United States Department of the Interior
Bureau of Land Management
Lewistown District Office

State of Montana
Department of Environmental Quality
Hard Rock Bureau

August 1995

Volume I
Draft Environmental Impact Statement
Zortman and Landusky Mines
Reclamation Plan Modifications and Mine Life Extensions

Historic Ruby Mill near the town of Zortman

The Bureau of Land Management is responsible for the stewardship of our public lands. It is committed to manage, protect, and improve these lands in a manner to serve the needs of the American people for all times. Management is based on the principles of multiple use and sustained yield of our nation's resources within a framework of environmental responsibility and scientific technology. These resources include recreation; rangelands; timber; minerals; watershed; fish and wildlife; wilderness; air; and scenic, scientific, and cultural values.

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August 1995

Dear Reader:

Enclosed for your review and comment is the Draft Environmental Impact Statement (DEIS) for the expansion of the Zortman and Landusky mines in north central Montana, and modified reclamation measures at both mines.

The DEIS presents a preferred alternative (Alternative 7) and six other alternatives including the company proposed action. The preferred alternative is the agencies' attempt to reduce or avoid the potential environmental impacts of the proposed action. The DEIS discloses the environmental consequences associated with each alternative.

You are invited to make written or oral comments on the DEIS. We are particularly interested in comments that address one or more of the following: (1) needs for clarification; (2) new information that would have a bearing on the analysis; (3) a possible new alternative not within the range of alternatives presented here; and (4) possible errors in the analysis. Specific comments will be most useful.

We have scheduled four open houses/meetings to discuss this DEIS. They will be: September 18, at the Medicine Bear Lodge in Lodgepole; September 19, at the John Capture Center in Hays; September 20, in the Guard Armory in Malta; and September 21, in the Community Hall in Landusky. All of these open houses/meetings will begin at 5:00 p.m. with an open house to answer questions followed at 7:30 p.m. by a meeting to accept comments. These meetings will also be the forum for the U.S. Corps of Engineers to collect public comments on Zortman Mining, Inc. 404 permit application for the Zortman and Landusky mine expansions.

For consideration, your written comments should be received by close of business on October 17, 1995. Please include your name and complete mailing address on all written comments, including any copies of testimony that you make available to us.

Written comments should be addressed to David L. Mari, District Manager, Bureau of Land Management, Lewistown District Office, P.O. Box 1160, Lewistown, Montana 59457-1160.

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Draft
Environmental Impact Statement

Zortman and Landusky Mines
Reclamation Plan Modifications and Mine Life Extensions
Phillips County, Montana

August 1995

Lead Agencies: United States Department of the Interior, Bureau of Land Management, Lewistown District and State of Montana, Department of Environmental Quality, Hard Rock Bureau.

Cooperating Agencies: United States Environmental Protection Agency, United States Army Corps of Engineers, and State of Montana, Department of Environmental Quality, Water Quality Division.

Contacts for Further Information: Jim Robinson, Team Leader, Department of Environmental Quality, Hard Rock Bureau, P.O. Box 201601, Helena, Montana 59620-1601 (406/444-2074) and Scott Haight, Team Leader, Bureau of Land Management, Lewistown District Office, P.O. Box 1160, Lewistown, Montana 59457 (406/538-7461).

Abstract: This Draft EIS analyzes impacts associated with expansion of mining and modification of reclamation plans at the Zortman and Landusky mines in north-central Montana. The DEIS analyzes seven alternatives, including the No Action Alternative and the Company Proposed Action. Significant issues include: acid rock drainage, reclamation success, impacts to Native American traditional cultural and historic resources, and economics. A preferred alternative has been identified (Alternative 7) which addresses these, and other issues. This alternative would provide for expansion of mining and modified reclamation plans using mitigating measures developed by the lead agencies to avoid or reduce environmental impacts.

Other Environmental Review: This Draft EIS will also serve as the environmental review document for a permit issued by the U.S. Army Corp of Engineers under Section 404 of the Clean Water Act.

Comments: Comments should be received by close of business on October 17, 1995, and addressed to David L. Mari, District Manager, Bureau of Land Management, Lewistown District Office, P.O. Box 1160, Lewistown, Montana 59457-1160.

INTRODUCTION

This Draft Environmental Impact Statement (EIS), prepared by the Montana Department of Environmental Quality (DEQ) and the U.S. Department of the Interior, Bureau of Land Management (BLM), describes the evaluation of a proposal by Zortman Mining, Inc. (ZMI) to continue and expand mining operations at both the Zortman and Landusky mines in Phillips County, Montana. This summary of the Draft EIS contains a description of the proposed action and other alternatives; identifies the agencies' preferred alternative; summarizes existing environmental conditions in the study area; and discloses the major impacts and issues associated with the various alternatives. If more detail is desired regarding all or certain aspects of these topics, the relevant sections of the Draft EIS should be reviewed in whole.

PROJECT DESCRIPTION, PURPOSE, AND NEED

Project Description

On May 11, 1992, ZMI filed an application with the Lewistown District BLM and the Montana DSL (part of the DEQ as of July 1, 1995) to expand mining operations at the Zortman Mine in the Little Rocky Mountains, Montana. The proposal includes: expansion of existing mine pits to access sulfide ore; a 150-acre, 60-million ton waste rock disposal area; crushing facilities; a 2 ½-mile conveyor system; a 200-acre, 80-million ton leach pad; a new processing plant and ponds; a limestone quarry; and other associated facilities. Total disturbance would increase from the existing 401 acres to about 1,292 acres. The operation is located on private and BLM-managed land. Issues of special note include Native American religious concerns, acid rock drainage, reclamation, and socioeconomics. In a March 9, 1994, Decision Record, the BLM and DEQ included the analysis of acid rock drainage corrective measures for the nearby Landusky Mine within the scope of the Environmental Impact Statement for the Zortman Mine expansion, since acid rock drainage has been a problem at both mines. The Draft EIS addresses additional mining at the Landusky and Zortman mines, plus modified reclamation plans for both facilities.

Purpose and Need

The purpose of the modified reclamation plans and proposed mine expansions is to address two different types of needs. The first is the need to correct inadequacies in the existing reclamation plans. It has become apparent that the current approved reclamation plans. are not adequate to limit or prevent the development of acid rock drainage from the present mine facilities. In early 1993, the agencies informed ZMI that the reclamation plans had to be modified to mitigate existing acid rock drainage and to ensure successful surface reclamation. ZMI has submitted proposed modifications to the current reclamation plans. These are described under Alternatives 2 and 4.

The second purpose is to consider ZMI's need to develop their mineral property rights. These rights have been secured on federal land under the Mining Law, or are privately owned where the land has been patented. ZMI's proposal for additional mining and reclamation is presented in Alternative 4.

There is considerable interdependence between mine expansion activities and corrective measures to address the inadequacies of the existing reclamation plans. To consider these in a comprehensive fashion, the scope of the EIS includes alternatives that address both these needs. The EIS addresses impacts from past, present, and reasonably foreseeable future activities at the Zortman and Landusky mines. Baseline for this analysis is circa 1979 which marks the beginning of modern, large-scale mining in the Little Rocky Mountains. Earlier baseline is used when discussing specific historic mining disturbances such as the Ruby Gulch tailing.

The EIS Process

The environmental analysis of ZMI's applications for a mine permit modification for the Zortman and Landusky mines is being conducted under requirements of the National Environmental Policy Act (NEPA) and the Montana Environmental Policy Act (MEPA) and the administrative rules and regulations implementing both these acts. An EIS is required because federal and state agency consideration of the proposed permit modifications constitutes federal and state actions which may significantly affect the quality of the human environment under NEPA and MEPA. The BLM and the DEQ are the joint lead agencies responsible for the preparation of the EIS and for issuing a final decision on the mine permit applications. However, a number of other agencies provide input to the EIS analysis. The

U.S. Environmental Protection Agency (EPA), the U.S. Army Corps of Engineers (COE), and the Montana Water Quality Division (WQD) of the DEQ are cooperating agencies, and several other agencies are providing comments.

The EIS process includes the following steps:

1. Public and agency "scoping" during which issues and concerns are identified early in the process;
2. Alternatives development;
3. Data collection;
4. Impact analysis;
5. Completion of a Draft EIS;
6. Public review and comment period;
7. Completion of a final EIS; and
8. Completion of a Record of Decision (Final Decision)

At the end of the process, it is the responsibility of the BLM and DEQ as the lead agencies to consider the proposed action and alternatives presented in the EIS and issue a decision on the permit and approvals required for both the Zortman and Landusky Mine expansion projects. The agencies may approve the application as submitted, or they may approve a modified application and/or approve the application with stipulations. Any of these options may require ZMI to adopt measures to mitigate environmental impacts. The final decision would be presented in a document known as the Record of Decision.

Major Issues

Significant areas of concern or controversy were identified through public scoping and review by agency specialists. Public scoping meetings have been held at various locations in the study area to solicit public comment. Based on scoping and agency review, four primary issues were identified that reflect concerns or conflicts which could be partially or totally resolved through the EIS process. These issues are:

- Water Quality (Groundwater and Surface Water)
- Reclamation Plans and Procedures
- Cultural Resource Impacts
- Socioeconomics

These four issues are by no means the complete list of environmental concerns identified during project review and public scoping or used to develop alternatives. However, they do represent the issues that, because of the potential magnitude, duration, or significance of their effect on the environment, have played the greatest role in the development of alternatives. The following discussion provides a brief summary of these issues.

Water Quality. The public and the agencies have expressed concern that existing and/or historic mining operations have impacted and are continuing to impact water quality, and therefore aquatic habitat, in the area. Releases of acidic and metal-bearing waters from the mines have resulted in the loss of aquatic habitat and have adversely impacted the streams and groundwater in the area. Cyanide and metals are mentioned most often as analytes of concern.

Of particular interest is acid rock drainage and its effects on both surface and groundwater. Concern has been expressed that some of the existing mine, heap leach, and waste rock facilities have acidified and are releasing dissolved metals to ground and surface waters. The proposed mine expansion would develop sulfide ore and waste to an extent not contemplated previously for the Zortman and Landusky mines. Concerns have been raised regarding both mitigation of existing impacts and possible additional adverse water quality impacts mine expansion.

Other water quality issues include the potential leakage of heap leach process solution from storage ponds, contamination of water in pits and release of that water to surface drainages and groundwater, and the scope and adequacy of the water quality monitoring program.

Reclamation Plans and Procedures. Some reclamation at the mines has proved to be inadequate and/or ineffective. For instance, acid rock drainage emanating from some heap leach facilities and waste rock dumps may be due to incomplete reclamation procedures, or a failure to use appropriate materials to prevent water infiltration into the acid-producing materials. ZMI has proposed various rock characterization methods, materials handling procedures, and engineering practices to enhance the potential for successful reclamation. The agencies have also developed alternatives which incorporate engineering and reclamation modifications and mitigations as further protection. The scope and adequacy of reclamation monitoring has also been raised as an issue.

