch operations
Existing topsoil stockpiles (3)
Percolation ponds remaining for Stillwater Valley Ranch operations (4)
Nye Creek
Approx. location of relocated downwind PM10 monitor
Riprap diversion channel (During Stage 3)
Riparian zone assumed to be 25' either side of Nye Creek
Existing pipeline containment pond
Limits of disturbance area for bonding
Existing percolation pond used for stormwater control if needed
PLAN
Scale A
Surface is to be topsoiled and revegetated after construction of visibility and containment berms
Stage 3 approx. El. 5,080'
Stage 1 approx. El. 5,000'
Riprap placed along outer face for erosion protection
Visibility and containment berms constructed at beginning of each stage
SECTION 1
Scale B
Stage 1
Stage 2
Stage 3
Stillwater Mine
Revised Waste Management Plan
and Hertzler Tailings Impoundment
Draft Environmental Impact Statement
0 250 500 1000
SCALE (FT)
Plan and Section of the
East Side Waste Storage Site
Figure 2-3
Source: Stillwater Mining Company

connections exist for hauling rock to the 4400 level completely underground) and then back underground to access the connection.

SMC would construct the east side waste storage site in three stages (**Figure 2–3**). In Stage 1, the storage site would be constructed south of Montana Power Company's high-voltage power line. During Stage 2, SMC would extend the storage site north to within 100 feet of the riparian area associated with Nye Creek. In Stage 3 SMC would raise the waste pile to an elevation of 5,080 feet with no lateral expansion.

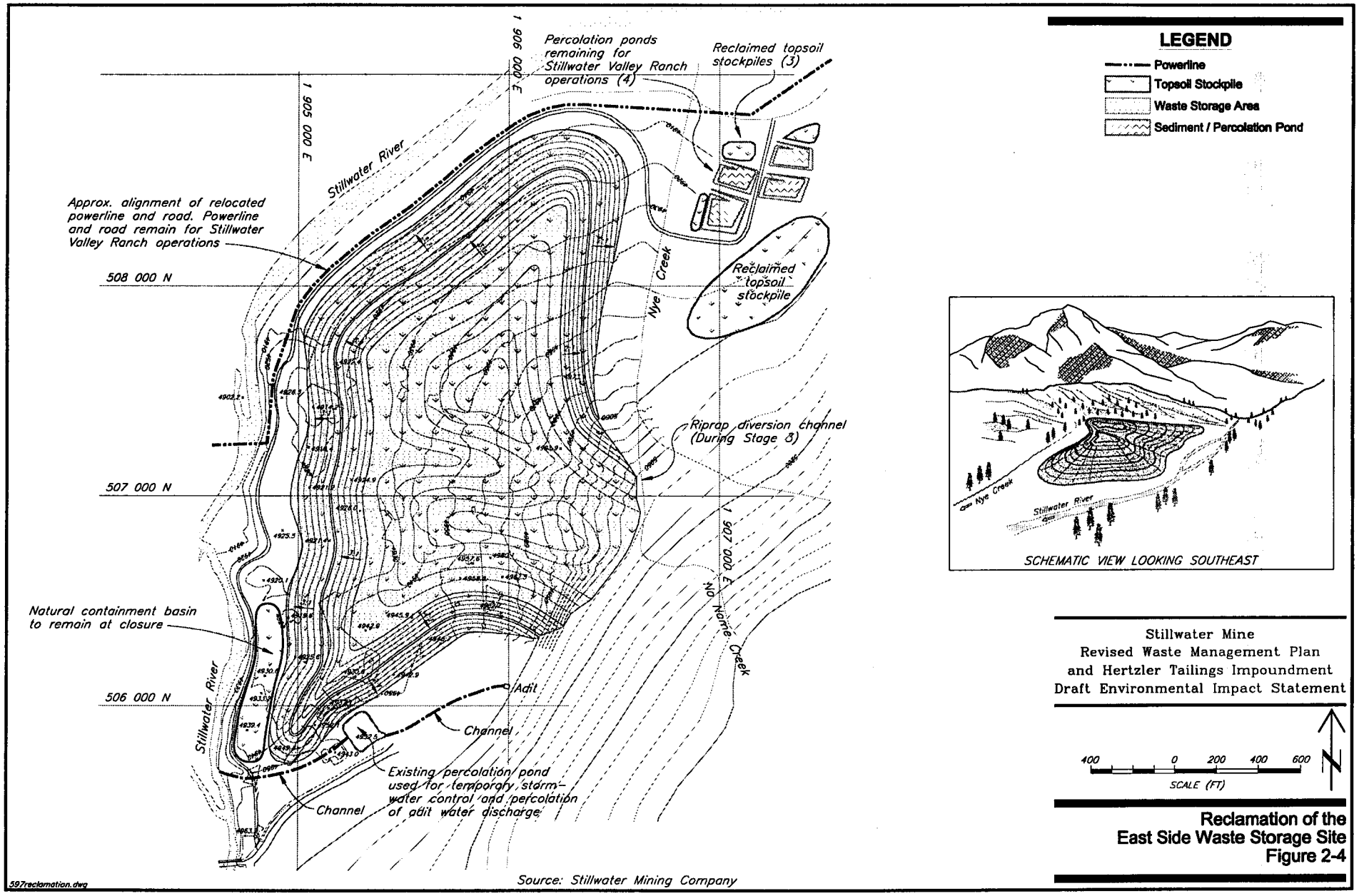
Facilities currently present at the east side waste storage site would be relocated or modified to accommodate the storage facility. Montana Power Company's high-voltage power line and Beartooth Electric's power line would be relocated to the downstream toe of the embankment. The LADs would be relocated to Hertzler Ranch, Stratton Ranch, or both, as discussed in the water management and disposal section below. Topsoil stockpiles and some sedimentation/ percolation ponds also would be relocated. Water monitoring facilities would be relocated or modified to accommodate the waste storage site. Additional monitoring wells also would be added, as needed.

Although constructed in stages, overall construction and reclamation of the east side waste storage site would incorporate several features to mitigate potential adverse effects. During the last years of construction, the top cap would be selectively shaped to sculpture the embankment about the 5,080-foot elevation. This shaping would result in an irregular surface that would help the embankment blend with the adjacent natural terrain (**Figure 2–4**). Embankment slopes would vary between 3:1 (three units of distance horizontally to one unit vertically) and 2:1. Lower slopes would be flattened to 3:1 to minimize erosion in case of a probable maximum flood (PMF). Additionally, final reclamation would involve establishing a mosaic of vegetation similar to that permitted for the existing tailings impoundment. This mosaic also would help the embankment blend with the adjacent terrain.

2.4.2.2 Tailings Production and Management

As discussed under the No Action alternative, the capacity of the existing tailings impoundment is limited. This impoundment is designed to hold 3.5 million tons of tailings. At present rates of production, the impoundment will reach its capacity in 2003. Thus, SMC needs additional capacity to continue operating the mine for an additional 20 to 30 years.

To provide the additional capacity for tailings needed for continued operation, SMC proposes to construct and operate a new impoundment at the former Hertzler Ranch. Tailings would be transported from the mine to this impoundment



Source: Stillwater Mining Company

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Revised Waste Management Plan
and Hertzler Tailings Impoundment
Draft Environmental Impact Statement

Reclamation of the East Side Waste Storage Site
Figure 2-4

through two 8-inch high-density polyethylene-lined steel pipelines. Additionally, process water would be reclaimed from the impoundment and returned to the mill through a 10-inch diameter steel pipeline installed in the same rights-of-way as the two tailings pipelines. Adit water would be transported to the LADs through a steel pipeline installed with the other pipelines (the two water pipelines are discussed further in **Section 2.4.2.3**). Thus, all four pipelines would be buried in the same trench.

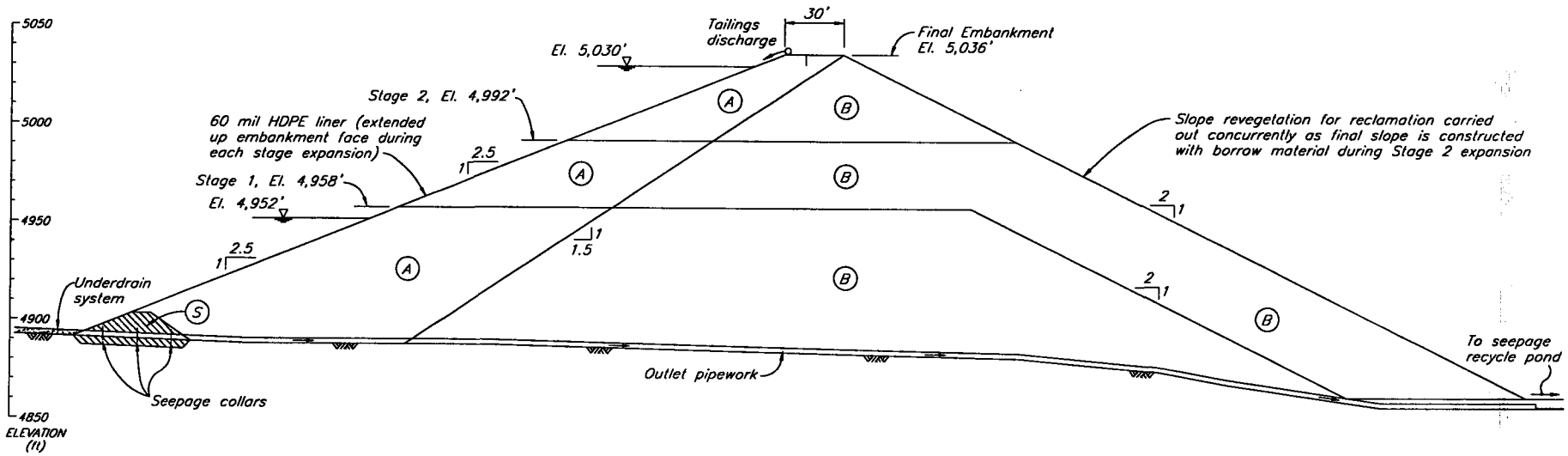
SMC plans to operate the Hertzler tailings impoundment in concert with the existing tailings impoundment to maximize operational flexibility. The integrated tailings transport system, as proposed, would allow SMC to pump tailings from the concentrator circuit or the underground sand plant to either tailings impoundment. It also would allow SMC to recover and transport tailings from the existing tailings impoundment to the Hertzler tailings impoundment. With this mode of operation, the operational life of the existing tailings impoundment could be extended. The impoundments could be operated in rotation or seasonally. Maintenance on sections of pipeline could occur without impeding production. Also, if problems arise with the buried pipelines or Hertzler tailings impoundment, the flow of tailings could be diverted to the existing impoundment until the problems are corrected.

Hertzler Tailings Impoundment

As proposed, the Hertzler tailings impoundment would have a final embankment height of about 156 feet (crest elevation of 5,036 feet) and would occupy 163 acres. With these dimensions, this impoundment would hold approximately 15 million tons of tailings. This capacity would allow SMC to continue operating the Stillwater Mine for at least another 30 years, at average production rates of 3,000 tons of ore per day.

The embankment for the impoundment would be constructed in three stages using the downstream method (**Figure 2–5**). Tailings and water piped from the mill would be deposited behind the embankment during each stage of development. The first stage would be constructed to a maximum height of 78 feet (crest elevation of 4,958 feet). Construction of stage 2 would raise the embankment's crest elevation to 4,992 feet, increasing the maximum height to 112 feet. The third stage would be constructed to the maximum height of 156 feet (crest elevation of 5,036 feet). With final slopes of 2:1 and 2.5:1 on the embankment's downstream and upstream faces, respectively, the total volume of borrow material needed for construction would be about 6.7 million cubic yards.

Because of the long haul distance from the mine, the embankment would be built from on-site borrow material rather than waste rock from the mine. Some of the material would be excavated from within the footprint of the impoundment during initial construction of the embankment and the impoundment's liner and



ZONE	MATERIAL TYPE
S	Low Permeability Glacial Till
A	Glacial Till
B	Random Fill

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and Hertzler Tailings Impoundment
Draft Environmental Impact Statement

NOT TO SCALE

Hertzler Impoundment Typical Cross Section of the Embankment
Figure 2-5

597cross.dwg

Source: Stillwater Mining Company, 1996.

underdrain system. The rest of the material would be obtained from two borrow areas located near the impoundment **(Figure 2–2)**.

The impoundment also would be designed to incorporate technology to minimize seepage and promote drainage of the tailings. The impoundment would be lined with a 60-mil thick, high-density polyethylene (HDPE) liner to reduce the amount of seepage to groundwater beneath the impoundment. Finer glacial till, which is a clayey material with a naturally-low permeability of at least 1×10^{-6} cm/sec, is available at Hertzler Ranch (Knight Piésold Ltd. 1996) and would be used as the bedding for the HDPE liner. The HDPE liner would have an effective permeability of at least 1×10^{-10} cm/sec.

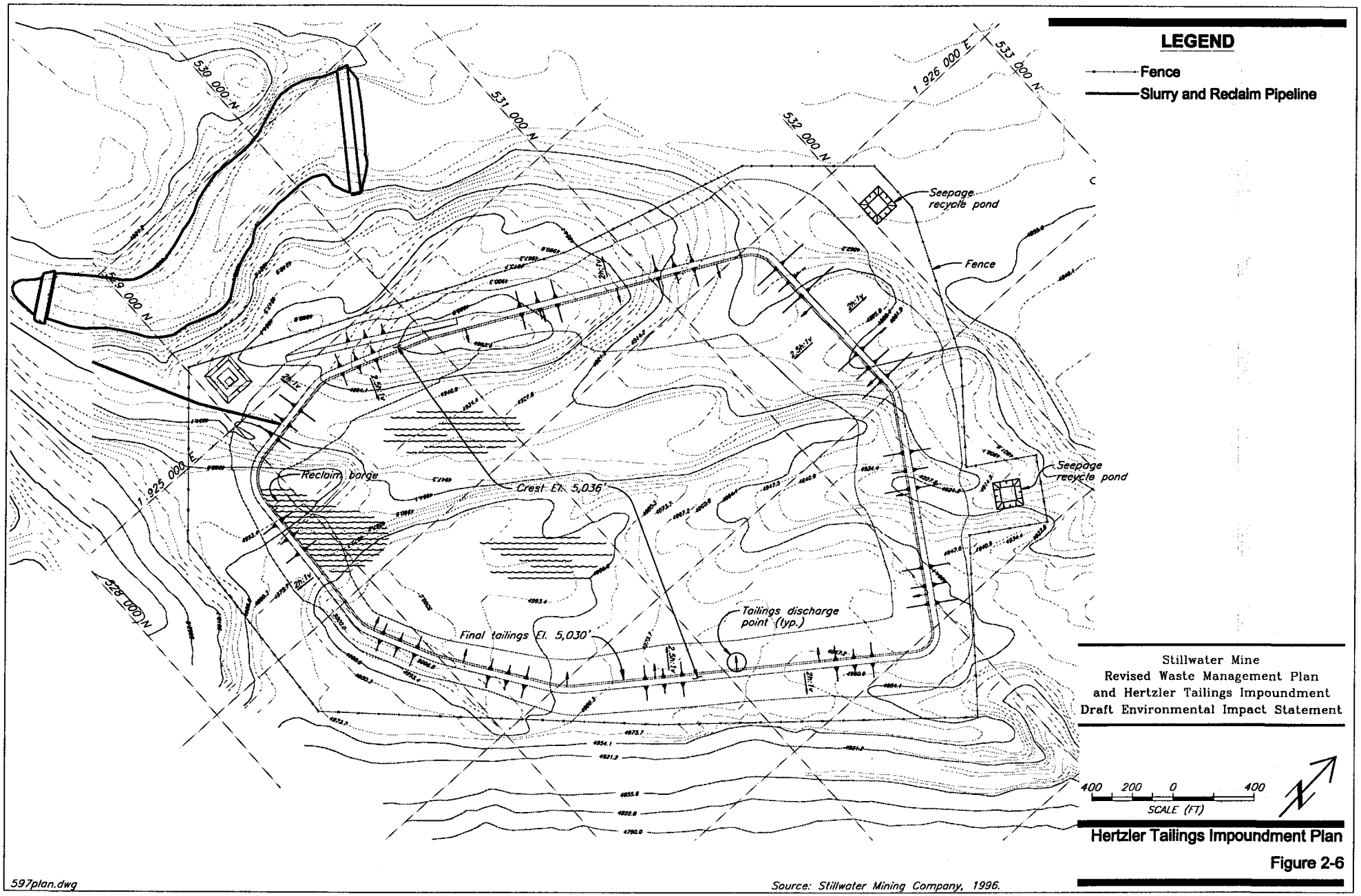
The seepage collection system would consist of underdrain pipes covered with a filter media (6-inch perforated corrugated polyethylene (CPT) pipe spaced a maximum of 300 feet apart in a 1-foot thick layer of sand) constructed on top of the HDPE liner and recycle ponds. The seepage collected by these underdrains would drain into HDPE-lined seepage recycle ponds located outside the impoundment **(Figure 2–6)**. Seepage collected in these ponds would be pumped back into the tailings impoundment. Automated level-control switches would start pumping of the ponds when water in the ponds reaches a pre-determined level.

The tailings impoundment's design includes minimum freeboard, both during construction and normal operations, to ensure overtopping of the embankment does not occur. During construction, SMC would maintain sufficient freeboard to store the volume of a Probable Maximum Precipitation (PMP) event. This freeboard would contain internal runoff from storm events and the negligible external runoff that may enter the impoundment.

Tailings Pumping and Transmission Systems

The tailings pumping and transmission systems would consist of a series of facilities constructed to transport tailings from the concentrator, underground sand plant, or existing tailings impoundment to the new Hertzler impoundment. Components of this system include a tailings thickener plant, tailings reclaim system (to reclaim tailings from the existing impoundment), tailings pumping system, and tailings slurry pipelines. Each component is described below.

Slimes generated from the cycloning of bulk tailings would be directed to a process thickener in the tailings thickener plant. The process thickener would increase the solids content of the slimes being pumped to the Hertzler tailings impoundment. This increase in solids would reduce requirements for pumping and provide the flexibility to handle wide variations in input flows and densities. Thickened slimes extracted from the bottom of the process thickener would report to a tailings pumping facility for pumping to the Hertzler impoundment.



Stillwater Mine
Revised Waste Management Plan
and Hertzler Tailings Impoundment
Draft Environmental Impact Statement

Hertzler Tailings Impoundment Plan

Figure 2-6

A tailings reclaim system also would be constructed in association with the process thickener. This system would include a barge within the existing tailings impoundment, a bank of cyclones, and pipelines. The barge would dredge tailings from the existing impoundment under operational procedures that would ensure the impoundment's HDPE liner is not compromised. Tailings would be pumped to the bank of cyclones. The cyclone overflow (slimes fraction) would be directed to the process thickener. Sand generated in the process would be used as mine backfill or for other surface uses or returned to the tailings impoundment.

The tailings pumping facility would consist of a series of pumps that would move the tailings through the tailings slurry pipelines to the Hertzler impoundment. A similar series of backup pumps also would be constructed. The pumps would be electrically driven. Gravity-fed high-pressure water from the underground mine water reservoir at the 6,500-foot elevation would be available through the tailings pumping facility for emergency flushing of the pumping system during power failures, if flushing is needed.

The tailings slurry pipelines would extend about 41,000 feet (7.8 miles) from the tailings pumping facility at the mine to the Hertzler impoundment. Between the mill and the Hertzler impoundment, the pipelines would be buried in the rights-of-way of Stillwater County roads 419 and 420 (**Figure 2–2**). The pipelines would be buried about 5 feet deep, including under all streambeds, drainage crossings, and the West Fork of Stillwater River. Where possible, SMC proposes to bury the pipelines below the frost line. However, in some instances where the pipeline may not be buried below the frost line, such as within the roadway, SMC will insulate the pipeline to prevent freezing using the same technology currently being used on Alaskan pipelines. Both pipelines would be double walled, constructed of 8-inch steel pipe lined with an inner sleeve of HDPE.

2.4.2.3 Water Management and Disposal

As discussed under the No Action alternative, SMC handles two primary waste water streams at the Stillwater Mine. One stream is adit water, which is groundwater intercepted by the mine workings. The second stream is process and tailings water, which is the water used in the milling and concentrating circuits and pumping of the tailings. Under this alternative, SMC would continue to handle the water in these waste water streams differently.

Adit Water

Under this alternative, SMC would continue to handle adit water using the existing percolation ponds, the ABC, and LAD systems. SMC may double the capacity of the ABC treatment to handle up to 1,000 gpm. SMC also would add

additional LAD systems at the Stratton and Hertzler ranches (**Figure 2–2**) when construction of the east side waste storage site forces SMC to move the east side LAD to these sites. An unlined steel pipeline buried with the slurry tailings pipelines (discussed above) would transport the adit water from the clarifiers to these sites. The capacity of the Hertzler LAD system could be designed to handle flows in excess of 2,000 gpm.

During the winter, excess adit water would be routed to the Stillwater Valley Ranch and mill site percolation ponds and to LAD storage ponds at the Stratton and Hertzler ranches (see **figures 2–1, 2–2, 2–3, 2–4, and 2–5**). The Hertzler LAD storage pond would have a capacity of about 80 million gallons of water. Materials used to construct the Hertzler LAD storage pond's foundation would consist of low-permeability, fine-grained, glacial till deposits that would minimize percolation (Knight Piésold 1996).

During the growing season (generally April through October), excess adit water and water stored in the Hertzler LAD storage pond would be routed to the LAD pivots at the Stratton and Hertzler ranches. SMC's records over the last 4 years on its east-side LAD suggest the LAD removes more than 80 percent of the nitrates dissolved in the adit water. Due to this effectiveness, application of adit water using the LAD qualifies as secondary treatment for removing nutrients.

Tailings and Process Water

Process water includes water used within the mill and concentrating circuits. This water contains reagents SMC uses to separate concentrate from the ore. The reagents, which are mainly long-chain alcohols and organic compounds that readily breakdown in water, are used in small quantities. Consequently, they are highly diluted in the tailings water. However, some inorganic constituents, such as sulfate, may remain at high concentrations. The reagents used in milling are fully described in the 1985 Final EIS for the Stillwater Mine (DSL and Forest Service 1985, pgs VI–12 through VI–15).

Although the reagents, at the concentrations present in the tailings water, pose no hazard to human health or the environment, SMC handles the water containing these reagents separately from adit water. In addition to being used in the milling and concentrating circuits, process water also would be used to transport tailings to the Hertzler tailings impoundment through the slurry pipelines. In the impoundment, the tailings water would either evaporate or would be reclaimed and pumped back to the mill for reuse in the milling and concentrating circuits.

To facilitate reclaiming tailings water, SMC would construct a reclaimed water pipeline between the mill and the Hertzler tailings impoundment. This 10-inch steel pipeline would be constructed and buried in the same rights-of-way as the tailings slurry and adit water pipelines. The pipeline would return tailings water

from the Hertzler impoundment back to a process water head tank above the concentrator for reuse in the milling and flotation circuits.

2.4.2.4 Power Requirements

Montana Power Company's power line servicing the mine is capable of providing up to 25 megawatts of power (Cluett 1998). Currently, the mine requires about 12 megawatts to mine and process 2,000 tpd of ore. Although SMC plans to operate at an average production of 3000 tpd, production could peak as high as 5,000 tpd. Additional power of up to a total of 28 to 32 megawatts would be required for 5,000 tpd of ore production.

When the capacity of the existing 50 kV power line to the mine (18 to 25 megawatts) is unable to meet the mine's needs as production increases, improvements would have to be made to the existing line. Before production at the mine exceeds approximately 4,200 tpd, the existing line would have to be upgraded from 50 kV to 69 kV. Montana Power Company would accomplish this upgrade by replacing the insulators presently on the poles with heavier insulators and changing transformers at substations along the route. This upgrade (to 69 kV) is expected to be adequate for up to 5,000 tpd, depending upon the mining equipment SMC employees. If and when the demand for power exceeds the capacity of the 69 kV line, Montana Power Company would upgrade the line to 100 kV. This upgrade would involve stringing new conductors (wires) and upgrading transformers. Thus, in all cases, upgrades of the power line to the Stillwater Mine would involve improvements to the existing line as opposed to the construction of an additional line into the area Cluett 1998).

Development of the Hertzler impoundment would include about a one-mile extension of the existing three-phase power line from a point near the junction of Stillwater County roads 419 and 420. This extension would probably follow the existing road rights-of-way or the power line right-of-way. The new power line would provide for an operational power demand of about 500 horsepower at the Hertzler Ranch location.

2.4.2.5 Roads and Traffic

SMC proposes no modifications of existing and previously-approved permit-related roads within the permit boundary. Access roads to the Hertzler Ranch (Stillwater County roads 419 and 420) may be upgraded to allow for installation of the system of buried pipelines within the rights-of-way. SMC would negotiate an agreement with Stillwater County for the upgrades separate from SMC's Hard Rock Impact Plan (SMC 1998).

If SMC and Stillwater County were unable to negotiate an agreement for the rights-of-way along Stillwater County roads 419 and 420, SMC may consider

use of the power of eminent domain to claim the use of the rights-of-way for installation of the pipelines. Montana statute defines eminent domain as "the right of the state to take private property for public use." (Montana Code Ann. § 70-30-101, 1995). The legislature; however, provided private individuals and corporations with the power of eminent domain for specific public uses (Montana Code Ann. § 70–30–102, 1995). Use of the statute by corporations, including mining companies, has occurred and provides a precedent for such an application of eminent domain.

Minor road extensions would be required from Stillwater County Road 420 to the Hertzler impoundment. These extensions would be constructed on property owned by SMC and would not be open to the public. Furthermore, they would be reclaimed after SMC closes and reclaims the impoundment.

2.4.2.6 Workforce Requirement/Socioeconomics

Present economic indicators and estimated reserves of ore suggest the operational life of the Stillwater Mine could be extended at least another 30 years. Workforce requirements for the operation depend on levels of production and the methods used for mining. Current projections are for employment (permanent employees and contractors) at SMC's mineral operations to increase from 655 employees on December 31, 1997 to 700 employees and contractors with implementation of this alternative and an average level of production of 3,000 tpd. SMC anticipates that future expansion of underground production would be accompanied by a shift toward mechanized mining, which is less labor intensive than conventional cut and fill mining methods. These potential shifts in mining methods would not be expected to reduce the present workforce requirement of 700 employees and contractors, but may reduce the need for expanding the workforce as production at the mine increases.

Recently (August 1998), SMC and affected units of local government agreed to an amendment of SMC's 1988 Amended Hard Rock Mining Impact Plan. The 1998 amendment was needed because SMC's employment had exceeded the threshold for amendment established in the 1988 amended plan. The affected units of local government involved in the 1998 amendment are Stillwater County, Town of Columbus, Columbus Elementary School District, Columbus High School District, Absarokee Elementary School District, Absarokee High School District, Fishtail Elementary School District, Nye Elementary School District, and Absarokee Water and Sewer District (SMC 1998). The "affected units of local government" are those units of local governments that would experience net impact costs during any one year of SMC's mining operation or a unit of government within which the mineral development is located.

2.4.2.7 Monitoring

Tailings and Waste Rock

Sampling of the ore body conducted for more than 20 years has shown no capacity for acid generation. Once each year, SMC combines samples from all mine waste rock storage sites for laboratory analysis to verify the lack of acid-generating potential of the materials as directed by previously-approved/required agency mitigations. The tailings, which are sampled separately, also are tested for acid-generating potential. The tailings at the Hertzler tailings impoundment would be included in this sampling program. The sampling program would continue for the life of the mine and would be expanded to include any new storage sites.

Pipeline Monitoring and Spill Contingency Plan

The Monitoring and Spill Contingency Plan for the pipelines (tailings slurry, reclaimed water, and mine water) is comprised of three elements. They are pipeline design, pipeline inspections, and pipeline leak detection and response. Each contributes to the overall monitoring and spill contingency plan.

All four pipelines have been designed to minimize the potential for leaks and to maximize the potential for localizing the effects of any leaks. The design includes burial of the pipelines to minimize the potential for freezing, vandalism, and damage from vehicles. Also, the pipelines would be installed within the western right-of-way of Stillwater County roads 419 and 420, which maximizes the potential to localize the effects of any rupture. Finally, the design incorporates several features specifically included to minimize the potential for leakage and contain any leakage that may occur.

SMC would conduct routine inspections of the pipelines. Inspections would be accomplished from access sites located along the path of the pipelines. Inspection vaults would be installed at five locations along the pipelines with access provided through man-hole entry points. Two inspection vaults would be installed at the crossings on the West Fork of the Stillwater River. Removable pipe spools would be located within the inspection vaults and the pump station. These pipe spools would be periodically unbolted and checked for wear. The inspectors would record the thickness of the pipe's wall and would document any unusual patterns of wear. Before any wear identified during the inspections threatens the integrity of the liner, SMC would shut down the transport of tailings, flush the pipeline to clear the tailings, and extract and replace the HDPE liner between the two vaults that encompass the section being removed. This extraction would not require any digging or disturbance to the rights-of-way. The liner is simply pulled out of the pipeline between access points and a new liner is pulled through and welded to the ends of the existing liner at each access point.

Inspections of the pipe spools would occur on specific schedules. During the first two years of the tailings slurry pipelines' operation, inspections would occur every six months. Inspections of the water lines would occur once per year. At the end of the initial two-year period, SMC may modify the inspection schedule, based on the results of the initial inspections.

SMC also would install an automated leak detection system during construction of the pipelines. This system would include sensors and a central control system. Sensors installed in the tailings and water pipelines at the main pump station, at the Hertzler terminal station, and in the five inspection vaults would continuously monitor flows and pressures. A rapid drop in pressure may indicate a rupture of the pipeline and a decrease in flows combined with a higher pressure may indicate a blockage in the pipeline. In addition, moisture sensors installed in the vaults would monitor the tailings pipelines for leaks. Leaks within the tailings pipelines would migrate up the line between the HDPE liner and the steel pipe and trigger the moisture sensors within the vault.

Information from the various sensors would be transmitted to the central control system in the main pump station for monitoring. The sensors would be connected to a computerized logic control system by a control cable conduit buried within the pipeline trench. The control system would monitor the operational parameters and sound an alarm should any significant deviation from normal operational values occur. An alarm would result in the shutdown and inspection of the pipelines.

If a leak is detected in a pipeline, the line would be flushed before repairs are made. Water and slurry materials flushed from the pipelines would be directed to the Hertzler tailings impoundment. If flushing must occur during a power outage, SMC would use a diesel generator or a high-pressure, gravity connection from an underground mine water storage reservoir located on the 6500 level to flush the lines. When constructed, the size of this reservoir would be sufficient to contain enough water to flush both tailings pipelines of all tailings. The tailings would be flushed into the Hertzler impoundment.

Should a rupture occur, SMC would respond immediately and make every effort to keep the contents of the pipeline from entering adjacent surface waters. If a rupture occurs at the Hertzler terminal station where the pipelines make the transition from underground to aboveground, the contents would be transferred to the terminal station containment pond. From this pond, the contents would be pumped into the impoundment. Ruptures along other locations of the pipeline would be handled as appropriate. In any case, SMC would notify DEQ, CNF, and Stillwater County of any rupture and inform all parties of conditions at the site of the rupture and cleanup efforts underway.

Water Quality
The program for monitoring water quality would be the same as that described under Alternative A because the same MPDES permit would exist under this alternative. Thus, sampling for nutrients at and below the percolation pond outfalls would occur and specific limitations on nitrate and phosphate loading would exist. Direct discharge of adit water to the Stillwater River through Outfall 001 would initiate sampling of metals and nutrients in surface water upstream and downstream of the mine. Biomonitoring of this directly-discharged water also would occur.

Stormwater containment measures and sampling would follow SMC's Stormwater Pollution Prevention Plan, which has been approved by, and is on file with, the DEQ and CNF. In the event of a stormwater discharge to surface waters, SMC would sample and report the discharge as required by its approved stormwater MPDES permit.

If this alternative is approved, SMC would be required to modify its water monitoring plan and submit it to DEQ for approval. This plan would incorporate the placement of additional monitoring wells in the areas proposed for development and would specify the sampling intervals and parameters for testing. These areas would include the Hertzler tailings impoundment site, the east side waste rock storage site, and any areas upon which LAD or percolation ponds are constructed.

The water quality monitoring plan for the impoundment, which must be approved by the agencies, would specifically include the following components:

- sampling of process water in the tailings pond and seepage recycle ponds for water quality analyses;
- sampling of groundwater in monitoring wells;
- sampling of surface water quality down gradient of the impoundment; and
- flow monitoring in the seepage collection system within the impoundment.

2.4.2.8 Reclamation

Reclamation procedures have been defined for the tailings impoundments, east side waste rock storage site, and pipelines. These procedures are discussed below.

Existing Tailings Impoundment
Reclamation of the tailings impoundment would occur concurrently to the extent practical. Reclamation is concurrent when a disturbance is reclaimed as soon as practical. For example, a lower lift of an embankment might be reclaimed as soon as it was constructed and at the same time as the next lift was being built.

The embankments would be reclaimed concurrently as lifts are completed. SMC would be continually adding tailings from the mill and removing and pumping tailings to both impoundments over the life of the mine. Consequently, final reclamation of both impoundments' surface would not occur until SMC stops tailings production and the impoundments are dewatered. All reclamation would be completed according to plans in the existing permit.

Hertzler Tailings Impoundment

The outer slope of the tailings embankment would be reclaimed concurrently with the facility's operation in stage 1. It would be redisturbed again in stage 2 and reclaimed again. The primary purpose of this concurrent reclamation is to minimize visual effects and fugitive dust. A minimum of 12 inches of growth media (soil, soil substitute, or both) would be placed on the outer surface of the embankment and revegetated with an approved seed mix.

Growth media for use in reclaiming the tailings impoundment would originate from one of two sources. The top 12 inches of topsoil and subsoil ("soil") within the Hertzler impoundment site would be salvaged. This soil would be used immediately in concurrent reclamation of the embankment or stored in topsoil stockpiles (**Figure 2–2**) for use in final reclamation of the impoundment. The second source of growth media would be borrow material obtained within the Hertzler Ranch area (**Figure 2–2**) that SMC would use as "soil substitute." This borrow material would consist of alluvial and glacial till subsoils.

Although this borrow material lacks some characteristics of topsoil, several characteristics make it a suitable growth medium. The gravel content of this material makes it less erosive than topsoil alone, which has made similar borrow material within the permit area suitable for use on the existing impoundment and waste rock storage embankment slopes within the permit area. Volumes of the borrow material present in the area are sufficient to compensate for the relatively shallow soils that exist at the Hertzler Ranch. The extra volumes of material have made it possible to reclaim areas where existing soils are very shallow. Also, because this material would be used to construct the embankment, the primary requirement for soil would be the amount needed to reclaim the surface of the impoundment upon closure.

Final reclamation, revegetation, and closure of the impoundment would follow the same procedures specified in SMC's plan for the existing tailings impoundment, which DEQ and CNF approved previously. The surface of the impoundment may settle between 1 and 10 feet, depending on the distribution and thickness of the tailings. An average cap of 5 feet (including a minimum of 24 inches of soil or soil substitute) would be placed on the impoundment surface after dewatering and regrading.

Before closure, SMC would conduct a capping study of the in-situ tailings to determine the degree of consolidation and settlement. This information would be used by the agencies and SMC to determine potential long-term settling that might compromise the reclamation cap, cause a safety hazard, create ponding of stormwater on the surface, or create pathways for surface water pollution. They also would incorporate this information into final plans for surface regrading.

East Side Waste Rock Storage Site

During each of the three stages of construction, the visibility and containment berms would be regraded, covered with topsoil, and revegetated. The outer edges of each lift of the waste rock storage site would be reclaimed concurrently as the lifts are completed. After Stage 3 is completed, the waste rock storage site would be regraded to blend with the surrounding natural terrain, capped with subsoil, covered with 12 inches of topsoil, and revegetated. Riprap and permanent stormwater drainage diversions would be installed along the east and northeast sections of the storage site between the No Name and Nye Creek drainages, if necessary.

Pipeline System

The surface disturbance along the pipeline route would be reclaimed immediately after the pipelines are installed. Twelve inches of salvaged soil would be placed over the compacted fill above the pipelines. The surface would then be revegetated with an approved seed mix.

Following closure of the Hertzler tailings impoundment, the inspection vaults and man-hole entries would either be removed or filled with concrete. The surface would then be regraded, covered with 12 inches of topsoil, and revegetated. The pipelines would remain buried in the ground.

2.4.2.9 Bonding

If this alternative is selected, the additional bond would be calculated using the specifications, stipulations. and mitigation measures contained in the approved and permitted amendment. The bond would include costs for long-term maintenance of water management practices, such as percolation ponds and diversion ditches; demolition of buildings and other facilities; earth movement and soil replacement; seedbed preparation; and revegetation. SMC could not begin constructing any of the facilities comprising this alternative until the additional bond has been transferred to DEQ.

DEQ has developed an approximate estimate of the range in which the new bond amount would be, if this alternative is selected. Bond for SMC's operations would increase from slightly more than $3 million to $11 to $13 million dollars.

Additionally, if DEQ decides long-term water treatment is necessary at closure, the bond for this alternative would increase to $20 to $25 million.

2.4.3 Alternative C — Modified Centerline Expansion and Hertzler Tailings Impoundment

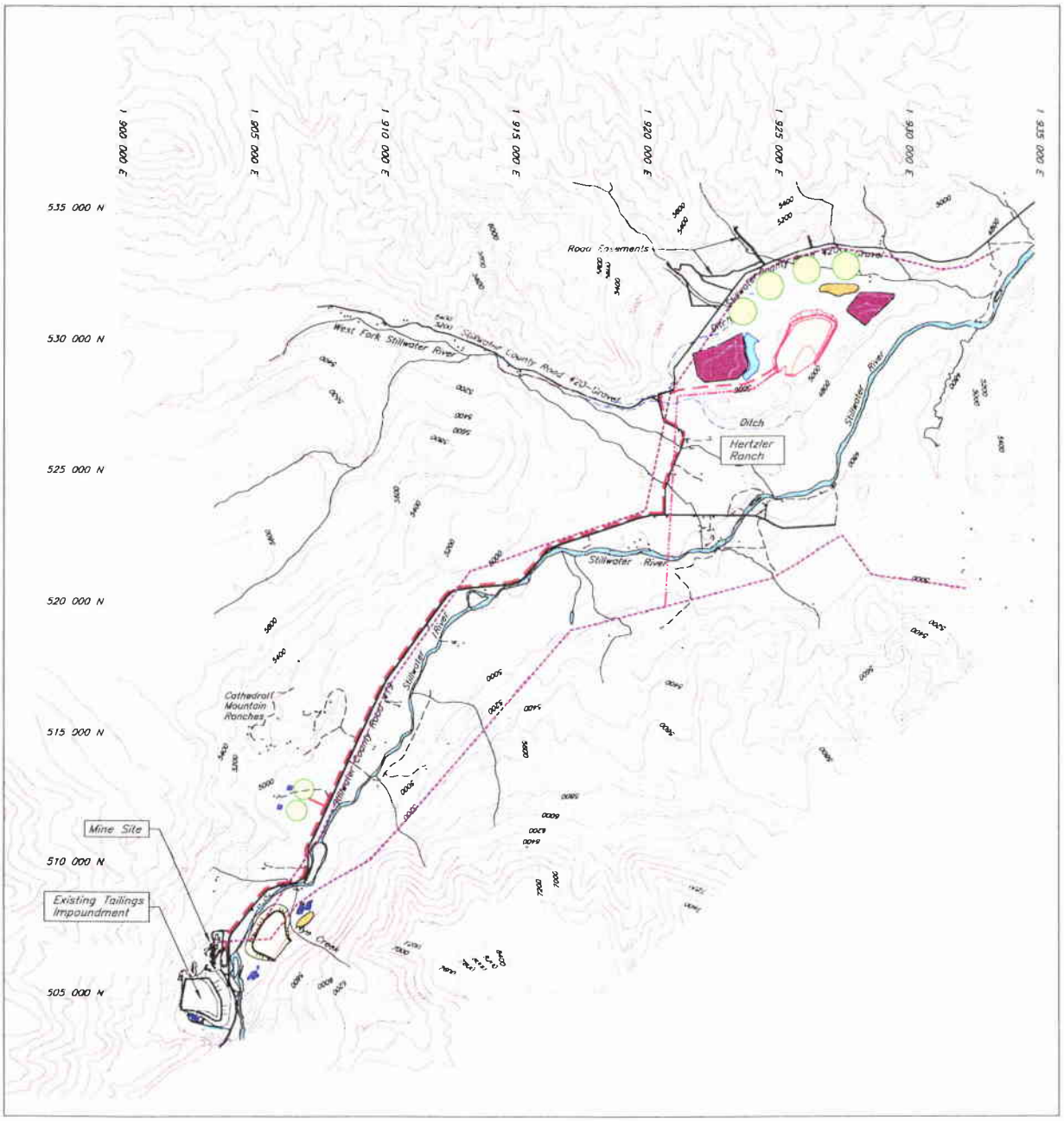
Under this alternative, SMC would expand the existing tailings impoundment and construct a new impoundment at Hertzler Ranch. SMC also would then later construct a waste rock storage facility on the east side of the Stillwater River and develop additional facilities for LAD. **Figure 2–7** shows the distribution of the primary facilities comprising this alternative. The primary facilities are described below.

Implementation of this alternative would result in a smaller impoundment at Hertzler Ranch than would be constructed under the Proposed Action (Alternative B). This smaller impoundment would be 42 feet lower than the Proposed Action's impoundment and less visible. Also, the areal extent of surface disturbance would be about 40 percent less than what would occur under the Proposed Action.

Selection and implementation of this alternative also would remove the limitation on daily production (currently at 2,000 tpd). The permit would be based on an approved "footprint" of surface disturbance, not a rate of production. SMC would be able to alter daily levels of production to respond to changing conditions in the market, as described under the Proposed Action.

2.4.3.1 Waste Rock Production and Management

Under this alternative, SMC would have the capacity to dispose of an additional 21.271 million tons of waste rock. First, 1,630,000 tons of waste rock would be placed in the temporary and permanent storage areas already permitted by DEQ and CNF for waste rock (**Figure 2–1**). Another 1,755,000 tons of waste rock would be incorporated into the embankments of the existing tailings impoundment as it is completed to its currently-permitted configuration. About 2,660,000 tons of waste rock then would be incorporated into the embankments of the existing tailings impoundment as it is expanded from its currently-permitted configuration. The remaining 15,226,000 tons of waste rock would be placed in the east side waste storage site (**Figure 2–3**). The east side waste storage site would be constructed and located as described under Alternative B — Proposed Action.



LEGEND

- Proposed Pipeline Alignment
- Approximate Location of Overhead Power Line
- Approximate Location of Proposed Overhead Power Line
- Road
- Land Application Disposal Site
- Borrow Area
- Topsoil Stockpile
- Land Application Disposal Storage Pond
- Waste Rock Storage Area
- Hertzler Tailings Impoundment
- Sediment / Percolation Pond

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Location of Primary Facilities Comprising Alternative C - Modified Centerline Expansion and Hertzler Tailings Impoundment
Figure 2-7

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2.4.3.2 Tailings Production and Management

SMC would split the disposal of tailings generated during the next 20 to 30 years between the existing impoundment and a new tailings impoundment constructed at the Hertzler Ranch. The first 6,450,000 tons of tailings generated would be placed in the existing tailings impoundment. The next 10,150,000 tons of tailings would be placed in the new Hertzler impoundment. Thus, construction of the pipelines and Hertzler tailings impoundment would occur about 10 to 15 years into the 20- to 30- year period.

Existing Tailings Impoundment

The existing tailings impoundment contains 1,900,000 tons of tailings today and can accommodate another 1,600,000 tons of tailings in its currently-permitted configuration. It then would be expanded by modified centerline construction to accommodate another 4,850,000 tons of tailings. This expansion would increase the total capacity of the existing tailings impoundment to 8,350,000 tons and increase the areal extent of the tailings impoundment from 60 acres to 68 acres. Also, the final crest elevation of the impoundment would increase 64 feet, from 5,111 feet to 5,175 feet (**Figure 2–8**).

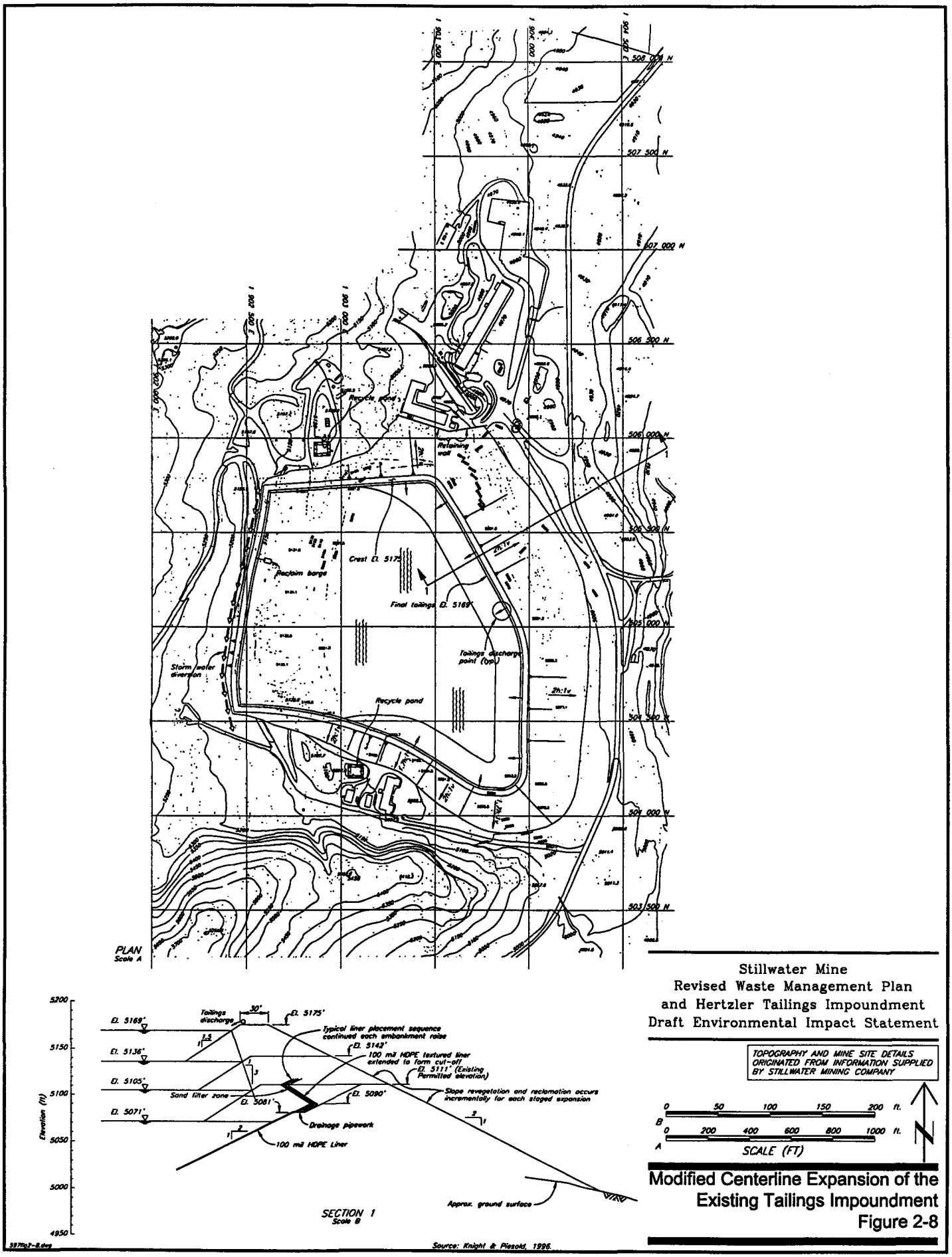
Hertzler Tailings Impoundment

The tailings impoundment constructed at Hertzler Ranch under this alternative would be smaller than that under the Proposed Action. This impoundment would cover about 129 acres of Hertzler Ranch. The impoundment would be constructed in three phases, with the final crest elevation at 5,007 feet. By comparison, the Hertzler impoundment of the Proposed Action would cover 163 acres and have a crest elevation of 5,036 feet. **Figure 2–9** shows the plan and cross section of the Hertzler impoundment that would be constructed under this alternative.

The Hertzler tailings impoundment would be constructed similarly to the Proposed Action's impoundment. The embankment would be built from on-site borrow material excavated from within the footprint of the impoundment and from one or two borrow areas located near the impoundment. The impoundment would be lined with a 60-mil thick HDPE liner. A seepage collection system consisting of underdrains constructed on top of the HDPE liner and recycle ponds would be included. Finally, the impoundment's design includes minimum freeboard to ensure overtopping of the embankment would not occur.

Tailings Pumping and Transmission Systems

The tailings pumping and transmission system would be the same as described for the Proposed Action. Thus, it would consist of the same series of facilities constructed to transport tailings from the concentrator, underground sand plant,



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Draft Environmental Impact Statement

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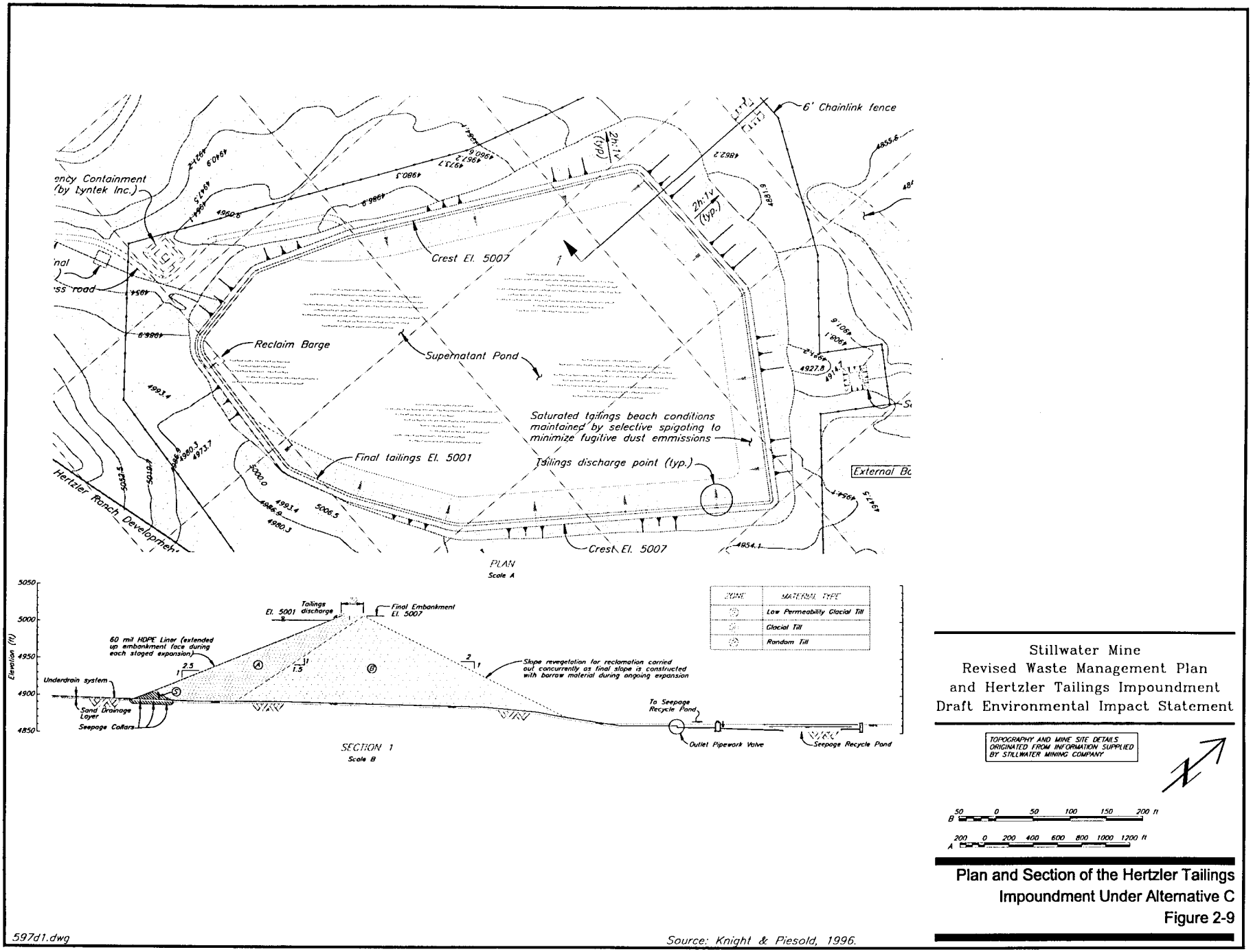
Modified Centerline Expansion of the Existing Tailings Impoundment
Figure 2-8



Source: Knight & Piesold, 1996.

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Plan and Section of the Hertzler Tailings Impoundment Under Alternative C

Figure 2-9

or the expansion of the existing tailings impoundment to the new Hertzler impoundment. Components of the system include a tailings thickener plant, tailings reclaim system (to reclaim tailings from the existing impoundment), tailings pumping system, and tailings slurry pipelines. Each component is described in detail under the Proposed Action. Construction of the tailings pumping and transmission systems would occur during the initial construction of the new Hertzler impoundment, 10 to 15 years into the 20- to 30-year extension of the Stillwater Mine's operations.

2.4.3.3 Water Management and Disposal

Under this alternative, SMC would continue to handle the adit water and process and tailings water separately. SMC would dispose of adit water using existing percolation ponds, the ABC, and LAD systems as discussed for the Proposed Action. SMC would add LAD systems at the Stratton and Hertzler ranches (**Figure 2–8**) when construction of the east side waste storage site forces SMC to move the east side LAD to these sites. A pipeline buried with the slurry tailings pipelines would transport the adit water from the clarifiers to these sites.

SMC would handle tailings or process water under this alternative in the same manner as described for the Proposed Action. The water would continue to be used in the milling and concentrating circuits and to transport tailings to the tailings impoundments. In the impoundments, the water would either evaporate or would be reclaimed and pumped back to the mill for reuse in the milling and concentrating circuits.

2.4.3.4 Power Requirements

The requirements for power for this alternative would be similar to those of the Proposed Action. Montana Power Company would supply the power to the main Stillwater Mine using its existing line. A one-mile extension of that line to the Hertzler Ranch impoundment to provide the 500 horsepower to meet the operational demands of this impoundment. The extension would probably follow the existing road rights-of-way or power line right-of-way.

2.4.3.5 Roads and Traffic

No modifications of existing and previously-approved permit-related roads within the permit boundary would occur. Access roads to the Hertzler Ranch may be upgraded to allow for installation of the system of buried pipelines within the rights-of-way. Minor road extensions would be required from Stillwater County Road 420 to the Hertzler impoundment.

2.4.3.6 Workforce Requirements/Socioeconomics

Essentially, the workforce requirements and socioeconomics of this alternative would be the same as those described for the Proposed Action. Thus, the number of SMC's employees at the Stillwater Mine would increase from about 655 (December 31, 1997) to 700. Forty to 45 percent of the additional workers are expected to be local residents.

2.4.3.7 Monitoring

The monitoring program for this alternative would be identical to that described for the Proposed Action. SMC would continue to monitor annually the acid-generating potential of tailings and waste rock. The pipelines would be monitored according to the Pipeline Monitoring and Spill Contingency Plan developed by SMC. Monitoring of water quality would continue as directed by SMC's MPDES permit and operating permit. Stormwater containment measures and sampling would follow SMC's Stormwater Pollution Prevention Plan. Finally, if this alternative is selected, SMC would modify its water monitoring plan and submit it to DEQ for approval.

2.4.3.8 Reclamation

Reclamation procedures have been defined for the tailings impoundments, east side waste rock storage site, and pipelines. These procedures are the same as those described under the Proposed Action.

2.4.3.9 Bonding

If this alternative is selected, the additional bond would be calculated using the specifications, stipulations, and mitigations contained in the approved and permitted amendment. The bond would include costs for long-term maintenance of water management practices, such as percolation ponds and diversion ditches; demolition of buildings and other facilities; earth movement and soil replacement; seeded preparation; and revegetation.

DEQ has developed an approximate estimate of the range in which the new bond amount would be, if this alternative is selected. Bond for SMC's operations would increase from slightly more than $3 million to $10 to $12 million dollars. Additionally, if DEQ decides long-term water treatment is necessary at closure, the bond for this alternative would increase to $19 to $24 million.

2.4.4 Alternative D — Modified Centerline Expansion and East Side Tailings Impundment

Under this alternative, SMC would expand the existing tailings impoundment and construct a new impoundment on the east side of the Stillwater River. SMC also would construct a small waste rock storage facility on the east side of the Stillwater River and develop additional facilities for LAD. **Figure 2–10** shows the distribution of the primary facilities comprising this alternative. The primary facilities are described below.

Implementation of this alternative would result in no development at Hertzler Ranch. All new facilities would be concentrated in the general vicinity of the Stillwater Mine and Stratton Ranch.

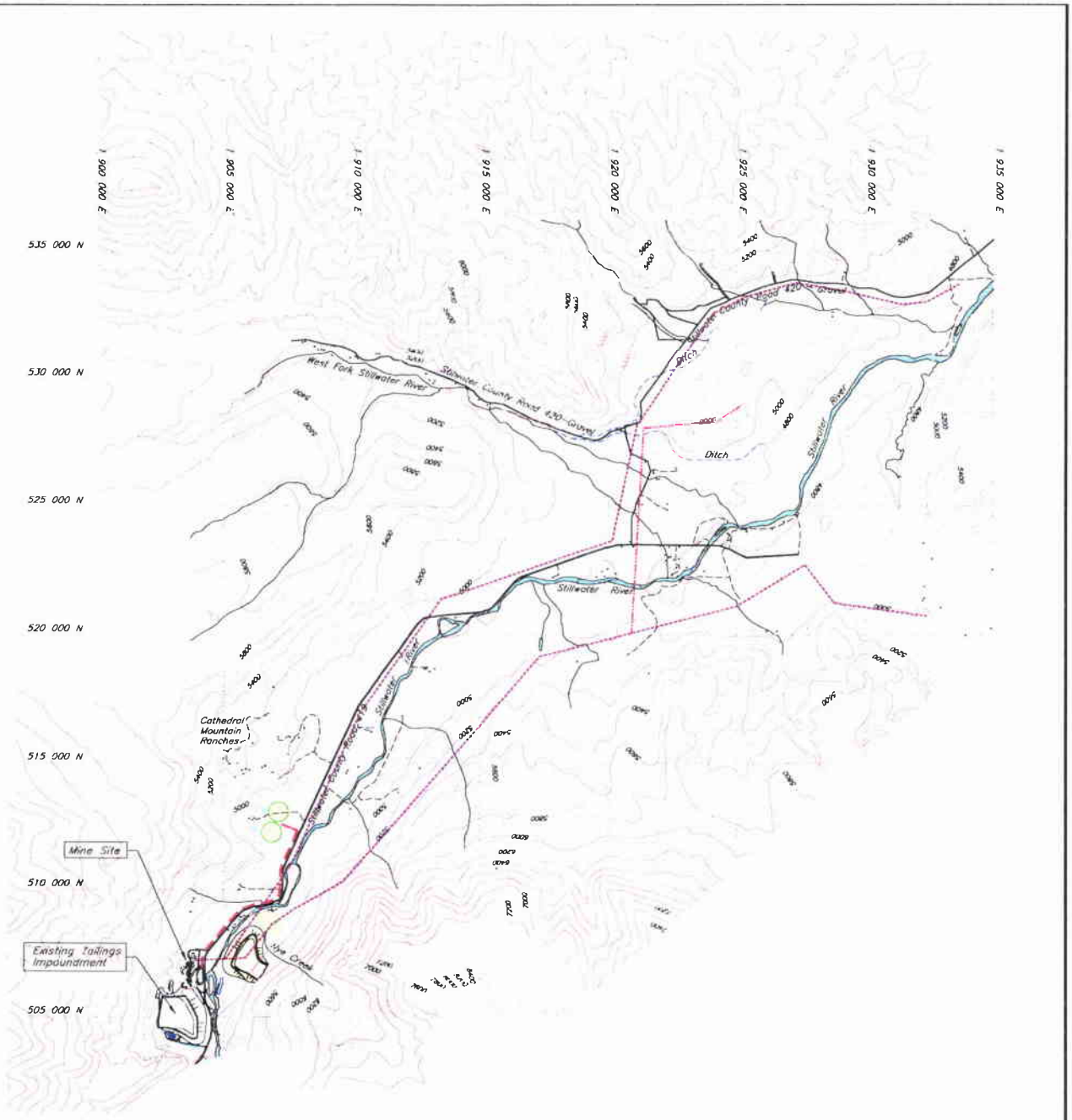
Selection and implementation of this alternative also would remove the limitation on daily production (currently at 2,000 tpd). The permit would be based on an approved "footprint" of surface disturbance, not a rate of production. SMC would be able to alter daily levels of production to respond to changing conditions in the market, as described under the Proposed Action. However, under Alternative D, only 15,885,000 tons of waste rock and 11,390,000 tons of tailings could be stored in the two tailings impoundments, thus reducing the life of these facilities from 30 to 23 years at 3,000 tpd. SMC would need to submit a revision for a third impoundment to continue operating beyond this 23-year period.

2.4.4.1 Waste Rock Production and Management

Under this alternative, SMC would have the capacity to dispose of almost 15.9 million tons of waste rock. First, 1,630,000 tons of waste rock would be placed in the temporary and permanent storage areas already permitted by DEQ and CNF for waste rock (**Figure 2–1**). Another 1,755,000 tons of waste rock would be incorporated into the embankments of the existing tailings impoundment as it is completed to its currently-permitted configuration. About 2,660,000 tons of waste rock would be incorporated into the embankments of the existing tailings impoundment as it is expanded from its currently-permitted configuration. The remaining 9,840,000 tons would be incorporated into the embankments of the East Stillwater tailings impoundment.

2.4.4.2 Tailings Production and Management

SMC would split the disposal of tailings generated during the next 20 to 30 years between the existing impoundment and a new tailings impoundment constructed at the east Stillwater site. About 6,450,000 tons of additional tailings could be



LEGEND

- Proposed Pipeline Alignment
- Approximate Location of Overhead Power Line
- Approximate Location of Proposed Overhead Power Line
- Road
- Land Application Disposal Site
- Borrow Area
- Topsoil Stockpile
- Land Application Disposal Storage Pond
- Waste Rock Storage Area
- Tailings Impoundment

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Location of Primary Facilities Comprising Alternative D - Modified Centerline Expansion and East Side Tailings Impoundment
Figure 2-10

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placed in the existing tailings impoundment. Another 4,940,000 tons of tailings would be placed in the new East Stillwater impoundment. Construction of the pipelines and East Stillwater tailings impoundment would occur immediately upon approval to facilitate the use of both impoundments.

Existing Tailings Impoundment

The existing tailings impoundment contains 1,900,000 tons of tailings today and can accommodate another 1,600,000 tons of tailings in its currently-permitted configuration. It then would be expanded by modified centerline construction to accommodate another 4,850,000 tons of tailings. This expansion would increase the total capacity of the existing tailings impoundment to 8,350,000 tons and increase the areal extent of the tailings impoundment from 60 acres to 68 acres. Also, the final crest elevation of the impoundment would increase 64 feet, from 5,111 feet to 5,175 feet (**Figure 2–8**).

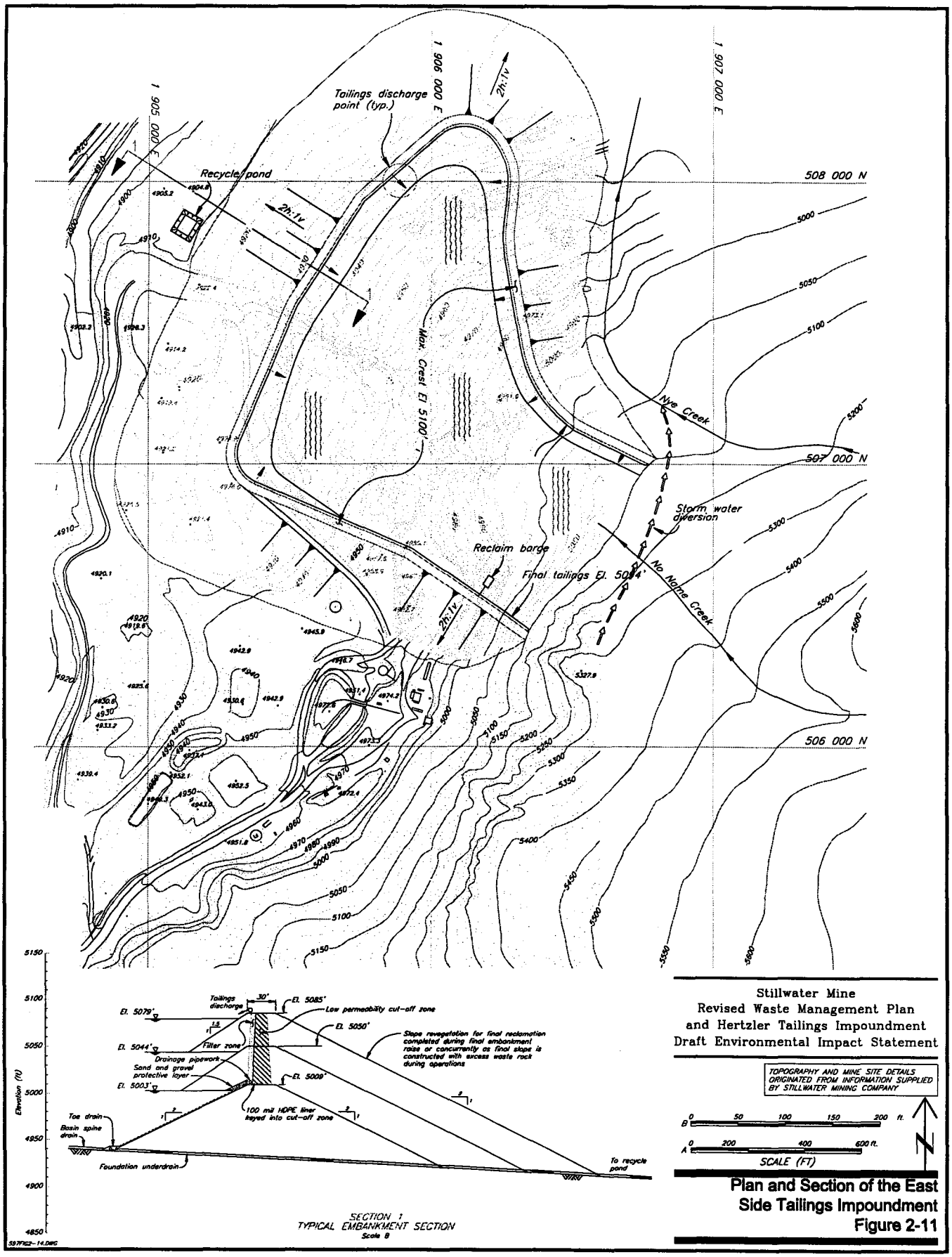
East Stillwater Impoundment

The tailings impoundment constructed on the east side of the Stillwater River under this alternative would be slightly higher than the east side waste rock storage facility included in alternatives B and C. This impoundment would cover about 72 acres, 8 acres less than the what the east side waste storage facility would cover. The impoundment would be constructed in three phases with the final crest elevation at 5,085 feet. By comparison, the east side storage site associated with the other action alternatives would have a crest elevation of 5,080 feet. **Figure 2–11** shows the plan and cross section of the East Stillwater impoundment that would be constructed under this alternative.

Except for one feature, the East Stillwater tailings impoundment would be constructed similarly to the Hertzler impoundment. Instead of using on-site borrow material excavated from within the footprint of the impoundment and borrow areas located near the impoundment, the embankment would be built using waste rock from the mine. Also, the impoundment would be lined with a 100-mil thick HDPE liner. The rest of the construction would be similar to that described under the Proposed Action. A seepage collection system consisting of underdrains constructed on top of the HDPE liner and recycle ponds would be included. Finally, the impoundment's design includes minimum freeboard to ensure overtopping of the embankment would not occur.

Tailings Pumping and Transmission Systems

The tailings pumping and transmission system would be the same as described for the Proposed Action, except it would be substantially shorter. It would consist of the same series of facilities constructed to transport tailings from the concentrator, underground sand plant, or the expansion of the existing tailings



Stillwater Mine
Revised Waste Management Plan
and Hertzler Tailings Impoundment
Draft Environmental Impact Statement

Plan and Section of the East Side Tailings Impoundment
Figure 2-11

impoundment to the new east side impoundment. Components of the system include a tailings thickener plant, tailings reclaim system (to reclaim tailings from the existing impoundment), tailings pumping system, and tailings slurry pipelines. Each component is described in detail under the Proposed Action.

Due to constraints in crossing the Stillwater River, the pipelines would be suspended across the river or attached to the bridge it could not be buried under the river.

2.4.4.3 Water Management and Disposal

Under this alternative, SMC would continue to handle the adit water and process and tailings water separately. SMC would dispose of adit water using percolation ponds, the ABC, and LAD systems as discussed for the Proposed Action. SMC would construct additional percolation ponds and LAD systems on the east side of the Stillwater River and at the Stratton Ranch (**Figure 2–10**) when construction of the east side waste storage site forces SMC to move its existing LAD facilities. A pipeline suspended with the slurry tailings pipelines across the Stillwater River and a separate pipeline to Stratton Ranch would transport the adit water from the clarifiers to these sites.

SMC would handle tailings or process water under this alternative in the same manner as described for the Proposed Action. The water would continue to be used in the milling and concentrating circuits and to transport tailings to the tailings impoundments. In the impoundments, the water would either evaporate or would be reclaimed and pumped back to the mill for reuse in the milling and concentrating circuits. The water resource monitoring plan would be modified.

2.4.4.4 Power Requirements

The requirements for power for this alternative would be similar to those of the Proposed Action. Montana Power Company would supply the power to the main Stillwater Mine using its existing line. A short extension of that line to the East Stillwater tailings impoundment would be constructed to provide the 500 horsepower to meet the operational demands of this impoundment.

2.4.4.5 Roads and Traffic

No modifications of existing and previously-approved permit-related roads within the permit boundary would occur. Stillwater County Road 419 may be upgraded between the Stillwater Mine and Stratton Ranch to allow for installation of the buried pipeline within the rights-of-way.

2.4.4.6 Workforce Requirements/Socioeconomics

Essentially, the workforce requirements and socioeconomics of this alternative would be the same as those described for the Proposed Action. Thus, the number of SMC's employees at the Stillwater Mine would increase from about 655 (December 31, 1997) to about 700. Forty to 45 percent of the additional workers are expected to be local residents.

2.4.4.7 Monitoring

The monitoring program for this alternative would be identical to that described for the Proposed Action. SMC would continue to monitor annually the acid-generating potential of tailings and waste rock. The pipelines would be monitored according to the Pipeline Monitoring and Spill Contingency Plan developed by SMC. Monitoring of water quality would continue as directed by SMC's MPDES permit and operating permit. Stormwater containment measures and sampling would follow SMC's Stormwater Pollution Prevention Plan. Finally, if this alternative is selected, SMC would modify its water monitoring plan and submit it to DEQ for approval.

2.4.4.8 Reclamation

Reclamation procedures have been defined for the tailings impoundments, east side waste rock storage site, and pipelines. These procedures are the same as those described under the Proposed Action.

2.4.4.9 Bonding

If this alternative is selected, the additional bond would be calculated using the specifications and stipulations contained in the approved and permitted amendment. The bond would include costs for long-term maintenance of water management practices, such as percolation ponds and diversion ditches; demolition of buildings and other facilities; earth movement and soil replacement; seed bed preparation; and revegetation.

DEQ has developed an approximate estimate of the range in which the new bond amount would be, if this alternative is selected. Bond for SMC's operations would increase from slightly more than $3 million to $5 to $7 million dollars. Additionally, if DEQ decides long-term water treatment is necessary at closure, the bond for this alternative would increase to $14 to $19 million.

2.4.5 Agency Mitigations

DEQ and CNF's decisions on the previous environmental analyses (1985 through 1996) required SMC to implement a variety of mitigation measures. Many of these measures are ongoing or annual requirements. Consequently, SMC must continue to implement them, regardless of the decision made on this analysis. A summary of the mitigation measures required in the previous decisions is included as **Appendix C**.

Through the analysis of environmental consequences, DEQ and CNF identified additional mitigation measures relative to this proposed action or the action alternatives discussed in this EIS. These measures are:

1) The agencies would require testing and monitoring of the permeability of the clay liner or compacted base on which the HDPE liner would be placed. If this testing showed that the material does not meet the minimum permeability requirement of 1x10-6 cm/sec, then additional clay material would need to be brought in to reduce the permeability. The actual cost of obtaining this material would vary depending upon how much material was needed and how far it had to be hauled to get to the site, because this affects the cost of purchasing the material and the amount of work involved in transporting the material to and placing the material at the site. SMC could also investigate other options of achieving the desired permeability. There are too many variables to determine what this cost might entail. If the monitoring showed that required permeabilities were obtained, SMC would noot incur costs for obtaining the additional clay material. No less restrictive method of protecting ground water has been identified.

2) SMC would be required to monitor ground water at the Hertzler Ranch to determine effects of seepage from the impoundment. The agencies would require an additional mitigation measure based on the results of the ground water monitoring. If ground water monitoring at the Hertzler Ranch indicated that nitrates or other contaminants were migrating at concentrations that would cause increases above the trigger level in the Stillwater River, SMC would be required to conduct biological monitoring of periphyton and macroinvertebrates above and below the site twice a year. This mitigation measure, if implemented, would require SMC pay for additional monitoring and testing. This type of monitoring and testing costs approximately $30,000 per year. The number of years of testing required would depend upon when ground water monitoring indicated biological monitoring was necessary. The additional monitoring would be required to comply with both MMRA and the Montana Clean Water Act.

3) If monitoring at Hertzler Ranch showed that groundwater quality exceeded nondegradation standards outside of the mixing zone then SMC would be required to identify, collect baseline data prior to construction of the pipeline and Hertzler impoundment from, and monitor nearby down-gradient residential wells that could potentially be affected by seepage from the Hertzler impoundment. SMC would be required to pay for the collection and testing of water samples. Typical collection and laboratory costs for a single sample range between $35.00 and $330.00 for nitrates and a full range of the constituents specified in SMC's ground water monitoring plan respectively. The total cost would depend upon the number of wells being sampled. This sampling would ensure that down-gradient water users would be identified and help determine if their water supplies became contaminated as a result of the Hertzler impoundment. If that occurred, then SMC would provide replacement water sources as required under MMRA. No less restrictive means of ensuring long term compliance is available.

4) SMC would be required to purchase a 250 kW backup generator to ensure pipeline leak detection sensor function and operation during power failures or partial power outages. This would cost SMC approximately $50,000 to purchase and $32.00 per hour to operate; it would take about 4 hours of pumping to vacate the tailings pipeline. However, if a power outage resulted in undetected leaks or ruptures of the pipeline, the cost of fines, penalties, and repairs could potentially exceed that amount. SMC proposes to construct an underground water storage reservoir at the 6400 foot level, however, it may not be constructed immediately and it would take time for it to fill up with enough water to provide sufficient volume to flush the pipelines by gravity feed alone. There may also be times during mine life when there was insufficient volume of water in the storage reservoir. Therefore, there is no less restrictive means of ensuring that the pipelines could be flushed in the event of a rupture during a power failure although a smaller generator would be sufficient to supply enough power to keep the leak detection system function.

5) If, after 2 years, agency review of pipeline monitoring data resulted in a decision to continue the monitoring of the tailings pipelines every six months and the water pipelines annually, there would be a continuing cost of monitoring the pipelines more frequently than SMC might want to specify. If the agency determined that pipeline monitoring frequency could be reduced, costs to SMC would be reduced slightly. No less restrictive means of ensuring pipeline failure does not occur has been identified.

6) SMC, DEQ, and CNF would re-evaluate paste technology applicability for use at the Stillwater Mine after 5 years of operations. There would be some costs for engineering studies. If the evaluation resulted in implementation of paste technology, there might be increases in construction and operational costs over more traditional mining and waste storage methods proposed under Alternative B. Those costs cannot be estimated at this time. No less restrictive means of providing a denser, and thus potentially smaller impoundment, which also retains less water and can be reclaimed in a shorter period of time has been identified. However, DEQ will make this evaluation again when paste technology is re-evaluated.

7) SMC would be required to work with the Stillwater Valley Bighorn Management Committee to explore options for mitigating indirect impacts to bighorn sheep. The company's main involvement would be attending meetings, developing mitigations, and implementing those mitigations. SMC currently works with the committee as required in their operating permit so no additional costs would be incurred for attending the meetings. No costs of mitigation implementation can be determined at this time because the plans have not be developed; the costs are not expected to be substantial. Furthermore, whether less restrictive means are available will be evaluated before a mitigation is imposed.

8) The agencies would require SMC to replace creeping meadow foxtail with a more palatable native species in the reclamation seed mix for the LADs. There would be virtually no difference in costs to SMC for implementing this mitigation measure.

9) SMC currently has a dust abatement program for the existing impoundment. As mitigation, the agencies would require that program be extended to the Hertzler or east side impoundments, depending upon the alternative implemented. The dust abatement program would be implemented whenever one of the impoundments was not in use as well as when both were inactive. This mitigation would result in a slight increase in operating costs to keep both surfaces wet. This mitigation would be required under the air quality permit to comply with the Montana Air Quality Act.

10) During final design development of the Hertzler tailings impoundment, SMC would be required to conduct stability modeling and analyses on the Colorado Shale Unit for deep foundation failures. The agencies would also require that a professional engineering geologist or geotechnical engineer would observe the excavation of the Hertzler Ranch impoundment foundation and borrow areas to determine if any geomorphological features were exposed that would indicate ancient

mass failure. If such features were observed or if the modeling indicated a potential for mass failure, then SMC would be required to develop a plan for a detailed bedrock drilling program and analysis. The plan would be subject to agency review and approval prior to implementation. Necessary changes to the design of the impoundment would be developed, reviewed and approved by the agencies, and implemented to resolve any problems identified by the drilling and bedrock analysis. There would be a slight increased cost for running the additional stability modeling during final design ($2,000 to $5,000). Since SMC typically has a professional engineer on hand during construction for quality control purposes, there would be no additional cost for the engineer to look for signs of mass failure. The costs associated with drilling and bedrock analysis and any resulting engineering designs and construction changes cannot be determined at this time. This mitigation would confirm that the shale bedrock and glacial till had not been affected by past mass movement and that the glacial till would provide a suitable foundation for the impoundment. This requirement would be required under MMRA and no less restrictive means of ensuring that the impoundment would not be subject to mass failure has been identified.

11) The agencies would require SMC to develop incentives for employee carpooling. This requirement is based on the need for minimizing the potential for accidents on road segments in need of resurfacing. Incentives could have varying costs to SMC depending upon what SMC included in their plan and how many employees take advantage of the incentives. These costs cannot be estimated at this time. This analysis of restriction would be reevaluated when a plan is submitted to the agencies. The need for this stipulation may be eliminated through the Hard Rock Impact Plan.

12) The agencies would require SMC to extend the first lift of the proposed Hertzler tailings impoundment to the full footprint so that the outer slopes can be reclaimed once and not redisturbed during construction of the second lift. This could increase construction costs of the embankment of the first lift by approximately $1.2 million, but it would eliminate the need to reclaim that portion of the embankment a second time under alternatives B and C (there would be no impoundment at Hertzler Ranch under Alternative D). The cost for stage two would be reduced by $1.2 and so there would be no net increase in cost of constructing the impoundment Interim revegetation of the first left as planned under Alternative B would mitigate visual impacts and provide for slope stabilization, but the slope would be redisturbed when the second lift was constructed and require revegetation for a second time. There are no other ways to provide for final revegetation of the outer slope of the first lift and eliminate

redisturbance of the slope. SMC could investigate modifying the final design so that there is no net increase in volume of borrow needed to build the first lift out to the final footprint, it is anticipated that this would reduce the height of the first lift which would be made upp in the second lift; this could reduce the up front capital needed to construct the first lift. This mitigation is more restrictive than that proposed under Alternative B.

13) SMC specified in its revision application that the outer slopes of the Hertzler impoundment and east side waste rock storage site would be reclaimed with a mosaic of vegetation and rock. SMC did not specify how long the soiled and vegetated slopes would be. The agencies would require a mitigation measure to specify that revegetated slopes would not exceed 150 feet in length before being intercepted by a rocky zone. This rocky zone or armor would be placed asymmetrically across the slope. This would not result in any additional costs to SMC and is an extension of a mitigation for the existing required under the 1992 ROD on the 2,000 tpd EIS. This mitigation would be necessary to ensure successful reclamation of these slopes, to reduce erosion, and comply with MMRA.