Cultural Resource Impacts. Areas within the Little Rocky Mountains, and specific sites near the Zortman and Landusky mines, are culturally and historically important to various North American Indian peoples. Many public comments received by the agencies during the scoping meetings for this Draft EIS and previous mine permitting actions have expressed concerns about impacts to cultural resources resulting from mine actions. In response, the agencies have included an analysis of impacts to cultural resources and the use of these resources as a result of mine noise, air quality and water resources degradation, and modification of the visual perspective from certain locations of traditional cultural practices and importance.

Socioeconomics. The Zortman and Landusky mines have employed a large number of workers during the years 1979 through 1994. This employment represents a significant percentage of the total workforce in the surrounding region. A concern to many people is the socioeconomic impact mine closure would have upon mine workers and the area economic base.

PROPOSED ACTION AND ALTERNATIVES

Development of Alternatives

The issues identified through agency review and public scoping efforts were used to formulate reasonable alternative actions pertaining to the proposed Zortman-Landusky mine expansion. These alternatives were then evaluated based on engineering, environmental, and economic factors. The engineering evaluation included technical implementability and effectiveness, while the environmental evaluation considered potential impacts on air, water, and soil, with consideration of subsequent impacts to cultural resources, vegetation, wildlife, and human health. Cost was only considered as a factor in the elimination of an alternative where it would likely result in an uneconomic mine project, thus equating to the No Action Alternative. The following describes in more detail the considerations evaluated by the agencies in developing project alternatives.

Several alternatives were developed regarding the location of two major facility components of the proposed action: 1) the waste rock storage facility site and 2) the location for the ore heap leaching facility. At Zortman, seven alternatives to the proposed Carter Gulch waste rock storage site were evaluated. Three of these - the Ruby Flats site, partial backfill of the mine pits, and placement of waste rock on top of and adjacent to existing disturbances - were retained as viable waste rock storage alternatives for detailed evaluation. At Landusky, the proposed waste rock storage alternative (Gold Bug site or backfilling in other pits) was considered the only reasonable alternative. Regarding heap leach locations at Zortman, five alternatives to the proposed Goslin Flats location were considered, but only Alder Gulch remains as a viable alternative heap leach site for detailed evaluation. At Landusky, alternatives to the expansion of the existing pad were considered but eliminated.

In addition to the two major facility components discussed above, several items were considered for incorporation into an agency-modified alternative. These included: 1) mining methods, 2) reclamation, 3) ore transport, 4) beneficiation technology, 5) conveyor route, 6) process solution storage, 7) leach pad type, 8) processing, 9) waste rock transport, and 10) water control. Alternative actions were then developed by considering and evaluating:

- Company proposed action;
- Agency comments to the company proposed action, generated during completeness reviews;
- Public comments about the proposed extension projects, solicited during scoping meetings;
- Experiences at other mining projects;
- Technical literature and the relevant scientific database; and
- Past and present environmental concerns at the Zortman and Landusky mines.

Following review of engineering, environmental, and economic feasibility, seven alternatives were retained for detailed analysis. These include the company-proposed action, the no-action alternative, and 5 other agency alternatives. Actions which were eliminated from further evaluation were considered to be unacceptable in terms of engineering feasibility or environmental protection. In addition, certain actions such as complete backfilling of the mine pits were eliminated from consideration because they are not economically feasible.

Summary Description of Alternatives

The seven alternatives (including the proposed action) are listed and described below. For ease of reading, these are arranged from the simplest (No Action) to the most complex (Expanded Mining with Imposed Mitigation), as follows:

Alternative 1: No Action (continue permitted operations and reclamation)

Alternative 2: Mine Expansions Not Approved and Company Proposed Reclamation

Alternative 3: Mine Expansions Not Approved and Agency Mitigated Reclamation

Alternative 4: Company Proposed Expansion and Reclamation (Company Proposed Action or CPA)

Alternative 5: Agency Mitigated Expansion and Reclamation with Leach Pad Located in Upper Alder Gulch rather than on Goslin Flats

Alternative 6: Agency Mitigated Expansion and Reclamation with Waste Rock Repository Located on Ruby Flats rather than in Carter Gulch

Alternative 7: Agency Mitigated Expansion and Reclamation with Waste Rock Repository Located on Existing Mine Facilities rather than in Carter Gulch

Alternative 1 - No Action (continue permitted operations and reclamation). At the **Zortman Mine,** mine expansion plans would not be approved. Leaching and reclamation would continue as permitted. At the **Landusky Mine,** expansion plans would not be approved and the permitted ore reserves would be mined out by the beginning of 1996.

Alternative 2 - Mine Expansions Not Approved and Company Proposed Reclamation. ZMI would continue already permitted activities at both the Zortman and Landusky mines. Mine expansion plans would not be approved. The existing reclamation plans for the mines would be revised as proposed by ZMI to mitigate the existing acid rock drainage problems. Company proposed revisions include low permeability capping of unreclaimed heaps and waste rock dumps, redesign of diversion structures, water treatment contingencies, and enhanced monitoring for evaluating reclamation effectiveness.

Zortman Mine - Existing mine facilities would be tested to determine their acid generation potential. Those facilities that could generate acid rock drainage would be reclaimed with a 6-inch compacted clay infiltration barrier between the mine waste unit and the topsoil. Clay material for reclamation would be mined from the Seaford clay pit approximately 9 miles south of Zortman.

Landusky Mine - The existing Landusky Mine disturbances would be reclaimed using enhanced reclamation measures proposed by ZMI. The existing interim reclamation covers on the Mill Gulch and Gold Bug waste rock repositories would become the final covers. The other mine waste units would be tested to determine their acid generation potential. Those facilities that could generate acid rock drainage would be reclaimed with a 6-inch compacted clay infiltration barrier between the mine waste unit and the topsoil. Clay material for reclamation would be mined from the Williams clay pit approximately 3 miles southwest of Landusky.

Alternative 3 - Mine Expansions Not Approved and Agency Mitigated Reclamation. This is similar to Alternative 2 described above, but with additional agency-imposed requirements on ZMI's proposed plans to ensure reclamation success. These mitigating measures would include, but not necessarily be limited to:

Zortman Mine - Low permeability capping on all mine facilities not just those that test positive for acid generating potential; slope reduction to 3H:1V on most mine waste units; increasing the clay cap thickness to 12-inches; adding a 3-feet thick non-acid generating capillary break between the clay layer and the cover soil; development of a limestone quarry in the Beaver Creek area to be used for reclamation materials; removing the existing Alder Gulch waste rock dump and using it for mine pit backfilling; removing the OK and Ruby waste rock dump/stockpile and placing them in the mine pit as backfill; removing the 85/86 leach pad and retaining dike and using it as mine pit backfill; grading and capping of the mine pits floors to achieve a free-draining surface that discharges into Ruby Gulch; and enhancement of capture-pumpback-treatment facilities to function through runoff/seepage from a 100-year, 24 hour storm event.

Landusky Mine - Low permeability capping on all mine facilities; slope reduction to 3H:1V on most mine waste units; increasing the clay cap thickness to 12-inches; adding a 3-feet thick non-acid generating capillary break between the clay layer and the cover soil; development of a limestone quarry in the King Creek area to be used for reclamation materials; excavation of a drainage notch to route surface runoff from the reclaimed Landusky Mine pit floors into Montana Gulch instead of infiltrating through the pit floor and daylighting at the toe of the Montana Gulch waste rock dump.

Alternative 4 - Company Proposed Expansion and Reclamation (Company Proposed Action or CPA). ZMI would continue already permitted activities at both the Zortman and Landusky mines. This is ZMI's proposed Zortman Mine Expansion Plan contained in the application documents initially submitted to BLM and DSL on May 11, 1992 and revised through the completeness process until September of 1994. It also includes the smaller proposed expansion of the Landusky Mine detailed in the ZMI document of September, 1994. Enhanced reclamation measures for both operations are included in the proposals. These are collectively known as the Company Proposed Actions (CPA).

Zortman Mine - Approximately 877 additional acres would be disturbed. Major disturbances would be from construction of the leach pad, the waste rock repository, crusher, conveyor system, and processing facilities. Mining activities would expand and deepen the current pit areas. The proposed limestone quarry, shale pit expansion, Goslin Flats leach pad, Landusky powerline extension, and the conveyor would be outside the current mine permit boundaries.

ZMI proposes to mine and process oxide and non-oxide ore reserves. The proposed expansion would include mining 80-million tons of ore and 60-million tons of waste rock at the rate of 60,000-80,000 tons per day, 350 days per year for 5 to 8 years. The operation would enlarge the existing pits, combine run-of-mine oxide and crushed non-oxide ore, and transport the ore via a 12,000-foot overland conveyor to a cyanide heap leach facility located at Goslin Flats. Cyanide solution would be applied to the ore heap and the precious metal-enriched solution would be captured within the leach pad, and processed at an adjacent recovery facility. Precious metals from the recovery process would be smelted to a dore' bullion product on site.

Support facilities for mining and processing would include existing offices, shops, labs, warehouse, and explosive storage facilities. A new land application disposal area would be on Goslin Flats adjacent to the leach pad. Electrical power would be delivered to the operation along existing powerline corridors owned and operated by Big Flat Electric. To utilize available power supply from the Landusky Mine, a buried powerline is proposed to be constructed between the Zortman and Landusky mines.

One million tons of limestone is proposed to be mined from a quarry in upper Beaver Creek to support drainage construction and mine waste unit reclamation. Shale would be mined from the Seaford clay pit for leach pad liner and reclamation cap construction.

In addition to expanding operations at the Zortman Mine, ZMI also proposes to change the present reclamation plan for existing facilities. ZMI proposes to enhance surface reclamation of all existing leach pads, containment dikes, and waste rock dumps to restrict infiltration of precipitation into these facilities, thereby preventing or limiting acid rock drainage. All existing facilities would be resloped to 3H:1V where topography allows. Where testing indicates acid generating materials are present, the surface would be reclaimed by placement of two compacted 6-inch clay layers, overlain with 36-inches of non-acid generating rock, followed by 8-inches of topsoil with surface revegetation. Where surface slopes are less than 5 percent, a PVC liner with a geotextile would be placed immediately above the clay liner.

ZMI also proposes to remove the existing Alder Gulch waste rock dump (an acid rock drainage source) before the area is covered by the proposed new Carter Gulch waste rock facility and transport it to Goslin Flats. Some of the spent ore from the 85/86 leach pad would be used to backfill the mine pits at the end of mining to achieve a free-draining pit floor configuration.

All seepage capture and pumpback systems would be sized to accommodate the seepage resulting from a 100-year, 24-hour storm event. A water treatment plant with a 2,000 gpm capacity would be used to improve the quality of effluent from the mine facilities. Active water treatment would be phased out as source controls proved effective. Passive methods such as wetlands and limestone drains would be used in the long term.

Landusky Mine - Permitted ore reserves would be mined out by the beginning of 1996. ZMI has proposed mining an additional 7.6 million tons of ore and 7 million tons of waste rock beyond that already permitted. This would extend the mine life by less than one year. Four million tons of the waste rock would be scheduled as backfill in the Gold Bug waste rock facility. The remaining waste rock would be stored in the mine pits for use in reclamation.

The 7.6 million tons of additional ore is proposed to be placed on the existing 87/91 leach pad extension. The ore would be stacked on top of the existing ore increasing the heap height by 50 feet. This would require no increase in surface disturbance.

Besides additional mining, ZMI proposes to enhance the existing reclamation plans for the Landusky Mine to address acid rock drainage concerns. ZMI proposes to enhance surface reclamation of all unreclaimed leach pads, containment dikes, and waste rock piles to restrict infiltration of precipitation into these facilities thereby preventing or limiting acid rock drainage. All existing facilities would be resloped to 3H:1V where topography allows. Where testing indicates acid generating materials are present, the surface would be reclaimed by placement of two compacted 6-inch clay layers, overlain with 36-inches of non-acid generating rock, followed by 8-inches of topsoil with surface revegetation. Where surface slopes are less than 5 percent, a PVC liner with a geotextile would be placed immediately above the clay liner. The existing interim reclamation covers on the Mill Gulch and Gold Bug waste rock repositories would become the final reclamation covers.

The existing acid rock drainage seepage and pumpback systems in Mill Gulch and Rock Creek would be sized to accommodate runoff/seepage from a 6-inch, 24-hour storm event. A water treatment plant with a 2,000 gpm capacity would be constructed in the Montana Gulch area to improve the quality of effluent from the mine facilities if the need arises. Active water treatment would be phased out as source controls took effect. Passive methods such as wetlands and limestone drains would be used in the long term.

ZMI would mine approximately 50,000 tons of limestone from a 10-acre quarry to be developed on private land in the King Creek area. This material would be used to construct drains and diversions to aid in reclamation and maintenance of water quality.

Alternative 5 - Agency Mitigated Expansion and Reclamation with Leach Pad Located in Upper Alder Gulch rather than on Goslin Flats. This alternative is similar to the CPA (Alternative 4) for both mine expansion and modification of reclamation plans, but with agency mitigation added to reduce or avoid potential environmental impacts.

Zortman Mine - The major change is that the Goslin Flats leach pad would be constructed in Upper Alder Gulch just west of the proposed waste rock dump. The conveyor system would not be constructed. Truck haulage would be used to transport both ore and waste rock from the mine to their respective facilities.

The agencies would also require changes in ZMI's proposed plans to ensure reclamation success. These mitigating measures would be similar to Alternative 3.

Landusky Mine - No change in mining operations from that proposed in Alternative 4.

Modification to the reclamation plan would be similar to Alternative 3. The post-reclamation pit drainage would include cutting a drainage channel or notch out of the pit wall so that all surface water runoff from the pit floor would drain into King Creek. A drainage diversion would be constructed along the pit highwall so that highwall runoff would discharge into Montana Gulch.

Alternative 6 - Agency Mitigated Expansion and Reclamation with Waste Rock Repository Located on Ruby Flats rather than in Carter Gulch. This alternative is the same as the CPA (Alternative 4) for both mine expansion and modification of reclamation plans, but with agency mitigation added to reduce or avoid potential environmental impacts.

Zortman Mine - The major modification is that the Alder Gulch waste rock repository would not be constructed. Instead waste rock would be disposed of at a repository site on Ruby Flats east of the proposed leach pad. The waste rock would be transported from the mine site by the conveyor to an off-load area near the leach pad. It would then be transported by truck to Ruby Flats waste rock repository for disposal. This waste rock facility would be reclaimed similar to the leach pad.

The agencies would also require changes in ZMI's proposed plans to ensure reclamation success. These mitigation measures would be similar to those in Alternative 3.

Landusky Mine - No change in mining operations from that proposed in Alternative 4.

Modification to the reclamation plan would be similar to those in Alternative 3. The post-reclamation pit drainage would involve cutting a drainage notch or channel out of the pit wall so that all surface water runoff from the pit floor would drain into Montana Gulch. Spent ore from the 85/86 leach pad and dike would be excavated from Montana Gulch and used to backfill the mine pits. This would raise the backfilled pit floor elevation, thus decreasing the size of the drainage notch needed to achieve a free-draining surface, and it would remove potentially acid generating material from close proximity with the Montana Gulch drainage.

Alternative 7 - Agency Mitigated Expansion and Reclamation with Waste Rock Repository Located on Existing Mine Facilities rather than in Carter Gulch. This alternative is similar to the CPA (Alternative 4) for both mine expansion and modification of reclamation plans, but with agency mitigation added to reduce or avoid potential environmental impacts.

Zortman Mine - The major modification is that the company proposed Carter Gulch waste rock repository would not be constructed. Instead, waste rock would be disposed on top of and adjacent to existing disturbances at the Zortman Mine. This would mean placement of waste rock over some of the existing leach pads and retaining dikes. The waste rock repository would be constructed at a 3H:1V slope and concurrently reclaimed as it was built upward from the lower slopes. The existing Alder Gulch waste rock dump would be removed and placed on the new leach pad at Goslin Flats.

The agencies would also require changes in ZMI's proposed plans to ensure reclamation success. These mitigation measures would focus on constructing reclamation cover using a water balance approach rather than a barrier approach. Thicker cover soil with a capillary break would be required. Compacted clay would not be used in the reclamation covers.

Landusky Mine - This would be the same as described for the Landusky Mine under Alternative 5 for the post-reclamation drainage. The water balance reclamation cover would be used for unreclaimed facilities and those requiring re-reclamation.

Comparison of Alternatives. Tables 2.2-2 and 2.2-3 are provided to facilitate a comparison of the seven alternatives described above. The tables compare the differences in the various project components (type, location, extent, method, etc.) among the seven alternatives. A comparison of impacts among alternatives is provided later in the summary.

Summary of Agencies' Mitigations

During the development and evaluation of project alternatives the agencies identified a number of mitigations designed to eliminate or substantively reduce environmental impacts. Many of these mitigations are integral parts of one or more alternatives. No mitigations are applied to Alternative 1 since it represents no action and no modification to existing permit conditions. In addition, no specific mitigations have been developed for Alternatives 2 or 4 since they were proposed by ZMI.

The following is a list of mitigations which the agencies have incorporated into one or more agency-developed alternatives. The numbers in parentheses following each mitigation refer to the alternatives containing the mitigation, although each alternative should be read and considered for the context in which a particular mitigation is applied.

Mitigations Common to Both Mines

- All mine expansion and reclamation activities would be conducted in accordance with the Water Quality Improvement Plan. (all alternatives)

- All mine expansion and reclamation activities would be conducted in accordance with the signed Memorandum of Agreement developed under Section 106 of the National Historic Preservation Act (see Appendix E). (4, 5, 6, 7)

- ZMI's proposed Reclamation Cover C would be modified to include 6 inches of compacted clay (as opposed to 3 inches of compacted clay) between the bottom substrate and the PVC liner. The PVC liner thickness would be increased to 30 mil. For the purpose of discussion in this and future alternatives, this cover is known as "Modified Reclamation Cover C." (3, 5, 6)

- With the exception of leach pad dikes, existing and expanded facilities would be reclaimed to a 3H:1V slope with constructed benches every 200 feet of slope length. In order to achieve the slope reductions while minimizing additional land disturbance, some material may have to be off-loaded from existing facilities and backfilled into the pit. (3, 5, 6)

- With the exception of leach pad dikes, existing and expanded facilities would be reclaimed to a 3H:1V slope with constructed benches every 50 vertical feet. (7)

- In order to classify as "Non-Acid Generating" and be used without restriction in construction and reclamation, waste rock or other material (3, 5, 6, 7):

  1) Cannot be composed of igneous breccia, felsic gneiss, monzonite, quartzite, or trachyte lithologies;

  2) Amphibolite, mafic gneiss, shale, dolomite or limestone must have a total sulfur content less than 0.8%, and a paste pH of 6.0 or greater;

  3) If syenite, must have a total sulfur content less than or equal to 0.2%, a paste pH of 6.5 or greater, <u>and</u> a NNP greater than or equal to 0 with an NP:AP ratio greater than or equal to 1;

  4) Must meet the criteria above as demonstrated by sampling and analyzing lithologies from every blasthole providing non-acid generating material.

- The water-balance reclamation covers would be used to reclaim mine facilities. The performance criterion for the reclamation covers would be to limit infiltration to not more than 5 percent of precipitation. (7)

- Additional material used for capillary break/drainage layers in reclamation covers may be obtained from an area limestone source or non-acid generating waste rock. (3, 5, 6, 7)

- Reclamation viability would be monitored by ZMI until the agencies have approved final closure and released the mine reclamation bond. Vegetative cover must achieve 90 percent of that in adjacent natural communities of similar composition and location. (3, 5, 6, 7)

- ZMI would be required to conduct a study after mine closure of the potential to use the pit highwalls as peregrine falcon hack sites. (7)

- The reclamation requirements of this EIS and the Water Quality Compliance Plan would be used as a basis for determining reclamation success and directing any further corrective measures. (3, 5, 6, 7)

- Prior to liner perforation, ZMI would undertake an expanded and more rigorous analysis of heap detoxification, to include additional sampling and monitoring requirements, water level measurements monthly, and agency notification. (3, 5, 6, 7)

- An expanded reclamation quality control program would be implemented to include such items as particle size restrictions for clay, used in reclamation clay installation procedures, foundation preparation, testing of placed materials, inspection requirements, and construction reporting. (3, 5, 6)

- All drainage and diversion ditches would have to be able to pass the peak flow from a 100-year storm event with 1 foot of freeboard. (3, 5, 6, 7)

- Seepage water capture and treatment systems must be sized for a 100-year, 24-hour storm event. (3, 5, 6, 7)

- Trees would be used in revegetation only to mitigate visual impacts. Crested wheatgrass would not be allowed in the revegetation mixture. (3, 5, 6, 7)

- Long-term soil loss rates could not exceed 2 tons per acre per year. (3, 5, 6, 7)

- For reclamation material haul trips utilizing convoys that are routed through the communities of Zortman or Landusky, pilot cars would escort the convoys over the entire length of the haul routes and the speed of the convoys would be reduced to 15 mph. (3, 5, 6, 7)

- Performance of an Environmental Audit on an annual basis would be carried out at both mines to assure that spill containment systems work properly, that leak detection systems are in proper working order, and that spill prevention and response planning can be realistically implemented through review of company training programs and inspection of emergency response equipment. (5, 6, 7)

- At the end of mine life, a comprehensive Environmental Site Assessment would be carried out that covers the entire Zortman and Landusky mine permit areas. This site assessment would include inspection of all locations where hazardous materials were stored and used and would identify evidence of spills or accidental releases that may have contaminated soil and groundwater. This site assessment would include soil and groundwater sampling should evidence of contamination be identified. (3, 5, 6, 7)