14) SMC would be required to have a professional archeologist present during construction of the pipeline and the embankments for the first lift of the Hertzler impoundment when construction of these facilities approaches identified and potential cultural sites. The archeologist would be responsible for identifying any cultural material that might be exposed during construction. This would result in additional costs of paying for those services. Current rates for a professional archeologist range between $25.00 and $50.00 an hour; SMC would also need to cover lodging and meals for the person hired for this purpose. The total cost would depend upon on how long construction took and on any needed mitigations. This restriction would be required to comply with the various federal laws pertaining to cultural, historic, and archeological resources. No less restrictive means of protecting archeological resources has been identified.

2.5 Alternatives Considered but Eliminated (& rationale)

Several potential alternatives were considered for this analysis, but were dropped from detailed study for various reasons. These alternatives are listed below and the reasons they were excluded from further consideration are summarized. Addition information on these alternatives is included as **Appendix H**.

When reviewing the alternatives presented in this section, the reader must keep in mind the MEPA/NEPA process requires that alternatives evaluated in detail be implementable (i.e., something that could be developed if approved). Moreover, economic feasibility in part defines whether or not something could go forward or is reasonable. The intent that economic feasibility is to be included in the determination of the reasonableness of alternatives is expressed in CEQ's memorandum on the 40 Most Asked Questions about NEPA. In part, CEQ's answers to these questions state *"reasonable alternatives include those that are practical or feasible from the technical and economic standpoint and using common sense... "* (CEQ 1981). In response to this direction, DEQ and CNF considered economic feasibility or cost in their determination of the reasonableness of the alternatives developed for this MEPA/NEPA analysis.

2.5.1 1985 Tailings Facilities Sites

During the initial permitting of the Stillwater Mine, the DSL and CNF evaluated 18 possible locations for a tailings impoundment within a reasonable distance of the Stillwater Mine (DSL and Forest Service 1985; Appendix B). All but three sites were eliminated in the two-step selection process. The three sites not eliminated were the mine site, Stratton Ranch, and Hertzler Ranch (DSL and Forest Service 1983, 1985).

During the current MEPA/NEPA process, DEQ and CNF reexamined 17 of the 18 sites to determine if the previous reasons for eliminating the sites from evaluation are still valid or if new information or technologies make some of the sites viable now. The 18th site was the Mine Site, which was selected as the preferred option in 1985. SMC constructed this facility and has operated it for the last nine years.

Table 2–2 summarizes the results of the reevaluation of the 1985 sites. Of the 17 sites reconsidered, all but the Hertzler Ranch sites (Sites B, C, and D) and the Old Tailing Mine (Site I) were eliminated from detailed consideration in this MEPA/NEPA analysis (at least one of the action alternatives analyzed in detail involves these sites). For all but Site G (Stratton Ranch), Site K (Beartooth Ranch), and Site M (Horseman Flats), the reevaluation found the rationale used in 1985 to eliminate the sites was still valid (**Table 2 –2**). Sites I, K, and M were eliminated for reasons other than those identified in 1985. The following discussion presents the reasons for which these three alternative sites for a tailings impoundment were dropped from detailed consideration in this EIS.

Table 2–2 Results of Reevaluation of 1985 Tailings Facilities Sites

Site ID	Name	Status	Reasoning
A	Robinson Draw	eliminated	1985 decision to eliminate due to failed floodplains test is still valid.
B	Hertzler Ranch	under consideration	SMC's present proposal involves Hertzler Ranch.
C	Hertzler Ranch	under consideration	SMC's present proposal involves Hertzler Ranch.
D	Hertzler Ranch	under consideration	SMC's present proposal involves Hertzler Ranch.
E	Stanley Coulee	eliminated	1985 decision to eliminate due to failed floodplains test is still valid.
F	Prairie Creek	eliminated	1985 decision to eliminate due to failed floodplains test is still valid.
G	Stratton Ranch	eliminated	1985 decision was to retain this site. However, more recent information suggests geologic stability and high groundwater table are concerns.
H	Limestone Cave	eliminated	1985 decision to eliminate due to concerns about geological stability and high groundwater are still valid. Also, to use this site, SMC would have to acquire private property and relocate individuals living there.
I	Old Tailing Mine	under consideration	This site is the East Stillwater site that is part of Alternative D.
J	Mine Site	eliminated	This site already is occupied by SMC's present tailings impoundment.
K	Beartooth Ranch	eliminated	This site was reevaluated for inclusion in action alternative as discussed in the narrative.
L	Mountain View	eliminated	1985 decision to eliminate due to concerns about geological stability is still valid. Also, pumping tailings for backfilling several mine sites is not economically feasible.
M	Horseman Flats	eliminated	This site was reevaluated for inclusion in an action alternative as discussed in the narrative.
N	Horseman Flats	eliminated	1985 decision to eliminate due to concerns about geological stability and the need to acquire privately-owned land is still valid.
O	Cathedral Mountain	eliminated	1985 decision to eliminate due to concerns about geological stability and the need to acquire the privately-owned lands is still valid.
P	Buffalo Jump	eliminated	1985 decision to eliminate due to concerns about geological stability is still valid.
Q	Ranch Creek	eliminated	1985 decision to eliminate due to concerns about geological stability and violations of Stillwater County's zoning regulations is still valid.
R	Horseman Flats	eliminated	1985 decision to eliminate due to the need to acquire privately-owned lands and concerns about geological stability is still valid.

Alternative Considered:	Tailings impoundment at Stratton Ranch (Site G on **Table 2–2**).
Reasons Considered:	The 1985 analysis determined this site was reasonable for construction of a tailings impoundment. Use of this site may have eliminated the water-related concerns and potential effects associated with a tailings impoundment at Hertzler Ranch and the 7.8-mile long pipelines needed to support an impoundment at Hertzler Ranch.
Reasons Dropped:	Current information suggests much of the Stratton Ranch site is geotechnically unstable and unsuitable as a foundation for a tailings impoundment. A potential landslide area exists on the site's western margin. Because the site has shallow groundwater and wetlands, extensive diversion of surface water would be necessary as part of any attempt to stabilize the site. Also, the facility would be highly visible.

Alternative Considered:	Tailings impoundment at Beartooth Ranch (Site K on **Table 2–2**) developed in conjunction with the East Stillwater impoundment to provide the necessary capacity for tailings.
Reasons Considered:	This site is close to the Stillwater Mine. It also involves private lands owned by SMC and federal lands administered by the Forest Service, so acquisition of the site is possible. In conjunction with the East Stillwater impoundment, it would eliminate the near-term need for a tailings impoundment at Hertzler Ranch.
Reasons Dropped:	Compared to the other alternatives available, technical, environmental, and economical concerns rendered this alternative unreasonable. Development of a tailings impoundment at the site also would present technical challenges. The site is within the floodplain of the Stillwater River and would require significant floodproofing of the tailings retention structure and possibly modification of the drainage channel to accommodate design stream flows. There is a high potential for soft, unstable foundation conditions

in the floodplain soil deposits, requiring flatter embankment slopes or a reduced level of stability.

Use of this site would force the relocation of individuals and a working ranch, would remove winter range occupied by the Stillwater Valley's herd of bighorn, and would establish a large tailings impoundment near the wilderness boundary. The location within a riparian environment also may result in wetlands disturbance requiring additional mitigation measures. The shallow depth to groundwater would increase the risk of water quality impacts due to any seepage incidences.

Additional disturbance would occur because SMC would have to construct a single pipeline to Stratton Ranch to transport adit water to LAD systems installed here. However, even with LADs at Stratton Ranch, SMC probably would not be able to dispose of all the adit water it would produce as production is increased.

An initial estimate of the costs for operation of a tailings impoundment at the Beartooth Ranch site suggests costs would be on the order of $3.88 per ton of tailings, or almost 19 percent higher than similarly-based costs for Alternative B ($3.27 per ton of tailings). The primary reason for these increased costs is the increased capital costs to develop a second impoundment site with associated tailings pipeline and water reclaim lines as well as the requirement to pump tailings 1.5 miles to a site that is 300 feet above the Stillwater Mine's mill.

Alternative Considered: Tailings impoundment on Horseman Flats (Site M on **Table 2–2**) developed in conjunction with the East Stillwater impoundment to provide the necessary capacity for tailings.

Reasons Considered: This site is comparatively close to the Stillwater Mine. It also involves federal lands administered by the Forest Service so acquisition of the site is possible. In conjunction with the East Stillwater impoundment, it would eliminate the near-term

need for a tailings impoundment at Hertzler Ranch.

Reasons Dropped:

The primary concern with the Horseman Flats site is associated with the risk involved in pumping the tailings long distances under high pressure. The Horseman Flats Site is located about 2.5 miles away and 1,100 feet higher than the existing mill facility. Access to the site could be achieved by existing roads, however improvement would be required to allow all-weather access from the mill site. Several pumping schemes are conceptually viable; however, from considerations of surface disturbance, operational reliability, and overall efficiency, the economic analysis considered that future tailings would be pumped by high horsepower, positive displacement pumps located at the existing mill facility. The tailings would be conveyed through a HDPE lined, steel pipe with secondary containment. The high pumping pressures and resulting pipe friction and abrasion would require a high level of pipeline maintenance. Accordingly, this pipeline would need to be at the surface to allow monitoring and maintenance access.

Alternative methods of transporting slurry tailings to the impoundment site such as trough conveyors or bucket conveyors are not considered feasible. Trough conveyors are limited by the gradation and consistency of the material that can be conveyed and would not allow transport of even dewatered or thickened tailings. Bucket conveyor systems would require specialized containment provisions to transport slurry. Either system would be considered non-traditional with limited, if any, demonstrated use in long-distance tailings transport.

The potential for accidental discharge of tailings is very likely over the operational life of the facility. Due to the tailings pipeline being above grade and extending up the valley slope, there would be a high visual impact. The risk of surface and ground water quality impacts, while not as high as the Beartooth site, would still be an issue. There are

several downstream water users that would be affected by any water quality impacts. The upper portion of Horseman Creek would require diversion around the impoundment.

This site and its environs are used heavily for recreation and a substantial number of identified sources of domestic water occur up and down gradient of the site and elsewhere on Horseman Flats. These sources supply water to residents of the Cathedral Mountain Ranch subdivision.

Additional disturbance would occur because SMC would still have to construct a single pipeline to Stratton Ranch to transport adit water to LAD systems installed here. However, even with LADs at Stratton Ranch, SMC probably would not be able to dispose of all the adit water it would produce as production is increased.

An initial estimate of the costs for operation of a tailings impoundment at the Horseman Flats site suggests costs would be on the order of $3.94 per ton of tailings, or almost 21 percent higher than similarly-based costs for Alternative B ($3.27 per ton of tailings). The primary reason for the higher costs associated with this alternative is the increased capital costs to develop the second impoundment site at Horseman Flats with associated tailings pipeline and water reclaim lines as well as the requirement to pump tailings 2.5 miles to a site that is about 1,100 feet above the Stillwater Mine's mill.

2.5.2 1997 Alternatives Considered but Eliminated

Several new alternatives also were developed for consideration in the current MEPA/NEPA analysis, based on public input during scoping or public review of the draft EIS (40 CFR 1502.9 (b) and ARM 17.4.603 (10) (b)). Although the alternatives discussed below were initially developed for consideration, they were dropped from detailed analysis for the reasons identified.

Alternative Considered: A tailings impoundment in the Nye Creek drainage east of SMC's east side operation.

Reason Considered: This alternative location for the Hertzler tailings impoundment was suggested by a member of the public. The Nye Creek site is located approximately 1 mile east of the mill facility and is approximately 1,600 feet higher than the mill site. There is sufficient capacity within the drainage to impound in excess of 6 million tons of tailings; however, a dam that is more than 160 feet high would be required. Access to the site would require a major upgrades of existing four-wheel drive trails.

Reason Dropped: Compared to the other alternatives available, technical, environmental, and economical concerns rendered this alternative unreasonable. The accessibility to the site during winter would be restricted and any closure of the access road would prohibit operational access to the tailings impoundment and water reclaim system. To develop the required impoundment capacity, the required dam would be almost twice as high as required at either the Beartooth or Horseman Flats sites. This increases the risk of failure and the consequences of a failure. The potential for accidental discharge of tailings from the tailings transport pipeline would be very likely over the operational life of the facility. Due to the tailings pipeline being above grade and extending up the valley slope, there would be a high visual impact. Development of the tailings impoundment would require diversion of the Nye Creek drainage, which, considering the steep topography of the drainage basin, would be very disruptive to normal stream flows. The proximity of the Stillwater River increases the risk of any release of tailings or discharge of water causing a water quality impact. This would include both releases from the impoundment and accidental releases due to failure of pipelines leading to and from the impoundment.

Established technology for transport of the tailings to the impoundment would consist of either a multiple stage pumping system consisting of a series of pumps with surge tanks and reclaim ponds or a single stage pumping system and a high

pressure pipeline. Use of multiple pumps would require significant site disturbance to develop each pumping station, provide all-weather vehicle access, provide a surge tank, provide electrical power, and provide emergency containment. Capital and operating costs would increase with each additional pump station installed. Accordingly, it was assumed that a single pumping stage would be used, with the pump station constructed near the existing mill facility.

The high horsepower, positive displacement pumps this alternative would require would cause substantial wear on the pipeline necessitating high maintenance and frequent access to the pipe. Consequently, the pipeline would have to be placed on the surface rather than be buried. During the course of operation, there would be a high probability that at some point, the pipeline would fail resulting in discharge of tailings to the environment. Secondary containment would be required in the pipeline design to control this discharge.

An initial estimate of the costs for operation of a tailings impoundment at the Nye Creek site suggests costs would be on the order of $4.09 per ton of tailings, or about 25 percent higher than similarly-based costs for Alternative B ($3.27 per ton of tailings). The primary reason for the higher costs associated with this alternative is the increased capital costs to develop the impoundment site at Nye Creek with associated tailings pipeline and water reclaim lines as well as the requirement to pump tailings 1 mile to a site that is about 1,600 feet above the Stillwater Mine's mill.

Alternative methods of transporting slurry tailings to the impoundment site, such as trough conveyors or bucket conveyors, are not considered feasible. Trough conveyors are limited by the gradation and consistency of the material that can be conveyed and would not allow transport of even dewatered or thickened tailings. Bucket conveyor systems would require specialized containment provisions

to transport slurry. Either system would be considered non-traditional with limited, if any demonstrated use in long-distance tailings transport. This alternative also would require construction of a significant catchment basin at the mine site for surge control and to capture spills and drawdowns for accidents or maintenance.

Alternative Considered: Disposal of tailings in the abandoned Benbow mining facilities instead of in a new tailings impoundment. These facilities are in the upper part of the Little Rocky Creek drainage just below the ridge that divides the Nye Creek and Little Rocky Creek watersheds.

Reason Considered: This alternative was suggested by members of the public.

Reason Dropped: This alternative was determined to be unreasonable because implementation would be technically unfeasible. This alternative would require pumping tailings from the Stillwater Mine up the Nye Creek drainage and over the 8,800-foot high drainage divide, a vertical gain in elevation of more than 3,500 feet. Established technology for transport of the tailings to the disposal site would consist of either a multiple stage pumping system consisting of a series of pumps with surge tanks and reclaim ponds or a single stage pumping system and a high pressure pipeline. Use of multiple pumps would require significant site disturbance to develop each pumping station, provide all-weather vehicle access, provide a surge tank, provide electrical power, and provide emergency containment. Capital and operating costs would increase with each additional pump station installed. Accordingly, it was assumed that a single pumping stage would be used, with the pump station constructed near the existing mill facility.

The high horsepower, positive displacement pumps this alternative would require would cause substantial wear on the pipeline necessitating high maintenance and frequent access to the pipe. Consequently, the pipeline would have to be

placed on the surface rather than be buried. During the course of operation, there would be a high probability that at some point, the pipeline would fail resulting in discharge of tailings to the environment. Secondary containment would be required in the pipeline design to control this discharge.

Alternative methods of transporting slurry tailings to the impoundment site such as trough conveyors or bucket conveyors are not considered feasible. Trough conveyors are limited by the gradation and consistency of the material that can be conveyed and would not allow transport of even dewatered or thickened tailings. Bucket conveyor systems would require specialized containment provisions to transport slurry. Either system would be considered non-traditional with limited, if any, demonstrated use in long-distance tailings transport.

At this time, it is unknown if there is sufficient volume to dispose of the tailings in existing underground mine workings because the extent and condition of the underground workings is undefined. There is a high risk that there would not be sufficient volume and that development of surface disposal facilities would be required at some point in the future. The immediate site area does not readily allow development of an impoundment, requiring development at one of the other alternative sites. Further, the potential for groundwater impacts from seepage resulting from the subsurface tailings disposal would be very difficult to predict or control. Additionally, this alternative would require construction of a significant catchment basin at the mill site for surge control and to capture spills and drawdowns for accidents or maintenance.

Alternative Considered: Total Tailings Paste Backfill and Landfill (backfill and landfill were considered together because if SMC does not implement total tailings paste backfill, total tailings paste landfill would not be possible — SMC would be removing the sand fraction for backfilling in the mine.)

Reason Considered:

Total tailings paste backfilling is one of the new emerging technologies for handling and disposing of tailings. Depositing the paste as backfill in underground mining areas involves the placement of tailings in abandoned mine shafts and workings. This method of disposal could eliminate the placement of at least some of the tailings on the surface.

Paste landfilling involves the placement on the ground surface of a tailings paste that consists of tailings that have a low moisture content. The paste retains moisture in a manner similar to wet concrete. Thus, the moisture does not separate when the paste is allowed to rest. Paste properties allow the tailings paste to be placed on the surface as an engineered fill, rather than as a wet slurry placed behind a dam. Use of paste also may decrease the time required for the tailings mass to achieve its ultimate density and volume.

Reason Dropped:

The agencies determined implementation of total tailings paste backfill at the Stillwater Mine is not reasonable at this time. Several considerations formed the foundation for this conclusion. First, this technology has only recently been implemented in a full-scale, operational mode in other underground mines and critical issues remain unresolved. For example, no one knows:

- if SMC's tailings can be dewatered by a paste plant effectively,
- the amount of cementing materials that need to be added to provide the strength necessary for safe mining,
- the amount of time required for the paste backfill to gain strength,
- if the amount of time needed to gain strength can be accommodated by the mine's production schedule,
- the distance the paste can be pumped, and
- the requirements for adding any additional natural sand materials to provide a suitable backfill.

Second, implementation of a total tailings paste backfill system would not eliminate the need for additional aboveground storage for tailings. The increase (swell) in volume of rock resulting from mining and processing of the ore combined with the necessity for maintaining certain areas of the mine open for access indefinitely ensure that all tailings cannot be placed underground. SMC would have to store this excess volume somewhere on the surface. (Considerations of surface disposal are discussed under total tailings landfill).

If whole tailings paste backfill was implemented, about 68 percent of the tailings would be used as paste backfill in place of the current sand system and 32 percent of the would have to report to the surface for disposal. Under SMC's current system, 58 percent of the tailings report as backfill in the mine and 42 percent report as slurried tailings to the tailings impoundment. Consequently, the volume of whole tailings paste reporting to a surface impoundment would not reduce the size of the impoundment required for storage much over that needed for slurried tailings. For example, to store the same volume of tailings as addressed by Alternative B, an impoundment built at Hertzler using whole tailings paste would cover about 150 acres (compared with 163 acres for Alternative B) and would have a final embankment elevation of 4,996 feet (compared to 5,036 feet for Alternative B). Placing total tailings paste on the east side of the Stillwater River, would require an impoundment that would cover about 80 acres of surface area with a final crest elevation of 5,060 feet.

Transport of the total tailings paste to the landfill site would be a substantial problem, technically. As discussed below, the paste plants would be at the mine site. However, pipeline transport of total tailings paste is not technically feasible because the paste would have to be re-slurried for delivery to the landfill site and then dewatered again to reestablish a paste for disposal. A conveyor system to move the volume of tailings generated from a 3,000 to 5,000 tpd operation would be

prohibitively large and inefficient. Also, transporting the paste by trucks at these production levels would substantially increase the volume of traffic on Stillwater County roads.

Third, construction of an overall paste backfill system would generate a surprisingly large amount of new disturbances. With present knowledge, it appears that SMC would have to construct 3 or 4 paste plants similar to the experimental plant SMC is constructing now (however, tailings production would support the operation of only three or four plants at any single time) and move them to 9 or 10 sites over the next 20 to 30 years. They would have to be constructed near portals due to limitations on distances the paste can be pumped. SMC would have to construct a 200-foot by 200-foot (0.9 acre) pad at each of the 9 to 10 portals. Due to the steep slopes and the need for cut-and-fill construction, disturbance for the pads would encompass much more than one acre (and at least some of the waste rock generated by construction would have to be stored somewhere). The overall slopes on SMC's present system of roads to the upper portals are too steep for loaded cement trucks to negotiate. Each paste plant would require at least 2 truck loads of cement daily (6 to 8 trucks total). Thus, SMC would have to construct a new system of roads with shallower slopes for the cement trucks. If SMC did construct a new network of roads, it's still questionable if the cement trucks could access the plants during the winter.

Fourth, the addition of the paste backfill system would substantially, increase the requirements for electrical power. Each plant would require about 1.5 megawatts of power. Currently, Montana Power Company's distribution lines supplying the Stillwater Mine and Stillwater Valley could not provide that much power when the other demands of increasing production, even with the upgrades discussed earlier. The power lines may have to be completely reconstructed back to Billings before the power for the paste plants and the rest of the mine could be supplied.

Fifth, the paste backfill system would substantially affect the visual characteristics of the mountain above the mine. The additional disturbances at the portals, the 200-foot long by 65-foot wide, by 50-foot tall paste plants, new roads, and power lines all would be visible from the valley.

Finally, the addition of the paste backfill system would require a substantial financial investment. Each paste plant would cost about $7 to $10 million dollars to construct. At 3 to 4 plants, the total cost would approach $40 million just for the paste plant facilities, exclusive of roads, pumps, pipes, etc. An initial estimate of the costs for operating a whole tailings paste backfill and landfill operation at the Stillwater Mine suggests costs would be on the order of $6.77 to $6.88 per ton of tailings, or about 107 to 110 percent higher than similarly-based costs for Alternative B ($3.27 per ton of tailings).

As a result of these considerations, DEQ and CNF determined this alternative is not currently feasible. Under MEPA/NEPA, all alternatives considered in detail must be reasonable ((CEQ 1981, 40 CFR 1502.14, and ARM 17.4.603 (2) (b)). This alternative does not meet the technology test for feasibility (CEQ 1981 and ARM 17.4.603 (2) (b)). It would require re-engineering and excessive cost to redo the mine, therefore, not meeting the economic test for feasibility (CEQ 1981). Therefore, this alternative was not included for consideration in detail.

However, the agencies recognize that the results of SMC's experimental paste plant and advancing technology may alter the feasibility in the future. They also recognize the need for aboveground storage of tailings would still be required and that any of the waste management facilities comprising the alternatives considered in detail could be converted to total tailings paste backfill and landfill should the technology be demonstrated feasible in the future. Thus, DEQ and CNF proposed an additional mitigation measure to

reconsider paste technology within five years of the decision makers' signing the RODs.

Alternative Considered: Slimes Tailings Paste Landfill (slimes tailings were not considered for backfilling because it is unlikely slimes tailings paste would have the structural strength needed in SMC's backfilling operations).

Reason Considered: Paste landfilling is one of the new emerging technologies for handling and disposing of tailings. Paste landfilling involves the placement on the ground surface of a tailings paste that consists of tailings that have a low moisture content. The paste retains moisture in a manner similar to wet concrete. Thus, the moisture does not separate when the paste is allowed to rest. Paste properties allow the tailings paste to be placed on the surface as an engineered fill, rather than as a wet slurry placed behind a dam. Use of paste also may decrease the time required for the tailings mass to achieve its ultimate density and volume.

Reason Dropped: Implementation of slimes tailings paste landfill at the Stillwater Mine is not a reasonable alternative at this time. Several considerations formed the foundation for this conclusion. The volume of slimes tailings paste reporting to a surface impoundment would not reduce the size of the impoundment much over that needed for slurried tailings. For example, to store the same volume of tailings as addressed by Alternative B, an impoundment built at Hertzler using slimes tailings paste would cover about 150 acres (compared with 163 acres for Alternative B) and would have a final embankment elevation of 5,025 feet (compared to 5,036 feet for Alternative B). To dispose of slimes paste tailings on the east side of the Stillwater River, the impoundment would cover slightly more than 80 acres (compared to 72 acres for Alternative D) and would have a final crest elevation of 5,120 feet (compared to 5,085 feet for Alternative D). With a final height of more than 150 feet, the static and seismic stability of such a slimes tailings paste

impoundment would be a concern because slimes tailings paste is likely to remain saturated and susceptible to liquefaction during earthquakes.

During June 1995, pilot tests were conducted at the Stillwater Mine to determine the efficiency and ability of dewatering Stillwater slimes tailings. The results of this analysis on the potential use of slimes-based paste for landfilling suggest the use of this technology would not substantially reduce SMC's requirements for storage of the tailings, would not provide any substantive environmental benefits, and would not provide any advantages for concurrent reclamation over slurried tailings disposal.

More than 70 percent of SMC's tailings (by weight) is finer than 20 microns. With this level of solids, the paste would be fully saturated, would have low strength characteristics, and could liquify under seismic loading conditions. To ensure stability, SMC would have to contain the paste by constructing a perimeter embankment from local borrow materials or using cement-amended paste to create a structural zone around the tailings paste. If a perimeter embankment is constructed, the final structure would be almost the same size as that of the Hertzler impoundment proposed by SMC. Little information is available on the behavior of paste amended with less than three percent of cement by weight (the amount needed to achieve the desired increase in strength).

Use of slimes tailings paste disposal also is not projected to provide any substantive improvement on the loss of seepage to groundwater over that projected for a slurried tailings impoundment. Due to the fine-grained nature of SMC's tailings, the paste produced likely would have a high water content and remain fully saturated. Although dewatering of the tailings to form the paste would eliminate the initial settling and consolidation of the slurry, seepage from the paste would still occur. Initial seepage from the paste would be less than that from slurried tailings. However, on-going seepage from the tailings paste would be

similar to that from slurried tailings that have completed the initial settling and consolidation. Thus, SMC would still have to construct a liner and underdrain system for paste disposal.

Because slimes tailings paste would most likely be placed in a saturated condition, it will have low strength and correspondingly poor trafficability. Thus, concurrent reclamation would not be possible without the use of a surface layer of cement-amended paste to provide adequate support for reclamation activities.

The addition of the slimes paste landfill system would require a substantial financial investment. The paste plant would cost about $7 to $10 million dollars to construct. An initial estimate of the costs for operating a slimes tailings paste landfill operation at the Stillwater Mine suggests costs would be on the order of $5.72 to $5.83 per ton of tailings, or about 75 to 78 percent higher than similarly-based costs for Alternative B ($3.27 per ton of tailings).

As a result of these considerations, this alternative is not currently reasonable. Under MEPA/NEPA, all alternatives considered in detail must be reasonable (CEQ 1981, 40 CFR 1502.14, and ARM 17.4.603 (2) (b)). Therefore, this alternative was not included for consideration in detail.

However, the agencies recognize that the results of SMC's experimental paste plant and advancing technology may alter the feasibility of this alternative in the future. They also recognize the need for aboveground storage of tailings would still be required and that any of the waste management facilities comprising the alternatives considered in detail could be converted to paste landfill should the technology be demonstrated feasible in the future. Thus, DEQ and CNF proposed an additional mitigation measure to reconsider paste technology within five years of the decision makers' signing the RODs.

Alternative Considered:	Tailings impoundment at Hertzler Ranch with additional lining (e.g., thicker liners [100 mil] or a second liner).
Reason Considered:	This alternative was considered to address concerns about the potential for seepage from the tailings to contaminate groundwater at Hertzler Ranch. Also, a 100-mil liner was used in the existing tailings impoundment.
Reason Dropped:	This alternative was dropped because a review of the characteristics of SMC's proposed Hertzler tailings impoundment suggested additional liners or a thicker liner would not provide any substantive decrease in the potential for seepage to reach groundwater. The proposed 60-mil thick HDPE liner, liner bedding material, and underdrain system provide a better system of protection. The HDPE liner and the compacted soil liner together provide as low or lower transmissivity as a 100-mil liner by itself (a 100-mil liner is not installed with a compacted soil liner). Additionally, 60-mil liners are easier to handle during installation than the thicker and heavier 100-mil liners, which results in fewer chances for problems, such as tears. The 60-mil liners lie flat and sit tight on the soil liner, whereas 100-mil liners (due to their thickness) tend to bridge over the soil resulting in a poorer fit over the soil. Finally, although a 100-mil liner was used in the existing tailings impoundment, a 60-mil liner was determined to be adequate for protecting ground-water and was initially approved. However, winds at the mine were too high for the 60-mil liner. They pulled the liner up where it was exposed or had a thin cover. These same winds could not move the 100-mil liner. Because the valley at Hertzler is wider, the winds are not as strong as at the mine and a 100-mil liner would not be needed to resist the stronger winds.

Alternative Considered:	Centerline expansion of the existing tailings impoundment combined with a new impoundment at Hertzler Ranch.

Reason Considered:	Implementation of this alternative would result in a smaller impoundment at Hertzler Ranch than would be constructed under the Proposed Action. The smaller impoundment would be less visible and its areal extent would be less than what would occur under the Proposed Action.
Reason Dropped:	Expansion of the existing tailings impoundment would push the impoundment's toe farther into the PMF flood plain. This extension of the toe is unacceptable to DEQ and CNF. Also, this alternative would be substantially redundant with Alternative C, which was carried through the analysis.
Alternative Considered:	Alternate routes for the pipelines that would connect the mill and concentrating circuits at the Stillwater Mine to the proposed Hertzler tailings impoundment.
Reason Considered:	Alternative routes might offer more environmentally-acceptable means for connecting the mill and concentrating circuits to the proposed Hertzler tailings impoundment.
Reason Dropped:	Alternative routes would not offer more environmentally-acceptable means for connecting the mill and concentrating circuits to the proposed Hertzler tailings impoundment. Alternative routes would generate more disturbance because they would traverse undisturbed private lands. Construction and reclamation of these routes would be more difficult due to the irregular topography the routes would have to cross. In contrast, the proposed route along the rights-of-way of Stillwater County roads 419 and 420 is already disturbed and readily reclaimed to its present use and conditions.

2.6 Reasonably Foreseeable Projects

Effects resulting from implementation of the following projects may, to some degree, combine cumulatively with the effects of the alternatives considered in detail in this analysis. Several reasonably foreseeable projects have been

identified for this analysis. They are discussed below and shown on **Figure 2–12**.

2.6.1 Custer National Forest Projects

Two projects proposed for the Beartooth District of the CNF were identified as reasonably foreseeable projects. They are:

- *Woodbine Campground Reconstruction* — Modernization and increased capacity of Woodbine Campground has been completed (Pierson 1998, pers. comm.). Watershed concerns will be addressed in this project through the paving of roads and spurs. The project should occur in the near future. With the recent reconstruction of County Road 419 from Highway 78, recreational opportunities in the Stillwater Valley, use of the campground, and traffic are expected to increase.

- *Horseman Flats Prescribed Burn* — The CNF is planning to conduct a prescribed burn of Forest Service system lands on Horseman Flat to increase the amount of forage available for wildlife. Currently, the CNF plans to conduct the burn in 1999.

2.6.2 Other Projects

Several residential subdivision projects were identified within the general project area for one or more resources. They are:

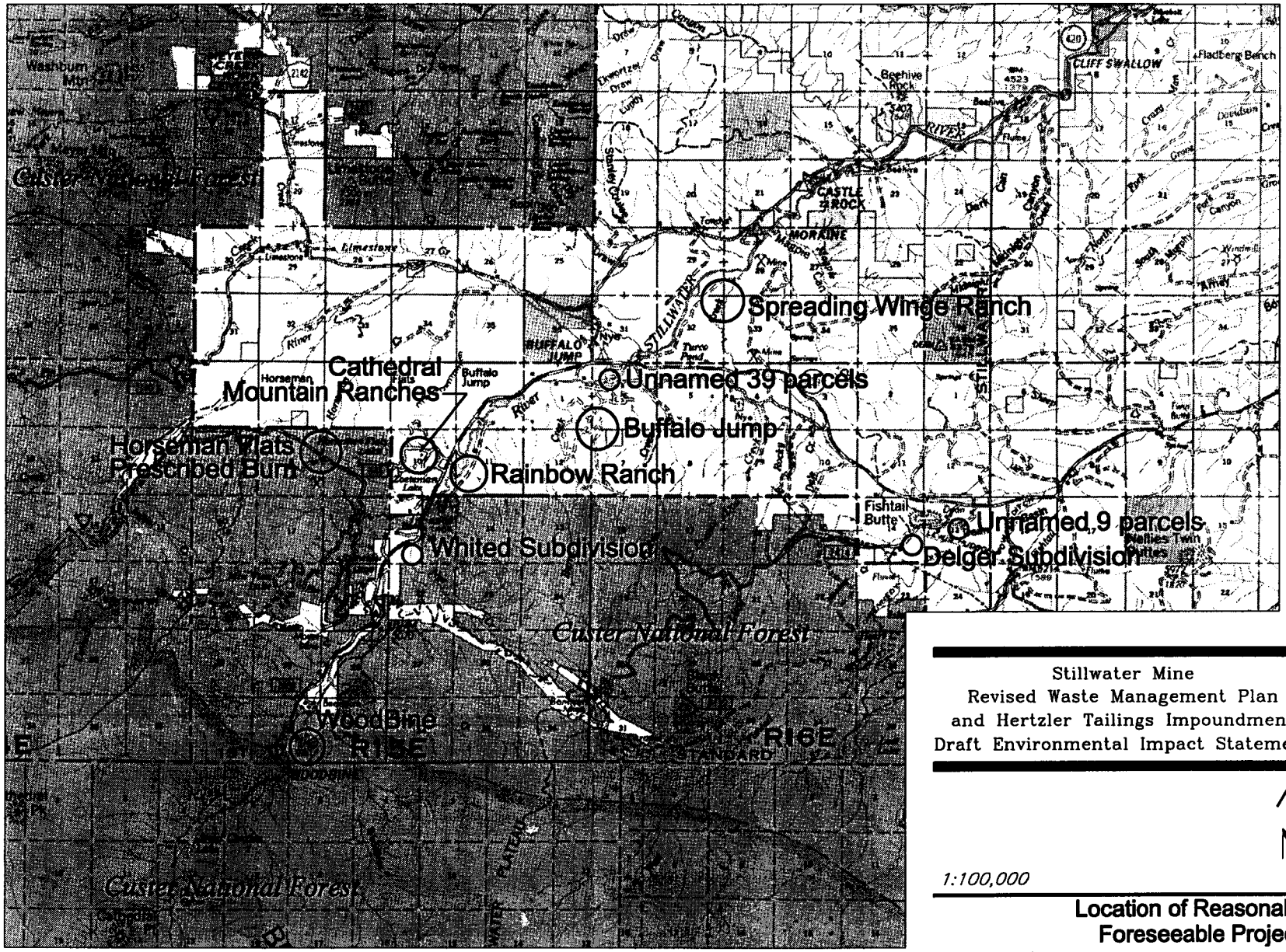
- *Cathedral Mountain Ranch*. Located west of the Stillwater River and adjacent to the Custer National Forest boundary in Sections 3, 10, and 11, T5S, R15E. Platted areas comprise approximately 600 acres.

- *Rainbow Ranch*. Located adjacent to the Stillwater River and the Custer National Forest Boundary in Sections 10 and 11, T5S, R15E. Platted areas comprise approximately 240 acres.

- *Buffalo Jump*. Located one mile south-southeast of Nye, Montana, in Sections 1 and 12 in T5S, R15E; Sections 31 and 32 in T4S, R16E; and Sections 5, 6, and 7 in T5S, R16E. Platted areas comprise approximately 300 acres.

- *Whited Subdivision*. Located east of the Stillwater River in Section 15, T5S, R15E. Platted areas comprise approximately 40 acres.

- *Delger Subdivision*. Located west of Dean, Montana, in Section 14, T5S, R16E. Platted areas comprise approximately 40 acres. The plat map dated September 15, 1970 shows 22 lots.



Stillwater Mine
Revised Waste Management Plan
and Hertzler Tailings Impoundment
Draft Environmental Impact Statement

1:100,000

Location of Reasonably Foreseeable Projects
Figure 2-12

597forsee.dwg

- An unnamed plat of nine parcels including the Dean Community Club property west of Dean, Montana, in Section 13, T5S, R16E. Platted areas comprise approximately 45 acres.

- An unnamed plat of 39 parcels, 17 of which are on the Stillwater River southwest of the County Road 419 bridge over the Stillwater River. All located in Section 6, T5S, R16E.

- *Spreading Winge Ranch*. Located in Sections 28, 29, 32, and 33 in T4S, R16E, and Sections 4 and 5 in T5S, R16E east of Nye, Montana. The plat shows 61 tracts, 27 of which were on the Stillwater River.

2.7 Projects Not Considered Reasonably Foreseeable at This Time

2.7.1 Future Mine Expansion

Given the continued worldwide demand for platinum and palladium and that the ore body owned or controlled by SMC extends 27 miles between the Stillwater Mine and the unconstructed East Boulder Mine, it is possible that the Stillwater Mine would continue to operate beyond 30 years. The extent and duration of future operation and expansion cannot be predicted at this time and will depend upon the market for these metals, operational costs, and mining and milling technologies. If SMC decided to continue its operations, the company would be required to submit a revision that would undergo full environmental analysis and disclosure under the NEPA/MEPA process.

If SMC decided to continue operations, future expansion would most likely require additional mine waste storage facilities, such as have been proposed for this project being analyzed. Future storage space could be achieved by expanding approved facilities (the existing facilities and any that might be approved per the current proposed permit revision), constructing new facilities in different locations, or developing more efficient means of storing mine waste underground or finding an offsite beneficial use for the waste products that would not require long-term storage in the vicinity of the mine.

It is possible that Hertzler Ranch could store additional tailings in the future if more capacity is needed. However, storage beyond the Hertzler impoundment as proposed has not been looked at in detail. A preliminary review of the property and Hertzler tailings impoundment (as proposed in Alternative B) suggests some additional capacity exists. The Hertzler tailings impoundment could be raised using modified centerline construction from the proposed crest elevation of 5,036 feet to 5,065 feet, which would provide capacity for an additional 5 million tons of tailings (Greenaway 1998). Additionally, a new impoundment

could be constructed in the drainage where the LAD storage pond is proposed and where the southwestern borrow area would be located (see **Figure 2–2**). An impoundment at this location would probably encompass an area similar in areal extent to the 163 acres that the Hertzler impoundment would encompass and could have a capacity similar to that proposed under Alternative B. However, without detailed analysis, one cannot determine if sufficient fill material exists on Hertzler to construct another tailings impoundment. If sufficient fill material does not exist at Hertzler, then the feasibility of another impoundment would depend, in part, on the availability of a suitable supply of fill material.

As the discussion above suggests, many variables and unknowns exist relative to the possibilities for future expansion of the Stillwater Mine. Consequently, inclusion of a possible expansion scenario into the cumulative impact analysis at this time could not be made reasonably and was not evaluated.

2.7.2 Stillwater River Corridor Zoning Petition

The Stillwater River Corridor Zoning Petition has been formally accepted with the necessary signatures and, pursuant to Montana State Code, the Stillwater River Corridor Planning and Zoning District was recently formed. Additionally, a zoning commission also has been established (Beaudry 1998). To date (September 1998), the commission has not approved any formal land use or development density changes for the corridor, which includes a portion of the Hertzler Ranch site. Until the time when such zoning changes are formally approved by the commission, these zoning restriction cannot be considered a reasonably foreseeable project for this analysis.

2.8 Summary of Alternatives and Environmental Consequences

The following tables summarize the alternatives considered in detail and the likely environmental consequences of each alternative. **Table 2–3** contains the summary of alternatives. This table contrasts the four alternatives in terms of their physical characteristics and requirements for such items as power, workforce, and monitoring. For example, one can readily compare the alternatives to see how many tons of waste rock and tailings each alternative accommodates and what facilities would be involved in storing waste rock and tailings. Additionally, the areal extents of facilities are presented. Finally, the table summarizes the amount of physical disturbance that would occur under each alternative and how much of that disturbance involves areas that are already disturbed. **Table 2–4** contains the summary of environmental consequences. Chapter 4 presents the consequences identified in **Table 2–4** in more detail.