<u>Zortman Mine Mitigations</u>

- The 80-million ton capacity heap leaching facility would be constructed in Upper Alder Gulch as a valley fill leach pad, rather than at Goslin Flats. (5)

- The ore crushing facility would be sited in the vicinity of the pit complex. (5)

- Crushed ore would be transported to the heap leach pad by truck (rather than by conveyor system). (5)

- The 60-million tons of waste rock would be placed in a repository constructed on the Ruby Flats, just east of the Goslin Flats heap leach pad. (6)

- The waste rock repository would be lined on the bottom with a solution detection and collection system to reduce the potential for contamination of area water resources. (6)

- Rerouting of Phillips County Seven Mile Road around the Ruby Flats waste rock repository. (6)

- The Thermopolis shale could not be used without restriction in construction or reclamation purposes. Under-drains for the leach pad would have to be constructed using the native calcareous subsoil material or unmineralized limestones or carbonates from other sources. (6, 7)

- The waste rock repository would be constructed mostly on existing facilities around the Zortman pit complex, rather than in Carter Gulch. (7)

- More rigorous construction quality control procedures would be applied to the leach pad construction. (5, 6, 7)

- With the exception of the 89 leach pad dike, all facilities not used as pit backfill are assumed to be potentially acid generating and require re-reclamation. Cover soil on the facilities would be removed, stockpiled, and reused. The 89 leach pad dike would be tested and re-reclaimed if it exceeds the test criteria. (3, 5, 6, 7)

- The existing Alder Gulch waste rock dump would be used to backfill the pit complex. The cover soil would be re-salvaged and the waste rock footprint reclaimed using this material. (3)

- After detoxification, portions of the 85/86 leach pad and dike would be removed to create a free draining surface and placed in the pit as backfill material prior to pit floor reclamation. (3, 5, 6, 7)

- The OK waste rock dump would be removed and used to backfill the pit complex or used as reclamation material. Cover soil would be re-salvaged and the waste rock footprint reclaimed. (3, 5, 6, 7)

- The tailing in Ruby Gulch above the town of Zortman would be removed from the drainage and placed in the pit complex. The drainage would be restored as mitigation for existing disturbance to waters of the United States by other Zortman and Landusky mines facilities. (3, 5, 6, 7)

- The sulfide storage area would also be removed and used as backfill in the pit complex. (3, 5, 6, 7)

- Additional backfill in the pits would be graded so that runoff freely drains, without impoundment in the pit, into the Ruby Gulch drainage. (3, 5, 6, 7)

- A borrow pit would be developed on Ruby Flats, if needed, to provide subsoil for use in construction and reclamation activities, and to stockpile reclamation materials removed from Goslin Flats during leach pad construction. (7)

- An alternate water source for bats (or other wildlife) would be constructed in Goslin Gulch between Azure Cave and the leach pad site to mitigate potential loss of wildlife drinking water on Goslin Flats. (6, 7)

<u>Landusky Mine Mitigations</u>

- The 91 leach pad dike would be re-reclaimed. Other facilities, not used as pit backfill would be tested for sulfur content and re-reclaimed if the test criteria are exceeded. Cover soil on the facilities would be removed, stockpiled, and reused. (3, 5, 6, 7)

- With the exception of leach pad dikes, the Gold Bug repository and the Mill Gulch waste rock dump, existing facilities would be reclaimed to a 3H:1V slope with constructed benches every 200 feet of slope length. In order to achieve the slope reductions while minimizing additional land disturbance, some material may have to be off-loaded from existing facilities. (3, 5, 6)

- The pits would be backfilled to a minimum elevation of 4,900 ft (at the midpoint of the drainage ditch) to create a surface which will freely drain into Montana Gulch. Approximately 13 million tons of backfill would be required to reach this level. Material used in backfill would come from existing waste rock dumps and leach pads. (3, 6)

- Prevent runoff from the Queen Rose/Suprise and August/Little Ben pit areas from flowing into the August tunnel by constructing a drainage notch between the August/Little Ben pit and Montana Gulch, and directing surface water to Montana Gulch immediately below the waste rock dump. (3, 6)

- Rock fill would be removed and used as backfill to raise the pit floor to a minimum elevation of 4,850 feet (at the midpoint of the drainage) to create a surface which would freely drain into King Creek. Sources of pit backfill to reach the 4,850 foot level would include the Montana Gulch waste rock dump and the 85/86 heap leach pad. (5, 7)

- Portions of the 85/86 leach pad and dike would be removed in order to unblock the western tributary of Montana Gulch and create a free draining surface. (5, 7)

- Highwall runoff would be diverted from the mine pits into Montana Gulch and treated if necessary. (5, 6, 7)

- Contingency water capture systems and settling ponds would be installed in upper King Creek to treat surface water runoff from the backfilled pit floors. (5, 7)

- Removal of the 85/86 leach pad from Montana Gulch and part of the Montana Gulch waste rock dump, and placement of this material in the pit as backfill. (6)

AGENCIES' PREFERRED ALTERNATIVE

Identification of a preferred alternative is required in a Draft EIS to allow the public to review the agencies' preference. The preferred alternative may be changed in the Final EIS based upon comments received on this draft. Rationale for the selection of a preferred alternative will be provided in the Record of Decision.

Alternative 7 has been identified as the agencies' (BLM and DEQ) preferred alternative. Alternative 7 satisfies the purpose and needs described in Chapter 1.

Of the seven alternatives in this Draft EIS, a mine expansion alternative has been identified to meet the need of providing for ZMI to develop their precious metal deposits at the Zortman and Landusky mines and reclaim both mine facilities. Of the various possible waste rock and leach pad facility locations for mine expansion at the Zortman Mine, Alternative 7 is preferred.

Preferred reclamation measures are described under Alternative 7. The water "balance" approach to reclamation covers is preferred over the "barrier" type construction, for both existing and new facilities. These measures, together with the other mitigations detailed in Alternative 7, would be used to address existing environmental problems and prevent unnecessary or undue degradation.

AFFECTED ENVIRONMENT

The proposed project is located in the Little Rocky Mountains of north-central Montana, near the southern boundary of the Fort Belknap Indian Reservation in the southwest corner of Phillips County. Nearby towns include Hays and Lodgepole (in the southern portion of the Reservation), Landusky (approximately 0.5 miles south of the Landusky Mine), and Zortman (about 1 mile south of the Zortman Mine).

The study area is characterized by rolling prairie dissected by streams and interrupted by "island mountains" that rise out of the relatively flat plains like islands in the ocean. Elevations range from approximately 2,300 feet above sea level at Fort Peck Lake east of the Little Rocky Mountains, to 5,700 feet above sea level at Old Scraggy Peak, located approximately 1.5 miles east of the Zortman Mine. Topography within the mountains is rugged, with high outcrops and steep v-shaped valleys. Mineral resources are abundant, and historic mining has occurred over the past century. Soil resources include young and relatively undeveloped soil in the mountain areas, and more developed soil in the plains areas, which are potential major sources of reclamation cover soil and subsoil.

Portions of the project area that have not been mined are mostly forested. Primary community types present include lodgepole pine forest, ponderosa pine forest, Douglas fir forest, deciduous tree forest, grassland, shrubland, and outcrop/scree communities. Small wetlands occur along the lower drainages. The area supports a wide variety of plants, and the Little Rocky Mountains are a source of plant materials for ethnobotanical uses. No plants listed as federally threatened or endangered or as of special interest or concern by the State of Montana are known to occur within the study area. A wide variety of wildlife species can also be found. Well-known species include big game animals, upland game birds, raptors, and bats. Eighteen species of special concern at either the federal and/or state level may potentially occur in the region.

The headwaters of several streams are located in the study area; most streams are ephemeral or intermittent in nature. These drainages and the subsurface aquifers in the area have been or can be affected by acid rock drainage associated with mining activities in this highly mineralized area. Surface water and groundwater have exhibited elevated chemical concentrations on specific occasions downstream as far as Zortman and Landusky since 1979. Water treatment systems are currently operating in all of the affected drainages, and significant improvement in downstream water quality has been observed.

The economy of the area is based primarily on the use of natural resources, which includes agricultural, mining, and outdoor recreation. Agriculture is the predominant land use in the study area. Public lands provide both developed and dispersed recreation opportunities. Fort Belknap Indian Reservation also provides some recreational facilities including Pow Wow grounds. A number of Native Americans have used the Little Rocky Mountains for subsistence, social, and religious activities, and the Little Rocky Mountains are considered eligible for listing on the National Register of Historic Places as a Traditional Cultural Property. The Alder Gulch Historic District, which contains historic mining remains, is also considered eligible for the National Register.

Other areas are recognized as Areas of Critical Environmental Concern (ACEC). These include Azure Cave and prairie dog towns 20 miles east of the Little Rocky Mountains. Three other areas nominated for ACEC consideration include Little Rocky Mountains, Saddle Butte, and Old Scraggy Peak.

Air resources in the project area are generally of good quality. Ambient noise levels reflect mining operations and have been measured throughout the study area.

ENVIRONMENTAL CONSEQUENCES

The seven alternatives described above were evaluated for their potential impact on various environmental, social, and cultural resources. A detailed discussion of these impacts, or environmental consequences, is contained in Chapter 4 of the Draft EIS. The following discussion highlights the EIS material, with emphasis on the most significant impacts, especially impacts associated with the four primary issues of concern previously discussed: water quality, reclamation and its associated impacts, cultural resources, and socioeconomics.

In addition to the narrative, Table 2.3-1 is provided as an impact summary matrix. The table contains both quantitative information and/or relative impact rankings for each resource and for primary issues of concern under the resources. Table 2.3-1 also documents where no significant impact is expected for some issues of concern, such as special status species. The rankings shown in Table 2.3-1 are based on professional and technical judgement in view of this particular project, its setting and context, other projects the EIS Team has reviewed, and the effects of this project in both a site-specific and regional sense. More information is available in Chapter 4 of the Draft EIS regarding methods and criteria used to assess impacts for each resource.

Alternative 1

This is the "No Action" alternative which involves no mine expansion, continuation of permitted operations, and implementation of existing reclamation plans. Potential negative impacts to *water quality* would be very high under this alternative since no enhancement of reclamation measures would occur to limit acid rock drainage (ARD) problems. Reclamation of spent ore piles, waste rock heaps, and pit floors is expected to result in poor vegetation cover and continued high rate of infiltration through the facilities. Closure of the mine under these conditions is expected to result in long-term generation of significant volumes of acid rock drainage.

The reclamation would also result in more severe impacts to on-site *soil resources*, since using the eight-inch minimum cover over waste rock and native rock would not provide sufficient soil thickness for support of a viable vegetative cover. Also, the soil layer would be subject to acidification from the acid-generating rock substrate. Continued and accelerated erosion on the 2.5H:1V slopes would result in high negative impacts.