2.9 Preferred Alternative

The agencies' preferred alternative is Alternative B, the Proposed Action, with the mitigations listed in **Section 2.4.5**. Alternative B would result in the construction of a second tailings impoundment at the Hertzler Ranch site, construction of a 7.8-mile long pipeline corridor along Stillwater County roads 419 and 420 between the mill and the new impoundment, construction of a waste rock storage facility on the east side of the river across from the mill, additional LAD sites at the Stratton and Hertzler ranch sites, and removal of the production cap.

Table 2–3 Comparison of Alternatives Considered in Detail

Parameter	Alternative A	Alternative B	Alternative C	Alternative D
Waste Rock Production and Management				
Capacity (tons)				
Temp. & Permanent Storage Areas[1]	1,630,000	1,630,000	1,630,000	1,630,000
Completion of Existing Impoundment[1]	1,755,000	1,755,000	1,755,000	1,755,000
Expansion of Existing Impoundment	na[2]	na	2,660,000	2,660,000
East Side Visual Berm[1]	386,000	na	na	na
East Side Storage Site	na	17,886,000	15,226,000	na
East Stillwater Impoundment	na	na	na	9,840,000
Total	3,771,002	21,271,000	21,271,000	15,885,000
Areal Extent of Coverage (acres)				
Temp. & Permanent Storage Areas	18	18	18	18
Complete Existing Impoundment Embankment	15	15	15	15
Expansion of Existing Embankment	na	na	8	8
East Side Visual Berm	12	na	na	na
East Side Storage Site	na	80	80	na
East Stillwater Impoundment	na	na	na	72
Total	45	113	121	113
Tailings Production and Management				
Capacity (tons)				
Existing Impoundment (present day)	1,900,000	1,900,000	1,900,000	1,900,000
Existing Impoundment (additional)	1,600,000	1,600,000	1,600,000	1,600,000
Expansion of Existing Impoundment	na	na	4,850,000	4,850,000
Hertzler Ranch Impoundment	na	15,000,000	10,150,000	na
East Stillwater Impoundment	na	na	na	4,940,000
Total Capacity	3,500,000	18,500,000	18,500,000	13,290,000
Areal Extent of Coverage (acres)				
Existing Impoundment	45	45	45	45
Expansion of Existing Impoundment	na	na	8	8
Hertzler Ranch Impoundment	na	163	129	na
East Stillwater Impoundment	na	na	na	72
Total	45	208	182	125
Final Crest Elevations (feet)				
Existing Impoundment	5,111	5,111	5,175	5,175
Hertzler Ranch Impoundment	na	5,036	5,007	na
East Stillwater Impoundment	na	na	na	5,085
Water Management and Disposal				
LADs (acres)	24	104	104	40
LAD storage ponds (acres)	2	17	17	2
Tailings/Process water	evaporate/reuse	evaporate/reuse	evaporate/reuse	evaporate/reuse
Power Requirements (MW)	12	16	16	16
Roads and Traffic	no change	additional traffic	additional traffic	additional traffic
Workforce (# employees)	655	700	700	700
Monitoring	no change	program would expand	program would expand	program would expand
Reclamation	no change	revise accepted plan	revise accepted plan	revise accepted plan
Currently-permitted disturbance (acres)	255	255	255	255
Existing Non-SMC disturbance[2] (acres)	0	172	172	84
New SMC disturbance (acres)	0	251	217	1
Total disturbance (acres)	255	678	644	340
Bonding	no change	increase	increase	increase

Notes:

1. Placement of waste rock in the temporary and permanent storage areas, embankment to complete the existing tailings impoundment, and east side visual berm has been permitted by DEQ and CNF. No waste rock has been placed in the east side visual berm.. If an alternative with the east side storage site or East Stillwater impoundment is selected, the east side visual berm would not be constructed. Instead, its capacity would be absorbed into the east side storage site or East Stillwater impoundment.
2. Existing non-SMC disturbance includes 80 acres of pastureland at Hertzler Ranch and portions of the east side where chrome tailings were previously deposited. Neither of these locations has a cover of native species.

Table 2–4 Summary Comparison of Impacts by Alternative

Issue or Resource	Indicator Units	Alternative			
		A — No Action	B — Proposed Action	C — Modified Expansion and Hertzler	D — Modified Expansion and East Side Impoundment
Purpose and Need		Does not meet Purpose and Need	Does meet Purpose and Need	Does meet Purpose and Need	Partially meets Purpose and Need
Physical Size	Acres	255	678	644	340
Water Resources	Groundwater Quantity	Aquifers are localized and highly variable. Overall mine discharges may reach 1,061 gpm.	Recharge as much as 2,000 gpm at Stratton and Hertzler Ranch by LAD in summer. Overall mine discharges may reach 1,342 gpm at an average production rate of 3,000 tpd.	Same as B, but effects at Hertzler Ranch delayed.	Recharge only at Stratton Ranch. Overall mine discharges may reach 1,277 gpm at an average production rate of 3,000 tpd.
	Groundwater Quality	Generally good. No change would occur.	Localized increase in nitrates near LADs at Stratton and Hertzler Ranches and the waste rock storage facility (approx. loading of 13.6 lbs/day).	Same as B, but effects at Hertzler Ranch delayed.	Localized increase in nitrates near LADs at Stratton Ranch and east side tailings impoundment. Loading of nitrates from east side tailings impoundment would be less than the 13.6 lbs/day that would occur with waste rock facility.
	Tailings Pollutant From Pipeline Accident	Not applicable.	No long-term effects, but short-term effects from increased sediment would be primarily contained within the borrow ditch.	Same effects as B, but slightly shorter period than B.	Slightly higher risk than B due to exposed pipelines suspended over the Stillwater River.
	Surface Water Quantity	No change.	Small, short-term increase in runoff	Slightly less risk than B	Least runoff
	Surface Water Quality	Good to excellent. No change.	Minor change due to increased water discharges	Same as B	Slightly better than B due to a lower increase in water discharges
	Tailings Pollutant from Impoundment Failure	Only tailings from existing impoundment would possibly reach the river.	Same as A, only tailings from existing impoundment would reach the river if it failed Hertzler is ≥½ mile upgradient from Stillwater River.	Greater risk than B because more tailings would possibly reach the river if the modified, existing tailings impoundment failed	Greater risk than B or C. All tailings from two impoundments would reach the river if the impoundments failed

Table 2–4 Summary Comparison of Impacts by Alternative, Con't.

Issue or Resource	Indicator Units	Alternative			
		A — No Action	B — Proposed Action	C — Modified Expansion and Hertzler	D — Modified Expansion and East Side Impoundment
Water Resources	Nitrates in Stillwater River	No change	Remain below Std. (an increase of 0.02 to 0.05 mg/L)	Same as B	Same as B
	Sedimentation	247 TDS mean adit water and 1,500 TDS mean process water. No change.	Sediment from pipeline construction would be contained within the borrow ditch. Sediment from Hertzler would have to travel about ½ mile to reach the river. No more than small, short-term increases during construction.	Modification of the existing impoundment would occur less than ¼ mile from the river. However, most sediment from this construction should be captured by SMC's stormwater containment system.	Same as C for the existing impoundment. Sediment would be generate from construction of the new impoundment less than ¼ mile from the river. However, most sediment from this construction should be captured by a new stormwater containment system.
	Heavy Metals	Some metals (cadmium, copper, lead, and zinc) have exceeded standards. on one or more occasions (from natural sources). No change.	Same as A.	Same as B.	Same as B.
	Water Wells	No effect.	No effect.	Same as B.	Same as B.
	Waters of the U.S.	None.	1.5 acres affected. Permitted under Nationwide Permits.	Same as B. Permitted under Nationwide Permits.	Less than 1 acre affected. Permitted under Nationwide Permits.

Table 2–4 Summary Comparison of Impacts by Alternative, Con't.

Issue or Resource	Indicator Units	Alternative			
		A — No Action	B — Proposed Action	C — Modified Expansion and Hertzler	D — Modified Expansion and East Side Impoundment
Wildlife	General Habitats Affected (acres)	No change from approved.	678 acres	644 — affects at Hertzler delayed up to 10 years.	340
	Winter Range Affected (acres)	No change from approved	678 acres of mule deer winter range affected (255 acres previously-permitted disturbance, 251 acres new disturbance, 68 acres previously disturbed, and 104 acres under LADs). No bighorn sheep habitat directly affected, but potential indirect effects to bighorn sheep from competition for forage from mule deer displacement.	644 acres of mule deer winter range affected (255 acres previously-permitted disturbance, 217 acres new disturbance, 68 acres previously disturbed, and 104 acres under LADs). 8 acres of bighorn sheep habitat directly affected. Same indirect effects to bighorn sheep as B.	340 acres of mule deer winter range affected (255 acres previously-permitted disturbance, 1 acre new disturbance, 60 acres previously disturbed, and 24 acres under LADs). 8 acres of bighorn sheep habitat affected. Same indirect effects to bighorn as B.
	T&E Impacts	No effect.	No effect.	Same as B.	Same as B.
Fisheries	Change in Stream Flow	No change.	No change.	Same as B.	Same as B.
	Increased Sedimentation	No change	No change.	Same as B	Same as B.
	Increased Nutrients	No change	No change	Same as B	Same as B
Air Quality	Criteria Pollutants Above Standards	None. (from 7 percent to 30 percent of NAAQS).	None.	Same as B slightly less dust.	Similar to B, but increased potential for dust with two impoundments in a high-wind area.
Social Economics	Population	No change (7,653 persons in the county).	456 new residents.	Same as B.	Same as B.
	Employment	No change (3,879 persons employed in the county).	45 additional people (a combination of permanent employees and contractors).	Same as B.	Same as B.
	Property Values	Would continue to increase.	Same as A, but some individual properties may loose value	Same as B, but delayed in time at Hertzler.	Similar to B. Any adverse effects are concentrated at the current mine site and new impoundment site.

Table 2–4 Summary Comparison of Impacts by Alternative, Con't.

Issue or Resource	Indicator Units	Alternative			
		A — No Action	B — Proposed Action	C — Modified Expansion and Hertzler	D — Modified Expansion and East Side Impoundment
Social Economics	Proximity of Residences to Mine Facilities	22 within 1 mile and 109 within 5 miles of existing impoundment	Same number of residences in proximity to existing impoundment. 33 within 1 mile and 158 within 5 miles of Hertzler	Same as B, but delayed activity at Hertzler.	Same as A, but increased amount of activity at existing mine site.
	New Students	No change (957 students).	34 new elementary students.	Same as B.	Same as B.
Tailings Impoundment Stability	Exceed Safety Factor of 1.0	Yes	Yes	Yes	Yes
	Risk of Failure and Consequences	No change.	Somewhat higher risk than A due because two impoundments would exist. Only failure of existing impoundment could discharge tailings directly into the Stillwater River.	Higher risk than B because existing impoundment would be expanded above the original design elevation. Only failure of existing impoundment could discharge tailings directly into the Stillwater River.	Risk about the same as B because existing impoundment would be expanded above the original design elevation. Failure of existing impoundment and new impoundment could discharge tailings directly into the Stillwater River.
Visual Quality	Meets Visual Quality Objectives for National Forest System lands.	Yes, no change.	Yes	Yes	Yes
Noise	Increased Noise Levels.	Yes, if production increases.	Yes, slightly at new locations.	Less than B, but effects at Hertzler Ranch delayed.	No noise effects at Hertzler, increased noise at mine site and east side, which would affect a larger number of residences because more homes exist around the mine site.
Lights and Lighting	Changes in the amount of lighting.	No change.	Minor additions of shaded lights.	Same as B, but effects at Hertzler Ranch delayed.	No lights at Hertzler Ranch, but increased lights at mine site and east side
Transportation	ADTs on County Road 419.	803	906	Same as B.	Same as B.

Table 2–4 Summary Comparison of Impacts by Alternative, Con't.

Issue or Resource	Indicator Units	Alternative			
		A — No Action	B — Proposed Action	C — Modified Expansion and Hertzler	D — Modified Expansion and East Side Impoundment
Reclamation Potential	Sufficient Topsoil for Reclamation	Yes, 4,000 cubic yards	Yes, 142,500 cubic yards	Same as B, but disturbance delayed up to 10 years.	Cubic yards would be different, source would be the same.
	Suitable Revegetation Plan	Yes	Yes	Same as B.	Same as B.
	Microclimate	High winds drive dust and blast revegetation.	Less winds to affect revegetation at Hertzler.	Same as B, but delayed revegetation due to construction delay.	Same as A, but two impoundments and revegetation efforts would be subject to high winds.
	Vegetation Disturbance (acres)				
	Currently-permitted disturb.	255	255	255	255
	Existing non-SMC disturb.[1]	0	172	172	84
	New SMC Disturbance	0	251	217[2]	1
	Total disturbance	255	678	644	340
Cultural Resources	Sites Affected	None	None	Same as B.	Same as B.

Note:
1. Existing non-SMC disturbance includes 80 acres of pastureland at Hertzler Ranch and portions of the east side where chrome tailings were previously deposited. Neither of these locations has a cover of native species.
2. Disturbance at Hertzler Ranch would be delayed up to 10 years relative to Alternative B.

Abbreviations in Table:

ADT	Average Daily Trips
APE	Area of Potential Effect
BMP	Best Management Practice
KOP	Key Observation Point
LAD	Land Application Disposal
T&E	Threatened and Endangered Species

Chapter 3.0 — Affected Environment

Chapter 3.0 — Affected Environment . . . . . 3 – 1
3.1 Water Resources . . . . . 3 – 1
3.2 Wildlife . . . . . 3 – 27
3.3 Fisheries . . . . . 3 – 34
3.4 Air Quality . . . . . 3 – 39
3.5 Socioeconomics . . . . . 3 – 40
3.6 Tailings Impoundment Stability . . . . . 3 – 50
3.7 Aesthetics . . . . . 3 – 54
3.8 Transportation . . . . . 3 – 59
3.9 Reclamation . . . . . 3 – 61
3.10 Cultural Resources . . . . . 3 – 65

Chapter 3.0 — Affected Environment

This chapter describes the affected environment for the project alternatives. The affected environment is the portion of the existing environment that could be affected by the project. The information presented here focuses on issues identified through the scoping process and interdisciplinary analyses (Chapter 2, **Section 2.2.1**).

The affected environment varies for each issue. This variation is dictated by both the nature of the issue and components of the proposed project and alternatives. Considerable information has been published about the Stillwater Mine in several environmental analysis documents (**Appendix A**). As discussed in Chapter 1 (**Section 1.6.1**), this EIS tiers off those environmental documents. Consequently, the following sections concentrate on providing only the specific environmental information necessary to assess the potential effects of the Proposed Action and alternatives. Summaries of the primary documents to which this EIS tiers are included in **Appendix A**.

The numerous comments on the draft EIS have resulted in additional information being incorporated into this chapter of the final EIS. Additional information focused primarily on water resources including precipitation data, flow data for Stillwater River and several springs, surface and ground water quality data, the recently revised MPDES permit, water rights, characteristics of the deposited materials at the Hertzler Ranch. Other changes included better defining civilian labor force numbers, identifying the maximum credible earthquake, and clarifying which cultural sites were in closest proximity to proposed facilities and incorporating the results of SHPO evaluation of identified cultural sites.

3.1 Water Resources

3.1.1 Surface Water Quantity

Surface water features present in the project area remain comparatively unchanged since the initial studies were conducted for the Stillwater Mine in the early 1980s. Consequently, the discussion below is a brief summary of surface water features. Additional information is available in the 1985 final EIS for the original project (DSL and Forest Service 1985) and subsequent documents.

3.1.1.1 Stillwater Mine Site

Stillwater River

The Stillwater River, which drains the northwest portion of the Beartooth Mountains, is the primary surface water feature in the project area (**Figures 3–1** and **3–2**). The Stillwater River flows within one-quarter mile of the mine/mill site.

The Stillwater River is a fourth and fifth order stream that drains an area of 371 square miles at USGS gage 06202610 at Beehive, Montana. Peak flows occur during June and July as a result of snowmelt and spring precipitation. Approximately 75 percent of the annual runoff occurs in May, June, and July (Camp Dresser and McKee, Inc. (CDM) 1981). Precipitation at the mine site averages 18.3 inches on data collected between 1950 and 1958 and 1981 to present (Western Regional Climate Center, 1998). The average snowfall is 102.2 inches, yielding six of the eighteen inches of precipitation. The precipitation regime, combined with substantial topographic relief, thin soil, and low headwater storage capacity account for large variations in flow rates. Stream channel gradients are 254 feet per mile in the upper reaches and 16 feet per mile in the lower reaches of the Stillwater River. Flow measurements taken during a 7-year period from the USGS' gage 06202510 near Nye, Montana, indicate that the maximum and minimum instantaneous discharges were 6,400 cfs and 16 cfs, respectively. Mean annual flows for the period of November 1979 to September 1991 averaged 373 cfs on the 193-square mile watershed (Shields, et al. 1992). The sustained low flow at a site is reflected by statistical determination of the seven-day, ten-year low flow, or the 7Q10. At the mine site, this value has been estimated at 31.1 cfs over the course of the year. The 7Q10 for July, August and September is 87 cfs (Thompson 1998, pers. comm.).

Floodplain data have been used to delineate flood-prone areas in the project area. The existing mine facilities and the proposed facilities lie outside both the 100-year flood zone and the PMF zone (**Figure 3–1** and **Figure 3–2**). Only the Stratton Ranch site lies within the PMF zone.

Other Surface Water Features

Several local tributaries of the Stillwater River occur within or near the Stillwater Mine. They include Nye Creek, No Name Creek, and Mountain View Creek. All three are subalpine to alpine creeks that flow during most of the year in their upper reaches, but may dry up in their lower reaches.

Nye Creek is a first order tributary located directly across the river from the SMC mine tailings impoundment and drains an area of about 3.7 square miles. Flows from June 1980 through June 1981 ranged from 0 to 0.60 cfs (CDM 1981). Flows acquired two to three times per year between May 1992 and

December 1996 exhibited flows between 0.32 and 7.23 cfs (Hydrometrics 1996b).

No Name Creek is the small drainage immediately south of Nye Creek, east of the Stillwater River at the Stillwater Mine site. The flow of this creek was severely reduced during the development of the east side adit.

Mountain View Creek flows due east from Mountain View Lake and skirts SMC's existing tailings impoundment on the south. The stream gradient is steep and the drainage area is small (1.37 square miles). Thus, the creek has low peak flows. Baseline monitoring from June 1980 through June 1981 at MV–1 (Mountain View Lake surface water sampling location No. 1) noted flows ranging from 0.01 to 0.09 cfs (CDM 1981). Operational monitoring at SMC–6 between May 1992 and December 1996 showed flows between 0.34 and 2.32 cfs (Hydrometrics 1996b).

3.1.1.2 Stratton Ranch

The Stillwater River lies one quarter of a mile east of Stratton Ranch. The river tends to lose water to the aquifer in this reach. A small perennial creek flows due east off the uplands above the ranch and disappears in alluvial fan material deposits on the ranch. The creek flows all year above the alluvial fan. There are several perennial ponds in the area. One is man-made and the others occur naturally in the hummocky terrain of the old landslide on the northwest side of the area. A depression west of County Road 419 was created by aggregate extraction.

3.1.1.3 Hertzler Ranch

The Stillwater River lies east of Hertzler Ranch and the West Fork of the Stillwater River lies southwest of the ranch. Hydrometrics (Thompson 1998; pers. comm.) has conservatively estimated that low flows on the Stillwater River south of Hertzler are fifty percent higher than at the mine site. The 7-day, 10-year low flow (7Q10) has been estimated as 46.65 cfs in this location.

The West Fork of the Stillwater River is a fourth order tributary draining 122 square miles at the discontinued USGS gage 06202598 near Nye, below Castle Creek. It runs approximately parallel to, and is located west of, the Stillwater River. The West Fork of the Stillwater River is separated from the upper reaches of the Stillwater River by a ridge and flows into it five miles downstream of the mine site, near Nye. The West Fork of the Stillwater River is split into two channels in the last mile. The southern or western channel does not flow year-round. Monthly flow monitoring between June 1980 and June 1981 showed flows ranging from 23.3 to 514.26 cfs (CDM 1981).

Two small, poorly-developed coulees with no distinct drainage channels drain the Hertzler Ranch (**Figure 3–1**). Both drainages start at the base of Bush Mountain and end in Hertzler Valley. The two drainages rarely, if ever, carry runoff. Rainfall and snowmelt falling on the site infiltrate into the glacial material and are either consumed by vegetation or become part of the groundwater system. An unnamed drainage flows down the center of the Hertzler Valley and has a small, indistinct channel. An irrigation ditch that brings water from the West Fork of the Stillwater River does fill the channel (near the Hertzler homestead) during the irrigation season, but the channel is normally dry.

Runoff flowing into the Hertzler Valley from the north (Robinson Draw, Stanley Coulee, and Tandy Coal Mine Draw) appears to flow into the irrigation ditch, rather than reaching the main Hertzler valley. All three drainages are ephemeral, meaning they flow only in response to rapid snowmelt or intense rainstorm events. Monitoring between June 1980 and June 1981 at surface water station RD–1 in Robinson Draw noted flows ranging from 0 to 8.88 cfs (CDM 1981). Monitoring of Stanley Coulee at surface water station SC–1 during the same time period showed flows ranging from 0.007 to 5.77 cfs. Monitoring of Tandy Coal Mine Draw (TC–1) had flows ranging from <0.01 to 0.972 cfs.

3.1.2 Surface Water Quality

3.1.2.1 Stillwater Mine Site

The following discussion describes general characteristics of water quality, ranges in concentrations, and departures from numeric water quality standards. The State of Montana has use-based standards and differentiates between acceptable water quality for aquatic organisms and humans. Aquatic life standards are based on exposure. Data suggests that aquatic life can better tolerate a short duration elevated concentration than long-term, slightly lower concentrations. Aquatic life are more vulnerable to metals under low concentrations of hardness as found in the Stillwater River. Thus, review of the water quality tables will reveal that the lowest standards are for chronic aquatic life and the highest standards are for human health. Many water quality standards are set in order of magnitude below reported toxicity levels. Montana's groundwaters are only subject to human health standards.

Complicating the review of historic data are the analytical difficulties of perceiving low concentrations, due both to the instrumentation and the surrounding chemical matrix. Highly sensitive, low level analyses are costly, and analytical breakthroughs have been preceded by the rush to protect biota. Thus, results which include analyses that are less than detection limits may still exceed the aquatic standards.

Page 3-3 to 3-7

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There is substantial discussion throughout the rest of the document about the nutrients, phosphorus, and nitrogen. These nutrients can stimulate algal growth during the growing season. Phosphorus concentrations are too low to support algal growth at this time, but SMC will release some through the anoxic biotreatment cell. Concentrations in the river are 0.045 mg/L under low summer flows. The MPDES permit regulates phosphorus loading up to 1.1 pounds per day. Nitrogen is present in natural waters as nitrate, nitrite, and unionized ammonia, in order of concentration. The human health standard for nitrate is 10 mg/L. The background concentration is 0.4 mg/L and the MPDES permit allows an increase of 0.6 mg/L to 1 mg/L using a daily loading of 100 pounds nitrogen per day. The loading limits for phosphorus and nitrogen are engineered to prevent unwanted algal growth and discharge concentrations below the mixing zones do not represent levels that pose human health concerns.

Water quality standards are used to evaluate discharges into a water body and to determine the suitability of a water for a specific use. The water quality standards for waters whose baseline characteristics statistically significantly exceed the numeric water quality standard are the baseline conditions.

Stillwater River

A 1978 water quality assessment (Mid-Yellowstone Areawide Planning Organization 1978) classified the quality of the water in the Stillwater River as good to excellent, reflecting the low level of development in the area. Over the last 20 years, and since the mine's development, the quality of water in the Stillwater River has been maintained at that quality. DEQ has classified the Stillwater River as a B–1 type, meaning the river's water is generally suitable, after conventional water treatment, for drinking, cooking, and food processing. The water may be used without further treatment for bathing; swimming; recreating; growth and propagation of trout fisheries and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supply (DEQ 1996). Metals periodically exceed water quality standards for domestic use (**Table 3–1**). Beneficial use of waters from the Stillwater River include industrial, commercial, domestic, irrigation, stock watering, and fish and wildlife uses.

Stillwater River water has a calcium-bicarbonate composition, is generally soft, is low in total dissolved solids, and has pH values ranging from 6.6 to 8.0 (**Table 3–1**) (Hydrometrics 1996b and 1997). Turbidity and total suspended solids are typically low. Seasonal variations in total dissolved solids typically occur in an inverse response to flow, with elevated concentrations occurring during periods of high flow, such as snowmelt or thunderstorms. Water temperature ranges from 0.5°C to 14.5°C. These temperatures, coupled with the moderately-high altitude, result in values of dissolved oxygen that are close to saturation (Hydrometrics 1996b, Karp, et al. 1975).

Table 3–1 Water Quality of Surface Water Sites near the Stillwater Mine

	Upstream SMC Complex, Stillwater River				Downstream SMC Complex, Stillwater River				Standards		
	Site SMC-1A				Site SMC-11				Aquatic		Human Health
Parameters[1]	Minimum	Maximum	Mean[2]	N[3]	Minimum	Maximum	Mean[2]	N[3]	Acute[4]	Chronic[4]	
Flow	0	2840	461	10	50.89	243.73	124.70	8			
pH (s.u.)	6.6	7.8	7.2	25	7.1	8	7	16		Narrative	
Specific Conductance (umhos/cm at 25 C)	30	123	50	25	30	113	68	16			
TDS (Measured at 180° C)	10	69	29	25	14	77	41	16		Narrative	
Total Suspended Solids	<1	26	<5	19	<1	8	<3	12			
Water Temperature (° C) (Field)	0	14.5	6	19	1	11	6	15			
Total Hardness as $CaCO_3$	12	61	20	24	13	53	28	15		Narrative	
Calcium (Ca)	3	11	5	24	4	13	7	15			
Magnesium (Mg)	<1	8	<2	24	1	5	2	15			
Sodium (Na)	<1	2	<2	21	<1	3	<2	12			
Potassium (K)	<1	1	<1	20	<1	1	<1	11			
Total Alkalinity as $CaCO_3$	9	67	21	23	13	44	26	15			
Bicarbonate (HCO_3)	10	82	26	22	18	54	34	13			
Carbonate as CO_3	0	0	0	22	0	0	0	13			
Sulfate (SO_4)	2	7	4	24	2	13	7	15		Narrative	
Chloride (Cl)	<1	3	<1	21	<1	1	<1	12	860	230	
Fluoride (F)	<0.10	<0.10	<0.05	20	<0.10	<0.10	<0.05	11			4.00
Total Ammonia (NH_3+NH_4 as N)	<0.05	<0.10	<0.05	29	<0.05	<0.10	<0.05	23			Note 5
Total Kjeldahl Nitrogen as N	<0.1	0.5	<0.1	34	<0.1	0.3	<0.1	29			
Nitrate + Nitrite as N	<0.05	0.4	<0.1	35	0.06	0.55	0.24	31			10
Total Nitrogen as N	0.2	0.7	0.4	9							
Phosphorus (P)	0.001	0.11	0.04	34	<0.001	0.14	<0.05	31			
Cadmium (Cd)	<0.0001	0.002	<0.0004	25	<0.0001	<0.0010	<0.0004	15	0.0008	0.0004	0.005
Chromium (Cr)	<0.001	<0.020	<0.003	25	<0.001	0.002	<0.001	15	0.558	0.067	0.1
Copper (Cu)	<0.001	0.013	<0.004	24	<0.001	0.007	<0.002	12	0.0048	0.0036	1.0
Iron (Fe)	<0.03	0.42	<0.14	12	<0.03	0.17	<0.05	12		1.0	0.3
Lead (Pb)	<0.002	0.02	<0.003	27	<0.002	<0.003	<0.001	15	0.014	0.0005	0.015
Manganese (Mn)	<0.005	0.02	<0.01	13	<0.005	<0.010	<0.005	12			0.05
Nickel (Ni)	<0.005	<0.030	<0.007	21	<0.005	<0.005	<0.003	11	0.439	0.049	0.1
Zinc (Zn)	<0.01	0.07	<0.01	22	<0.01	0.03	<0.02	12	0.036	0.033	5.0

Notes:

1. All results mg/L unless stated otherwise, metals concentrations are total recoverable.
2. Calculations of means used 0.5 times the detection limit in the calculations.
3. N = number of samples in data set.
4. Acute and chronic aquatic standards assume a hardness of 25 mg/L.
5. Ammonia standards vary by sample event, instantaneous flow, and pH.

Sources: DEQ 1995 (Standards) and Hydrometrics 1997 (data).

Alkalinity is typically low. Thus, the water has a limited buffering capability. The low alkalinity is typical of water that drains a mostly gneissic, granitic terrain. As the Stillwater River flows through the limestones found in the lower river valley, its alkalinity increases.

Concentrations of cadmium, copper, iron, lead, and zinc at sites upstream and downstream of the mine site have been above water quality standards set by DEQ (Hydrometrics 1997). This is believed to result form natural base line conditions influenced by both Nye and Verdegris Creek. For example, the maximum concentrations of cadmium, copper, lead, and zinc observed at the upstream site exceed the chronic aquatic standard on one or more occasions (**Table 3–1**). The average concentration of copper at the upstream site exceeds the chronic aquatic standard. The maximum concentration of iron exceeds the human health standards. The maximum concentrations of cadmium and copper exceed the chronic aquatic standard at the downstream site. The maximum concentration of copper also exceeds the acute standard at the downstream site. Mean concentrations of specific conductance, total dissolved solids (TDS), hardness, bicarbonate, sulfate, nitrate, and phosphorus are mildly elevated at the downstream surface water site, SMC–11, on the Stillwater River compared with the upstream surface water site, SMC–1A. These elevated levels of metals are a result of the weathering of ultrabasic rocks of the Stillwater Complex and the elevated nitrate concentrations are a result of LAD application of adit water enriched in nitrate.

Other Surface Water Features

Nye Creek contains magnesium bicarbonate waters of low salinity (TDS ranges from 49 to 84 mg/L) low hardness (47 to 67 mg/L $CaCO_3$), and slightly alkaline pH (7.1 to 8.0) (Hydrometrics 1996c). There are two water rights filings on Nye Creek for commercial and irrigation uses. SMC is monitoring two sites on Nye Creek to examine the impacts of the East Side percolation ponds. The upstream site, SMC–7, has TDS values 2 to 3 mg/L lower on average than the downstream site (SMC–7D). There is no significant difference in any of the nutrients (ammonia, Kjeldahl nitrogen, nitrate and nitrite, or phosphorus) between the upstream and downstream sites. Total chromium values ranged from 0.007 to 0.012 mg/L at SMC–7 and from 0.011 to 0.019 mg/L at SMC–7D (Hydrometrics 1996c). The weathering of the local rocks creates concentrations of chromium, iron, and manganese that are, at times, well above the Montana human health standards (DEQ 1995).

On Mountain View Creek, SMC monitors surface water sites SMC–5, upstream of the facilities area, and SMC–6, which is located below the percolation ponds and drainage from the western portion of the facilities area near the tailings pile. These two sites vary from one another periodically, but not in a statistically significant manner. Consequently, the quality of water is virtually the same for both sites (Hydrometrics 1996b). Water samples have always been within

Montana human health standards (DEQ 1995); however, chromium levels have been shown to be somewhat elevated. There is a single water rights filing on Mountain View Creek for fish and wildlife purposes.

Tailings Decant Water

Tailings impoundment decant water is represented by SMC–4 (SMC's surface monitoring sampling location No. 4), water that is collected at the mill. In 1996, this site had TDS values ranging from 1,760 to 2,280 mg/L and sulfate concentrations ranging from 958 to 1,390 mg/L (Hydrometrics, 1996a). Nitrate plus nitrite had values ranging from 23.3 to 26.2 mg/L, total Kjeldahl nitrogen had concentrations ranging from 0.9 to 4.0 mg/L, ammonia concentrations were 0.55 mg/L, and phosphate concentrations were 0.35 to 0.8 mg/L. Actual heavy metal exceedances have occurred infrequently and may be laboratory artifacts. Through September 1995, SMC's laboratory had a cadmium detection limit of 0.001 mg/L, exceeding the acute and chronic standards of 0.0008 and 0.0004 mg/L, respectively. There was one sampling event at SMC–4 in which 0.002 mg/L dissolved cadmium was recorded. Two of 15 samples of the mill decant stream (SMC–4) exhibited concentrations exceeding the acute and chronic aquatic standards of 0.036 and 0.33 mg/L, respectively. This water is recycled through the mill.

Geochemical Characterization

The granitic Stillwater Complex is a non-acid generating ore body. Although low concentrations of sulfur exist, annual testing of the acid-base potential conducted since the mine was developed have never identified zones of elevated acid potential. Results from the most recent sampling of waste rock and tailings are shown in **Table 3–2**. Generally, values of acid potential less than 20 tons $CaCO_3$ equivalents per 1000 tons of waste material reflect a neutral geochemistry. The acid-base potential of the samples confirm the low potential to generate acid.

A low potential for generation of acid typically suggests that the solubility and the subsequent migration of metals would be low. Nevertheless, SMC annually performs a Toxicity Characteristic Leaching Procedure (TCLP) on three composite samples: one each of ore, waste rock, and tailings (SMC 1997e). This test is used to evaluate the mobility of metals in liquid, solid, and multiphasic wastes and to determine whether the material is hazardous as identified in 40 CFR, Part 261.3. Mine wastes are exempt from these regulations. Arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver were analyzed in 1997 and many of the parameters never exceeded detection limits. All of the parameters were at least two orders of magnitude lower than standards.

Table 3–2 Acid-Base Evaluation Waste: Rock and Tailings (March 22, 1996)

Location	SMC Waste Rock Composite 96-0-112	SMC Tailings Composite 96-0-113
Sample Number	96-21286	96-21287
Lime as $CaCO_3$ (percent)	5.1	7.7
Neutralization Potential, T/1000 Tons[1]	51	77
Acid Potential, T/1000 Tons[1]	0	1
Acid-Base Potential, T/1000 Tons[1]	51	76
Non-Sulfate Sulfur (percent)	<0.01	0.04

Notes:
1. T $CaCO_3$/1000 Tons Soil
An acid-base potential equal to or greater than zero indicates that the material sampled has no potential to form acid. A result less than zero indicates the potential to form acid.
Source: SMC 1997e

3.1.2.2 Stratton Ranch

SMC's monitoring of surface water resources along the Stillwater River is summarized in its recent monitoring report on Stratton Ranch (SMC 1997d). Monitoring occurs upstream at surface water site SMC–11 near the permit boundary and downstream at Redman's Bridge at surface water site SMC–15. The water is a soft, slightly basic calcium bicarbonate liquid of low dissolved solids. Concentrations of nitrate plus nitrite ranged from 0.06 to 0.55 mg/L between 1993 and 1997 (Hydrometrics 1997) at SMC–11 and 0.14–0.24 mg/L at SMC–15 for sampling done in 1996. Metal concentrations were low.

Surface water monitoring site SW–11 is located in the vicinity of Stratton Ranch on the Stillwater River and is a calcium bicarbonate water of low hardness, slightly alkaline character. This site is approximately one-half a mile below the mine site. TDS has ranged from 25 to 77 mg/L (data collected from September 12, 1992 through December 13, 1996) (Hydrometrics 1996a). Sulfate concentrations range from 5 to 13 mg/L, nitrate plus nitrite levels have ranged from 0.06 through 0.55 mg/L and phosphate values have ranged from <0.001 through 0.14 mg/L. Concentrations of aluminum, arsenic, cadmium, chromium, copper, iron, lead, manganese, nickel, silver and zinc are all below Montana human health standards.

3.1.2.3 Hertzler Ranch

Surrounding surface water sites include SMC–14 located upstream on the West Fork of the Stillwater River, SMC–12, located upstream on the Stillwater River and SMC–13, located downstream on the Stillwater River. All waters were

monitored in 1996 and exhibited soft to moderately hard, neutral to slightly basic pH, calcium bicarbonate characteristics with low dissolved solids. Nutrient and metals concentrations were low or below laboratory detection limits (SMC 1997c).

The quality of water in the West Fork of the Stillwater River is generally good. This water is a calcium-carbonate type with low average total dissolved solids (60 mg/L) and a low average alkalinity of 29 mg/L of $CaCO_3$ (Botz 1976). The presence of sensitive aquatic invertebrates in the West Fork of the Stillwater River also suggests the quality of water in the river is good. The DNRC identifies water uses of domestic stock watering, and irrigation within the west fork of the Stillwater River water rights.

Baseline water quality data in the three small, poorly-developed drainages, Robinson Draw, Stanley Coulee, and Tandy Coulee were collected monthly from June 1980 through June 1981 (CDM 1981). Four samples from Tandy Coulee exceed human health drinking water quality standards for fecal coliform. Additionally, runoff from Tandy Coulee always exceeded the federal secondary domestic standards and Montana human health standard for iron. Single sampling events in February 1981 in Stanley and Tandy Coulees exhibited 0.02 gm/l cadmium, which exceeds the human health standard of 0.01 mg/L. The bedrock (Eagle Formation) underneath these drainages contains sulfide metal complexes that slightly acidify runoff waters and probably are the reason for the elevated cadmium and iron values. Even though these waters are unsuitable for human consumption, they are of acceptable quality for irrigation and stock watering, their primary uses.

3.1.3 Groundwater

3.1.3.1 Stillwater Mine Site

Groundwater is contained in bedrock of the Stillwater Complex within the area of the mine site, landslide deposits, colluvium (sheetwash deposits), and unconsolidated alluvium (stream deposits) landslide deposits.

The bedrock aquifers may be found in zones of secondary permeability associated with either the Precambrian ultrabasic rocks of the Stillwater Complex, metamorphic or meta-igneous units of gneiss, schist or hornfels, or quartz monzonite intrusives (CDM 1981). These are located in the southern part of the study area. To the north are Paleozoic to Mesozoic sedimentary formations consisting of the Madison limestone, the Colorado Group shale, and the Montana Group sandstone, siltstone, shale and carbonaceous units. The bedrock aquifers are recharged mainly by snowmelt water at higher elevations. Water is stored in fractures, faults, joints and other breaks in the bedrock, which essentially has zero effective matrix permeability and porosity. Because the

occurrence and density of fractures is variable and hard to predict, the discharge rates of the bedrock are localized and vary greatly. In many instances, however, new mine development into fractured aquifers result in initial inflows that decline rapidly and level out at low sustained rates (Hydrometrics 1997).

Water-bearing zones encountered during adit development give an indication of bedrock aquifer flows. The total water output of the mines varies with time as new zones are encountered and old zones decline. Between 1992 and 1994, the adit discharge for the west side ranged from 105 to 416 gpm, whereas discharges from the east side ranged from 286 to 1,940 gpm (Hydrometrics 1996a) averaging 500 to 700 gpm total (HKM Associates 1994). Groundwater is discharged from the bedrock aquifer into springs, creeks, the unconsolidated aquifers, and directly into the Stillwater River, as well as the mine adits. Bedrock groundwater generally flows toward the Stillwater River.

No wells are known to be completed in the Precambrian crystalline metamorphic rock. Five springs were observed to discharge from these geologic formations in the area (CDM 1981). SMC currently monitors three springs (SMC 1996a). Upper Jones Spring is located 2.2 miles northwest of the mine site and southwest of Horseman Flats. Flows have averaged 8 gpm in annual fall monitoring. Buffalo Jump Spring (SP-2 is located 3.2 miles northeast of the mine site, approximately halfway between Stratton and Hertzler. Flows average 3.8 gpm. The East Side Spring (SP-3) is located 400 feet east of the eastside clarifier and has been dry since 1994. Historic springs in that area (SPF-S, CV-S) had flows of 179 gpm (CDM 1981).

Groundwater quality remains generally good in the area of the SMC project. The most common water composition from the igneous and metamorphic formation is calcium-magnesium bicarbonate. The sedimentary formations produce more variable types ranging from a calcium sulfate to calcium bicarbonate to sodium bicarbonate waters reflecting the chemical composition of the host rock in the area. Groundwater is generally of drinking-water quality in the bedrock immediately surrounding the platinum-group mineralized zone. In contrast, the basal zone of the Stillwater Complex contains considerably higher amounts of sulfides; therefore, groundwater passing through these areas is expected to have higher metal values than most of the groundwater in the upper Stillwater River basin.

Table 3–3 shows a composite quality of water discharged from the SMC West Side Adit (SMC–3) and the SMC East Side Adit (SMC–9) between March 21, 1990 and June 10, 1997 (Hydrometrics 1997). Maximum concentrations of dissolved cadmium, copper, manganese and zinc and total recoverable cadmium, copper and lead exceed either aquatic or Montana's human health water quality standards. SMC's laboratory had a cadmium detection limit of 0.001 mg/L exceeding the acute and chronic standards of 0.0008 and 0.0004 mg/L through September of 1995. There were three sampling events at SMC-9 in which

Table 3–3 Surface Water Discharge Water Quality

	Adit Water Merged: SMC-3 and SMC-9				Process Water SMC-4				Standards		
									Aquatic		
Parameters[1]	Minimum	Maximum	Mean[2]	N[3]	Minimum	Maximum	Mean[2]	N[3]	Acute[4]	Chronic[4]	Human Health
Flow	105	2940	468	18							
pH (s.u.)	6.6	10.9	8	57	6.6	9	7.4	24		Narrative	
Specific Conductance (μmhos/cm at 25° C)	189	2640	382	57	642	2640	1809	24			
TDS (Measured at 180° C)	110	2280	247	57	467	2280	1520	24		Narrative	
Total Suspended Solids	8	240	96	10	21	106	50	3			
Water Temperature (°C) (Field)	2	25	11	18	2	25	13	9			
Total Hardness as $CaCO_3$	46	1160	133	57	242	1160	768	24		Narrative	
Calcium (Ca) - Dissolved	18	390	44	57	76	390	258	24			
Magnesium (Mg) - Dissolved	<1	46	<6	57	13	46	30	24			
Sodium (Na) - Dissolved	7	179	26	51	54	179	130	21			
Potassium (K) - Dissolved	<1	7	<1	49	3	7	5	20			
Total Alkalinity as $CaCO_3$	17	106	66	54	17	76	39	24			
Bicarbonate (HCO_3)	0	110	79	53	18	93	48	22			
Carbonate as CO_3	0	32	1	53	0	6	0	22			
Sulfate (SO_4)	11	292	87	57	253	1390	848	24		Narrative	
Chloride (Cl)	1	59	5	51	11	59	32	21	860	230	
Fluoride (F)	<0.10	0.17	<0.07	47	<0.1000	<0.1000	<0.0005	19			4.00
Total Ammonia (NH_3+NH_4 as N)	<0.05	8.70	<1.1	50	<0.1000	8.7	<3	21			Note 5
Total Kjeldahl Nitrogen as N	<0.1	9.2	1	57	<0.1000	9.2	<3.3083	24			
Nitrate + Nitrite as N	0.7	54.7	8	57	7.86	54.7	31.06	24			10.0
Phosphorus (P)	0.002	2.000	0	35	0.35	2	0.72	15			
Cadmium (Cd) - Dissolved	<0.0001	0.001	<0.0004	55	<0.0001	0.002	<0.0005	23	0.0008	0.0004	0.005
Cadmium (Cd) - TRC	<0.0010	<0.0010	<0.0003	9	<0.0010	<0.0010	<0.0005	2	0.0008	0.0004	0.005
Chromium (Cr) - Dissolved	<0.001	<0.002	<0.006	54	<0.0010	<0.0200	<0.0036	23	0.558	0.067	0.10
Chromium (Cr) - TRC	0.003	0.030	0.011	9	<0.020	<0.020	<0.010	2	0.558	0.067	0.10
Copper (Cu) - Dissolved	<0.0005	0.021	<0.0032	50	<0.0010	0.021	<0.0042	22	0.0048	0.0036	1.0
Copper (Cu) - TRC	0.0029	0.0800	0.0127	15	<0.0100	0.014	<0.0086	4	0.0048	0.0036	1.0
Iron (Fe) - Dissolved	<0.01	0.12	<0.02	23	<0.01	0.12	<0.02	11		1.00	0.30
Lead (Pb) - Dissolved	<0.0005	0.020	<0.0033	58	<0.0020	0.01	<0.0033	25	0.014	0.00005	0.015
Lead (Pb) - TRC	<0.002	0.021	<0.008	13	0.0035	<0.0100	<0.0046	4	0.014	0.00005	0.015
Manganese (Mn) - Dissolved	<0.01	0.09	<0.02	37	<0.01	0.04	<0.015	12			0.05
Mercury (Hg) - TRC	<0.0002	<0.0010	<0.0003	8	<0.0002	<0.0010	<0.0002	3	0.0024	0.00012	0.00014
Nickel (Ni) - Dissolved	<0.005	<0.030	<0.009	44	<0.005	<0.030	<0.009	19	0.439	0.049	0.10
Zinc (Zn) - Dissolved	<0.01	0.04	<0.01	46	<0.01	0.54	<0.06	20	0.036	0.033	5.0

Notes:

1. All results mg/L unless stated otherwise, metals concentrations are total recoverable.
2. Calculations of means of detection limit values used 0.5 times the detection limit in the calculations.
3. N = number of samples in data set.
4. Acute and chronic aquatic standards assume a hardness of 25 mg/L.
5. Ammonia standards vary by sample event, instantaneous flow, and pH.

Sources: DEQ 1995 (Standards) and Hydrometrics 1997 (data).

0.001 mg/L were noted. The mean concentrations of total recoverable copper from the adits exceed both chronic and acute aquatic standards. Copper had similar detection limit problems as cadmium with a detection limit of 0.01 mg/L. One sampling event had a copper concentration of 0.006 mg/L, exceeding the acute and chronic standards of 0.0048 and 0.0036 mg/L respectively. Three of the ten sampling events dissolved manganese at SMC-3 exceeded the secondary human health standard of 0.05 mg/L. Other maximum concentrations were one time exceedances. The mean concentration of all other parameters are within water quality standards suggesting that the adit and process waters are typically very good quality and exceedances occur infrequently.

Nitrogen concentrations in adit discharge water continue to be much higher than natural levels. These increases are the result of using nitrogen-based blasting agents in the mining operations. Elevated nitrogen values are found in the monitoring wells downgradient of the west side percolation ponds and increases have been detected between the upstream and downstream sites in the Stillwater River (Gurrieri 1997, pers. comm.). Nitrate levels in water sampled from wells upgradient and downgradient of the eastside percolation ponds are summarized in **Table 3–4**. Nitrate plus nitrite ranges from 0.3 to 3.36 mg/L upgradient and <0.05 to 22.1 mg/L downgradient. The newly reissued MPDES permit identifies a compliance level of 8 mg/L at designated wells below the groundwater mixing zones of percolation pond discharge outfalls. The human health standard for nitrate in groundwater is 10 mg/L outside of a permitted mixing zone.

Unconsolidated aquifers are found on the steep valley walls as well as in the valley floor of the Stillwater River. These heterogeneous materials have a highly variable hydrologic character. No known wells are found in these colluvial materials but minor springs and seeps are present within drainages and in association with larger landslide deposits.

The most significant aquifer is the Stillwater River alluvial aquifer in the valley floor. This aquifer generally consists of two layers: a lower layer of coarse gravel with high permeability, overlain by a second layer of lower permeability. The hydraulic conductivity of the upper and lower layers is 5 gallons per day per square foot and 200 to 400 gallons per day per square foot, respectively, with flow direction generally parallel to the river. The Stillwater River loses water to the aquifer upstream of the USGS's gaging station (**Figure 3–2**). Downstream from the gaging station, the river gains water from the aquifer. Local variations in aquifer thickness range from 50 to 250 feet, with an average of 100 feet. This aquifer is capable of producing a sustained flow of more than several hundred gallons per minute. The alluvial aquifers are recharged predominantly from the Stillwater River with some additional water coming from the bedrock aquifer.

In general, the alluvial aquifer has better quality water than the crystalline bedrock aquifer. This aquifer is classified by the State of Montana as a Class 1 groundwater; it is generally suitable for all beneficial uses with little or no

Table 3–4 Alluvial Monitoring Wells Associated with Percolation Ponds

	Upgradient Percolation Ponds Merge: MW-14A, MW-T1A				Downgradient Percolation Ponds Merge: MW-12A, 13A, 15A, 16A, 17A				Standards
Parameter[1]	Minimum	Maximum	Mean[2]	N[3]	Minimum	Maximum	Mean[2]	N[3]	Human Health
Depth to Water Level (Feet)	40.15	79.5	66.7	87	10.05	46.3	19.0	251	
pH (s.u.)	6.8	7.7	7.3	62	6.6	7.7	7.1	144	
Specific Conductance (umhos/cm at 25° C)	116	291	205	62	112	582	260	144	
TDS (Measured at 180° C)	21	204	130	84	14	382	162	250	
Water Temperature (° C) (Field)	7	10	8	57	3	18	9	188	
Total Hardness as $CaCO_3$	63	135	95	52	8	231	94	99	
Calcium (Ca) - Dissolved	11	28	17	52	10	42	18	99	
Magnesium (Mg) - Dissolved	9	20	13	52	7	31	12	99	
Sodium (Na) - Dissolved	3	8	4	46	2	37	8	84	
Potassium (K) - Dissolved	<1	2	<1	44	<1	2	<1	79	
Total Alkalinity as $CaCO_3$	63	108	80	52	54	101	67	99	
Bicarbonate (HCO_3)	77	132	98	48	66	123	82	89	
Carbonate as CO_3	0	0	0	48	0	0	0	89	
Sulfate (SO_4)	4	41	17	52	4	148	33	99	
Chloride (Cl)	<1	7	<2	46	<1	30	<3	84	
Fluoride (F)	<0.10	0.12	<0.05	42	<0.10	0.11	<0.05	76	4.00
Total Ammonia (NH_3+NH_4 as N)	<0.05	<0.10	<0.05	63	<0.05	<0.10	<0.05	168	Note 4
Total Kjeldahl Nitrogen as N	<0.1	0.7	<0.1	83	<0.1	0.8	<0.1	248	
Nitrate + Nitrite as N	0.31	3.36	1.71	84	<0.05	22.10	<3.8	250	10
Phosphorus (P)	0.010	0.160	0.068	58	0.002	0.200	0.075	212	
Cadmium (Cd) - Dissolved	<0.0001	<0.0100	<0.0004	53	<0.0001	0.0010	<0.0004	102	0.005
Chromium (Cr) - Dissolved	0.004	<0.050	<0.008	51	0.001	0.010	0.005	96	0.0
Copper (Cu) - Dissolved	<0.0005	<0.02	<0.004	47	<0.0005	0.010	<0.003	89	1.0
Iron (Fe) - Dissolved	<0.01	<0.03	<0.01	23	<0.01	0.08	<0.02	55	0.3
Lead (Pb) - Dissolved	<0.0020	0.0200	<0.004	54	0.0007	0.020	<0.003	107	0.015
Manganese (Mn) - Dissolved	<0.005	<0.020	<0.006	25	<0.005	<0.020	<0.006	58	0.05
Nickel (Ni) - Dissolved	<0.005	<0.030	<0.008	42	<0.005	<0.030	<0.006	73	0.10
Zinc (Zn) - Dissolved	<0.01	0.05	<0.01	46	<0.01	0.05	<0.01	84	5.0

Notes:

1. All results mg/L unless stated otherwise, metals concentrations are total recoverable.
2. Calculations of means of detection limit values used 0.5 times the detection limit in the calculations.
3. N = number of samples in data set.
4. Ammonia standards vary by sample event, instantaneous flow, and pH.

Sources: DEQ 1995 (Standards) and Hydrometrics 1997 (data).

treatment. Water data in the alluvial aquifer mainly come from drinking water wells and monitoring wells. The water most common to this aquifer has a calcium bicarbonate composition. Other compositions are calcium-magnesium bicarbonate and calcium-magnesium-sodium bicarbonate. The calcium and magnesium concentrations and the pH generally increase downgradient along the Stillwater River.

Five alluvial well locations currently being monitored are near the Stillwater River and are downgradient of the current tailings impoundment and westside percolation ponds (**Table 3–5**). These wells have good quality water and have never exceeded human health water quality standards for any metals (Hydrometrics 1989), except dissolved chromium (Hydrometrics 1997). The three wells in the old chromite tailings area on the east side of the river have, at times, had elevated concentrations of one or more of the following: iron, lead, chromium, manganese, or cadmium, which were above human health water quality standards.

Table 3–6 compares water quality at alluvial wells upgradient and downgradient of the current LAD sites, which adjoin historic dumps of chromium tailings. Dissolved chromium concentrations regularly exceed the human health standard at all sites, with slightly lower concentrations at the downgradient site. Slight elevations of sulfate, chloride, phosphorus, cadmium, iron, and zinc concentrations are observed in the downgradient sites compared with the upgradient sites. In some cases, this may reflect a laboratory artifact of varying detection limits rather than increases associated with the LAD.

Monitoring well MW–3TA has shown the highest levels of TDS recorded on the site, 370 mg/L. This site reflects water quality associated with ponded water on uncompacted waste rock, as well as impacts for the LAD. Sulfate concentrations have ranged from 10 to 93 mg/L. Total ammonia is at levels lower than 0.1 mg/L and total Kjeldahl nitrogen ranges from <0.1 to 0.7 mg/L. Nitrate plus nitrite has ranged from 1.27 to 23.4 mg/L in readings noted in 1994. Values of this parameter at this site in 1995 and 1996 ranged from 3.15 to 15.3 mg/L, but were typically less than the standard of 10 mg/L. Elevated concentrations appear to occur during situations when there is deep leaching, typically in conjunction with natural storm events.

Groundwater beneath the percolation ponds on the east side of the river has shown higher concentrations of ammonia, nitrate, sulfate, and TDS than groundwater elsewhere in the facilities area. Dilution of pond seepage water in the alluvial groundwater downstream of the mine is believed to render all but nitrates undetectable from baseline conditions. The elevated nitrate concentrations outside the defined mixing zones permitted by MPDES Permit MT–0024716 (approved August 1, 1998) are within compliance of human health water quality standards and would not preclude the use of the groundwater for drinking water or other purposes.

Table 3–5 Alluvial Monitoring Wells Downgradient of the Tailings Impoundment

Parameter[1]	Merge: MW-7A, 7B, 7C, 9A, 11A Minimum	Maximum	Mean[2]	N[3]	Standards Human Health
Depth to Water Level (Feet)	35.9	55.8	47.8	143	
pH (s.u.)	6.8	8	8	129	
Specific Conductance (umhos/cm at 25° C)	92	401	222	129	
TDS (Measured at 180° C)	17	244	126	129	
Water Temperature (°C) (Field)	6.5	10	8	71	
Total Hardness as $CaCO_3$	39	182	106	129	
Calcium (Ca) - Dissolved	10	29	17	128	
Magnesium (Mg) - Dissolved	4	27	15	128	
Sodium (Na) - Dissolved	3	11	6	113	
Potassium (K) - Dissolved	<1	5	<2	108	
Total Alkalinity as $CaCO_3$	48	127	87	127	
Bicarbonate (HCO_3)	58	155	107	119	
Carbonate as CO_3	0	0	0	119	
Sulfate (SO_4)	6	61	20	129	
Chloride (Cl)	<1	33	<4	114	
Fluoride (F)	<0.01	0.13	<0.08	104	4.00
Total Ammonia (NH_3+NH_4 as N)	<0.05	0.30	<0.1	112	Note 4
Total Kjeldahl Nitrogen as N	<0.1	0.5	<0.1	129	
Nitrate + Nitrite as N	<0.05	5.82	<1.3	129	10
Phosphorus (P)	<0.001	0.200	<0.1	64	
Cadmium (Cd) - Dissolved	<0.0001	0.0020	<0.0005	130	0.005
Chromium (Cr) - Dissolved	<0.001	0.060	<0.020	130	0.1
Copper (Cu) - Dissolved	<0.001	<0.010	<0.003	114	1.0
Iron (Fe) - Dissolved	0.01	0.06	<0.03	45	0.30
Lead (Pb) - Dissolved	<0.002	0.060	<0.004	130	0.015
Manganese (Mn) - Dissolved	<0.005	<0.020	<0.005	49	0.05
Nickel (Ni) - Dissolved	<0.005	<0.030	<0.008	109	0.1
Zinc (Zn) - Dissolved	<0.01	0.07	<0.03	114	5.0

Notes:
1. All results mg/L unless stated otherwise, metals concentrations are total recoverable.
2. Calculations of means of detection limit values used 0.5 times the detection limit in the calculations.
3. N = number of samples in data set.
4. Ammonia standards vary by sample event, instantaneous flow, and pH.

Sources: DEQ 1995 (Standards) and Hydrometrics 1997 (data).

Table 3–6 Alluvial Sites Associated with Land Application Disposal (LAD)

Parameter[1]	Upgradient LAD Sites Merge: MW-T1A, MW-14A				Downgradient LAD Sites MW-18A				Standards	
	Minimum	Maximum	Mean[2]	N[3]	Minimum	Maximum	Mean[2]	N[3]	Chronic[4]	Human Health
Depth to Water Level (Feet)	40.15	79.5	66.7	87	20.44	24.51	23.17	11		
pH (s.u.)	6.8	7.7	7.3	62	6.7	7.3	7.0	11	Narrative	
Specific Conductance (umhos/cm at 25 C)	116	291	205	62	168	234	189	11		
TDS (Measured at 180° C)	21	204	130	84	90	138	108	11	Narrative	
Water Temperature (°C) (Field)	7	10	8	57	7.5	10	8	10		
Total Hardness as $CaCO_3$	63	135	95	52	79	120	90	11	Narrative	
Calcium (Ca) - Dissolved	11	28	17	52	16	25	19	11		
Magnesium (Mg) - Dissolved	9	20	13	52	9	14	10	11		
Sodium (Na) - Dissolved	3	8	4	46	3	5	4	8		
Potassium (K) - Dissolved	<1	2	<1	44	<1	1	<1	7		
Total Alkalinity as $CaCO_3$	63	108	80	52	61	80	69	11		
Bicarbonate (HCO_3)	77	132	98	48	75	97	83	9		
Carbonate as CO_3	0	0	0	48	0	0	0	9		
Sulfate (SO_4)	4	41	17	52	12	23	18	11	Narrative	
Chloride (Cl)	<1	7	<2	46	2	4	3	8	230.000	
Fluoride (F)	<0.10	0.12	<0.05	42	<0.10	<0.10	<0.05	7		4.00
Total Ammonia (NH_3+NH_4 as N)	<0.05	<0.10	<0.05	63	<0.10	<0.10	<0.05	7		Note 5
Total Kjeldahl Nitrogen as N	<0.1	0.7	<0.1	83	<0.1	<0.5	<0.1	11		
Nitrate + Nitrite as N	0.31	3.36	1.71	84	1.05	4.39	1.65	11		10
Phosphorus (P)	0.010	0.160	0.068	58	0.040	0.190	0.100	11		
Cadmium (Cd) - Dissolved	<0.0001	<0.0100	<0.0004	53	<0.0001	0.002	<0.001	11	0.001	0.005
Chromium (Cr) - Dissolved	0.004	<0.050	<0.008	51	0.004	0.005	0.004	11		0.1
Copper (Cu) - Dissolved	<0.0005	<0.02	<0.004	47	<0.001	<0.001	<0.001	8	0.012	1.0
Iron (Fe) - Dissolved	<0.01	<0.03	<0.01	23	<0.03	0.08	<0.02	8	1.000	0.30
Lead (Pb) - Dissolved	<0.002	0.02	<0.004	54	<0.002	<0.003	<0.001	11	0.032	0.015
Manganese (Mn) - Dissolved	<0.005	<0.020	<0.006	25	<0.005	<0.010	<0.005	8		0.05
Nickel (Ni) - Dissolved	<0.005	<0.030	<0.008	42	<0.005	<0.005	<0.003	7	0.160	0.1
Zinc (Zn) - Dissolved	<0.01	0.05	<0.01	46	<0.01	0.04	<0.02	8	0.110	5.0

Notes:
1. All results mg/L unless stated otherwise, metals concentrations are total recoverable.
2. Calculations of means of detection limit values used 0.5 times the detection limit in the calculations.
3. N = number of samples in data set.
4. Chronic aquatic standards assume a hardness of 25 mg/L.
5. Ammonia standards vary by sample event, instantaneous flow, and pH.

Sources: DEQ 1995 (Standards) and Hydrometrics 1997 (data).

Monitoring wells MW–5A, MW–6A, and MW–10 are located east and upgradient of the existing tailings impoundment and west side percolation ponds on the Stillwater River. The water is characterized as a magnesium bicarbonate water, which is soft to moderately hard, with near neutral pH and low dissolved solids, sulfate, nutrients, and metal concentrations. Well MW–6A has shown low concentrations of chromium throughout most of the monitoring period with a historic range of 0.008 to 0.22 mg/L and 1996 levels of 0.01 to 0.02 mg/L. Well MW–5A had nitrate plus nitrite levels of 0.13 to 0.21 mg/L during the 1996 monitoring year while well MW–6A had nitrate plus nitrite levels of 0.52 to 0.84 mg/L. Montana's standard for nitrate plus nitrite is 10 mg/L.

Table 3–5 displays a statistical summary of five wells located below the tailings impoundment. They include data from MW–7A, MW–7B, MW–7C, MW–9A, and MW–11A collected between March 21, 1990 and June 10, 1997. All show parameters at these sites met human health standards.

Monitoring wells MW–7A, MW–7B, and MW–7C are located 500 feet downstream of MW–6A and 400 feet downstream of the west emergency spill basin 200 feet east of the toe of the tailings impoundment. They are completed at depths of 170 feet, 98 feet, and 64 feet, respectively. Concentrations of nitrate plus nitrite have shown a ten-fold increasing trend from baseline in wells MW–7A and MW–7C with 1996 concentrations ranging from 1.93 to 2.34 mg/L and 1.97 to 3.1 mg/L, respectively. Hydrometrics (1996a) identified three potential factors to explain these results: the use of the west side percolation ponds, runoff and infiltration from the tailings dam area, which was constructed using waste rock, and periodic use of the mine water overflow pond.

Well MW–19A is located near the north permit boundary, 100 feet west of the Stillwater River after the river has flowed through the mine site for 0.8 miles. The soft, calcium bicarbonate water has low concentrations of dissolved solids, sulfate and nutrients, with metals at or below analytical detection limits. There is no impact from the mine at this site.

3.1.3.2 Stratton Ranch

The Stratton Ranch is similar to the existing mine site in many ways. A large percentage of the groundwater flowing under the ranch flows to the northeast and then shifts eastward in the unconsolidated surface deposits. The water table ranges in depth from 9 to 18 feet below the ground surface. Surface water encountered nearer to the Stillwater River (small ponds and a slough) appears to be a surface expression of the water table.

Hydrometrics (1996c) inventoried springs and wells in the Stratton Ranch study area on the west side of the Stillwater River between Silver Creek and Redman's Bridge on Stillwater County Road 419. Thirteen sites were identified as springs

or potential springs. All of the sites are either upgradient of proposed LAD sites or receive recharge from an upgradient source. Four springs are on the Stratton Ranch itself: SRSSP; SRUSSP; SRNSP; and an unnamed spring near the highway south of the Stratton Ranch area. SRSSP has a reported flow of 100 gpm and SRNSP has a reported flow of 58 gpm. There is no flow information available for the unnamed spring south of Stratton Ranch and SRUSSP has a reported flow of 8 gpm. The remaining springs are located in the landslide deposits associated with Cathedral Mountain or on other upland areas within the study area. Flows range from unreported to 53 gpm, but typically are less than 5 gpm. Water rights have been filed for twelve of the springs and the owners are summarized in the Hydrometrics (1996b) report.

Ten wells were noted in the study area (Hydrometrics 1996c). Three are located directly on the Stratton Ranch site: (1) SREW, (2) SRWW; and (3) the old Stratton Ranch well. The first two are 59 feet deep and yield 100 gpm. The old Stratton Ranch well, which is not in use, is 200 feet deep and reportedly yields 5 gpm. Seven wells are downgradient of the site on the west side of the river and range in depth from 6.5 to 60 feet for those sites for which data have been reported. Reported yields range from 25 to 35 gpm. Water rights have been filed on six of the sites and ownership is summarized in Hydrometrics' (1996c) report.

3.1.3.3 Hertzler Ranch

Groundwater in the Hertzler Valley is primarily found in two distinct geologic units: sedimentary bedrock and unconsolidated surficial deposits. The majority of the Hertzler Valley is underlain by sedimentary shale and sandstone. The bedrock is mantled with almost two hundred feet of unconsolidated glacial and alluvial deposits. Surficial materials in the Hertzler Valley are predominantly alluvial fan deposits, but glacial drift deposits are found on the north and south sides of the Valley (CDM 1981). Poorly-sorted colluvial deposits also are present to the north and west. As a consequence, unconsolidated groundwater resources are variable. Groundwater is available in the sedimentary units, but generally is not used where more reliable near-surface water in alluvial unconsolidated deposits exists.

Groundwater in the sedimentary rocks of the Hertzler Valley generally flows toward the valley bottom, roughly following the relief of the landscape, and then trends eastward towards the Stillwater River. Much of the lower elevations are underlain by bedrock composed of Colorado shale, which is roughly 1,000 times less permeable than the overlying sand and gravel. The shale's low permeability does not facilitate migration of groundwater, severely limiting the amount of vertical leakage from the overlying surficial deposits. A pumping test of alluvial wells dropped water levels slightly in observation wells completed in the shale. This suggests that the upper portion of the shale bedrock is, to a small degree,

hydrologically connected with the overlying saturated unconsolidated material and that some exchange of groundwater between the two units is possible.

The depth of unconsolidated material within the Hertzler Valley varies. The thickest accumulation occurs along the central east-west axis of the valley where it is approximately 137 feet thick (CDM 1981). These materials range in depth from 55 feet to 171 feet. The material is composed primarily of a mixture of alluvial fan and glacial outwash deposits. Most of the groundwater in the alluvium moves in an unconfined state.

During most of the year, these unconsolidated deposits are saturated at depths ranging from 76 feet at the western end of the valley to 42 feet at the eastern end where the Hertzler Valley joins the Stillwater River. Water levels vary with the season. The water table is highest during the late spring and summer and lowest during winter and early spring. It rises as much as 20 feet between low to high periods (CDM 1981).

Testing of hydraulic conductivities below the Hertzler tailings impoundment site range from 1×10^{-3} to 8×10^{-7} cm/sec (Wahler 1981). Flexible wall permeability analyses conducted by Knight Piésold (1996) yielded permeabilities ranging from 4.3×10^{-4} cm/sec to 1.4×10^{-8} cm/sec, depending on confining pressures. Other portions of the Hertzler Valley exhibited high transmissivities. Groundwater can be extracted from the unconsolidated deposits of the Hertzler Valley at high rates. Pumping and recovery tests of glacial outwash materials in the Hertzler Valley indicate transmissivities ranging from 150,000 to 800,000 gpd/ft (CDM 1981). Recovery tests in the overlying alluvial materials indicate transmissivities of 656 to 11,165 gpd/ft. Several observation wells were capable of producing more than 200 gpm, sufficient for sprinkler irrigation of hayfields. Recharge is derived from precipitation, losses from stream channels, and contributions from bedrock aquifers. Infiltration of irrigation water also is a major source of recharge for the valley system. Over half of the irrigation water brought in from the West Fork of the Stillwater River is lost to infiltration. An irrigation ditch runs most of the length of the Hertzler Valley and is used to flood irrigate hayfields.

Five wells produce water from alluvial deposits in the Hertzler Valley study area (Hydrometrics 1996c). Two are upgradient of proposed operations (RW–2 and Hart/Evans). The MDFWP's well is located one mile east of all proposed disturbance in the Stillwater alluvium. The two DeGroat wells are upstream of the intersection of the Hertzler Valley and the Stillwater River, 0.9 miles east of the proposed tailings impoundment location. There are also three springs north of the Hertzler Valley in the Stanley and Tandy Coulees. The springs have reported flows ranging from 12.5 to 40 gpm. Water rights have been filed on the springs. The old Hertzler Homestead Spring is located near the southeast toe of Bush Mountain. There are no water rights filing on the spring and no flow

information. It is downgradient of an irrigation ditch derived from the West Fork of the Stillwater River, which could serve as a source of recharge.

Two wells, the Nye Firehouse well and the Hart/Evans domestic well, produce water from sedimentary units in the area. Completion reports are not available, but it is surmised that water is derived from sandstones in the Colorado Group. The Madison limestone is the source of several springs, the largest, Madison Spring (MD–5), discharging 45 gpm. The Eagle sandstone is the source of the Tandy Coal Spring (TC–5), which flows less than 10 gpm throughout the year. CDM's (1981) baseline survey noted five springs discharging from sedimentary deposits.

All six observation wells drilled in the Hertzler Valley in the unconsolidated deposits tapped groundwater of quality suitable for use in irrigation or stock watering, the water's current primary use. The calcium bicarbonate water is moderately hard with a slightly basic pH and low to moderate TDS concentrations. Valley groundwater was found to consistently exceed Montana's human health water quality standard for iron. Sampling information on lead is inconsistent. Three of six observation wells also had lead values above the recommended limit for human health (four to 15 times the standard) during the collection of baseline data in 1981. Lead levels were below the human health standard and at the detection limit in quarterly monitoring performed in 1996 (SMC 1997c). Manganese was above the human health water quality standard of 0.05 mg/L for four of six wells in the valley. Nitrate plus nitrite concentrations ranged from 0.24 to 1.47 mg/L in the monitoring of seven wells in 1996 and do not pose a risk to human health. Phosphorus levels ranged from <0.001 to 0.56 mg/L (SMC 1997c). In general, alluvial groundwater under most of the Hertzler Valley would not be desirable for domestic water supplies due to elevated concentrations of iron and manganese. The standards for these metals are based on aesthetics and are federal secondary drinking water standards to prevent staining. The origin of the constituents that make the water undesirable for drinking water is unknown, but probably is the poor quality water seeping upward from the underlying bedrock and from infiltration of surface irrigation water (CDM 1981 and SMC 1997c).

Water quality samples taken from two observation wells completed in the bedrock that underlies most of the valley (Colorado Shale Group) exceeded the drinking water limits for the following constituents: total dissolved solids, arsenic, cadmium, chromium, iron, lead, manganese, selenium, silver, and sulfate. The poor quality of the water in the Colorado Group rocks, coupled with the very small amount that could be pumped from the units, makes the Colorado Shale an undesirable source for beneficial use.

3.1.4 Wetlands

Wetlands occur at Hertzler Ranch and along the proposed route for the pipelines. These wetlands are extensively described in SMC's Section 404 Permit Authorization Request (SMC 1997b). Overall, an estimated 1.5 acres of wetlands fall within the project area and most of this acreage occurs along the pipeline route.

Westech (SMC 1997b) identified five categories of wetlands within the project area. They are herbaceous wetlands, tall shrub/deciduous tree wetlands, riparian channel fringe wetlands, irrigation ditch channel fringe wetlands, and basin wetlands. Westech also provided full descriptions of each category of wetlands, the wetland sites identified, and their locations. The following discussion summarizes this information.

Herbaceous wetlands occupy permanently- to seasonally-flooded sites that are inundated or have saturated soils. They are generally dominated by species of hydrophytic grasses, sedges, rushes and forbs. Woody species are scarce. Herbaceous wetlands are predominantly associated with roadside borrow pits and diversion ditches, small spring-fed streams, and hillside seeps. Most of the wetlands potentially affected by the action alternatives are herbaceous wetlands.

Wetlands in the other four categories are much more restricted in occurrence. Tall shrub/deciduous tree wetlands occur on saturated sites that are usually associated with the margins of perennial streams. These sites typically occur along small spring-fed streams, riverine floodplains, and, occasionally, in the seep collections at the base of road fill. Riparian channel fringe wetlands are associated with the two branches of the West Fork Stillwater River. Irrigation ditch channel fringes are narrow wetlands bordering irrigation water flow on seasonally-saturated soils. Finally, the occurrence of basin wetlands is restricted to the central portion of a reclaimed stock pond in an internally-drained basin on the Hertzler property.

In addition to the delineations, an assessment of the wetlands' functional values was conducted for each category of wetlands. The assessment determined all wetlands, except the West Fork Stillwater River and its associated floodplain, had low functional ratings overall (SMC 1997b). Reasons given for these low ratings included any or all of the following conditions: small size of the wetland, small size of the watershed, artificial nature of the wetland, existing disturbance, low vegetation/water interspersion, no threatened or endangered species present, and proximity to human activity. The West Fork Stillwater River and its floodplain had an overall functional rating of moderate (SMC 1997b). High hydrologic support, high erosion control, high water purification, and high aquatic diversity/abundance values accounted for the West Fork Stillwater River's overall rating of moderate.

3.2 Wildlife

The project area and its wildlife resources have been extensively reviewed and discussed in previous documents, including the 1981 baseline reports (CDM 1981) and 1985 final EIS for the Stillwater Mine (DSL and Forest Service 1985). A reconnaissance conducted during 1996 determined large-scale changes have not occurred in the areal extent of habitats available for wildlife in the area or their distribution since the 1980 studies (Western Technology and Engineering, Inc. 1996c). However, small-scale changes have occurred. They include the development of the Stillwater Mine, an increase in the number of homes and cabins along the Stillwater River and West Fork Stillwater River, and improvements at public recreation sites along the Stillwater River. The increase in the number of homes and cabins (many of which appeared to be recreational or second homes) does not appear to be limited to the project area, but appears to have occurred downstream of the project area and in other drainages (Western Technology and Engineering, Inc. 1996c). These changes were predicted in the final EIS for the Stillwater Mine (DSL and Forest Service 1985).

Because no major changes have occurred in the project area, the wildlife habitats remain relatively unchanged. Consequently, this discussion does not repeat information documented in the 1985, 1992, and 1996 final EISs and the 1989 Environmental Assessment (see **Appendix A** for additional descriptions of these documents) that has not changed. Instead, it focuses on those issues developed through scoping and the species and groups of species affected by the changes that have occurred since the previous documents were prepared.

3.2.1 High-Interest Species

3.2.1.1 Stillwater Mine Site

3.2.1.1.1 Bighorn Sheep

A small, native herd of about 20 to 25 bighorn sheep resides in the Stillwater Valley around the Stillwater Mine. The herd has been monitored since the early 1970s, more than 10 years before the Stillwater Mine was developed. This monitoring suggests the trend for this population of bighorn sheep has been downward since the 1980s. In order for the population to recover, lambs must survive for several years into reproductive age and losses of adult ewes must decrease (recently, annual mortality of adult ewes exceeded 20 percent for two consecutive years and reached 47 percent during the winter of 1996–97). Also, the population needs to expand its current home range or reoccupy historic home range.

The traditional primary winter concentration area for these sheep lies along the west side of the Stillwater River between the Stillwater Mine and Woodbine Campground. However, monitoring of the population conducted since the mid-

1980s (Farmer and Stewart 1986, 1987, 1988; Farmer, Stewart, and Richter 1990, 1991, 1992, 1993, 1996) suggests part of the population spends at least part of the winter on the West Fork Stillwater River about 3 miles west of the 1980 baseline study area. Although some sheep have been using the West Fork Stillwater River as winter range recently, most still appear to winter close to the Stillwater Mine (Western Technology and Engineering, Inc. 1996c).

A review of sightings of bighorn sheep mapped since the mid-1980s indicates very few sightings occurred where the new facilities would be constructed (Western Technology and Engineering, Inc. 1996c). In particular, no sightings have been recorded downstream from near Stratton Ranch or at the Hertzler Ranch area. Consequently, the occurrence of bighorn sheep is unlikely where most of the new facilities are proposed.

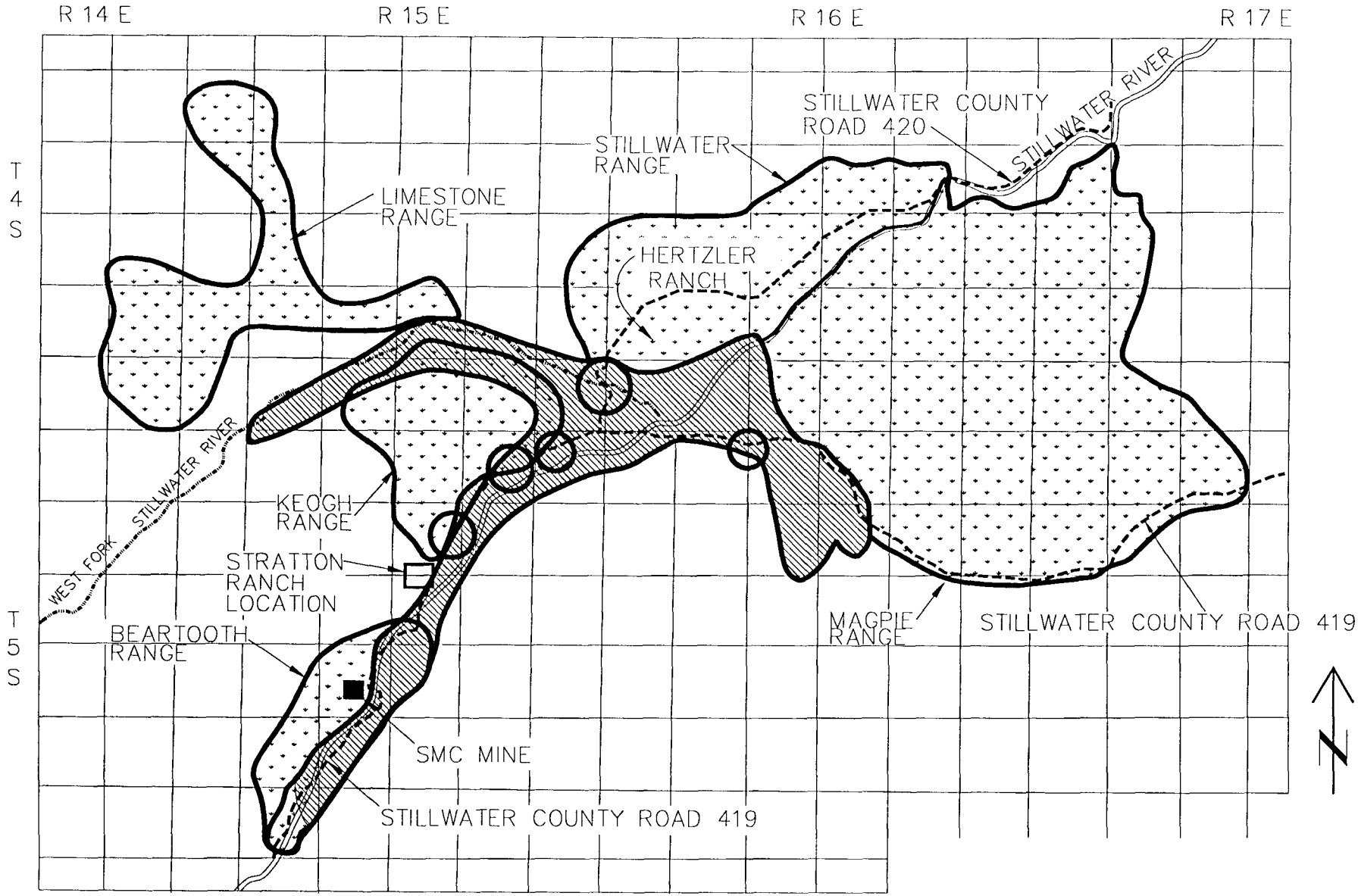
3.2.1.1.2 Mule Deer

Mule deer are the principal big game species found in the project area. Although present year-round, they are most abundant during the winter when they concentrate on winter range. Four distinct mule deer winter ranges exist in a complex that covers about 130 square miles. Generally, this complex extends from Woodbine Campground north to Beehive, Montana, and from Sweetgrass County east across Horseman Flats to Twin Butte. **Figure 3–3** shows the portion of this range present within the project area.

Previous aerial and ground surveys conducted within the project area determined mule deer use a variety of habitats within their local winter ranges. Use of stoney grasslands and hay meadows was highest. However, they also use open Douglas-fir forest, limber pine forest, steep aspects, and south slopes (Western Technology and Engineering, Inc. 1996c).

During peak occupancy of their winter range (January to April), observations of 100 mule deer between the Stratton Ranch and Woodbine Campground are common. In 1989, about 200 deer occupied the range immediately adjoining the mine and between 400 and 600 deer occupied the Horseman Flats portion of winter range (Stewart 1989, pers. comm.). However, mule deer populations are at their lowest in recent history (Stewart 1997, pers. comm.). The reasons for the decline are not clear, but may be related to naturally-occurring fluctuations, mortality that occurred during the winters of 1995–96 and 1996–97, and changes originating from increased human presence and activity in the Stillwater Valley. Additionally, fawn recruitment over the past two years has averaged about 18 per 100 adults (Stewart 1997, pers. comm.).