Because of the expected water and soil impacts associated with the limited reclamation under Alternative 1, secondary adverse impacts would also be expected on *vegetation* and *wildlife* resources. Under the Alternative 1 scenario, revegetation success is estimated at only 25 percent due to soil erosion and acid rock drainage impacts. The failure of long-term reclamation would result in high negative cumulative impacts on both vegetation and wildlife. Residual water quality impacts on macroinvertebrate populations and habitat would be moderately negative. However, since new mining is limited, Alternative 1 does result in fewer acres of new surface disturbance and no further direct impacts on biological resources.

All of the alternatives represent relatively high and negative impacts to Native American *cultural resources*, defined as the Little Rocky Mountains Traditional Cultural Property (TCP) Historic District, individual cultural properties within the boundaries of the District, and Native American values. However, Alternative 1 is considered to have moderate impacts overall on the cultural resources of the area. This is because there would be no impact to historic or prehistoric resources under Alternative 1, and the completion of existing operations without expansion and with reclamation would result in some improvement to the visual quality of the area and would limit additional disturbance to Native American cultural resources. Along with Alternative 2, this alternative is ranked second most favorable on Table 2.3-1.

Socioeconomic impacts are significant under Alternative 1, since this alternative results in mine closure and the associated impacts on local employment and economy. Phillips County and the communities of Malta and Zortman would sustain almost immediate significant negative impacts to economic and fiscal conditions, community resources, and social well-being because of sharply reduced employment and spending by ZMI and the reduction or loss of income and the potential out-migration of laid-off workers and their households. County government and schools would lose tax revenue directly and indirectly generated by ZMI and potentially would not be able to reduce service costs in proportion to the reduction in revenue. Material and service providers elsewhere in Montana, especially in Billings and Helena, would lose significant revenue. Property values potentially would decline in Phillips County, especially in the communities of Zortman and Malta. Finally, there may be an increase in what local consumers throughout the study area would pay for power from the Big Flat Electric Cooperative as they adjust to lost revenue from the mine closure.

In Phillips County, and especially in the communities of Malta and Zortman, social impacts would include a weakening of local social structures and a potential weakening of local facilities, services, schools, and businesses due to the reduced economic well-being and potential out-migration of laid-off workers and their households.

The impact of mine closure on attitudes toward the quality of life on Fort Belknap Indian Reservation would be significant and positive, because reclamation would eliminate many of the mines' impacts upon social and cultural activities, contemporary and heritage cultural sites, and life-styles dependent on the Little Rocky Mountains. This would occur despite lingering concern about water quality and quantity in drainages affecting the reservation and job losses by Native Americans now employed by ZMI. About 18 percent of the mines' work force is comprised of Native Americans.

Regarding *recreation and land use*, impacts are expected to be negative and moderate for developed and dispersed recreation and negative and relatively high for land use overall. This is because no mine expansion would end any foreseeable mining activities in the Little Rocky Mountains which would effectively end a BLM-approved land use in the area. Residual visual impacts, caused by the irreversible change in topography present after reclamation, would remain and have a permanent and moderate negative effect on the aesthetic quality of the landscape, which effects the recreational setting.

Alternative 1 would limit new visible ground disturbance by not allowing expansion activities at the Zortman or Landusky mines. Existing disturbance, particularly the mine pit highwalls, would cause significant long-term impacts to scenic quality of the affected lands. Potentially poor reclamation success would cause long-term *visual impacts* on most disturbed lands. VRM Class II objectives would not be met.

Transportation impacts are all considered low for Alternative 1. There would be no convoys of trucks associated with this alternative. This alternative would limit public access to the Little Rocky Mountains, as do all alternatives, which could be considered a high negative impact. However, the duration of this limitation under Alternative 1 is less than the expected duration under alternatives that involve mine expansion.

Because expansion of the mines would not be approved, impacts to *geologic resources* are limited. No additional gold or silver would be produced from these mines without additional regulatory review. No additional topographic modifications or disturbances to clay pits or limestone quarries would occur as a result of mining.

Mine activities would result in significant cumulative *noise* impacts at the towns of Zortman and Landusky. Direct and cumulative impacts to *air quality* from reclamation activities would not be significant. Impacts to air and noise for Alternative 1 are the lowest projected for any alternative because of limited reclamation activities and earlier closure of mine operations. Impacts relating to *hazardous materials* would be low and negative for this alternative and any of the non-expansion alternatives, since there would be less likelihood for exposure or incidents to occur without expansion and extended mine life.

Finally, no *ACEC* would experience significant impacts; the impact on the ACEC nominations would be less than for any of the other alternatives involving mine expansion.

Alternative 2

Alternative 2 is essentially the same as Alternative 1, but with ZMI-proposed modified reclamation plans replacing the existing reclamation plans. Because of the additional reclamation measures, this alternative would have a less negative impact to those resources that are dependent on the extent and success of reclamation, but would still have significant impacts because of the limitations of the proposed modified plans. Impacts to *surface and groundwater quality* would still be considered negative and high. The low permeability clay layer proposed for the modified reclamation would likely become desiccated after a short time due to temperature changes and dehydration. Therefore, this alternative is expected to result in acid rock drainage requiring long-term capture and treatment, as was discussed for Alternative 1.

The limited reclamation would result in similar adverse impacts to *soil resources* as discussed for Alternative 1, i.e., high soil erosion and soil productivity impacts. Similar impacts for *vegetation* and *wildlife* would also remain, since the proposed reclamation plan is expected to increase the success of revegetation by only ten percent over that predicted for Alternative 1. Cumulative impacts on vegetation are considered high negative. For wildlife, similar residual impacts to aquatic macroinvertebrates and habitat are expected, and the failure of the long-term effectiveness of reclamation is expected to result in a moderately negative impact on wildlife habitat.

Impacts to *cultural resources* are also considered similar to those predicted for Alternative 1, i.e., moderately negative impacts. Again, this alternative represents a relatively high impact to Native American cultural resources, because of existing disturbance, but reclamation and mine closure would improve the existing situation somewhat and would result in no further impact to historic, prehistoric, or Native American resources. This alternative, along with Alternative 1, is ranked as second most favorable in Table 2.3-1.

The economic and social impacts of Alternative 2 would be essentially the same as those of Alternative 1. In the long term, the quality of life, as perceived by all groups within the study area, may improve somewhat because of the greater probability of reclamation success.

Similarly, *recreation and land use* impacts are expected to be similar to those predicted for Alternative 1, with the main difference being the increased effectiveness of reclamation. However, mine expansion would effectively end a BLM-approved land use in the area, resulting in a negative impact. Also, the residual visual impacts that are expected due to the limited success of the reclamation would have a moderately negative impact on the quality of the landscape, affecting the recreational setting.

Alternative 2 would limit new visible ground disturbance by not allowing mine expansion activities at the Zortman or Landusky mines. Existing disturbance, particularly the mine pit highwalls, would cause significant long-term impacts to scenic quality of the affected lands. Potentially limited reclamation success would cause long-term *visual impacts* on most disturbed lands. VRM Class II objectives would not be met.

The main difference in *transportation* impacts from Alternative 1 would be the predicted medium negative impact associated with the number of truck trips through Zortman and Landusky, due to the concentrated periods of intense reclamation material hauling through these communities. For Alternative 2, it is predicted that there would be 300 truck trips through each of the towns per day for a duration anywhere from 12 to 27 days in the peak year.

No additional gold or silver would be produced, but there would be some limited impact to *geologic resources*. Nine acres of additional disturbance to mine clay would occur at the Seaford and Williams pits. No disturbance at limestone quarries would occur.

Reclamation activities would result in significant *noise* impacts at the towns of Zortman and Landusky. Direct impacts to *air quality* from reclamation activities would generally <u>not be significant</u>. Cumulative fugitive emissions from haul truck traffic in Zortman could exceed the 24-Hour PM_{10} standard, resulting in a <u>significant impact</u>. Impacts relating to *hazardous materials* would be low and negative for this alternative and any of the non-expansion alternatives since there would be less likelihood for exposure or incidents to occur without expansion and extended mine life.

Impacts to *ACEC* would generally be similar to those predicted for Alternative 1.

Alternative 3

Alternative 3 also involves no mine expansion. It adds agency mitigation to the ZMI proposed modified reclamation plans. Therefore, any resources dependent on the success of reclamation would be positively affected under Alternative 3. This is particularly important for predicted impacts on *water quality* for which low to moderate positive impacts are expected. The composite reclamation covers would limit the infiltration of water through reclaimed facilities, and the resultant discharge volumes would decrease significantly. In addition to the enhanced reclamation activities, several existing sources of acid rock drainage would be removed and placed in the pit as backfill. Negative impacts associated with the implementation of Alternative 3 include development of quarries required as a source for NAG capillary break and clay although water quality impacts associated with these developments are expected to be short term only.

Given the enhanced reclamation proposed under Alternative 3, adverse impacts to *soil resources*, *vegetation*, and *wildlife* are expected to lessen compared to Alternatives 1 and 2. This results in a moderate negative ranking for soil, a moderate negative ranking for vegetation, and a negative low impact ranking for wildlife. Soil productivity would still be somewhat limited since the placement of only eight inches of cover soil to serve as the growth medium may limit the establishment of an effective vegetative cover. There would also be additional acres of disturbance under Alternative 3. However, the predicted revegetation success increases to 95 percent. This would result in low negative impacts on wildlife populations, including aquatic macroinvertebrate populations and habitat.

Alternative 3 has the least impact to *cultural resources* of all alternatives considered with an overall low negative impact ranking. Alternative 3 does represent a high and negative impact to the cultural resources of the area because of the existing disturbance. However, as with Alternatives 1 and 2, there would be no additional impact to historic or prehistoric resources. Due to the improved reclamation measures and no mine expansion, a lower impact level would be predicted. This alternative is ranked number 1 (least impacting) on Table 2.3-1.

The *socioeconomic* impacts of Alternative 3 would be essentially the same as those of Alternative 1. In the long term, the quality of life of all groups in the study may improve somewhat more, as compared to other non-expansion alternatives, because of further improvements in the probability of success in reclamation and the correction of the existing water quality problems.

Alternative 3 results in the least negative *land use and recreation* impacts, because of the predicted success of the proposed reclamation. It does have the same impact on land use as Alternatives 1 and 2 regarding the denial of mine expansion; however, the increased potential for successful reclamation improves the possibility for productive future land uses and recreational activities.

Alternative 3 would limit new visible ground disturbance by not allowing mine expansion activities at the Zortman or Landusky mines. Existing disturbance, particularly the mine pit highwalls, would cause significant long-term *visual impacts* to scenic quality of the affected lands. The improved reclamation plan associated with this alternative would reduce existing visual contrasts. VRM Class II objectives would not be met from close in viewpoints (0-5 mi.), and from those viewpoints with views of the mine pit highwalls. VRM Class II objectives would be met from the more distant viewpoints (>5 mi.) without clear views of the mine pit highwalls.