Mule deer using the winter ranges from the Stillwater Mine to Woodbine Campground do not spend their summers in the upper Stillwater Valley. Instead, they migrate to Yellowstone National Park for the summer.



DEER WINTER RANGES

LEGEND

- MULE DEER WINTER RANGES
- WHITE-TAILED DEER WINTER RANGES
- COUNTY ROADS
- MAJOR WHITE-TAILED DEER ROAD CROSSINGS

1 Mile

SOURCE: DSL AND FOREST SERVICE, 1985

597deer.dwg

Stillwater Mine
Revised Waste Management Plan
and Hertzler Tailings Impoundment
Draft Environmental Impact Statement

Deer Winter Range Complex
in the Upper Stillwater Valley
Figure 3-3

3.2.1.1.3 White-tailed Deer

White-tailed deer occupy the project area year-round. These deer primarily occur along the Stillwater River. Vegetation types most frequently used by the deer include riparian woodlands, stony grasslands, and meadows. **Figure 3–3** shows the areal extent of winter range for white-tailed deer identified around the Stillwater Mine.

During 1985, the MDFWP estimated 570 white-tailed deer inhabited the area, a density of 27 animals per linear mile of riparian habitat (Stewart 1990, pers. comm.). Populations of white-tailed deer in the project area were at all-time highs in the early 1990s. However, their numbers declined substantially during the winter of 1996/97 (Stewart 1997, pers. comm.).

3.2.1.1.4 Elk

Historically, the number of elk inhabiting the upper Stillwater Valley has ranged between about 80 and 160 animals. Winter ranges for elk are located along the Stillwater River between the mine and the West Fork of the Stillwater River, Horseman Flats, Picket Pin (north of the West Fork of the Stillwater River), Meyers Creek area, Lodgepole Creek area north of Limestone, and, recently, the Bad Canyon and Trout Creek areas. Calving areas are located along Rabbit Gulch and Horsehead Draw in Horseman Flats and in the Bear Pen Creek-Swamp Creek drainages in the Picket Pin area. Elk travel to summer ranges as distant as the Breakneck Plateau and Placer Basin during May through July. Movement back to winter ranges begins in September.

Although elk do occur within the general vicinity of the project area, they do not occur at the sites where components of the alternatives considered in detail are proposed. Consequently, no potential exists for the alternatives to affect elk and they are not discussed any further in this EIS.

3.2.1.1.5 Other High-Interest Species

Other high-interest species known to occur within the project area include mountain lions and black bears. MDFWP captured and radio collared mountain lions during the 1989 to 1990 and 1990 to 1991 winters as part of the monitoring for the bighorn sheep. The data collected from these collars suggested that the ranges of 3 to 5 mountain lions overlap with the project area. Mountain lions primarily prey on deer.

Black bears or their sign have been observed occasionally within the project area. Because individual black bears have large home ranges, CDM (1981) concluded that the project area probably comprises only portions of one or more home ranges. The current understanding of black bear's habits and preferences for habitats suggests the primary habitats present in the project area (stony grassland and open Douglas-fir/limber pine forest) do not comprise denning or

other critical habitats for black bear (Western Technology and Engineering, Inc. 1996c).

Although mountain lions and black bears do occur within the general vicinity of the project area, they do not occur specifically at the sites where components of the alternatives considered in detail are proposed. Consequently, little potential exists for the alternatives to affect mountain lions or black bears and they are not discussed any further in this EIS.

3.2.1.2 Stratton Ranch

Although bighorn sheep and elk do not occur at the Stratton Ranch, the other high-interest species (mule deer and white-tailed deer) occur on the ranch during the winter. Like the situation at the mine, mule deer using the winter ranges around the Stratton Ranch do not spend their summers in the upper Stillwater Valley. They also migrate to Yellowstone National Park for the summer. Furthermore, most of the ranch's winter range has been disturbed by the aggregate mining and previous construction and occupation of employee housing.

Within the upper Stillwater Valley, five sites have been identified as major road crossings for white-tailed deer. These sites are located between Nye, Montana, and the Stratton Ranch along Stillwater County roads 419 and 420 (**Figure 3–3**). All sites are along or near the route SMC proposed for the pipelines and they are within delineated winter range.

3.2.1.3 Hertzler Ranch

Two high-interest species occur at the Hertzler Ranch. They are the mule deer and white-tailed deer.

3.2.1.3.1 Mule Deer

As with the Stillwater Mine site, the mule deer is the most abundant large mammal in the area. Although present in the general area year-round, they are most common during the winter when they concentrate on winter range (**Figure 3–3**). In particular, one group of migratory deer (200 to 300 animals) occupies the Hertzler Ranch site (Stewart 1990, pers. comm.) and migrates to Lodgepole Creek and the divide above the Dry Fork of East Boulder Creek for the summer. However, unlike the mule deer occupying the winter ranges around the mine and Stratton Ranch, none of these deer migrate into Yellowstone National Park. Like most mountain populations of mule deer, recruitment in this herd is generally low (13 young per 100 adults during 1996–97).

3.2.1.3.2 White-tailed Deer

White-tailed deer also occupy the Hertzler Ranch area year-round. The deer primarily occur along the Stillwater River and major tributaries, such as Little Rocky Creek. As discussed previously, vegetation types most frequently used by the deer include riparian woodlands, stony grasslands, and meadows. In 1985, the MDFWP estimated 570 deer inhabited the upper Stillwater Valley (Stewart 1990, pers. comm.), a density of about 27 animals per linear mile of riparian habitat.

3.2.2 Threatened, Endangered, and Sensitive Species

The USFWS identified four species listed as threatened or endangered that may occur in the project area (McMaster 1997, pers. comm.). All four are species of wildlife. They are the bald eagle, peregrine falcon, grizzly bear, and black-footed ferret. For the present analysis, the USFWS did not identify any species of plants for consideration.

3.2.2.1 Bald Eagle (Threatened Designation)

Two general habits of bald eagles are of primary concern with this species: nesting and wintering. Breeding bald eagles typically build stick nests in the tops of coniferous or deciduous trees along streams, rivers or lakes. They also may select cliffs or ledges as nest substrates (Call 1978). Selection of nest trees appears to depend, in part, on the availability of food early in the nesting season (Swenson et al. 1986).

Primary wintering areas are typically associated with concentrations of food sources along major rivers that remain unfrozen where fish and waterfowl are available and near ungulate winter ranges (Montana Bald Eagle Working Group 1990). Wintering bald eagles are known to roost near concentrations of domestic sheep and big game in forests with large, open conifers and snags often protected from winds by ridges (Anderson and Paterson 1988).

Bald eagles occur along the Stillwater River as fall (October to December) and spring (February to March) migrants. However, sporadic winter occurrence has also been recorded (Flath 1989). This pattern of occurrence coincides with general trends observed in other mountain valleys of Montana. Although habitats appropriate for concentration areas occur along the length of the Stillwater River, no concentration areas have been identified (DSL and Forest Service 1989). Finally, although suitable habitats are present in the area, only a single occurrence of bald eagles nesting in the Stillwater River drainage has been documented. This nest is well outside the project area.

3.2.2.2 Peregrine Falcon (Threatened Designation)

Nesting habitats of the peregrine falcon usually involve cliff faces 200 to 300 feet high, but cliffs as high as 2,100 feet have been used. Most known nest sites are below 9,500 feet in elevation, but nests located as high as 10,500 feet have been documented (USFWS 1984). An available prey base of shorebirds, waterfowl or small- to medium-sized terrestrial birds usually occurs within ten miles of a nest site. Wetlands and riparian zones, as well as open meadows, parklands, croplands, lakes and gorges are potential habitats in which prey bird species are found and easily hunted by peregrines. Nesting peregrines may, however, hunt up to 17 miles from their nest to locate prey (USFWS 1984).

Bird populations on the project area appear to be sufficiently abundant and diverse to support peregrines and some of the cliffs located in the central and southern portions of the Stillwater Valley are high enough to provide suitable nesting habitats. In spite of the presence of what appears to be suitable habitats, no recent observations of peregrines in or near the project area have been documented. However, a historic nest site occurs in the valley near Nye, Montana. This site is on a cliff complex overlooking the West Fork of the Stillwater River and provides excellent foraging habitats. The last confirmed occupancy of this nest occurred in 1976.

3.2.2.3 Black-footed Ferret (Endangered Designation)

Prairie dog colonies are essential habitat for the black-footed ferret, which depends on prairie dogs for food and uses the prairie dogs' burrows for shelter and raising their young (Hillman and Clark 1980, Fagerstone 1987). Because ferrets are nocturnal and spend much of their time underground, their presence in an area is difficult to ascertain, but their original distribution in North America closely corresponded to the distribution of the prairie dog (Hall and Kelson 1959, Fagerstone 1987).

Although prairie dog colonies are present in the Stillwater River valley (McMaster 1989), many of the individual towns by themselves may be too small to support black-footed ferrets. Furthermore, no known colonies exist near any of the proposed facilities. Therefore, the black-footed ferret is unlikely to be present within or near the project area and is not considered any further in this analysis.

3.2.2.4 Grizzly Bear (Threatened Designation)

The grizzly bear is present in the Absaroka-Beartooth Mountains and may enter the project area on occasion. Wildlife monitoring activities conducted for the Stillwater Mine have not produced or located any confirmed reports of grizzlies

in the project area. However, this was not unexpected. Also, the project area does not contain any denning habitats or other sites that might be considered critical to grizzly bears (Western Technology and Engineering, Inc. 1996c). Thus, any grizzly bears that might occur within the project area would be transitory.

Although grizzly bears occasionally may occur within the general environs of the project area, they do not inhabit the sites where components of the alternatives considered in detail are proposed. Consequently, little potential exists for the alternatives to affect grizzly bears and they are not discussed any further in this EIS.

3.2.2.5 Sensitive Species

The previous MEPA/NEPA documents prepared for the Stillwater Mine included discussions of various species of wildlife identified as sensitive by the Forest Service (e.g., the documents identified in **Appendix A**). These documents and species were reviewed during this analysis. The sensitive species list was compared with the current USFS Northern Region sensitive species list (Risburdt C., June 10, 1994 pers. comm.). The review determined the affected environment involving these species was still valid for the alternatives under consideration here. The high-gradient streams in the area do not provide suitable habitat for *Gentianopsis simplex*, which requires boggy areas (Pierson and Reid 1998, pers. comm.).

3.3 Fisheries

3.3.1 Stillwater Mine Site, Stratton and Hertzler Ranches

The Stillwater River is a torrential-type stream, flowing large amounts of clear, cold, high-quality water. The aquatic habitats, including the riparian zones, at all stations on the Stillwater River and the West Fork of the Stillwater River are in stable condition and provide an excellent wild trout fishery with an abundant food supply. Habitat conditions were considered suitable for aquatic insect production and ideal for game fish spawning and rearing. Characteristics contributing to this situation include a stable gravelly substrate, shallow side channels, and favorable stream gradient, flow regimes and water quality. For a more detailed description of the Stillwater River's physical habitat refer to the Water Quality and Quantity Section.

The MDFWP has instream flow reservations on the Stillwater River and West Fork of the Stillwater River to help maintain minimum flows in the system to protect the fishery.

3.3.1.1 Fish

The MDFWP considers both the Stillwater River and the West Fork of the Stillwater River to have substantial fishery resources (MDFWP 1990). Nongame fish present throughout the river include longnose sucker, mountain sucker, longnose dace, and white sucker. The year-long average species composition in the Stillwater River within the study area during a 1980–81 survey was 35 percent brown trout, 33 percent mountain whitefish, 27 percent rainbow trout, and 5 percent brook trout (CDM 1981). In the lower river, the comparable composition was 50 percent whitefish, 27 percent brown trout, and 13 percent rainbow trout. No bull trout occur in the Stillwater River.

The nature of the gravel substrate, shallow side channels, flow regimes, water quality, and stream gradient make the Stillwater River within the project area ideal for spawning and rearing of game fish that live in the lower Stillwater and Yellowstone rivers. The river environment downstream from Beehive, Montana, is suitable for year-round occupancy, but does not provide the ideal spawning and rearing habitats that are present in this section (especially near the town of Nye).

The composition of game fish in the Stillwater River within the project area varies seasonally, depending largely on the spawning times of each species. Brown trout and whitefish are the most common fish in the Stillwater River during their fall spawning. However, during the spring, rainbow trout increase in number.

Since 1981, annual estimates of the numbers of brown trout present in the Stillwater River within the project area have varied. During 1981 and 1985, numbers of brown trout ranged from 400 to 500 per mile in the spring and from 600 to 700 per mile in the fall. MDFWP (1990) attributes the seasonal differences to influxes of spawners into the area in the fall. In 1986 and 1989, the number of brown trout per mile were lower than the 1981 and 1985 estimates. The decrease was attributed to severe drought conditions present during that period.

By 1994, data collected at another station in the Stillwater River indicated the fishery had recovered from the drought. In March 1994, MDFWP found 2,392 brown trout per mile with 300 per mile exceeding 13 inches in length. Excluding yearling fish, the 1994 population estimate was 40 percent higher than in 1991 and 75 percent higher than a 1987 estimate. MDFWP (1997) attributes this increase to implementation of more restrictive fish limits in 1990 and a decrease in drought conditions that were evident during the 1987 collection.

The reach between Woodbine Campground and the West Fork of the Stillwater River appears to be used by large spring-spawning rainbow migrating from the Stillwater and Yellowstone rivers through the area to prime spawning gravels

upstream and by small rainbows (age 1 and 2) that leave prior to maturity. In 1994, MDFWP estimated the number of rainbow trout present in the section of the river near Hertzler Ranch as 355 per mile (MDFWP 1997).

Increased mining in the Absaroka-Beartooth Mountains and increasing popularity of the Stillwater Valley (resulting in subdivision developments) have contributed to a population boom in the Stillwater area. This increase in the people in the valley has resulted in increased fishing pressure on the fishery. As a result, MDFWP imposed more stringent fishing regulations, which included reducing the fish limit from five to two. MDFWP's overall management is apparently working because populations of fish present in the Stillwater River in 1994 exceeded MDFWP's goals.

3.3.1.2 Aquatic Macroinvertebrates

Aquatic invertebrates were sampled within the Stillwater River in 1980, 1981, and 1997. On October 10, 1997, quantitative(triplicate surber) samples were taken at SW–1 and SW–2 (SMC–11) within the section of the Stillwater River near the Stillwater Mine (**Figure 3–1**). Samples also were taken at SW–3 and SW–4 (SMC–13) within the section of the Stillwater River near the Hertzler Ranch (**Figure 3–1**).

The results of the 1997 sampling were very similar to the data collected in 1980 and 1981. Both sets of results suggest aquatic conditions of the Stillwater River are very healthy. The bioassessment metrics calculated on the 1997 data suggest clean-water conditions, good diversity, and good biotic condition (**Table 3–7**).

Abundance during the 1997 collection was lower than the fall 1980–81 data. However, flows that were substantially higher than normal (at least 50 cfs above normal) probably influenced 1997's results. These abnormally-high flows made sampling difficult and efficiency questionable. Therefore, the quantitative data should be considered minimum estimates of macroinvertebrate populations.

Species found in 1997 were generally the same as those found in 1980–81, with the newly found stonefly *Doroneuria theodora* being the notable exception. Species found were generally those considered to be clean-water taxa, indicating the presence of good water quality and a healthy aquatic habitat. Additionally, several species are found only in torrential-type, well oxygenated waters. Metrics not related to abundance were generally healthier than the average values Bahls et al. (1992) identified for other mountain streams in Montana.

Another notable observation in 1997 was a significant shift in species composition and dominance by order at the SW-3 station compared to the other stations (**Table 3–7**). Although Ephemeroptera is the dominant order at the three other stations, the order Diptera is dominant at SW–3. The shift was caused by

Table 3–7 Macroinvertebrate Bioassessment Metrics for Stations in the Stillwater River

Parameter	Sample Stations[1]			
	SW-1	SW-2	SW-3	SW-4
General Metrics				
Total Abundance (# / ft²)	75	148	207	153
Total Abundance (# / m²)	808	1593	2232	1643
Total Number Taxa	25	26	34	30
EPT Taxa	21	23	22	20
Percent Dominant Taxon	20.9	19.6	31.8	17.0
Percent Chironomidae	3.6	1.6	3.2	8.1
EPT/Chironomidae	22.35	61.01	16.65	9.49
Diversity Indices				
Shannon (H)	3.74	3.71	3.88	4.07
Evenness (e)	0.76	0.69	0.62	0.00
Biotic Indices				
HBI	2.9	2.6	1.8	3.0
CTQ	48.6	46.4	36.6	59.3
Percent Composition Per Order				
Ephemeroptera	50.2	57.2	26.4	46.9
Plecoptera	10.2	10.8	5.8	8.3
Trichoptera	20.0	26.8	21.4	21.4
Odonata	0.0	0.0	0.0	0.0
Diptera	14.3	4.7	44.5	15.9
Coleoptera	5.3	0.0	1.4	6.6
Hemiptera	0.0	0.0	0.0	0.0
Miscellaneous Taxa	0.0	0.5	0.5	0.9
Total	100.0	100.0	100.0	100.0

Notes:

1. Station locations are shown on **Figure 3–1**.

Abundance:	Under certain types of stresses, this value may be increased (by tolerant organisms) or reduced (by lowering the number of non-tolerant organisms).
Total # of Taxa:	The total number of taxa (richness) generally increases with increasing biotic condition.
EPT Taxa	The total number of distinct taxa within the orders Ephemeroptera, Plecoptera, and Trichoptera. This value summarizes taxa richness within the insect orders generally considered sensitive to pollution.
Percent Dominant Taxa:	The percent contribution of the most numerous taxon found. Undisturbed environments generally support communities having large numbers of species with no individual species present in overwhelming abundance.
Percent Chironomidae:	The percent contribution of the family chironomidae. Disproportionate dominance of this generally tolerant group usually indicates poor biotic condition.
EPT/Chironomidae:	Skewed population having a disproportionate number of the tolerant chironimids relative to the more sensitive EPT group may indicate environmental stress.
Shannon H:	A diversity index where relative abundances of the different taxa are taken into account. In general, values from 3 to 5 indicate clean water (good), 1 to 3 moderately polluted water (fair), and values below 1 indicate heavily polluted water (poor).
Evenness:	The measure of how evenly the individuals are distributed among species. Values greater than 0.5 are considered to characterize natural stream communities. Even slight levels of degradation can reduce evenness below 0.5, and generally below 0.3.
HBI:	The HBI (modified Hilsenhoff biotic index) summarizes the benthic community's overall tolerance to pollution. 0.00-3.75 (excellent), 3.76-4.25 (very good), 4.25-5.00 (good), 5.01-5.75 (fair), 5.76-6.5 (fairly poor), 6.51-7.25 (poor), and 7.26-10.00 (very poor).
CTQ:	(Community Tolerance Quotient). Similar to the HBI, each individual organism in a sample has a preassigned tolerance value. Mean values range from 40 to 108. The higher numbers indicate more tolerant communities and may show stressed conditions.

Source: Greystone 1997.

the abundant occurrence of the taxa *Bibiocephala* and *Philorus*. These species were not found in the Stillwater River above SW–3 and only in very small numbers at SW–4. The presence of these species in the West Fork of the Stillwater River directly upstream of this station likely explains this shift in species composition within this short segment of the Stillwater River. Despite this shift to dipterans, the two taxa are still characteristic of the Stillwater River because they are both considered clean-water taxa and occur in torrential-type streams.

3.3.1.3 Periphyton

A 1980–81 periphyton study of the Stillwater River within the project area and the West Fork of the Stillwater River indicated a diverse periphyton community (CDM 1981). The data suggest diversity was higher in the Hertzler Ranch section of the Stillwater River and the West Fork of the Stillwater River than upstream in the Stillwater Mine/Stratton Ranch section. Several of the species collected are indicators of good water quality. Furthermore, many of the most-abundant species found are indicators of high concentrations of dissolved oxygen, high velocities, and cool temperatures. The dominance of diatoms at most stations indicates an aquatic ecosystem that is largely undisturbed.

A study of periphyton and limiting nutrients (ENSR 1992) suggests primary production (algal growth) is limited in the Stillwater River within the project area. This was supported by the low concentrations macronutrients and micronutrients found. Data indicate nitrogen is not limiting in the Stillwater River, but phosphorus, possibly in conjunction with micronutrients, may be limiting algal growth.

Additionally, the presence of abundant filamentous green algae at a station 20 miles downstream of the Stillwater mine indicates that point and nonpoint sources not related to the mine are affecting the river's nutrient load. Septic systems leaching into the surface water and agricultural run-off are the likely sources of these nutrients.

Data from SMC's water quality monitoring (collected since the mine's initiation) indicate nitrates are somewhat higher at the downstream surface water site (SMC–11) than at the site upstream of surface water site (SMC–1A). The difference is apparently caused by SMC's operations leaching nitrates into the groundwater and then into the surface water. This increase, up to 0.2 mg/L, is not likely to be substantially altering primary production, especially because nitrogen was found to not be a limiting factor for growth of algae. This is further supported by ENSR's determination that primary productivity in the Stillwater River is low (ENSR 1992).

3.4 Air Quality

Air quality in the project area remains good. Particulates less than 10 microns in diameter (PM_{10}) are well below established federal and Montana ambient air quality standards. Therefore, the area is rated as in attainment status for air quality. Concentrations for sulfate and lead are also low. The entire area surrounding the project area, including the Absaroka-Beartooth Wilderness, is classified as a Prevention of Significant Deterioration (PSD) Class II airshed. The closest Class I PSD airshed is Yellowstone National Park, located about 20 miles southwest of the mine. Class I areas are pristine national parks and wilderness areas where very little degradation in air quality is allowed. Class II areas (all areas other than Class I) are areas where well-managed industrial growth can occur without significant degradation of air quality.

SMC presently operates the underground mine and mill under Air Quality Permit Number 2459–07 issued by DEQ's Air and Waste Management Bureau (AWMB). This air quality permit covers a maximum production of 730,000 tons of ore per year (tpy) at an average production rate of 2,000 tpd and a maximum rate of 3,500 tpd. However, the AWMB is reviewing SMC's application to revise the permit to cover a maximum rate of 5,000 tpd (see **Appendix E** for the preliminary determination on this permit application).

SMC has been monitoring particulates since 1981. SMC also monitored PM_{10} at Hertzler Ranch from February 1996 through March 1997, specifically for this analysis. The latest PM_{10} data (**Table 3–8**), measured at upwind and downwind locations within the permit boundary, show ambient air concentrations of particulates at the Stillwater Mine are well below the federal and State of Montana National Ambient Air Quality Standards (NAAQS) established for PM_{10}. The measured values at the mine indicate present activities result in ambient levels that are 25 percent or less of the established NAAQS.

Particulates (total suspended particulates [TSP], of which PM_{10} generally constitutes less than 50 percent) were sampled at Hertzler Ranch from August 1980 through July 1981 (CDM 1981). During the fall, winter, spring, and summer, average TSP concentrations were 14, 6, 11, and 25 $\mu g/m^3$, respectively. Using the general relationship between TSP and PM_{10}, one can assume concentrations of PM_{10} were less than half of the TSP values.

Lead and sulfates also were monitored at the Hertzler Ranch from August 1980 through July 1981 (CDM 1981). Concentrations of lead and sulfate were found to be quite low. The maximum concentration of lead was 0.008 $\mu g/m^3$ and concentrations of sulfate did not exceed 6 $\mu g/m^3$ during the 12 months of monitoring.

Table 3–8 Stillwater Mine and Hertzler Ranch PM_{10} Data[1]

PM_{10} Monitor Site and Year	Annual Average NAAQS	Annual Data (Percent of NAAQS)	Annual 24–Hour NAAQS	Highest 24–Hour Data (Percent of NAAQS)	Second Highest 24–Hour Data (Percent of NAAQS)
Stillwater Mine	50[2]		150[3]		
Site 1, 1995		7 (14.0)		26 (17.3)	22 (14.7)
Site 2, 1995		9 (18.0)		28 (18.7)	26 (17.3)
Hertzler Ranch					
Feb 1996 to Mar 1997		9 (18.0)		38 (25.3)	32 (21.3)

Notes:
1. Values are in micrograms per cubic meter (μg/m3).
2. 24–Hour average not to be exceeded more than once per year.
3. Annual average is arithmetic average of quarterly averages.

Source: Gelhaus 1997

3.5 Socioeconomics

The Stillwater Mine is located in Stillwater County, Montana. For purposes of this analysis, the area of potential effect has been defined as Stillwater County. The communities of Absarokee, Columbus, Fishtail, Nye, Park City, Rapelje, and Reedpoint are the primary communities in the study area.

3.5.1 Population

Since the completion of the previous NEPA/MEPA documents (e.g., DSL and Forest Service 1985 and DSL, DHES, and Forest Service 1992), Stillwater County's population has continued to grow. In 1996, the Bureau of the Census estimated the population of Stillwater County, Montana at 7,653 persons. Based on these numbers, Stillwater County's population has grown at an average rate of about 2 percent annually since 1990. This rate of growth is higher than projected and is higher than the rate of growth experienced by Montana and the United States.

In terms of demographics, Stillwater County probably has changed little since the 1990 census. Data from this census indicate residents of Stillwater County comprise a fairly homogeneous population, with a very low percentages of minorities. In addition, Stillwater County's population was generally older than the statewide average. In 1990, the median age in Stillwater County was 36.5 years, compared to 33.8 years for the state. The 1990 census listed 16.7 percent of the County's population as 65 or older compared to 13.3 percent statewide.

3.5.2 Labor and Employment

3.5.2.1 Civilian Labor Force

As of 1996, the civilian labor force in Stillwater County consisted of 3,952 people. Of this labor force, 3,774 workers were employed in the county and 178 were unemployed, which equates to an annual unemployment rate of 4.5 percent. This rate is lower than Montana's statewide average of 5.3 percent for 1996 (Montana Department of Labor 1997).

The distribution of employment for Stillwater County by industry for 1996 is shown in **Table 3–9**. The distribution presented is for "covered" employment as defined by the Montana Department of Labor. The term covered employment includes employers who are subject to Montana's unemployment insurance law and excludes railroad employees, employees paid by commission, elected officials, and direct sellers of consumer products. Therefore, the total employment shown in **Table 3–9** is lower than the total employment figure mentioned above. The mining industry accounted for the single largest portion of the County's total employment (almost 26 percent). Trade, government, and manufacturing comprised next largest categories of employment.

Table 3–9 Employment Distribution by Industry, Stillwater County, 1996

Industry	Average Annual Employment (number of employees)	Portion of Total (percent)
Mining	574	25.6
Construction	77	3.4
Manufacturing	364	16.2
T.C.P.U.[1]	29	1.3
Trade	428	19.1
F.I.R.E[2]	29	1.3
Services	302	13.5
Agriculture	41	1.8
Government	398	17.8
Total	2,242	100.0

Notes:
1. T.C.P.U. = Transportation, Communication, Public Utilities.
2. F.I.R.E. = Finance, Insurance, Real Estate.

Source: Montana Department of Labor 1997.

3.5.2.2 Stillwater Mine Employment

The Stillwater Mine provides a significant contribution to employment in Stillwater County and this contribution has increased since the completion of the previous NEPA/MEPA documents (e.g., DSL and Forest Service 1985 and DSL, DHES, and Forest Service 1992). As of December 31,1997, employment at the Stillwater mine was 655 employees (SMC 1998). This level of employment represents about a 42 percent increase over the 460-employee level projected in SMC's Amended Hard Rock Impact Plan (SMC 1988). SMC's recent monitoring reports suggest 56 percent of mineral development employees are immigrating (i.e., employees originating from outside Stillwater County). SMC also estimates secondary employment to amount to 7 percent of the immigrating mineral employment. Approximately 16 percent of Stillwater County's labor force is employed at the mine.

3.5.3 Local Economy

The distribution of labor income among major industries provides some insight into the structure of a local economy. As shown on **Table 3–10**, the mining industry accounted for almost half of total labor income in Stillwater County during 1996. Labor income in manufacturing was slightly higher (14.7 percent) than the statewide figure of 8.7 percent. Compared to the state, agriculture and mining in Stillwater County are relatively more important industries and other industries make up a smaller percentage of total labor income compared to statewide totals. Industries, such as trade, services, finance, insurance, and real estate, suggest residents leave the county to purchase goods and services (Montana Department of Labor 1997). Recent trends indicate retail sales have decreased in Montana's rural counties and increased in more populated counties. In addition, the service sector has been growing rapidly in more populated counties.

Although agricultural activities do not account for a large percentage of labor income in Stillwater County, agriculture represents a substantial use of land. As of 1992 (the latest agricultural census information available), 446 farms existed in Stillwater County. Together, they encompassed a total of 889,294 acres, equating to about 77 percent of land in the county (**Table 3–11**). The average size of the farms was 1,994 acres. The market value of agricultural products sold in the County in 1987 was $26.2 million. More than 75 percent of this value was generated from the sale of livestock and poultry. Additionally, just over 25 percent was generated from the sale of crops (Census of Agriculture 1987 and 1992).

Table 3–10 Labor Income by Major Industry, 1996

Industry	Income ($thousands) Stillwater County	Income ($thousands) Montana	Portion of Total Stillwater County	Portion of Total Montana
Agriculture	$887	$66,883	1.6	0.9
Mining	$25,944	$225,239	47.1	3.0
Construction	$1,734	$436,065	3.1	5.9
Manufacturing	$8,083	$641,057	14.7	8.7
T.C.P.U[1]	$619	$511,293	1.1	6.9
Trade	$4,729	$1,470,109	8.6	19.9
F.I.R.E[2]	$563	$412,085	1.0	5.6
Services	$4,349	$1,862,237	7.9	25.2
Government	$8,222	$1,766,022	14.9	23.9
Total	$55,130	$7,390,990	100.0	100.0

Notes:
1. T.C.P.U. = Transportation, Communication, Public Utilities.
2. F.I.R.E. = Finance, Insurance, Real Estate.

Source: Montana Department of Labor 1997.

Table 3–11 Farm Statistics, 1987 and 1992

	Number of Farms		Average Size (acres)		Market Value of Agricultural Products (average per farm)	
	1987	1992	1987	1992	1987	1992
United States	2,087,759	1,925,300	462	491	$65,165	$84,459
Montana	24,568	22,821	2,451	2,613	$62,980	$75,818
Stillwater County	447	446	1,885	1,994	$58,637	na[1]

Note:
1. na = not available

Source: Census of Agriculture, 1987 and 1992 (census conducted every 5 years)

3.5.4 Property Tax Base

The 1997 taxable valuation of property in Stillwater County totaled $25.4 million. As of this year (1997), taxable valuation of the Stillwater Mine and precious metals smelter was $3,412,000. This represents about 19 percent of the total valuation of Stillwater County. SMC is a significant source of property tax revenue to the County. The 1996 property tax liability of SMC, including the

smelter in Columbus and gross proceeds tax, was approximately$1.8 million. In addition, SMC pays a metal mines license tax to the state on the gross proceeds from the mine and 25 percent of that is returned to the County. At least 40 percent of the County's share must be put in a reserve for use when the mine closes or a substantial reduction in employment occurs. As of June 1997, this reserve fund contained nearly one million dollars (Beaudry 1997, pers. comm.).

3.5.5 Property Values

One of the issues raised during scoping is the potential for a reduction in property values in subdivisions near the proposed facility sites. Similar issues have been raised for earlier proposals for mine expansion submitted by SMC. Earlier environmental documents determined that this potential impact would be considered significant if the new facilities could be shown to directly cause a decrease in property values of greater than 15 percent. However, no significant effects on property values were identified.

An comparative analysis of this issue was done in 1990 during preparation of the preliminary Draft EIS for SMC's proposed smelter. The measure of potential impacts was a review of what had happened historically in the Stillwater Valley. Data were obtained from Stillwater County (Ferster 1989, pers. comm.) for lot prices at the various subdivisions over time. Because exact prices are confidential under Montana law and lot prices vary by location, average prices were used. The focus was on prices in 1984 and earlier (pre-mine) and prices in 1990–1991 (post-mine) to determine if there was a trend in price changes and the magnitude of any changes that had been realized from development of the mine.

At Cathedral Mountain Ranch, lots of two different sizes were being sold. The smaller lots sold for an average price of $7,000 to $7,500 in 1984 and earlier. From 1987 through 1989, they sold for an average price of $9,000 to $9,500. The larger lots, which sold for an average price of $10,000 to $12,000 in 1984 and earlier, sold for about $20,000 in 1989.

At the Rainbow Ranch and Whited subdivisions, lot prices remained fairly constant over the study period, but the listing period increased somewhat. Lots down-valley from Nye with river frontage also remained stable with very slight increases in price. At Buffalo Jump, the value of lots near the river remained constant, whereas the lots in the more remote areas in the subdivision decreased slightly in value ($10,000 to $12,000 in 1984 and earlier compared with about $10,000 in 1989).

During the same period (1983–1989), land values in Stillwater County as a whole remained relatively stable. Prices of subdivided lots in the County and house prices in Columbus and Absarokee also remained relatively stable. Prices for agricultural land, however, decreased by 30 to 50 percent. The analysis was

unable to provide any explanation for the decrease in agricultural land values, but since it occurred country-wide, it did not appear related to the development of the mine.

3.5.6 Housing

In 1980, 2,480 year-round housing units and 200 vacant units were present in Stillwater County. The average rate of occupancy was 2.67 persons per unit. About 77 percent of the residents lived in owner-occupied units and 23 percent lived in rented units. At that time, vacancy rates were approximately 15 percent.

By 1990, the total number of housing units in Stillwater County had increased to 3,291, a 22.8 percent increase. Of these units, 2,523 were occupied and 73.6 percent of these were occupied by owners. On average, there were 2.56 persons per household. The median value of a home was $56,200. Approximately 2.6 percent of owner-occupied units were vacant, and 9.5 percent of rental units were vacant. At that time, the statewide vacancy rate for owner-occupied units was 2.9 percent, whereas the vacancy rate for rental units was 9.6 percent (Bureau of the Census 1990).

Persons relocating to Stillwater County for employment at the Stillwater Mine have often had to accept temporary accommodations, including renting vacation homes or mobile homes, until permanent accommodations become available. As a result, rental rates have increased by 5.9 percent. From 1980 to 1990, the median value of single family homes was categorized as stable, increasing by an average of 2.7 percent.

In response to local conditions, SMC developed a temporary mobile home park at the Stratton Ranch for its employees, but the park has been closed and reclaimed by SMC. In addition, SMC has subdivided the Circle T Ranch northwest of Absarokee and employees used to be able to purchase lots at a cost below what SMC had invested in the development. However, SMC is now selling the last few lots at market value. Electricity and domestic water are available to the lots, but individual septic sewer system must be installed. The subdivision contains 59 lots and there is additional room for expansion, as needed.

In addition, SMC is in the process of developing a single-family unit subdivision in the Town of Columbus. Although this subdivision will be geared primarily toward SMC's employees, it also is intended to ease the demand for housing in the county. Thus, the homes will be available to anyone seeking housing.

3.5.7 Community Services

3.5.7.1 Hard Rock Impact Plan

The Montana Hard Rock Mining Impact Act of 1981 requires each developer of new, large-scale hard rock mineral developments to prepare a local government impact plan in cooperation with affected units of local government. Through the impact plan, the developer identifies and pays the increased costs for local government services and facilities needed as a result of the mineral development. Affected local governments review the proposed plan and the county holds a public hearing on it before it is approved. The governing body may negotiate with the developer to change the proposed plan and may ask the state Hard Rock Mining Impact Board to adjudicate disputed issues. Together, the local government units and the developer implement the approved impact plan. The impact plan may trigger tax base sharing under the Property Tax Base Sharing Act, and may also affect distribution of metal mines license tax revenue (Montana Department of Commerce 1997).

SMC's original Hard Rock Mining Impact Plan and the 1988 amendment define the affected local jurisdictions as Stillwater County; the town of Columbus; the Absarokee Rural Fire District; and school districts in Absarokee, Columbus, Fishtail, and Nye. Among the needs identified by these jurisdictions were additional personnel and increased funding for such functions as municipal court operations, libraries, mental health programs, and assistance to low income individuals. Additionally, the local agencies and districts identified needs for additional facilities and equipment.

The Hard Rock Impact Plan establishes that SMC will provide mitigation in the form of tax prepayments, grants, and guarantees for the payment of principal and interest in educational impact bonds. A substantial amount of financial assistance has been provided by SMC through the Plan and most residents seem to feel that this funding has enabled the local communities to better accommodate growth. Under the 1985 Impact Plan and its 1988 amendment, SMC has paid a total of about $4 million for expanding schools, buying equipment for the Absarokee Fire District, upgrading the Absarokee sewage treatment plant, upgrading the Columbus sewer and water systems, and improving Stillwater County roads 419 and 420 (Richard 1997, pers. comm.).

In spite of the mitigation, concerns still exist about the provision of services to Stillwater County's residents. The sewer system for the Town of Columbus is at capacity and water lines in Columbus need to be upgraded. Additional traffic from population growth has resulted in unmet street maintenance needs and some gravel roads need to be paved to accommodate traffic better (DSL, DHES, and Forest Service 1992). Between 1987 and 1991, in-migrating school-aged students whose parent or guardian moved into the area to work at the mine accounted for all of the increases in enrollment at Absarokee's schools, but were

less of a factor in the expansion of the Columbus and Fishtail elementary schools. Absarokee's schools have a limited capability to absorb future increases, especially in the elementary school. Fishtail and Nye's elementary schools could accommodate more students. Columbus' elementary school system is at capacity, both in terms of class size and facilities. However, its junior and senior high schools are below capacity.

Increases in mill levies since the mine was developed appear to be primarily due to changes for some individual expense categories, such as the removal of a freeze on school levies and a new levy of 40 mills authorized by the 1989 state legislature to equalize school funding in all counties. In terms of constant dollars, the taxable value of Stillwater County's property is essentially the same in fiscal year 1991–1992 as it was in fiscal year 1982–1983 before the mine was developed.

3.5.7.2 Water Supply

Absarokee, Columbus and Rapelje have central water systems. The remaining areas of the county are served by individual water systems. These include wells, springs and cisterns.

The Absarokee Water and Sewer District is a cooperative that provides, for each purchasing property owner, potable water and treatment. This district was converted from a Water User's Association in 1995. Absarokee receives its water from a series of wells. The existing system is capable of providing 340,000 gpd in the winter months and up to 840,000 gpd in the summer. Two storage tanks have a maximum storage capacity of 325,000 gallons of treated water, combined. Columbus' municipal water system has surface water supply sources with a combined capacity of more than 2 million gpd. The town also has 1.5 million gallons of storage capacity. The Rapelje Water Users Association's water supply source is a developed spring from which water is pumped into an 8,000 gallon cistern.

3.5.7.3 Sewer Systems

Absarokee, Columbus and Park City have public sewer systems. The remaining areas of the county are served by individual septic systems.

Absarokee's sewer system, maintained by Stillwater County, includes an aerated, three-celled lagoon system encompassing 1.46 acres. An ultra-violet light system and seven aerators provide secondary treatment. The system is designed to serve up to 1,200 people. Columbus' municipal sewer system consists of a collection system and a four-cell facultative lagoon treatment system. Capacity of the system is considered to be 1,600 people. Park City's sewage collection

and treatment system is managed by Stillwater County. It consists of a two-celled, 5-acre lagoon, with sufficient land to develop a third cell.

3.5.7.4 Solid Waste

The Town of Columbus provides solid waste collection to the residents and businesses within the corporate limits of the town. Most of the solid waste is hauled to the Billings Landfill for disposal. The remaining waste is taken to the Stillwater County Landfill. Stillwater County's refuse disposal district collects solid waste in the unincorporated areas of the county. The county operates a Class II landfill 3 miles north of Columbus. The Class III landfills at Absarokee, Park City, and Rapelje have been closed out. In the past, the county has also hauled garbage to the Livingston resource agency recovery facility when necessary.

3.5.7.5 Educational System

Stillwater County has five high school districts and eight elementary school districts plus a portion of the Broadview district. Recently completed construction and plans for future development in the district include a new high school in Absarokee, additional rooms at Columbus' high school and elementary school, and a new classroom at Nye Elementary. Enrollment figures for certain school districts in Stillwater County, as well as more recent information on the number of students from families of mine employees (mineral development students) are shown in **Table 3–12**.

3.5.7.6 Hospitals and Clinics

Stillwater Community Hospital has 27 beds, an emergency room, a laboratory, facilities for physical therapy, a nursery, and expanded outpatient services in a nearby clinic. In addition, it has a seven-unit, limited-care retirement home. The Hospital employees 46 people, including three physicians and nine nurses.

Additional medical services in Stillwater County include: three volunteer ambulance services with EMTs in Absarokee, Columbus, and Park City; an 81-bed convalescent center in Columbus; and a satellite office of the South Central Montana Regional Mental Health Center in Columbus. Two dentists, an optometrist, and a chiropractor have offices in Columbus. Absarokee is served by one dentist office, an optometrist and a chiropractor.

Table 3–12 Distribution of Elementary and High School Students, Stillwater County

School	Total Enrollment March 31, 1991	In-Migrating Mineral Development Students 1988 Plan	March 31 1991	December 31 1996
Elementary Schools				
Absarokee	259	110	78	77
Columbus	392	22	29	48
Fishtail	40	33	4	4
Nye	4	18	4	6
Red Lodge	na[1]	-	na	6
Other	na	3	na	29
Total	695	186	115	170
High Schools				
Absarokee	132	27	36	37
Columbus	130	5	18	16
Red Lodge	na	-	na	6
Other	na	1	na	3
Total	262	33	54	62

Notes:
1. na = not available.

Sources: SMC 1988; DSL, DHES, and Forest Service 1992; SMC 1996a; Campbell 1997, pers. comm.

3.5.7.7 Fire Protection

Four fire districts exist in the County. Absarokee, Broadview (encompasses parts of four counties), Park City, and Columbus have active districts. Additionally, five volunteer fire departments are present. They include Molt, Rapelje, Reed Point, Nye, and a county-wide department. The following are the number of volunteers at each fire district or department: Absarokee (26), Broadview (26), Columbus (14), Molt (12), Park City (25), Rapelje (22), Reed Point (7), Nye (26), and Stillwater County (12).

Mutual aid agreements exist among the departments and districts. Stillwater County and the Montana Division of Forestry also have a cooperative equipment agreement. Local resources for fire protection are adequate to handle most fires. In the event of major fires, state and federal assistance is requested.

3.5.7.8 Law Enforcement

Law enforcement services in unincorporated Stillwater County are provided by the Stillwater County Sheriff's Department, which consists of eight full time deputies. The Columbus Police Department has three officers.

3.6 Tailings Impoundment Stability

3.6.1 Area Geology and Seismicity

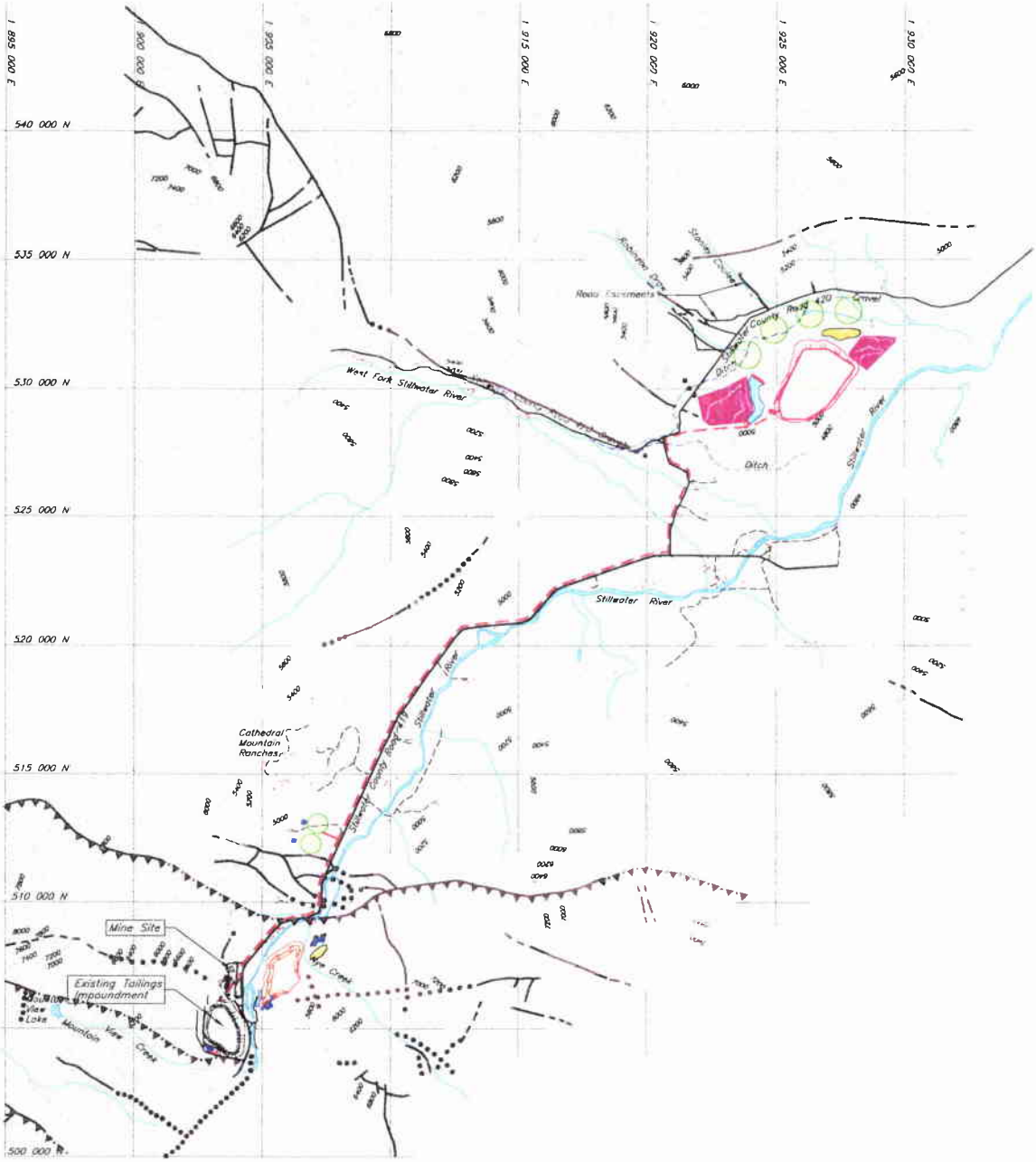
3.6.1.1 Stillwater Mine Site

Northerly-dipping Paleozoic and Mesozoic sedimentary bedrock outcropping in the mine area overlies Precambrian granitic bedrock of the Stillwater Complex (Page, et al. 1973). This complex consists of layers of iron- and magnesium-rich, generally dark-colored, intrusive igneous rocks. Near the mine site, the rocks of the Stillwater Complex are exposed over a 1.5- to 2-mile-wide band.

Two main sets of faults are present in the project area (**Figure 3–4**). One set consists of east-west trending fault systems. A large east-west trending fault, the Bluebird Thrust, borders the area on the south. The Horseman Thrust borders the project area on the north.

Low earthquake activity has been documented for this local area during the past thirty years. Areas within 50 miles of the mine site are, however, earthquake prone, and have been the site of recent earthquakes which have caused moderate ground shaking at the mine site. An updated search of the National Earthquake Information Center's Earthquake Data Base (USGS 1997) was conducted for a 100-km (62-mile) radius of the site. The search checked for seismic events exceeding a magnitude of 3.5 on the Richter scale (the scale is 0.1 to 9.9) during the period 1973 to 1997. Ten seismic events occurred during the period June 30 to July 7, 1975, centered 53 to 61 miles to the southwest in Yellowstone National Park. The largest event registered 6.1 on the Richter scale. Since 1975, only two events with magnitudes greater than 3.5 have occurred within 100 km of the site, most recently in 1985.

The 1959 Hebgen Lake earthquake, with its epicenter 30 miles to the west-southwest of the site, measured 7.1 on the Richter scale. Ground shaking at Nye caused a water main to break, foundations to crack, and initiated several rock falls. Earthquakes that are most likely to create future ground shaking in the Stillwater River valley will have their origin in the Hebgen Lake – Yellowstone Park area (CDM 1981). Based on the review of potential fault zones, the Maximum Credible Earthquake for use in designing structures was determined to be 7.0 along the Emigrant fault, which is about 30 miles from the Hertzler site (Knight Piésold 1996).



LEGEND

- Proposed Pipeline Alignment
- Road
- Land Application Disposal Site
- Borrow Area
- Topsoil Stockpile
- Land Application Disposal Storage Pond
- Waste Rock Storage Area
- Hertzler Tailings Impoundment
- Sediment / Percolation Pond
- Fault (Dashed where inferred; dotted where concealed)
- Thrust Fault (Dashed where inferred; dotted where concealed.) (Sawteeth on upper plate)

Source: Norman J. Page, Frank S. Simons, and John C. Dohrenwend, 1973

Stillwater Mine
Revised Waste Management Plan
and Hertzler Tailings Impoundment
Draft Environmental Impact Statement

TOPOGRAPHY AND MINE SITE DETAILS ORIGINATED FROM INFORMATION SUPPLIED BY STILLWATER MINING COMPANY

0 2000 4000 10000
SCALE (FT)

N

Geologic Faults

Figure 3-4

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Slope failures in the Stillwater River valley have varied in size from small slumps to large landslides with most activity occurring during the last ice age. Most areas along the Stillwater River valley are relatively stable at the present time, but some areas may be adversely affected by earthquakes and above normal water influx, which tends to lubricate slide planes.

Two landslide deposits were mapped in the vicinity of the SMC mine site, and partially lie above the site on the west side of the valley. The larger deposit extends to the banks of the Stillwater River and probably dammed the river in the past. These deposits appear to be stable and have not moved, despite the Hebgen Lake earthquake of 1959, and the mine and road development.

3.6.1.2 Stratton Ranch Area

The Stratton Ranch area is underlain by sedimentary rocks that dip steeply to the north. Resistant Madison Limestone forms a prominent ridge that extends about a third of the way across the Stillwater Valley along the southern edge of the ranch.

Three general types of unconsolidated deposits exist at Stratton Ranch. They are alluvium (stream-laid deposits), colluvium (gravity-controlled deposits), and ancient mass-movement deposits. The last type of deposit consists of two large landslides that cover much of the slope along the north-northwestern edge of the Stratton Ranch area.

3.6.1.3 Hertzler Ranch Area

Sedimentary rocks, mostly limestones and other carbonates with lesser sandstones, shales and volcanics were deposited in this area from the Cambrian through Tertiary eras. These rocks are variously exposed in the Hertzler Valley and along the Beartooth Mountain front.

The Hertzler Valley is underlain by the Colorado and Montana group sedimentary rocks. The Colorado group rocks, the deepest bedrock units identified in the valley, are composed mostly of shale with smaller horizons of interbedded sandstone. These rocks are between 2,300 and 3,000 feet thick. The Montana group rocks are comprised of a 100-foot-thick sandstone layer, overlain with alternating layers of shale and fine-grained sandstone that is overlain by a fine-grained silty sandstone. There is also a thin coal seam near the base of the Montana group rocks.

These rocks directly underlie the 55- to 170-foot deep surficial deposits in the Hertzler Valley and specifically at the proposed tailings impoundment site. These rocks are characterized as mostly dark grey, black shales interbedded with brown and grey sandstones. The shales are nearly impermeable. The surficial

deposits include glacial outwash deposits (**Figures 3–5** and **3–6**). These deposits are in turn overlain by younger alluvial fan deposits. These alluvial fans dominate the surface of the site and consist of bedded clay, silt, sand, pebbles, cobbles, and boulders. The Hertzler Valley is located at the west end of the Nye-Bowler Structural zone. Several folds and faults have been mapped in the area, though extensive surficial deposits preclude complete characterization of the area. Earthquake risks are the same as they are for the SMC mine site. Landslide and avalanche risk are nonexistent due to the site being located in a relatively flat area (CDM 1981).

3.7 Aesthetics

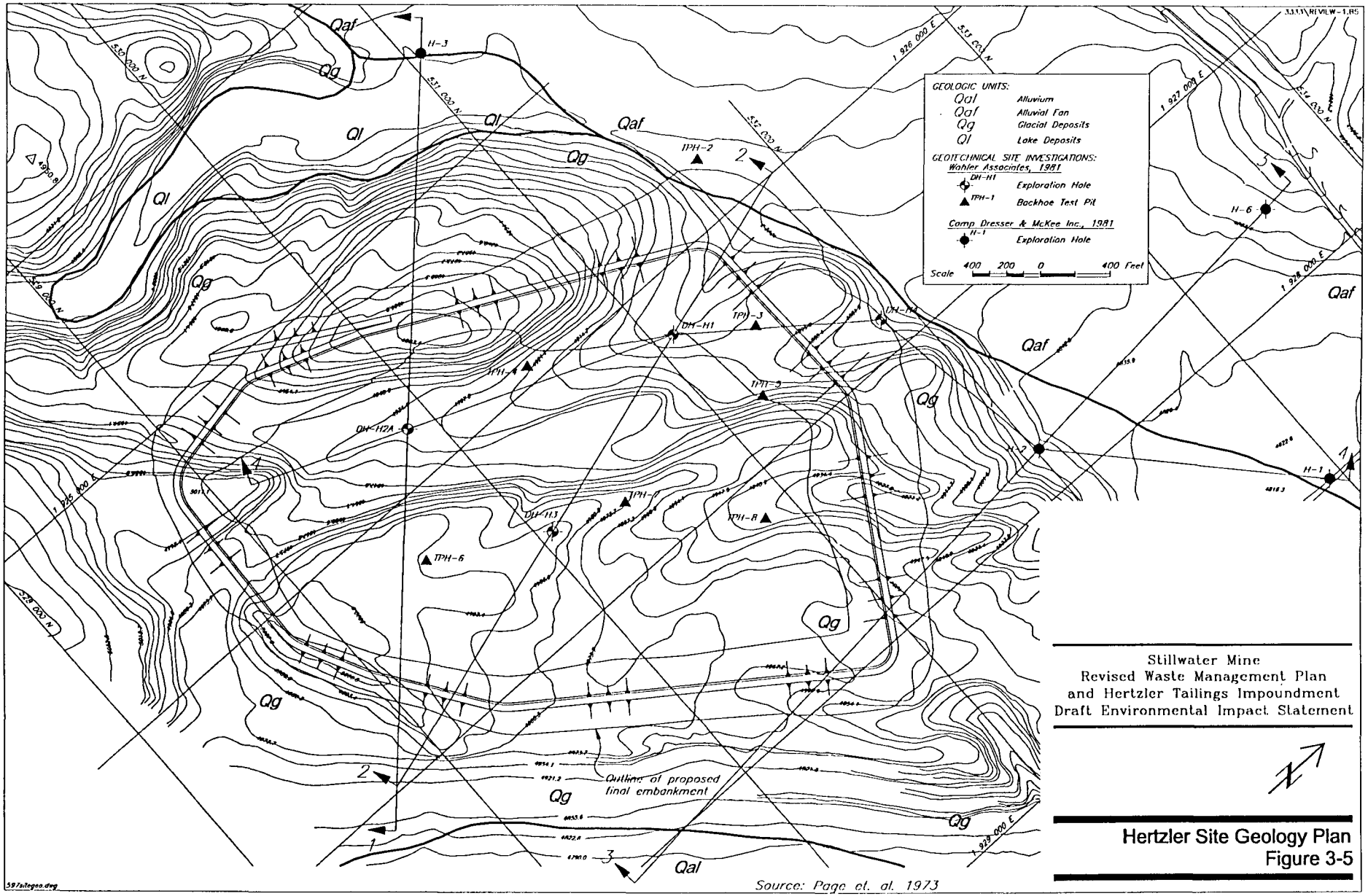
3.7.1 Visual Resources

Previous environmental analyses prepared for the Stillwater Mine used the Forest Service's Visual Management System (VMS) to evaluate visual resources in the project area. This system applies specifically to National Forest System lands. Although neither the State nor the Forest Service have enforcement authority over private lands, the Forest Service's VMS was applied to private lands for comparative purposes. Consequently, Visual Quality Objectives (VQOs), Existing Visual Conditions (EVCs), and the Visual Absorption Capabilities (VACs) have been established for public and private lands in the project area.

The VQO for lands in the CNF's Management Area E include Retention, Partial Retention, and Modification (Forest Service 1986a). The CNF's Forest Plan also states, "Short-term degradation will likely occur during mineral development that will not meet the assigned VQO of the area. Emphasis will be on rehabilitation immediately after the development phase and at the completion of production."

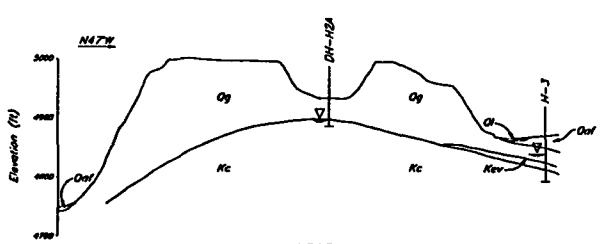
The existing visual condition (EVC) is the present state of visual alteration measured in degrees of deviation of the natural landscape. The EVCs for the Hertzler Ranch and the Stratton Ranch sites are classified as EVC 2 and EVC 3, respectively. EVC 2 is defined as Unnoticed: changes in the landscape are not visually evident to the average person, unless pointed out. This includes low visual roads. EVC 3 is defined as Minor Disturbance: changes in the landscape are noticed by the average person, but they do not attract attention. The natural appearance of the landscape still remains dominant. This includes pastures and roads.

The Visual Absorption Capability (VAC) is the inherent ability of the landscape to absorb alterations. The VAC of the project area in the Stillwater Valley, including the analysis areas, is high due to the vegetative regenerative capacity and relatively gentle slopes.

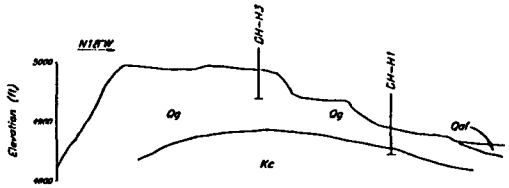


Stillwater Mine
Revised Waste Management Plan
and Hertzler Tailings Impoundment
Draft Environmental Impact Statement

Hertzler Site Geology Plan
Figure 3-5



SECTION 1



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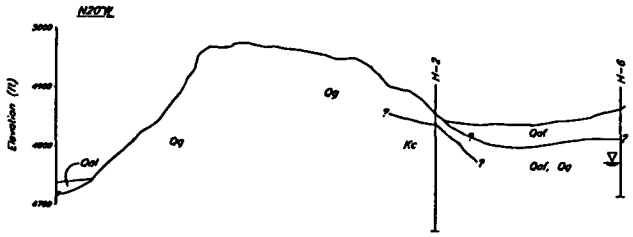
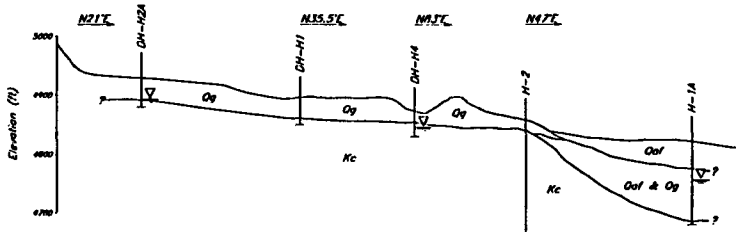


SECTION 3



SECTION 4

LEGEND

Geologic Units
Superficial Deposits

Ol – Lake deposits

Og – Glacial deposits

Qaf – Alluvial fan deposits

Bedrock Units

Kev – Eagle formation, virgelle sandstone

Kc – Colorado group shales

Geologic contact, approximately located

Information from Wahler Associates, 1981 Geotechnical Site Investigation

Vertical Scale 100 50 0 100 200 300 400 500 Feet

Horizontal Scale 500 250 0 500 1000 1500 2000 2500 Feet

Stillwater Mine
Revised Waste Management Plan
and Hertzler Tailings Impoundment
Draft Environmental Impact Statement

N

Geological Cross-Sections for Hertzler Ranch
Figure 3-6

597geosect.dwg

Source: Page etal. 1973

3.7.1.1 Stillwater Mine Site

The area surrounding this site falls within the Yellowstone Rockies Character Type. In the project area, this type has been subdivided into the foothill and mountainous subtypes (CDM 1981). The foothill subtype, located in the valleys of the study area, is composed of gently rolling, grass-covered hills with irrigated pastures. As seen from a distance, the valley presents a landscape of uniform brown or green, depending upon the season, and rolling land contrasted against the darker backdrop of rugged mountains. The dominant foreground feature is the Stillwater River and the associated cottonwood, aspen, and willow riparian vegetation.

Within the foothill subcharacter type, most of the man-caused alterations to the landscape are the result of past and present mining activities, ranching and agricultural activities, roads, and subdivisions. These alterations include fence lines, farm support structures, houses, irrigation ditches, haystacks, and farming equipment. Most of the ranching activities do not adversely affect scenic quality. The predominant visual alterations are second home/condominium developments. The ability of the valley bottom lands to absorb visual changes is greater than the upper portions of the valley due to gentler slopes.

The mountainous subcharacter type, located around the Stillwater Mine, consists of steeply-elevated, angular landforms that rise sharply from the Stillwater River Valley floor. Although most of the mountainous subcharacter type is free of visual impact, mine access roads and past and current mine development at the Stillwater Mine and in the Nye Creek, Verdigris Creek, and Mountain View Creek areas affect scenic quality. The visual impact is most evident where roads cut across steep slopes and where mine facilities have been constructed.

The Stillwater Mine has placed numerous yard lights around the buildings at the mine to provide safety and security, but lights are not placed where personnel do not work. In response to neighbor's concerns, SMC shrouded all outdoor lighting so light only goes down, which minimizes lights shining off the property. Additionally, SMC operates very little heavy equipment on the surface during night time hours. All construction and heavy equipment operation on the surface are conducted during daylight hours, or when necessary after dark, by means of the vehicles' own lights only.

3.7.1.2 Stratton Ranch

Stratton Ranch is located on SMC-owned lands in the relatively flat benches of the Stillwater valley on the west side of the river. The site is within the viewshed of several residences in the Cathedral Mountain Estates subdivision that overlook the site. Currently, considerable disturbance exists at the site where vegetation has been removed, resulting in a large area of exposed, light-

colored soils. Surrounding public lands have the VQOs of Retention, Partial Retention, and Modification assigned to them.

3.7.1.3 Hertzler Ranch

Hertzler Ranch (like the Stratton Ranch) is within the foothill character subtype. Evidence of farming and ranching activities occur here and some residences are also nearby. Most residences in the surrounding area are located in the valley near the community of Nye, and along the Stillwater River. Nearby Forest lands have been given the VQO of Partial Retention because there are man-made alterations already existing in these areas, but the natural appearance of the landscape is the dominant factor. Under the Partial Retention objective, management activities may introduce new form, line, color, or texture, but the changes must remain subordinate to the characteristic landscape.

3.7.2 Noise

Discussions of environmental noise do not focus on pure tones. Commonly-heard sounds have complex frequency and pressure characteristics. Accordingly, sound measurement equipment has been designed to account for the sensitivity of human hearing to different frequencies. Correction factors for adjusting actual sound pressure levels to correspond with human hearing have been determined experimentally. For measuring noise in ordinary environments, A-Weighted correction factors are employed. The filter de-emphasizes the very low and very high frequencies of sound in a manner similar to the response of the human ear. Therefore, the A-weighted decibel (dBA) is a good correlation to a human's subjective reaction to noise.

The following discussion sets a basis of familiarity with known and common noise levels. A quiet whisper at five feet is 20 dBA; a residential area at night is 40 dBA; a residential area during the day is 50 dBA; a large and busy department store is 60 dBA; 50 feet from a vehicle traveling 65 mph is 75 dBA; a typical construction site is 80 dBA; a subway train at 20 feet is 90 dBA; and a jet takeoff at 200 feet is 120 dBA.

3.7.2.1 Stillwater Mine Site

Site-specific noise studies have not been conducted in the vicinity of the Stillwater mine. However, the noise levels associated with the site are likely to be typical of those associated with underground mining. Typical sound levels at underground mine sites are presented below:

- entrance portal — 45 decibels (dBA);
- underground blasting — 54 dBA at 1,000 feet; and

- warehouse/shops — 45 dBA at 100 feet.

Noise levels from the existing operations are not obvious to travelers on County Road 419 or recreationists on National Forest lands (DSL and Forest Service 1989). Local residents living within 0.5 mile of the mine site stated in responses to the draft EIS that noise from beepers on vehicles, the mill, and other equipment operating at the mine is noticeable at their residences. In response to comments provided in the past, SMC has fitted some surface vehicles with mass-sensitive backup alarms that only sound when objects are present behind the vehicle. Thus, although SMC uses backup alarms at the mine, the frequency of their use is minimized.

Excluding the mine site activity, background noise levels in the Stillwater Valley can be expected to range from approximately 52 to 61 dBA. The major background sound sources are the Stillwater River and persistent winds (DSL and Forest Service 1985).

3.7.2.2 Hertzler Ranch

Specific noise surveys have not been conducted in the vicinity of the Hertzler Ranch. However, because the area is undeveloped and rural in character, existing sound levels are probably low. Rural areas are generally recognized as having day-night average sound levels (Ldn) of less than 50 dBA.

Ambient sound levels measured at a rural farm averaged about 40 dBA (Eldred 1974). Sound levels in the East Boulder Creek Valley were measured at 52 to 61 dBA, with the largest sound source being the East Boulder River (DSL and Forest Service 1985). It is likely that background sound levels can be expected to be similar or somewhat less than those measured in the East Boulder River Valley. The Stillwater River would contribute less to the sound levels due to the Stillwater Valley's more open topography, but a slightly greater effect would be expected from local traffic on County Roads 419 and 420.

3.8 Transportation

Overall, three roads serve the Stillwater Mine and the surrounding area. They include Stillwater County roads 419 and 420 (both secondary) and State Highway 78 (primary). Primary access to the Stillwater Mine is provided by Stillwater County Road 419 between Absarokee and the mine and State Highway 78 between Columbus and Absarokee. Stillwater County Road 420 provides secondary access to the mine from Absarokee. Stillwater County Road 419 is an improved two-lane road built in the 1940s by the Montana Department of Highways and the federal government to provide improved access to the now closed Benbow and Mouat mines. In addition to providing primary access to the

Stillwater Mine from Absarokee, this road provides primary access to Absarokee, Fishtail, Nye, Dean, and new rural developments in the area. The general public also uses this road to access fishing and recreational areas. It was designed to handle an average daily traffic capacity of 2,200.

Average Daily Traffic (ADT) totals for the period between 1994 and 1996 are shown on **Table 3–14**. Of the 1990 ADT total of 600 vehicles on Stillwater County Road 419, the Stillwater Mine-related traffic generated 286 vehicles. A condition of the decision on the 1989 East Side Expansion required that employees living more than two miles from the mine to car pool with at least three other employees. Although this condition was later modified to exclude employees within 10 miles of the mine from the car pooling requirement, the agencies are no longer pursuing monitoring because SMC has achieved the desired level and the agencies cannot enforce the requirement. The action was only expected to increase ADT by 24 trips.

Table 3–14 Average Daily Totals (ADT) of Traffic, 1994–1996

County Road	1994	1995	1996
Secondary 419 (22.5 miles, junction of Hwy 78 south of Absarokee to local road north of Nye)	595	818	803
Secondary 420 (6.9 miles, junction of Hwy 78 at Absarokee to local road 7 miles west)	402	427	442
Primary 78 (about 47 miles long)			
Red Lodge – milepost 0.000	1,665	1,890	2,230
Leaving Red Lodge – milepost 0.472	854	875	939
Roscoe – milepost 19.686	430	615	580
Leaving Carbon County – milepost 23.920	460	500	570
Leaving Stillwater County – milepost 24.317	490	560	570
Junction 419 – milepost 29.991	1,660	1,765	1,550
Junction 420 – milepost 32.880	1,554	1,950	2,055
Junction 421 – milepost 45.998	2,605	2,920	2,990
Entering Columbus – milepost 46.446	3,448	3,707	4,314
Leaving Columbus – milepost 47.250	2,260	2,900	3,340

Note: ADTs are for both directions of traffic.
Source: Lythgo 1997, pers. comm.

Currently, Stillwater County Road 419 is being upgraded between Absarokee and Nye. This upgrade includes widening the road, providing shoulders, replacing bridges, and improving the surface and subsurface drainage.

Stillwater County Road 78 is the major north-south highway in the region. Design capacity of the road is estimated at 3,000 ADT. The portion of the road between Absarokee and Columbus also has recently undergone improvements and reconstruction.

3.9 Reclamation

3.9.1 Soils

3.9.1.1 Stillwater Mine Site

Soils at the Stillwater Mine site are described extensively in the 1985 EIS (DSL and Forest Service 1985). Additionally, many of the soils have been disturbed by mining or covered by tailings and cannot be classified. Soils at the east side waste rock storage site have all been disturbed previously by the deposition of chrome tailings. SMC has been reclaiming some of these chrome tailings-covered areas.

3.9.1.2 Stratton Ranch

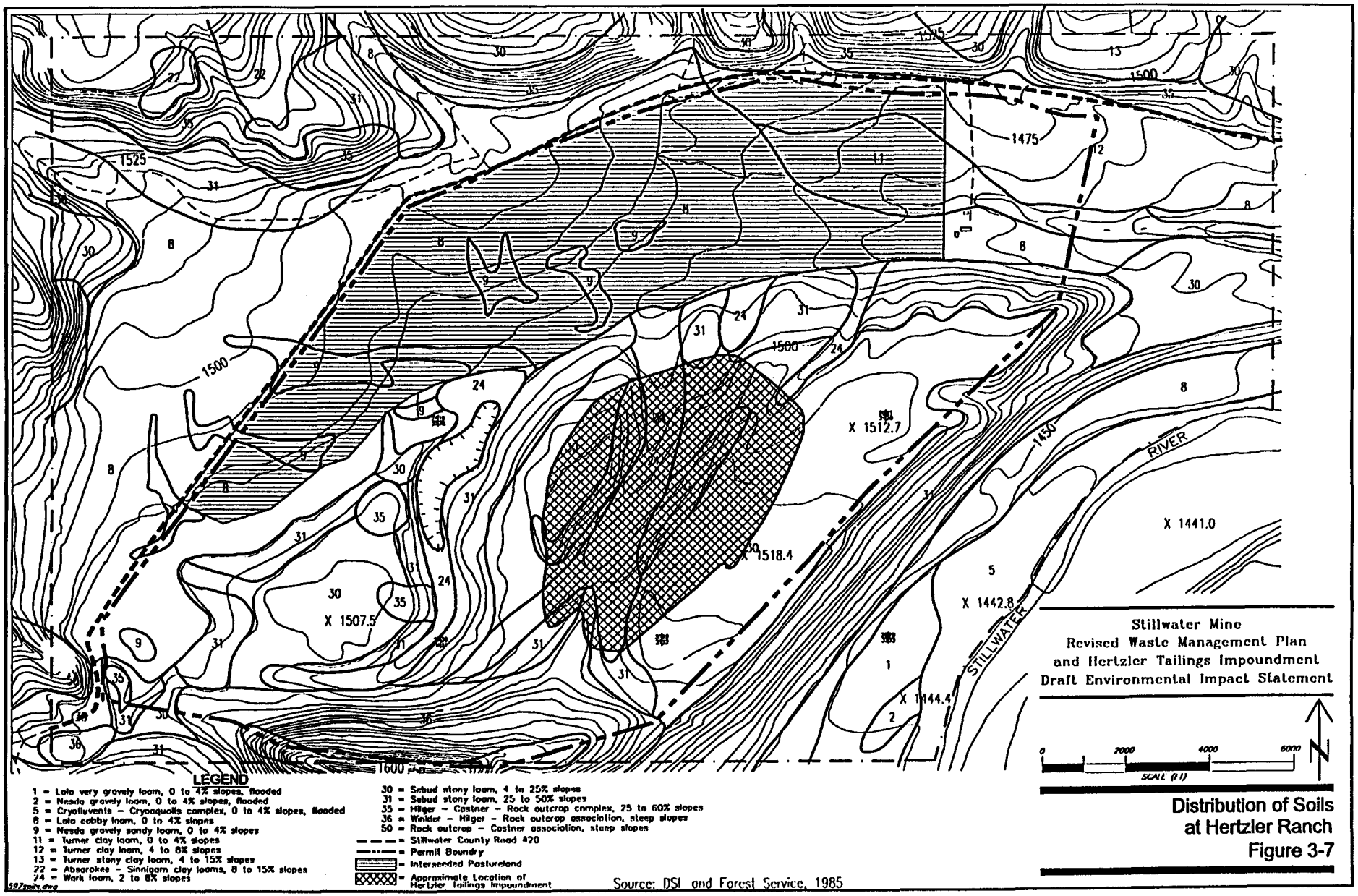
Native soils at the Stratton Ranch are deep, well-drained, and medium textured. They also are either very stony, cobbly, or gravelly. Numerous large boulders are present both on the surface and in the soil.

Although native soils exist on portions of the ranch, the dominant soils have been disturbed over most of the ranch. Under an opencut permit (#00549) from DEQ, SMC has twice conducted opencut mining of portions of the ranch for gravel. Currently, SMC is reclaiming its Stratton Ranch gravel operation.

3.9.1.3 Hertzler Ranch

Soils at the Hertzler Ranch site are similar to those at the Stratton Ranch. The Hertzler ranch site is located at a lower elevation than the Stillwater Mine site and in an open valley dominated by native grassland and improved pasture. About 26 percent of the ranch has been plowed and planted to improved pasture.

Soils in the vicinity of Hertzler Ranch are generally deep, well-drained, medium-textured, and very stony (ibid). In some places, large boulders are present at the surface and in the soil. **Figure 3–7** shows the distribution of soils at Hertzler Ranch.



Distribution of Soils at Hertzler Ranch
Figure 3-7

3.9.2 Vegetation

Vegetation present at the Stillwater Mine area, at Hertzler Ranch, and along the pipeline route, has been extensively described in previous environmental documents. Four basic categories of vegetation have been identified and further refined into 13 vegetation types. These types are listed in **Table 3–15**. For more detailed discussions of the vegetation types, readers may review the 1981 baseline reports (CDM 1981) and the Final EIS for the Stillwater Mine's original development (DSL and Forest Service 1985).

Table 3–15 Vegetation Categories and Types in the Stillwater Mine Project Area

Category	Types
Low Elevation Grass and Shrubland	1 Stoney Grassland 2 Sagebrush shrubland 3 Skunkbush shrubland
Low/Middle Elevation Riparian and Ravine Types with High Soil Moisture	4 Drainage bottomland 5 Riparian woodland 6 Ravine aspen-chokecherry
Forested Types	7 Open forest-meadow understory 8 Open forest-rocky understory 9 Lodgepole pine forest 10 Douglas fir forest
Disturbed Areas	11 Revegetated chrome tailings 12 Cultivated hayland 13 Other disturbed

3.9.2.1 Noxious Weeds

Noxious weeds are species of plants that undermine the quality of wildlife habitats, grazing and agricultural lands, and biodiversity. Efforts to control the spread of noxious weeds are overseen by both state and county agencies (Noxious Weed Act, County Weed Control Act 7–22–2101 (5), MCA). In Stillwater County, these efforts are focused primarily on leafy spurge (*Euphorbia esula*), spotted knapweed (*Centaurea maculosa*), and, to a lesser extent, on Canada thistle (*Cirsium arvense*), field morning glory (*Convulvulus arvensis*), mullein (*Verbascum thaspus*) and houndstongue (*Cynoglossum officinale*). Except for field morning glory, which affects agricultural productivity, these species have been designated as noxious due to their effects to rangeland.

Within the project area, these six species occur as isolated populations and as scattered individuals. Spotted knapweed is present on disturbed areas and an inventory of the Hertzler Ranch area conducted in 1996 noted the presence of leafy spurge, spotted knapweed, field morning glory and Canada thistle (Western Technology and Engineering, Inc. 1996a). Although new individual plants continue to appear in the area, efforts by Stillwater County to manage weeds have prevented the expansion of noxious weeds in the area. SMC's weed management practices are directed and implemented in cooperation with county weed managers and are focused primarily on the eradication of spotted knapweed. This species is especially problematic because it may be transported on site by machinery and become established on disturbed areas. Despite the constant potential for invasion, eradication of noxious weeds at the Stillwater mine is generally viewed as successful (Pearson 1998, pers. comm).

Stillwater County's weed management program is integrated, using biological, chemical and mechanical controls. To eradicate new infestations, herbicides (TORDON, ESCORT, and 2,4-D) are the single most effective tools and, as such, these chemical controls are the primary techniques used at the Stillwater Mine to control weeds. Stillwater County uses all three controls to contain the spread of well-established populations. Considered to be most effective on mature populations, biological controls used in the county focus primarily on leafy spurge and spotted knapweed. Although mechanical controls, such as grazing, are typically not viable due to toxic or unpalatable nature of most noxious weeds, Stillwater County has used sheep and goats to graze on mature populations of leafy spurge (Pearson 1998, pers. comm.).

3.9.2.2 Stillwater Mine Site

Vegetation types within the portion of the Stillwater Mine's current permit boundary east of the Stillwater River are a mixture of open forests with either a meadow or rocky understory, an open forest-rocky understory, ravine aspen-chokecherry, lodgepole pine, rocky grassland and disturbed. Within the 80-acre footprint of the proposed east side waste storage site, about one third (20 acres) is Rocky grassland. The rest (60 acres) is revegetated chrome tailings.

3.9.2.3 Hertzler Ranch

The 1,112 acres of rolling landscape comprising the Hertzler Ranch site are dominated by the Stony grassland vegetation type (65 percent). This vegetation type has been replaced by a band of Cultivated hayland in the northern portion of the ranch, which stretches from east to west. The hayland is flood-irrigated by a historic ditch that travels along the northern permit boundary. Cultivated hayland accounts for 26 percent of the total area encompassed by the Hertzler Ranch site.

Several vegetation types account for the remaining nine percent of the area. Sagebrush shrubland and Skunkbrush shrubland vegetation types account for 5 percent and 2 percent, respectively, and are restricted to northwestern and southeastern aspects defined by slope shoulders, toes of slopes and swales. About six acres (1 percent) of Drainage bottomlands are present and only three acres of open forest-meadow understory (less than 1 percent) are present. Disturbed areas other than the Cultivated haylands account for 1 percent of the Hertzler Ranch site's total acreage.

3.9.2.4 Pipeline Route

Most of the lands crossed by the proposed pipeline route presently support the rocky grassland vegetation type. However, several small segments also cross riparian woodland (at the Stillwater River crossing), cultivated hayland, drainage bottomland, skunkbrush shrubland, ravine aspen-chokecherry, and open forest with meadow understory.

3.10 Cultural Resources

3.10.1 Overview

The study area falls within the Northwestern Plains and Mountains archaeological culture areas as synthesized by Frison (1991) and summarized more specifically for the Custer National Forest by Beckes and Keyser (1983). The overall cultural chronology is a refinement of Mulloy's (1958) classic Northwestern Plains chronology. The latter chronology was based largely on investigations in south-central Montana and northwestern Wyoming. This chronology is conventionally divided into the Paleoindian (ca. 11,500–8000 years ago), the Early Plains Archaic, partially coinciding with the Altithermal climatic episode (ca. 8500–5000 years ago), the Middle Plains Archaic (ca. 5000–3000 years ago), the Late Plains Archaic (ca. 3000–1500 years ago), the Late Prehistoric (ca. 1500–500 years ago), and the Protohistoric (ca. 500–200 years ago). The cultural chronology of this region focuses on the stylistic and technological attributes of distinctive chipped stone hafted bifaces which exhibit widespread "traditions" over time. For a more detailed discussion of this chronology as it relates to this project area see Lahren (1997).

In the Protohistoric period, pottery-using Shoshoni groups are evident in southern Montana, but with the arrival of guns, horses, and other European elements, they are displaced by the Siouan speaking Absaroka, or Crow. Small groups of mountain or Sheepeater Shoshoni remained in some areas, but the valleys and open plains were dominated by the equestrian Absaroka. Absaroka tradition holds that they often hunted bison by the drive or jump strategy, as well

as the surround and chase that were made feasible by the adoption of the horse (Lahren 1997:8-12).

From the late 1700s through the mid 1800s, several private and government-sponsored expeditions, including the Lewis and Clark Expedition of 1806, passed through the region and fur trading companies established trade relationships with the Crow, Blackfeet, and Flathead, and brought trappers into the region. As the United States began to encroach on this territory in the early to mid 1800s, the Crow established and maintained amiable relationships with the encroaching whites and served as scouts with United States troops in the Plains Indian Wars.