Transportation impacts of Alternative 3 are similar to those of Alternative 2. Although increases in traffic volume would be minor and cause low negative impacts to the transportation network in general, there would be concentrated periods of intense reclamation hauling through the local communities of Zortman and Landusky which would result in medium negative impacts on the residents of those communities. For Alternative 3, approximately 300 truck trips through the towns per day would occur for a duration of 14 to 35 days in the peak year.

No additional gold or silver would be produced. However, this alternative has the greatest impact on *geologic resources* of any of the mine expansion denial alternatives. About 12.5 acres of additional disturbance to mine clay would occur. About 32 acres of new and additional disturbance to mine limestone would occur at the LS-1 and King Creek quarries.

Reclamation activities would result in significant *noise* impacts at Zortman and Landusky. Direct impacts to *air quality* from reclamation activities would generally not be significant. Cumulative fugitive emissions in Zortman could exceed the 24-Hour PM_{10} standard, resulting in a significant impact. Impacts relating to *hazardous materials* would be low and negative for this alternative and any of the non-expansion alternatives since there would be less likelihood for exposure or incidents to occur without expansion and extended mine life.

Alternative 3 is predicted to have the same impacts as Alternatives 1 and 2 on *ACEC*.

Alternative 4

Alternative 4 is the Company Proposed Action, which involves expansion of mining activities at both the Zortman and Landusky mines, plus enhanced reclamation measures for both operations. Reclamation involves some, but not all, of the same modifications proposed under Alternative 3. *Water quality* impacts are predicted to be moderately negative under the Alternative 4 scenario. There is additional land and water resource disturbance related to the mine expansion. The construction of a heap leach pad and waste rock repository in relatively impacted drainage areas is a factor. The construction of the waste rock repository in Carter Gulch on steep terrain makes effective source control and water quality management difficult. These negative impacts are somewhat balanced by the additional reclamation proposed. Although the additional exposure of more potentially acid-generating rock could result in negative impacts, the additional reclamation is expected to limit long-term acid rock drainage.

The reclamation measures proposed under Alternative 4 are expected to result in impacts to *soil resources* similar to those predicted for Alternatives 2 and 3, with moderate negative impacts overall for both erosion and soil productivity. However, the overall acres of soil disturbance increase by about 900 acres because of the proposed expansion. The 2.5H:1V side slopes of Goslin Flats heap leach pad create a moderate erosion hazard. The increased disturbance and vegetation clearing, associated with this alternative. This alternative would result in a cumulative loss of 1,387 acres of forest and 10 acres of riparian vegetation, plus 1.06 acres of wetland. The reclamation plan is expected to be as successful as that proposed for Alternative 3; a 95 percent revegetation rate is predicted. Overall cumulative impacts to *vegetation* are considered moderate negative. Residual water quality impacts on macroinvertebrates are expected to be moderate negative, and the overall *wildlife* impact rating would be moderate negative. This overall ranking for wildlife is based on the conveyor's impact on wildlife movement, the loss of forest habitat, and the increased sedimentation in Alder Gulch, coupled with the expected 95 percent reclamation effectiveness.

Cultural resources impacts for this alternative (and any of the alternatives involving mine expansion) are considered high and negative. This is because the continued operation, expansion, and new activities and facilities would result in substantial impact to the Little Rocky Mountains Traditional Cultural Property and associated Native American values. Also, impacts to both prehistoric archaeological and historic sites would occur under this alternative. A positive effect would be the increase in knowledge concerning Native American and historic mining activity in the Little Rocky Mountains due to impact mitigation. This alternative, along with Alternatives 6 and 7, is ranked number 4 (least favorable) in Table 2.3-1.

Alternative 4 would sustain the direct and indirect economic activity attributable to ZMI's operations for approximately seven additional years. In <u>socioeconomic</u> terms, the level of activity at the Zortman and Landusky mines during the period of extended mineral activity would be similar to that of the past. Therefore, the socioeconomic effect would be to sustain current economic and fiscal, community resource, and social conditions now experienced within the study area. The primary effect would be within Phillips County. Residents of the study area, especially in Phillips County and the communities of Zortman and Malta, would be satisfied by continued ZMI activity, because it would sustain current economic activities and levels of social well-being. Although some Native Americans of the Fort Belknap Indian Reservation may share this view, reservation residents generally would see the continued interference with social and cultural activities, contemporary and heritage cultural sites, and life-styles dependent on the Little Rocky Mountains as a negative impact related to continued mine activities.

Closure and reclamation would be delayed by about seven years but would eventually occur under Alternative 4. The socioeconomic impacts of closure under Alternative 4 would be similar to those described for Alternative 1 and other alternatives. This would be true for both the community at large within the study area, which would experience negative impacts overall, and for the Native American community of the Fort Belknap Indian Reservation, which would view closing as improving the quality of life and social well-being, despite some job losses. The main difference is that for Alternative 4, the impacts would occur later. This may change the relative magnitude of impacts somewhat, because conditions may change within the study area further in the future. However, this is not likely, based on the current outlook for employment, population growth, and social change.

Impacts to *recreation and land use* are considered moderately negative. Major impacts include continued access restrictions to areas within current mine operations, new access restrictions to Goslin Flats (which is used to access Saddle Butte and Azure Cave), and indirect impacts to recreationists in the vicinity of the Goslin Flats heap leach pad. There would also be loss of agricultural land in Goslin Flats and continuation of landscape disturbance in the areas surrounding the existing mining operations. The heap leach pad built in Goslin Flats would cause a major new disturbance visible to travellers on Seven-mile Road and Bear Gulch Road, both which provide access to the town of Zortman and recreational use areas in the Little Rocky Mountains.

New areas of *visual impacts* would be caused by the proposed Goslin Flats heap leach pad and associated conveyor system, and the proposed Carter Gulch waste rock repository. VRM Class II objectives would not be met from close in viewpoints (0-5 mi.), and from those viewpoints with views of the mine pit highwalls. VRM Class II objectives would be met from the more distant viewpoints (>5 mi.) without clear views of the mine pit highwalls.

Impacts on *transportation* for Alternative 4 are similar to those previously described for Alternatives 2 and 3, including the impact of convoyed truck trips through the towns of Zortman and Landusky. However, under Alternative 4, the duration of the impact regarding limitation of public access to the Little Rocky Mountains increases. For Alternatives 1, 2, and 3, duration of limited public access would be only until the year 2001 or 2002; with Alternative 4 the duration extends until the year 2008 because of the extended mine life. The inclusion of the conveyor to Goslin Flats would increase the area subject to public access closure.

Assuming development of reasonably foreseeable future activities, approximately 1.1 million Troy ounces of gold would be produced from the Zortman and Landusky mines, and Pony Gulch deposit. Other impacts to *geologic resources* include disturbance of about 17 additional acres at the clay pits to mine about 1.82 million yd^3 of clay. About 16 additional acres would be disturbed at the LS-1 and King Creek quarries to mine limestone.

Mining and reclamation activities would result in significant *noise* impacts at the towns of Zortman and Landusky, the Pow Wow Grounds, and Azure Cave. Direct and cumulative impacts to *air quality* from mine expansion and enhanced reclamation would be significant at the town of Zortman. Impacts to air quality in Landusky would not be significant. Impacts relating to *hazardous materials* are ranked as moderate negative for this alternative and any of the expansion alternatives, since the expansion and extended mine life increase the likelihood for exposure or incidents to occur.

Impacts to *ACEC* increase under Alternative 4. There is potential for moderate impact to Azure Cave. Alternative 4 involves removal of riparian areas and ponds for the construction of the conveyor and Goslin Flats facilities, and, therefore, a probable water source for bats resident to Azure Cave would be eliminated. These impacts can be mitigated through reclamation of riparian areas and the creation of surface water ponds near the cave. Alternative 4 would have a moderately negative effect on the Little Rocky Mountains and Old Scraggy Peak ACEC nomination. This is because impacts to Native American cultural and historic values would occur due to increased surface and visual disturbance from expanded mining, construction of a conveyor, and construction of the Goslin Flats facilities.

Alternative 5

Alternative 5 is similar to Alternative 4 with agency mitigation added to the reclamation plan and the leach pad located in Upper Alder Gulch. As mentioned above, steep terrain exists in the Carter Gulch/Alder Gulch area, and this would present some *water quality*/ acid rock drainage problems because of the large volume of acid underdrainage requiring capture and treatment. A positive side of this alternative is that both waste rock and leaching facilities would be limited to a single drainage area. Alternative 5 also addresses the issue of flow lost to the north by routing runoff from the reclaimed Landusky pit into King Creek. Also, the additional mitigation measures are expected to have a positive long-term impact on water quality. Therefore, water quality impacts are considered overall moderate and negative for Alternative 5.

Impacts to *soil resources* are expected to be similar to those described for Alternative 3. Possible mitigation would be to use all available cover soil and not limit cover thickness to 8 inches. The *vegetation* reclamation success is 95 percent with the addition of the agency reclamation measures. Overall impacts to vegetation resources are considered moderate negative due to the impacts that would be related to additional disturbance of forest resources (1,550 acres) and riparian vegetation (27 acres). Only 0.2 acres of wetlands would be affected. Impacts on *wildlife resources* are also related to the effectiveness of reclamation (95 percent) and are considered to be similar to that for Alternative 4, with the exception of lower potential for sedimentation and water quality impacts to aquatic life due to the Alder Gulch heap leach facility. Overall, impact to wildlife resources is ranked as a low to moderate negative impact, based on the residual water quality impacts, reduced sedimentation, the extent of disturbance, and the reclamation effectiveness.

Regarding Native American *cultural resources*, the impacts associated with Alternative 5 are similar to those described for Alternative 4, i.e., high impacts for continued operation, expansion, and new activities and facilities. The deletion of a conveyor belt and the leach pad in Goslin Flats would result in no disturbance to known historic or prehistoric resources, making this alternative the most favorable of the expansion alternatives (number 3 on Table 2.3-1).

The *socioeconomic* impacts of mine expansion under Alternative 5 would be somewhat lower but essentially the same as those for Alternative 4. Closure effects of the alternative would be the same as those for Alternative 4. In the long-term, the quality of life, as perceived by all groups within the study area, may improve somewhat because of the greater probability of reclamation success and the correction of existing water quality problems. Some additional benefit to quality of life may be perceived by Native Americans of the Fort Belknap Indian Reservation, because of the restoration of drainage to King Creek.

The *recreation and land use* impacts related to Alternative 5 are considered similar to those for

Alternative 4. Major impacts again consist of continued access restrictions to areas affected by current mine operations and the continuation/expansion of landscape disturbance in areas surrounding existing mining operations, which results in impacts to the recreational setting of the area.

Alternative 5 involves continued and expanded activities at the Zortman and Landusky mines. New disturbance would generally be confined to areas adjacent to existing disturbances which would lessen the *visual impact*. VRM Class II objectives would not be met from close in viewpoints (0-5 mi.), and from those viewpoints with views of the mine pit highwalls. VRM Class II objectives would likely be met from the more distant viewpoints (>5 mi.) without clear views of the mine pit highwalls.

Transportation impacts would be similar to those described for Alternative 4, with a slight increase in the duration of the number of convoy truck trips through the town of Zortman.

Approximately 1.0 million Troy ounces of gold would be produced from the Zortman and Landusky mines as a result of implementation of this Alternative. Impacts to other *geologic resources* include 20.5 additional acres of disturbance at the clay pits to mine about 1.9 million yd^3 of clay. About 16 additional acres would be disturbed at the LS-1 and King Creek quarries to mine about 776,000 yd^3 of limestone.

Mining and reclamation activities would result in significant *noise* impacts at Zortman and Landusky, the Pow Wow Grounds, and Azure Cave. Noise associated with Alternative 5 would have the least impact of any of the mine expansion alternatives. Impacts relating to *hazardous materials* are ranked as moderate negative for this alternative and any of the expansion alternatives, since the expansion and extended mine life increase the likelihood for exposure or incidents to occur.

Direct and cumulative impacts to *air quality* from mine expansion and enhanced reclamation would be significant at the town of Zortman. Impacts to air quality in Landusky would not be significant.

Impacts to *ACEC* under Alternative 5 are similar to those described for Alternative 4, with a slightly lower impact expected on the proposed Little Rocky Mountains ACEC, since this alternative does not include a conveyor or facilities in Goslin Flats.

Alternative 6

Alternative 6 is similar to Alternative 5, but with the Zortman Mine waste rock disposal facility located at Ruby Flats (near the existing Goslin Flats leach pad). From a *water quality* perspective, this alternative is expected to best reduce any potential water quality problems derived from the new facilities, since construction is in an environment with a gentle hydraulic gradient and underlying saturated, low permeability bedrock. Additionally, Alternative 6 routes surface runoff from the reclaimed Landusky pit complex to the south into Montana Gulch thereby further reducing flows to the north of the Little Rocky Mountains. Overall, water quality impacts are ranked low and negative for Alternative 6 for these reasons.

Soil resources impacts are expected to be similar to those described for Alternative 3. Overall soil disturbance increases to 2,422 acres, however. Total forest disturbance decreases to 1,245 acres, compared to Alternative 5, and the disturbance of riparian and wetlands decreases under Alternative 6. Effectiveness of reclamation is predicted to be approximately 95 percent. Impacts are rated moderate negative for vegetation. *Wildlife* impacts are ranked as low to moderate negative. This reflects the loss of habitat and increased sedimentation plus the expected reduced water quality impacts due to the increased reclamation and the location of the facilities in the Goslin Flats area.

Cultural resources impacts for Alternative 6 are considered to be high and negative, similar to the impact rankings for all expansion alternatives. This alternative, along with Alternatives 4 and 7, ranked number 4 (least desirable) in Table 2.3-1.

The *socioeconomic* impacts of mine expansion under Alternative 6 would be lower than that of Alternative 4 because less time would be devoted to mining, and ZMI's operations would be closed a full year earlier than under the other expansion alternatives. Closure effects of Alternative 6 would be the same as those of Alternative 4. In the short term, locating both the heap leach and waste rock repository in the Goslin Flats area may increase impacts somewhat to recreation south of the Little Rocky Mountains. In the long term, the quality of life as perceived by all groups within the study area, may improve somewhat more because of the greater probability of reclamation success and the correction of existing water quality problems.

Alternative 6 would increase the amount of highly visible land disturbance in the Goslin Flats and Ruby Flats areas which would cause a major increase in impacts to the recreational setting of surrounding land. Because of this, the impacts on dispersed *recreation and land use* for Alternative 6 are considered high and negative in comparison to the other mine expansion alternatives. There would be continued access restrictions to the areas affected by current mine operations and a new access restriction to Goslin Flats which is used to access Battle Butte and the Azure Cave. There would be loss of agricultural land in Goslin Flats and Ruby Flats. However, there would be continuation of mining as a land use in the Little Rocky Mountains.

Alternative 6 involves continued and expanded activities at the Zortman and Landusky mines. New disturbance in the Goslin and Ruby Flats area would increase, causing a significant increase in *visual impacts* to that area. VRM Class II objectives would not be met from close in viewpoints (0-5 mi.), and from those viewpoints with views of the mine pit highwalls. VRM Class II objectives would likely be met from the more distant viewpoints (>5 mi.) without clear views of the mine pit highwalls.

Transportation impacts under Alternative 6 would be very similar to those described for Alternatives 4 and 5. Public access to the Little Rocky Mountains would be limited through the year 2007, a slight decrease over Alternatives 4 and 5.

Including reasonably foreseeable future activities, approximately 1.1 million Troy ounces of gold would be produced from the Zortman and Landusky mines, and Pony Gulch deposit. Other impacts to *geologic resources* include 21 additional acres of disturbance at the clay pits to mine clay. About 16 additional acres would be disturbed at the LS-1 and King Creek quarries to mine limestone.

Mining and reclamation activities would result in significant *noise* impacts at Zortman and Landusky, the Pow Wow Grounds, and Azure Cave. Direct and cumulative impacts to *air quality* from mine expansion and enhanced reclamation would be significant at the Zortman. Impacts to air quality in Landusky would not be significant. Impacts to air quality from Alternative 6 would have the least overall impact of any of the mine expansion alternatives.

Regarding *ACEC*, Alternative 6 is predicted to have a moderate negative impact on Azure Cave and on the Little Rocky Mountains and Old Scraggy Peak ACEC nominations, similar to Alternative 4.

Alternative 7 (Preferred)

Using the existing disturbed areas for waste rock storage eliminates a significant impact to several resource areas. The water balance reclamation covers would enhance the evapotranspiration component of the water budget by providing a thicker soil profile and thus greater rooting depth. These improvements have a positive impact on predicted water quality effects of the proposed mine expansion. The improved soil profile would be expected to provide water storage when the plant cover is dormant, and the impact analysis shows that the reclamation covers would be effective in reducing infiltration. Therefore, overall *water quality* impacts under Alternative 7 are predicted to be low negative, with a positive moderate impact resulting from the predicted reclamation success.

Similarly, the predicted success of reclamation would lessen the amount of soil loss. Also, Alternative 7 results in less soil disturbance than the other mine expansion alternatives (2,083 acres). The overall impact ratings for *soil resources* are moderate negative for both soil productivity and soil erosion. The placement of 3.5 feet of soil on the disturbed areas would provide a superior growth medium for supporting long term cover of protective vegetation in comparison to the other alternatives. This would also result in a positive effect on reclamation success for *vegetation* impacts. The percent effectiveness of the reclamation plan is predicted to be 99 percent under Alternative 7, the highest of any alternative. Overall, vegetation impacts are ranked low negative. Overall impacts to *wildlife* resources are considered negligible to low and negative under Alterative 7. This is because disturbance-related impacts are offset by the enhanced reclamation and resultant increase in water quality, the lower acres of habitat lost because of the use of existing disturbed area for waste rock disposal, and the additional mitigation involving planting of grasses and forbs for wildlife use.

Cultural resources impacts under Alternative 7 are considered high and negative, similar to those under Alternatives 4 through 6. This is because of the disturbance associated with the mine expansion, which would result in low negative impacts to prehistoric archaeological and historic sites, relatively high and negative impacts to Native American cultural resources. This alternative, along with Alternative 4 and 6, is ranked as least favorable (number 4) in Table 2.3-1.

The *socioeconomic* impacts of mine expansion under Alternative 7 would be essentially the same as those of Alternative 4. Closure effects of Alternative 7 also would be the same as those of Alternative 4. In the long-term, the quality of life, as perceived by all groups within the study area, may improve further because surface disturbance would be reduced and there would be a greater probability of reclamation success and correction of existing water quality problems. Some additional benefits to quality of life may be perceived by Native Americans of the Fort Belknap Indian Reservation because of the restoration of drainage to King Creek under this alternative and the effects of the enhanced reclamation plan aimed at increasing wildlife habitat.

Recreation and *land use* impacts under this alternative are still considered moderate and negative. Alternative 7 impacts would generally be the same as those described for Alternative 4, except for the slightly less disturbance at Zortman Mine, which would limit the visual impacts which indirectly effect the recreation setting of surrounding lands. Alternative 7 still presents the continued access restrictions and loss of agricultural lands in Goslin Flats, with continuation of mining as a land use for the Little Rocky Mountains.

The waste rock dump at the Zortman Mine would be placed on existing disturbed land, reducing *visual impacts*. VRM Class II objectives would not be met from close in viewpoints (0-5 mi.), and from those viewpoints with views of the mine pit highwalls. VRM Class II objectives would likely be met from the more distant viewpoints (>5 mi.) without clear views of the mine pit highwalls.

Transportation impacts under Alternative 7 would be considered high and negative because of the restriction of public access to the Little Rocky Mountains through the year 2008 and medium negative with respect to truck convoys through Zortman. However, there would be no significant impact for Landusky, since reclamation convoys would not pass through that town.

Including reasonably foreseeable developments, approximately 1.1 million Troy Ounces of gold would be produced from the Zortman and Landusky mines, and Pony Gulch deposit. Impacts to other *geologic resources* include 3 additional acres of disturbance at the Seaford clay pit to mine clay. About 16 additional acres would be disturbed at the LS-1 and King Creek quarries to mine limestone. Alternative 7 would result in the least disturbance to clay pits and limestone quarries of any of the mine expansion alternatives. However, new areas would be mined on Ruby Flats for reclamation cover soil.

Mining and reclamation activities would result in significant *noise* impacts at the towns of Zortman and Landusky, the Pow Wow Grounds, and Azure Cave. Direct and cumulative impacts to *air quality* from mine expansion and enhanced reclamation would be significant at the town of Zortman. Impacts to air quality in Landusky would not be significant. Impacts relating to *hazardous materials* are ranked as moderate negative for this alternative and any of the expansion alternatives since the expansion and extended mine life increase the likelihood for exposure or incidents to occur.

Impacts to *ACEC*, under Alternative 7 are similar to those predicted for Alternatives 4 and 6.