The Fort Laramie Treaty of 1851 established most of what is now south-central Montana and north-central Wyoming as Crow territory. This territory extended from the Powder River on the east westward to Geyser Park at the head of the Yellowstone River and from the Wind River Range on the south northward to the Musselshell River. The second Fort Laramie Treaty, in 1868, ceded 30 million acres, nearly 80 percent, of Crow territory, and granted absolute and undisturbed use and occupation of the remaining land. The reduced territory in southern Montana started at the 107th degree of longitude on the east and ran westward to the Yellowstone River and from the Wyoming-Montana state line on the south northward to the Yellowstone River. Over the years Crow territory was repeatedly reduced by treaty cessions (1882, 1891, and 1904) to the present Crow Reservation in south-central Montana (see Lahren 1997, page 5–9 through 5–12). The early history of the region was dominated by mining exploration and cattle ranching. The Crow agency moved to several locations, including a location near present-day Absarokee in 1875, before moving to its present location on the Little Bighorn River in 1884.

The early history of the region was dominated by mining exploration and cattle ranching. The Stockgrower's Association remained a strong influence in Montana history, despite the setbacks of the harsh winter of 1886–87. The open range ranchers who dominated Montana prior to 1887 had largely avoided the Stillwater Valley because of the prevalence of indigenous loco weed.

Partially because of Indian conflicts in the region, the Yellowstone Valley did not experience gold rushes similar to California, Nevada, Colorado, and Idaho. Prospecting was sporadic in the Stillwater Valley in the 1860s and 1870s and marked by minor conflicts with the Indians. In 1881, the Northern Pacific Railroad established a depot at Stillwater (now Columbus) spurring a new period of prospecting in the region. In 1883 Jack Nye, Joseph Anderson, and hundreds of other prospectors staked mineral claims on the Stillwater and the Stillwater Mining Company was first established. Nye City was not officially established until 1887 and was briefly abandoned two years later when it was found to be within the Crow Reservation. Much of the early mining in the area was centered on various copper ores. World War II demands for chrome triggered a brief

development of the Mouat Mine in 1943 and a reopening of those operations in the early 1950s, but no major mining operations developed in the Stillwater Valley until the 1980s.

Homesteading and ranching began in this region in the 1880s and 1890s with major reductions in the Crow Reservation, but the major period of dryland homesteading was from 1900 to 1920. Encouraged by a series of wet years in the early 1900s, increased availability of steel plows and farm implements, an expansion of credit purchasing, and by the Enlarged Homestead Act of 1909, a major homesteading "boom" occurred in Montana from 1913 to 1919. This expansion was brought to a halt in southern Montana by major droughts accompanied by grasshopper, wireworm, and cutworm infestations in 1918 and 1919. Nearly half of the farm mortgages in Montana were foreclosed, precipitating numerous bank failures in the early 1920s. The survivors of this regional depression had diversified or turned to ranching and were better prepared than many areas for the Dust Bowl and Depression of the 1930s.

3.10.2 Previous Investigations

Lahren (1997) recently completed a cultural resource inventory for SMC's proposed slurry line and tailings impoundment in Stillwater County, Montana. This investigation of the project area included files searches, a review of previous investigations, interviews with local landowners and avocational archaeologists, oral histories, review of aerial photographs and historic maps, pre-survey reconnaissance of project area, intensive pedestrian survey of potential pipeline corridors and tailings impoundment area, and systematic testing at known site areas and areas of potential Holocene deposition. The preferred pipeline corridor and several alternates were investigated to establish the most reasonable route. The east side waste storage site had been covered by previous investigations (WCRM 1981) and no resources had been reported in those locations. The Stratton Ranch LAD area, involving limited surface disturbance for two small storage ponds and two LAD pivots, is located within a reclaimed gravel pit which, also was previously surveyed (WCRM 1981). One new site was recorded for the project area (24ST306), and the effect that the project might have on previously recorded sites was assessed. One "sensitive" area referred to as spring 15 was noted by Lahren as having the potential to contain buried cultural material, but was not recorded as a site.

Prior to the current investigation, there had been 12 cultural resource investigations covering portions of the project area:

- Lahren 1976, Johns-Manville Stillwater Complex, Baseline Study
- Lahren 1980, Johns-Manville Stillwater Complex, Class III Inventory
- WCRM 1981, Anaconda Stillwater Project, Baseline Study
- Lahren 1982, East Boulder Area, Sweetgrass County, Class III Inventory

- Mineral Research Center and BEAK Consultants 1982, Stillwater PGM Resources, Class I Overview
- Historical Research Associates 1984, Survey and Evaluation of Mouat Homestead (24ST67)
- DSL and Forest Service 1985, Stillwater Project, EIS
- GCM Services 1988, Addendum to Anaconda Stillwater Complex Cultural Inventory
- Lahren 1989, Additional Evaluations of East Boulder Area
- Lahren 1990, Additional Evaluations of East Boulder and Placer Basin
- RTI (Rosillon and McCormick) 1991, Stillwater River Road, Class III Inventory
- Forest Service and BLM 1993 Beartooth Mountain oil and gas EIS.

Anthro Research conducted a baseline study and a cultural resource inventory for the Johns-Manville Stillwater Complex (Lahren 1976, 1980), Western Cultural Research Management conducted a baseline study (WCRM 1981) of the Anaconda Stillwater Project (now SMC), GCM Services (1988) supplemented the latter inventory, and Renewable Technologies conducted a cultural resource inventory of the Stillwater River Road (Rossillon and McCormick 1991), roughly covering the proposed pipeline corridor. The remaining six investigations were summaries of existing data or evaluations of recorded sites.

3.10.3 Criteria for Evaluation

The sites within this project area represent a wide array of site types and dates of occupation. A primary goal of inventory and other investigations is to provide evaluations and management recommendations for these properties in terms of the Criteria for Eligibility for the National Register of Historic Places (Register). The evaluation process is best discussed with reference to the various types of sites that have been documented and may be encountered in future inventories. To be eligible for the Register, a resource must retain essential aspects of integrity and meet one or more of the Criteria for Eligibility (36 CFR §60.4). For archaeological resources, eligibility is typically recommended under criterion d, on the basis of the information potential of surface artifacts and features and intact subsurface cultural deposits. Some archaeological sites may also be exceptional manifestations of broad patterns important in prehistory (criterion a) or may be traditional cultural properties eligible under any of the criteria for eligibility (see Parker and King 1990). Historical resources may be evaluated under any of the four criteria on the basis of information potential or significant historic associations.

3.10.4 Known Resources

Twenty-two cultural resources had been recorded within 500 meters of the proposed pipelines and tailings impoundment (**Table 3–16**). Three sites would be crossed by the proposed pipeline (24ST54, 24ST306, and 24ST401) and one site is located within the proposed tailings impoundment (24ST51). The Guthrie site (24ST54) and the Keogh Bison Jump (24ST401) have been formally determined eligible for nomination to the National Register of Historic Places. Site 24ST51, the wagon road, was found not eligible during the investigations in 1981 (WCRM 1981). The Rocky Pass site (24ST306) is considered potentially eligible to the National Register, but no formal determination has been conducted to date.

3.10.5 Ethnography

The Crow were the principal tribal group in the region in the early historic period. There are traces in surrounding areas indicating that Numic groups occupied this region in the Protohistoric period, prior to the westward expansion of the Crow from the Middle Missouri. On the Upper Yellowstone and the Clarks Fork, Mountain Shoshoni or Sheepeater bands were still noted into the late 1800s. Lahren (1997:4-15) also notes Sheepeater lodges are still present in the Lodgepole and Myers creeks areas. By the time of sustained Euroamerican contact, the Crow, who had separated from the Hidatsa village horticulturalists of the Middle Missouri region, were a classic Plains Equestrian culture. The adoption of the horse, and later the consistent availability of guns and ammunition, had profound influences on settlement, social, and subsistence patterns. In northwestern Wyoming, south of the project area, there were frequent territorial conflicts between the Crow and the equestrian Eastern Shoshoni. The horse, and to a lesser degree the gun, made new bison hunting strategies (such as the chase and the surround) practical, increased the range of mobility of villages, and introduced new symbols of wealth and power. But the horse also introduced demands for forage and water that altered the requirements for settlement locations and made villages more vulnerable to sudden attacks. Symbolically and economically early historic Crow culture was centered on the horse and vast bison herds. Large-scale communal bison hunts, as might be represented at the Keogh Bison Jump, were important social and subsistence elements of Crow culture and many aspects of political and social organization were manifested in these hunts.

The Crow Reservation is about 50 miles east of the project area and, as recently as 1891, the study area was within the Crow Reservation, which then extended west to the Boulder River. In the period from 1875 through 1883 the Crow agency was located near Absarokee at the confluence of the Stillwater River and Rosebud Creek, east of the present project. The Crow, despite heavy losses in warfare with the Lakota and Cheyenne and in the smallpox and cholera

Chapter 4.0 — Environmental Consequences

Chapter 4.0 — Environmental Consequences . . . . . 4 – 1
4.1 Water Quality and Quantity . . . . . 4 – 2
4.2 Effects on Wildlife . . . . . 4 – 18
4.3 Effects on Fisheries . . . . . 4 – 25
4.4 Air Quality Effects . . . . . 4 – 30
4.5 Social and Economic Effects . . . . . 4 – 34
4.6 Tailings Impoundment Stability . . . . . 4 – 43
4.7 Effects on Aesthetics . . . . . 4 – 49
4.8 Effects on Transportation . . . . . 4 – 71
4.9 Effects on Reclamation Potential . . . . . 4 – 75
4.10 Effects on Cultural Resources . . . . . 4 – 87
4.11 Unavoidable Adverse Effects . . . . . 4 – 90
4.12 Relationship Between Short-term Uses of Man's Environment and the Maintenance and Enhancement of Long-term Productivity . . . . . 4 – 91
4.13 Irreversible and Irretrievable Losses . . . . . 4 – 92
4.14 Effects of Environmental Justice in Minority Populations and Low-Income Populations . . . . . 4 – 93
4.15 Evaluation of Restrictions on Private Property . . . . . 4 – 93

Chapter 4.0 — Environmental Consequences

This chapter describes the potential effects of each of the alternatives described in Chapter 2. Data and analyses from previous environmental analyses (see synopses in **Appendix A**) were also incorporated into this analysis. The intent of this chapter is to provide the scientific and analytical basis for the comparison of alternatives presented in Chapter 2. The discussion in this chapter includes direct, indirect, and cumulative effects from implementation of the proposed action and alternatives. The chapter also discusses mitigation measures that are part of existing operations at the SMC facilities and which would be implemented at the expansion facilities, plus additional mitigation measures that would be considered for the new facilities.

In addition to the analyses of changes to SMC's mine waste management operation discussed below by resource area, the effects of removing the limitation on daily production (currently 2,000 tpd) were evaluated. Removal of this limitation, which is included in all three action alternatives, would result in a permit based on an approved "footprint" of surface disturbance, not a rate of production. The analyses of removing this limitation on daily production identified no effects for almost all resource areas because most effects are associated with physical facilities and these facilities would not change with changes in rates of production. The single resource where potential effects were identified is transportation. These effects are discussed in the discussion of the transportation analysis (**Section 4.8**). The overall lack of effects associated with the other resource areas is not discussed any further.

The numerous comments on the draft EIS have resulted in additional information being incorporated into this chapter of the final EIS. The greatest amount of changes occurred in Water Resources including analyses relative to MPDES permit limitations (loading rates, mixing zones), clarification on the HELP model, additional modeling of surface and ground water quality impacts (LAD, impoundment and waste rock storage site seepage), impacts on flows, impacts on persons with water rights, and impacts from a potential pipeline rupture. Other changes include a discussion on indirect impacts to bighorn sheep, information on the diffuser for discharging water into the Stillwater River, information regarding the proposed zoning petition, and a new section on regulatory restrictions on the use private property (the applicant's private property). Twelve new mitigations were developed as a result of public comments on the draft EIS (see **Section 2.4.5**); six for Water Resources, two for Wildlife, one for Air Quality, one for Tailings Impoundment Stability, one for Transportation, three for Reclamation Potential, and one for Cultural Resources.

4.1 Water Quality and Quantity

4.1.1 Direct and Indirect Effects

4.1.1.1 Alternative A — No Action

Under the No Action Alternative, conditions would be as described in the Existing Environment section. Water quality at the Stillwater Mine site from the upper permit boundary to the lower permit boundary would be virtually the same, although there might be some temporary localized increases in nitrates and metals immediately adjacent to the Stillwater River and in its alluvium.

SMC would continue to operate its water management system for adit water and process water. Adit water is clarified, then disposed of through evaporation, evapotranspiration, and land application via irrigation sprinklers or through percolation ponds. Direct discharge to the Stillwater River also is an option under SMC's present MPDES permit. De-nitrification using anoxic biotreatment cells (ABC) accounts for approximately 500 gpm. Evaporation from the tailings impoundment spray systems on the tailings crest and ponds consumes approximately 385 gpm. Land application utilizes approximately 325 gpm. Some adit water is used for dust suppression and some for make-up water in the mill. Process water contains reagents used by SMC to "float" ore particles to the surface of tanks where they can be captured. This water is discharged to the tailings pond where it either evaporates or is recycled back to the mill.

4.1.1.2 Alternative B — Proposed Action

4.1.1.2.1 Stillwater Mine Site

Construction of the east side waste rock storage site would replace the two LAD sites located on the east side of the river, cover the chrome tails in the area, and result in the relocation of some of the east side percolation ponds and the topsoil stockpiles. The Proposed Action alternative would increase mine-related activity acreage from 38 to 88 acres, almost all of which has been previously disturbed. The east side waste rock storage facility will be located 120 to 600 feet from the Stillwater River Channel and outside of the 100-year, 24-hour floodplain. The base of the waste rock facility will be armored with large rock which will protect the structure in the event of a probable maximum flood event. The east side waste rock storage site could result in increased sediment loading during the construction phase, prior to stabilization with vegetation. This impact would be temporary and localized, as runoff would be mitigated with flow into stormwater detention ponds prior to discharge into the river. At the same time, runoff from the footprint of the east side waste rock storage site would increase due to the increase in slope and change in vegetative cover. Flows from the site during and following a storm would be controlled by the stormwater ponds, sized to handle flows from a 25-year, 24-hour event, resulting in moderate flows over a longer period than anticipated from an equivalent site without a pond.

Replacement of the existing LAD sites with the east side waste storage site would decrease the saturation of the alluvium in that area, increasing the depth to the water table slightly. Removal of the LAD sites would decrease the nitrates in the soils and groundwater immediately below the pivots. Deep percolation below the pivots is estimated at 0.1 pounds of nitrogen per acre/per day (MSE-HKM 1997). However, waste rock also would have nitrates left from blasting. Compaction of the waste rock and the use of water conveyance structures to move water off the pile quickly should limit the amount of water leaching through the waste rock. Water would leach nitrates into the adjacent alluvium over time.

SMC's MPDES permit regulates discharges of water from the Stillwater Mine. Water quality discharge standards were set based on potential impacts. Waters from the mine can have elevated concentrations of suspended solids, nutrients, or metals. Concerns about the aquatic ecosystem and downstream domestic users resulted in effluent standards for all three types of water quality parameters at Outfall 001, the direct discharge into the river. SMC minimizes the release of suspended solids in the percolation ponds through clarifiers or earthen sediment traps to maintain the percolation pond efficiency. Because the low concentrations of metals in discharges through the percolation ponds are adsorbed by fine soil particles in the alluvium, limits have been set only for total nitrogen at Outfalls 002, 003, and 004, which are the percolation ponds.

The nutrients nitrogen and phosphorus can stimulate algal growth. The effluent standards were developed to maintain the integrity of existing aquatic life. At concentrations exceeding 10 mg/L, nitrates also can limit human fertility and pose a risk to infants three months and younger.

Nitrogen loading is restricted to 100 pounds of nitrogen and 1.1 pounds per day of phosphorus from all outfalls. Nitrates and ammonia from blasting materials are found in adit waters. SMC treats elevated nitrogen in waste streams through denitrification in the ABC and LAD. Nitrogen removal from the ABC has ranged from 60 to 99 percent. Rates of removal were higher at regular maximum water throughput and warmer temperatures. Removal efficiencies are increased during cooler conditions with a reduction in flow rate and an increase in residence time. Nitrogen removal through plant uptake and evaporation at the LAD sites averages 80 percent. The nitrogen loading limitation would not increase the background concentration by more than 1 mg/L in the river.

The ABC facility generates discharges of 0.08 to 0.1 mg/L phosphorus when run at 90 percent efficiency, and 0.05 mg/L at 60 percent efficiency. The phosphorus loading limitation would not increase the background concentration by more than 0.001 mg/L during the summer and 0.003 mg/L during the winter.

To estimate the amount of nitrates that might leach from the proposed east side waste rock site into the alluvium, EPA's Hydrologic Evaluation of Landfill

Performance (HELP) model was used to estimate infiltration through the waste rock facility (Techlink and Greystone 1998). The HELP model estimates the rate of infiltration based on surface and subsurface water balances. The HELP model takes into account the following: precipitation, snow melt, surface runoff, land surface slope, size of area, vegetation, surface evaporation, temperature, precipitation, solar radiation, relative humidity, evapotranspiration, hydraulic conductivity and porosity of the soil, and the initial soil moisture conditions. Input assumption reflect site specific area and slope condition, monthly temperature and precipitation averages, quarterly averages on relative humidity, and the modeler's best professional judgement on other climatic and physical characteristics. The output from the HELP model gave an average infiltration rate of 2.7 inches per year through the waste rock pile at the Stillwater Mine site.

The total amount of nitrogen in the waste rock was estimated from laboratory analysis using the "Sequential Saturated Rolling Extractions" method. With this method, the rock is pulverized and mixed with water to determine the leachable nitrogen in the waste rock. Based on three tests, the average total nitrogen concentration was 40.12 mg/kg of waste rock. This value represents the maximum (worst case) amount of leachable nitrogen in the waste rock.

The rate at which this nitrogen is leached was estimated by the "Column Leach Extraction" method. This method consists of sequentially running 1, 2, and 3 pore volumes of water through the waste rock column and measuring the concentration of nitrogen in the outflow water. Based on the results from tests on three samples, the porosity of the waste rock was estimated at 5 percent.

Based on the average infiltration rate of 2.7 inches per year from the HELP model, a 30 percent soil porosity, and an estimated average thickness of 80 feet, it will take approximately 33 years to infiltrate one pore volume of water through the waste rock storage site. These parameters result in an estimated nitrogen loading rate of 13.6 lbs/day from the waste rock storage site or 0.12 lbs/acre/day. This value represents the average nitrogen rate of loading for the first volume of water through the waste rock storage site (i.e., the next 33 years). This nitrate loading on a per acre basis is similar to the LAD loading. However, the LAD application occurred on 26 acres and the waste rock storage extends across 80 acres. This source of nitrates would be monitored through SMC's MPDES permit obligations to sample water in the groundwater mixing zone and in the river.

Additional mine development may result in decreased flows in springs with hydraulic connections to faults or fracture systems intersected by the mine. As noted in Chapter 3, flows to SP–3, above the east adit ceased in the early nineties. Water quality impacts from the mine are not likely.

4.1.1.2.2 Stratton Ranch

SMC would install two 800-foot diameter LAD center pivot irrigation systems at the reclaimed gravel pit along Stillwater County Road 419 on the Stratton Ranch. The site previously was occupied by thirty trailers which had a leach field that handled 150 to 250 gpm. The Stratton Ranch LAD sites would be supported directly by the pipeline. These circles would take less than 1,000 gpm of adit water, which is at or slightly below the human health standard for nitrates, and irrigate two fields of high-nitrogen-uptake species. (Most of the adit water would be handled by the Hertzler Ranch LADs discussed below).

Hydrologically, the runoff characteristics of the site would decrease substantially, as water would run across a deep grass rather than across a surface of alluvial cobbles and gravel. In addition, less water would recharge the Stillwater alluvial aquifer during storm events than previously, as the alluvium would be saturated and there would be some uptake by the grasses. However, this would be offset by the continuous irrigation of the site for 7 months every summer with the LAD system. The water table in the vicinity would rise slightly. Should groundwater mounding in the area develop, which would saturate the toe of the colluvial material to the north and west, instability might occur. Use of the LAD system at Stratton Range would have no impact on the springs in the area, as they are either located upgradient or on the opposite side of the river.

In the unlikely event of a 100-year storm or a probable maximum flood event, the Stratton LAD site would be partially or completely inundated and the pivots may be lost. Secondary treatment though LAD disposal would temporarily cease until floodwaters drop.

Water quality concerns associated with nitrates focus on elevation of natural nitrate levels, human health effects, and the subsequent potential impacts to nutrient loading of the Stillwater River. Nutrient loading of nitrates and phosphates, in tandem, can result in significant algal growth. The ABCs are anticipated to discharge 0.1 mg/L of phosphate. The human health water quality standard for nitrate-nitrogen is 10 mg/L. The baseline levels of nitrate in the SMC complex area are <0.05 to 0.4 mg/L in surface waters and 0.31 to 3.36 mg/L for groundwater.

Nitrate concentrations would increase in the alluvial aquifer immediately downgradient of the LAD systems. Water quality at alluvial wells within 200 feet downgradient of SMC's existing LAD systems had nitrate-nitrogen values ranging from 0.13 to 23.4 mg/L, with an average value at approximately 3 mg/L. These LAD pivots are located within 250 feet of the river. Nitrate-nitrogen levels in the Stillwater River increased from the upstream site to the downstream site (**Table 3–1**) by up to 0.2 mg/L. The downstream site is located approximately 1,400 feet downstream of the northeastern-most point of the LAD pivots. The Stratton Ranch LAD sites would be 900 to 1,000 feet from the river.

Mixing calculations were performed by Hydrometrics in support of the MPDES renewal (SMC 1996b). LAD application rates of 600 gpm of adit water containing nitrate-nitrogen concentrations of 7.5 mg/L were modeled 1,600 feet downgradient from the LAD. These predictions indicated maximum concentrations of nitrate-nitrogen in the Stillwater River of 0.505 mg/L or an increase of 0.005 mg/L. The concentration of nitrate-nitrogen in the groundwater mixing zone would increase from 0.28 mg/L to 0.82 mg/L when water is applied 12 hours per day 5 days per week.

During 1996, the LAD pivot irrigation system irrigated 41.5 acres with 322 acre-feet of the 1,024 acre-feet of water produced between 4/23/96 and 10/29/96. MSE/HKM (1997) evaluated the performance of SMC's LAD system and found the LAD system consumed 2,841 pounds of the 3,299 pounds of nitrogen delivered, or 86 percent, through dispersive evaporation and plant and soil uptake. For permitting purposes, 80 percent uptake from these sources was assumed. SMC is limited to discharging less than 100 pounds of nitrogen per day under its existing MPDES permit.

LAD application of adit water may result in soil uptake of manganese, cadmium and lead and subsequent mobilization of soil bound copper (Grass-Land Maxim Technologies and Western Technologies and Engineering, Inc. 1996). Metals concentrations are not expected to preclude land use choices in the future and copper levels are not anticipated to diminish ground water quality.

The Stratton Ranch LADs would have several indirect impacts. The site is formerly an open pit gravel operation and the grasses would be visually more acceptable. The grasses would stay greener later into the summer than normal range in the area due to the continuous irrigation. The site also may act as a magnet for wildlife due to the high productivity of palatable grasses. The LAD storage ponds may serve as a watering site for wildlife unwilling to cross the Stillwater County Road 419 to the Stillwater River.

4.1.1.2.3 Hertzler Ranch

The Hertzler tailings impoundment would increase disturbance in the area during operations and result in a temporary increase in surface water runoff and sediment loss from the site. Following reclamation, surface water runoff would drop, but would still be greater than observed under current conditions due to the change from a gently-sloping terrain to an embankment with 2:1 (horizontal distance to vertical distance) crest sideslopes. At the Hertzler site, similar stormwater management practices would be in place to divert water from a storm of probable maximum precipitation (PMP) around the site. The tailings impoundment would be designed to have adequate freeboard to handle the PMP to prevent a surface water release during a large storm event.

Sediment loss would increase during operations, but would extend only a limited distance beyond the disturbance area due to the 1.5 percent slope of the valley, stormwater control measures, and plans to revegetate the downstream toe within 2 years of stage 1 construction. Sediment loss would continue to decrease with final reclamation.

The use of an HDPE liner on a clay liner, coupled with an overlying seepage collection system would minimize the potential of groundwater seepage into the unconsolidated materials in the valley and promote drainage of the tailings. The existing tailings impoundment has not had a rupture in the twelve years of operation. In the event a rupture in the liner occurred, lateral migration of waters with elevated total dissolved solids concentrations and nutrients would be limited, due to the low permeability of the underlying clays and slimes in the impoundment. This migration would occur either to the east along the centerline of the Hertzler Valley or south to the Stillwater River. Alluvial waters along the Stillwater River would not be affected, as it is more than one mile to the river. The three adjudicated springs and two of the existing wells in the area are upgradient of the proposed facilities and would not be impacted. The DeGroat wells are located on the Stillwater upstream from the river's intersection of the Hertzler Valley swale and would not be affected. The MDFWP's well is located in the Stillwater alluvium north of the intersection of the Hertzler Ranch swale and one mile downgradient and would not likely be impacted. The unadjudicated old Hertlzer Homestead spring is located downgradient of the Hertlzer LAD holding pond and the tailings impoundment. Baseline reconnaissance suggested that it is derived from irrigation return flows. In the unlikely event of seepage from the holding pond or tailings impoundment and hydrologic connection to the springs, flows could increase and water quality could change.

The two tailings recycle ponds located north of the proposed impoundment would be lined with an HDPE liner and have automated pumps to recycle the water back into the tailings impoundment. The use of an HDPE-lined impoundment results in a closed system that is unlikely to detrimentally impact the hydrologic balance at the site. The integrity of the liners in the tailings recycle ponds and the tailings impoundment is predicated on the QA/QC program during construction, which would regularly evaluate the installation with regard to design specifications of subgrade preparation, liner quality, and the soundness of the welds.

Four 1,000-foot diameter pivots would be installed north of the Hertzler tailings impoundment to support treatment of as much as 2,000 gpm of mine adit discharge water. Some of the 2,000 gpm would be treated by the two LAD circles at Stratton and the balance would be treated by the four LAD sites at Hertlzer. This water would have elevated nitrate and moderate salinity levels. Center pivot irrigation systems would irrigate a range seed mix that would include Garrison creeping meadow foxtail grass. Application would occur for approximately 7 months during the warmer portion of the year and application

Alternative B at Hertzler. The use of these sites would reduce the potential for low-level detrimental impacts to the Stillwater River, due to the substantial distance between the Hertzler LAD sites and the river.

4.1.1.3.4 Pipeline Corridor

A shorter construction and operational period of the Hertzler tailings impoundment would shorten the period in which the tailings pipeline would be used and would reduce the potential of an unplanned spill associated with the pipeline.

4.1.1.4 Alternative D — Modified Centerline Expansion and East Side Tailings Impoundment

4.1.1.4.1 Stillwater Mine Site

Alternative D would result in the long-term construction of two tailings impoundments on opposite sides of the Stillwater River. The existing tailings impoundment would have the same impacts as Alternative C in the expansion of the permitted tailings impoundment from 3.5 million tons to 8.35 million tons (see section **4.1.1.3.1**). This would have no significant effect on water flow in the facilities area or on surface or ground water quality. However, Alternative D includes the construction of a second tailings impoundment, with a footprint of 72 acres holding 4.94 million tons of tailings rising to an elevation of 5,085 feet. This tailings impoundment would cover the chrome tails in the area, eliminate the 41.5 acres of LAD sites in the area, and result in the relocation of some of the east side percolation ponds and the topsoil stockpiles.

Standard stormwater control features would be implemented at the new tailings impoundment. Water from the overlying drainage would be directed around the impoundment and diversion would carry drainage from the waste pile to stormwater collection basins.

SMC's water management plans might be pushed to their limit during the winter or under peak mine discharge events as the plans for the East Stillwater impoundment do not include a storage pond, such as that proposed at Hertzler. In the event that no additional water could be treated by the ABCs or stored in the tailings impoundments and percolation ponds at the mine site, adit discharges would have to occur directly to the river. If this occurred during the winter, during low flows, less water would be available for dilution and concentrations of nitrates would approach 1 mg/L. As discussed in SMC's MPDES permit, SMC's loading of nitrate to the Stillwater River is limited to 100 pounds per day from all sources.

The East Stillwater impoundment would have closed circuit water management design features similar to the proposed Hertzler tailings impoundment, having a 100-mil HDPE liner on a layer of fine-grained materials with an overlying seepage collection system. In the event a rupture in the liner occurred, there might be long-term migration of waters with elevated salinities and nutrients into the Stillwater River alluvium and, subsequently, into the Stillwater River, due its close proximity. As noted earlier, in the event of an unplanned excursion of liquid from the surface of either of the tailings impoundments, the Stillwater River is 200 feet away. Some protection is afforded by percolation ponds on the western side of both tailings impoundments, which may be in a position to contain a spill if they were not full.

The tailings pipelines for the East Tailings embankment would be suspended across the river or attached to the bridge. The potential for a breach of these lines would be greater under this alternative than other alternatives due to vandalism.

More than 9.8 million tons of waste rock would be used in the construction of the East Stillwater impoundment's embankment. The footprint of the structure would extend across 72 acres, in contrast to the 80-acre east side waste storage site proposed under alternatives B and C. This slightly smaller disturbance would result in a decrease in surface runoff compared with the other two action alternatives. Increased sediment loss would be routed into control structures during construction.

Although nitrate concentrations in the alluvial groundwater would increase slightly during operations, the increase would be substantially less than the 11.3 lbs/day estimated for alternatives B or C. Compacted waste rock would only be present in the embankment (leaching of nitrates occurs as water migrates through waste rock that has remnants of nitrate blasting materials), rather than throughout the structure as would be the situation with the east side waste rock facility under alternatives B and C. Thus, the surface area exposed to water would be substantially smaller. Also the impoundment would be about 50 feet higher than the east side waste rock facility, which would slow the rate of infiltration of seepage to groundwater. Nitrate leaching would end following capping of the impoundment and there would be no long-term impacts.

4.1.1.4.2 Stratton Ranch

The LAD sites at Stratton Ranch would have impacts similar to those described for alternatives B and C. However, more water might be disposed of at this site than would occur under alternatives B or C. Twenty-four acres of LAD sites at Stratton Ranch would replace the 41.5 acres of LAD sites currently operating at the mine. This alternative would not have the potential for 80 acres of supplemental sites at Hertzler as identified for alternatives B and C.

A pipeline handling only adit water would be built from the mill to Stratton Ranch, a distance of 8,000 feet. Disturbance associated with installation of the pipeline would impact a smaller area and the impacts of sediment loss in the immediate area of the trench would be commensurately more limited. There would be no disturbance in the vicinity of the West Fork of the Stillwater River. In the event of a spill from the pipeline, the slightly-nitrogenated water would pose little risk to the adjacent agricultural land prior to containment. Also, the site of the break would be reclaimed immediately after repair of the broken pipeline and other cleanup activities.

4.1.1.4.3 Hertzler Ranch

There would be no disturbance at the Hertzler Ranch under Alternative D. No tailings impoundment, borrow areas, LAD sites and support structures, or pipeline construction would be constructed. Conditions at the Hertzler Ranch would continue as described in Chapter 3, reflecting conditions associated with Alternative A — No Action.

4.1.2 Wetlands

4.1.2.1 Direct and Indirect Effects

Additional information regarding wetland and riparian soils and vegetation can be found under Section 4.9, Effects on Reclamation Potential.

4.1.2.1.1 Alternative A — No Action

Implementation of this alternative would have no direct or indirect effects on wetlands. Essentially, wetlands present in the project area would continue to exist in their current condition, as described in **Chapter 3**.

4.1.2.1.2 Alternative B — Proposed Action

Under this alternative, about 1.5 acres of wetlands would be disturbed for installation of the pipelines between the mine site and Hertzler Ranch. Most of this disturbance would be short-term in nature and reclaimed immediately after the pipelines' installation. One wetland (about than 0.75 acre in size) would be inundated by the LAD storage pond at Hertzler and some minor parts of wetlands may be disturbed by the toe of the east side waste storage site.

The U.S. Army Corps of Engineers has reviewed the potential effects of this alternative to wetlands. Based on this review, the Corps determined the disturbances to the 1.5 acres of wetlands discussed above would be authorized under the Corps' Nationwide Permit system (McInerney 1997, pers. comm.). Installation of the pipelines would be authorized under Nationwide Permit

Number 12.. The construction of the LAD storage pond and east side waste storage site would be authorized under Nationwide Permit Number 26.

4.1.2.1.3 Alternative C — Modified Centerline Expansion and Hertzler Ranch Site

The effects of implementing this alternative would be the same as those described for Alternative B. The same wetlands would be disturbed for construction of the same facilities. Also, the Corps' Nationwide Permits 12 and 26 would still apply to the wetlands disturbed by this alternative.

4.1.2.1.4 Alternative D — Modified Centerline Expansion and East Stillwater Site

The direct and indirect effects of implementing this alternative would be less than those described for alternatives B and C. The primary source of the difference is that the pipelines would not be constructed between Stratton Ranch and Hertzler Ranch and the LAD storage pond would not be constructed at Hertzler Ranch. Although the areal extent and number of wetlands that would be disturbed under this alternative would be less, the Corps' Nationwide Permits 12 and 26 would still apply to this alternative.

4.1.3 Cumulative Impacts to Water Resources

Anticipated changes in the Stillwater River watershed include the upgrade of a campground upstream of the mine and the anticipated increase in recreational use and an increase in residential units in the valleys northeast of the mine. Woodbine Campground improvements include the paving of roads and spurs, which should eliminate sediment loss from roads immediately adjacent to the Stillwater River while slightly increasing surface water runoff during storm events. Higher recreational use can result in an increase in disturbance associated with hiking trails and slight increases in runoff and sedimentation. Any campground has the potential to increase nutrient loading if sanitation is not adequately maintained.

Additional housing would change the vegetation type from native vegetation or agricultural crops to residences with lawns or pastures of introduced species for some acres. This would modify the runoff hydrograph in the area, increasing flows. Unimproved access roads would result in increased disturbance and accompanying sediment loading. Sewage treatment in rural portions of Stillwater County is accommodated through residential septic systems. Older, inadequately-sized or poorly-maintained septic systems could increase nutrient loading in the Stillwater River alluvium and in the river immediately adjacent to the discharge site. Increased residential construction may also increase demands for potable water.

The mine waste expansion project is the largest anticipated new disturbance and dwarfs the others in its projected impacts. However, SMC has anticipated the consequences and proposed mitigative measures to minimize those impacts. Increases in surface water runoff would not increase peak flows from storm events measurably and channel stability would not be compromised. Sedimentation might increase in limited localized areas for short periods during construction activities. Nitrate loading also would increase, but would not increase above the 100 pounds nitrate per day limit. The 100 pounds of nitrogen/day was based on not exceeding a total instream concentration of 1 mg/L nitrate-nitrogen during a 7-day low flow during a 10-year period (7Q10) of 31.1 cfs.

4.1.4 Water Quality and Quantity Mitigation

SMC would continue the annual sampling and testing of tailings and waste rock to verify the lack of acid-generating potential of the materials. This sampling and testing would continue for the life of the mine. SMC would also continue to follow its Stormwater Pollution Prevention Plan, which was previously approved by DEQ and CNF. In the event of a stormwater or mine discharge to surface waters, SMC would sample and report the discharge as required by its approved MPDES Permit. Most MPDES discharges occur through percolation ponds and effluent standards are tested weekly at the inlets to the pond. SMC has the option to discharge waste water to the Stillwater River through a diffuser. Use of this outfall would initiate daily flow measurements and weekly water quality measurements.

SMC's Mining Permit #00118 includes annual reporting and triannual monitoring of eight river or creek stations, one spring, fifteen alluvial wells, two adit discharge sites and one mill decant water site. In addition, five wells are monitored three to twelve times per year and two springs twice per year. Water levels are acquired at three piezometers monthly. The approval of an Action Alternative that includes Hertzler would result in tri-annual monitoring of three additional surface water sites and eleven shallow wells. The use of Stratton LAD sites would add triannual monitoring of one surface water site and four shallow wells.

SMC has prepared a Pipeline Monitoring and Spill Contingency Plan for operation of the pipelines. The plan has three elements to ensure the safety of the pipelines: (1) pipeline design that meets or exceeds industry standards, (2) pipeline inspections, and (3) pipeline leak detection and response. Details of this plan are presented in **Chapter 2**.

The agencies would require testing and monitoring of the permeability of the clay liner or compacted base on which the HDPE liner would be placed. If this testing showed that the material does not meet the minimum permeability

requirement of $1x10^{-6}$ cm/sec, then additional clay material may need to be brought in to reduce the permeability or SMC could explore other options which would achieve a minimum permeability requirement of $1x10^{-6}$ cm/sec.

SMC would be required to monitor ground water at the Hertzler Ranch to determine effects of seepage from the impoundment to the Stillwater River. If ground water monitoring at the Hertzler Ranch indicated that nitrates or other contaminants were migrating at concentrations that would cause increases above the trigger level, specified in the MPDES permit, with in the Stillwater river, SMC would be required to conduct biological monitoring of periphyton and macroinvertebrates above and below the site twice a year.

SMC would be required to identify and collect baseline data for nearby down-gradient residential wells prior to construction of the pipeline and impoundment. If monitoring at Hertzler Ranch showed that groundwater quality exceeded nondegradation standards outside of the mixing zone then SMC would be required to replace the affected water as required under MMRA. This sampling would ensure that down-gradient water users who could potentially be effected by construction and operation of the Hertzler impoundment would be identified and compensated if their water supplies became contaminated.

SMC would be required to purchase a 250 kW backup generator to ensure pipeline leak detection sensors function during power failures or partial power outages. This measure is intended to insure the integrity of the leak detection system associated with pipeline operations and to provide 24 hour leak detection. SMC will develop a power outage contingency plan for review and approval by the agencies.

In order to insure that pipeline design and operational parameters are achieved, SMC will provide the results of pipeline wear data for agency review. In the event that resultant data suggest excessive wear, SMC will be required to collect and submit this information for agency review every six months for tailings pipelines and annually for water pipelines.

SMC, DEQ, and CNF would re-evaluate paste technology applicability for use at the Stillwater Mine after 5 years of operations in order to insure that the most applicable reasonable tailing disposal is identified and implemented at the Stillwater Mining Company. This re-evaluation will focus on economic and technologic feasibility of paste tailing disposal.

4.2 Effects on Wildlife

4.2.1 Direct and Indirect Effects

4.2.1.1 Alternative A — No Action

Under this alternative, there would be no change in the current trend and condition of wildlife resources within the project area beyond those that were previously disclosed and permitted. Neither mule deer nor bighorn sheep would experience additional disturbance to their respective winter ranges that differ from what has been previously analyzed (DSL and Forest Service 1985, 1989).

A reconnaissance conducted during 1996 determined large-scale changes have not occurred in the areal extent of habitats available for wildlife in the area or their distribution since the 1980 studies (Western Technology and Engineering, Inc. 1996c). However, small-scale changes have occurred. They include the development of the Stillwater Mine, an increase in the number of homes and cabins along the Stillwater River and West Fork Stillwater River, and improvements at public recreation sites along the Stillwater River. The increase in the number of homes and cabins (many of which appeared to be recreational or second homes) does not appear to be limited to the project area, but appears to have occurred downstream of the project area and in other drainages (Western Technology and Engineering, Inc. 1996c). These changes were predicted in the final EIS for the Stillwater Mine (DSL and Forest Service 1985).

4.2.1.2 Alternative B — Proposed Action

4.2.1.2.1 High-Interest Species

The Proposed Action would affect a total of 678 acres. These effects would include the direct disturbance of an estimated 251 acres of previously-undisturbed terrestrial wildlife habitats, until such habitats are reclaimed, in addition to the 255 acres of disturbance already permitted within the existing permit area and 68 acres of existing disturbance at the location of the proposed east side waste storage area. These 251 acres of this additional direct disturbance would be associated with the development of facilities at the Hertzler (250 acres) and Stratton (1 acre) ranches.

All the 574 total acres removed from forage production under this alternative (255 currently permitted, 68 acres currently disturbed at the location of the east side waste storage site, and 251 proposed for new disturbance) would be reclaimed following mine closure. The disturbance of these 574 acres would be considered a long-term habitat loss during the life of the project, until final site reclamation is completed. Revegetation would result in a ground cover primarily consisting of cool season grasses (see the Reclamation section). These grasses, together with planted trees and shrubs, would provide adequate habitat for most