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LIST OF ACRONYMS

ABA	Acid-Base Accounting
ACEC	Area of Critical Environmental Concern
ACO	Administrative Compliance Order
ADT	Average Daily Traffic
AGP	Acid-Generating Potential
AIRFA	American Indian Religious Freedom Act
AMD	Acid Mine Drainage
ANB	Average Number Belonging
ANFO	Ammonium Nitrate and Fuel Oil
ANP	Acid Neutralizing Potential
APE	Area of Potential Effect
AQD	Air Quality Division, Montana Department of Environmental Quality
ARD	Acid Rock Drainage
ARM	Administrative Rules of Montana
ATSDR	Agency for Toxic Substance and Disease Registry
BACT	Best Available Control Technology
BAT	Best Available Technology
BCI	Bat Conservation International
BIA	U.S. Bureau of Indian Affairs
BLM	U.S. Bureau of Land Management
BP	Before Present
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environment Response, Compensation and Liability Act
CERCLIS	CERCLA Information System (potential Superfund sites list)
CERT	Council of Energy Resource Tribes
CFR	Code of Federal Regulations
CMR	Charles M. Russell National Wildlife Range
COE	U.S. Army Corps of Engineers
CPA	Company Proposed Action
CWA	Clean Water Act
DHES	Montana Department of Health and Environmental Sciences
DMR	Discharge Monitoring Reports
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
FBIR	Fort Belknap Indian Reservation
FLPMA	Federal Land Policy and Management Act of 1976
GBWRR	Gold Bug Waste Rock Repository
GWPCS	Groundwater Pollution Control System
HDPE	High Density Polyethylene
HRB	Hard Rock Bureau, Montana Department of Environmental Quality
HELP	Hydraulic Evaluation of Landfill Performance
IHS	Indian Health Service
IMP	Island Mountain Protectors

KOP	Key Observation Point
LAD	Land Application Disposal
LCNHT	Lewis and Clark National Historic Trail
LRM	Little Rocky Mountains
MBF	Thousand Board Feet
MCA	Montana Code Annotated
MDFWP	Montana Department of Fish, Wildlife and Parks
MEPA	Montana Environmental Policy Act
MFSA	Montana Major Facility Siting Act
MGWPCS	Montana Groundwater Pollution Control System
MMCF	Million Cubic Feet
MMRA	Montana Metal Mine Reclamation Act
MNHP	Montana Natural Heritage Program
MOU	Memorandum of Understanding
MPDES	Montana Pollutant Discharge Elimination System
MPM	Montana Principal Meridian
MSL	Mean Seal Level
NAAQS	National Ambient Air Quality Standards
NAG	Non-Acid Generating
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NNP	Net Neutralization Potential
NPDES	National Pollutant Discharge Elimination System
NPNHT	Nez Perce National Historic Trail
PSD	Prevention of Significant Deterioration
PVC	Polyvinyl Chloride
PWSA	Public Water Supply Act
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RMA	Recreation Management Area
RMP	Resource Management Plan
ROD	Record of Decision
RSPS	Reclamation Surface Performance Study
RUSLE	Revised Universal Soil Loss Equation
SARA	Superfund Amendments and Reauthorization Act
SHPO	Montana State Historic Preservation Office
TCP	Traditional Cultural Property
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
USDOC	U.S. Department of Commerce
USDOI	U.S. Department of the Interior
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VRM	Visual Resource Management
WQA	Water Quality Act
WQD	Water Quality Division, Montana Department of Environmental Quality
WSA	Wilderness Study Area
ZMI	Zortman Mining, Inc.

UNITS OF MEASURE

mg/l	milligrams per liter
mg/Kg	milligrams per kilogram
tpy	tons per year
lb/ton	pounds per ton
ppm	parts per million
gpm	gallons per minute
cm/sec	centimeters per second
cy	cubic yards
cfs	cubic feet per second
Kg/day	kilograms per day
ft/day	feet per day
ft^2/day	square feet per day
mph	miles per hour
$\mu g/m^3$	micrograms per cubic meter
μg/Kg	micrograms per kilogram
dB	decibel
g	gravity
g/Kg	grams per kilogram
KT	kiloton

CHAPTER 1.0

INTRODUCTION - PURPOSE AND NEED

This Draft Environmental Impact Statement (EIS) discloses the environmental consequences associated with expansion of the Zortman and Landusky mines in north central Montana and modified reclamation plans at both mines. The Company Proposed Action (to extend the mine life at the Zortman and Landusky mines and reclaim both mines), and alternatives to the proposed action have been evaluated by the Montana Department of Environmental Quality (DEQ), Hard Rock Bureau (formerly Montana Department of State Lands - DSL), U. S. Department of Interior, Bureau of Land Management (BLM), and a third-party consultant (Woodward-Clyde). Environmental issues and concerns expressed by the public and other agencies during EIS scoping have been considered and incorporated into this analysis. The Draft EIS is prepared under requirements of the National Environmental Policy Act (NEPA), for BLM purposes; and the Montana Environmental Policy Act (MEPA), for DEQ purposes.

This chapter of the EIS includes:

1. A brief description of the proposed Zortman and Landusky mine extensions and reclamation measures and a permitting history of each;

2. An explanation of the purpose and need for the project, and for agency preparation of the EIS;

3. A summary of the steps taken in the EIS process, including requirements for public participation;

4. A list of the major authorities and statutory responsibilities of the various agencies which have a role in the environmental analysis or permitting decision; and

5. A summary of the issues and concerns expressed by the public during project scoping.

1.1 PROJECT HISTORY

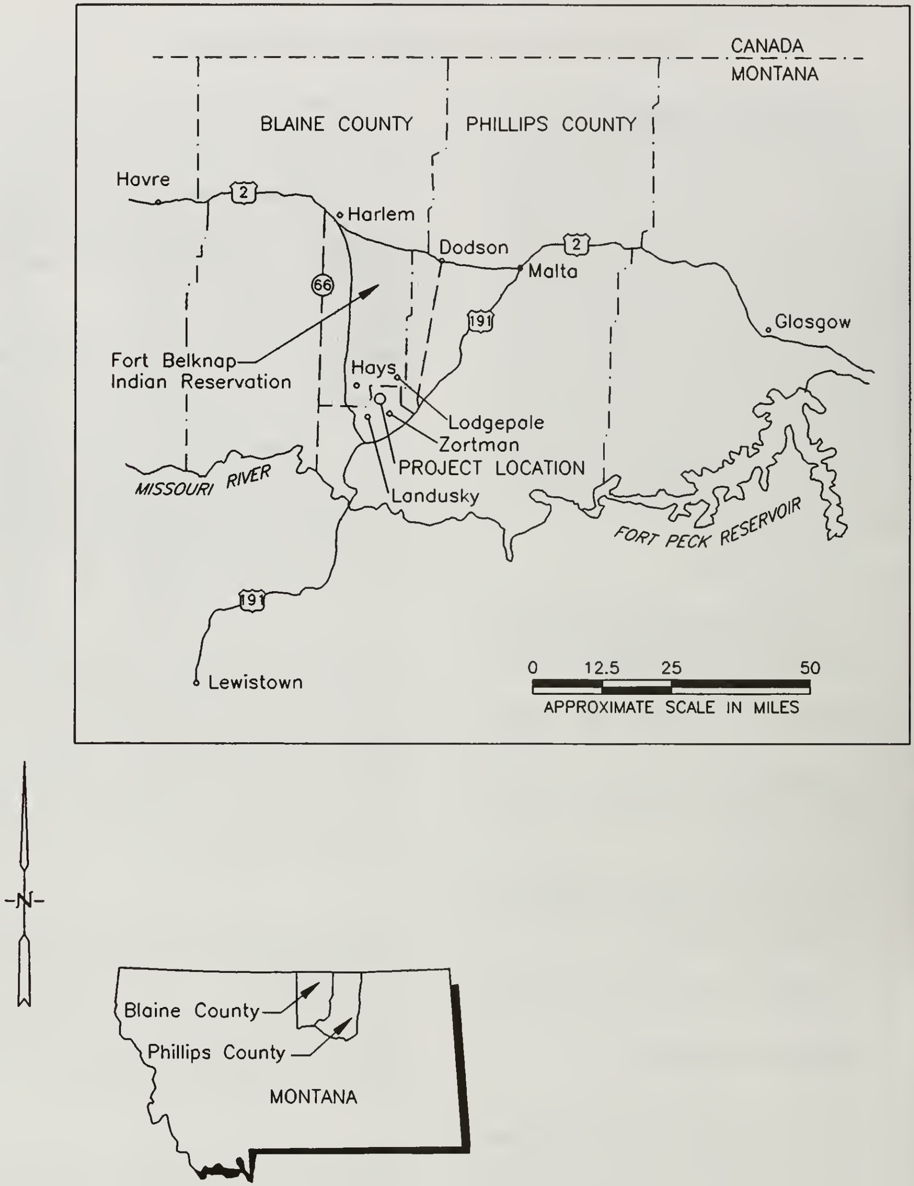
Zortman Mining, Inc. (ZMI) since 1979 has had two active gold mines in close proximity in the Little Rocky Mountains of north central Montana. The Zortman Mine is located in Sections 7, 17, and 18, Township 25N, Range 25E, Montana Principal Meridian (MPM); while the Landusky Mine is west of the Zortman Mine in Sections 14, 15, 22, and 23, Township 25N, Range 24E, MPM. Both mines are near the southern boundary of the Fort Belknap Indian Reservation in the southwest corner of Phillips County (Figure 1-1). The towns of Hays and Lodgepole are located in the southern portion of the Reservation, just to the north of the mountains. The town of Landusky is in the southwest portion of the Little Rocky Mountains, about 0.5 mile south of the Landusky Mine. The town of Zortman is about 1 mile south of the Zortman Mine, on the southern edge of the Little Rocky Mountains.

Historic mining has occurred in the area over the past century. Photos of the Zortman and Landusky mining area and towns in 1977 (Figures 1-2 and 1-3) show the amount of disturbance before the era of large-scale, modern mining began (about 1979). Note that at Zortman, disturbance in 1977 was confined primarily to the Linda K Mine in the northwest (upper left) of the picture, to the Ruby Mine and Mill and mill tailing deposition in Ruby Gulch in the center of the picture, and to numerous access and exploration roads. The town of Zortman (arrow, lower right) appears much as it does today.

At Landusky, the photo from 1977 shows disturbance from historic mining activity at the Gold Bug and Little Ben mines, among the exploration/drill roads in the center (Figure 1-3). At the top of the photo, the August Mine, mill, and tailing dam remnants are present, with tailing extending downstream along King Creek towards the Fort Belknap Indian Reservation. Remains of the tailing dam and tailing are evident today. The town of Landusky (arrow, lower center) has remained mostly unchanged in appearance through the decades (see Section 4.10, Socioeconomics).

Figures 1-2 and 1-3 are contrasted to Figure 1-4, an aerial photo showing disturbance in 1993. In Figure 1-4, the distance between the two mines is about 1.5 miles. The Zortman Mine and Ruby Gulch tailing are in the foreground for reference. The photo illustrates the amount of land disturbance which has occurred since large-scale mining began in 1979. The disturbance acreages are detailed under the discussions of each mine below and in the accompanying tables.

In 1979, a Draft EIS pertaining to both mines was prepared by the Montana Department of State Lands (DSL 1979a). The Final EIS documentation (responses to comments on the DEIS and adoption of the Draft as Final) was issued May 17, 1979 (DSL 1979b). These documents discussed proposed operations of the Zortman Mining Company (Gulf Resources) to develop



SOURCE: DSL/BLM 1990.

LOCATION OF ZORTMAN AND LANDUSKY MINE EXTENSIONS

MONTST

FIG. 1–1

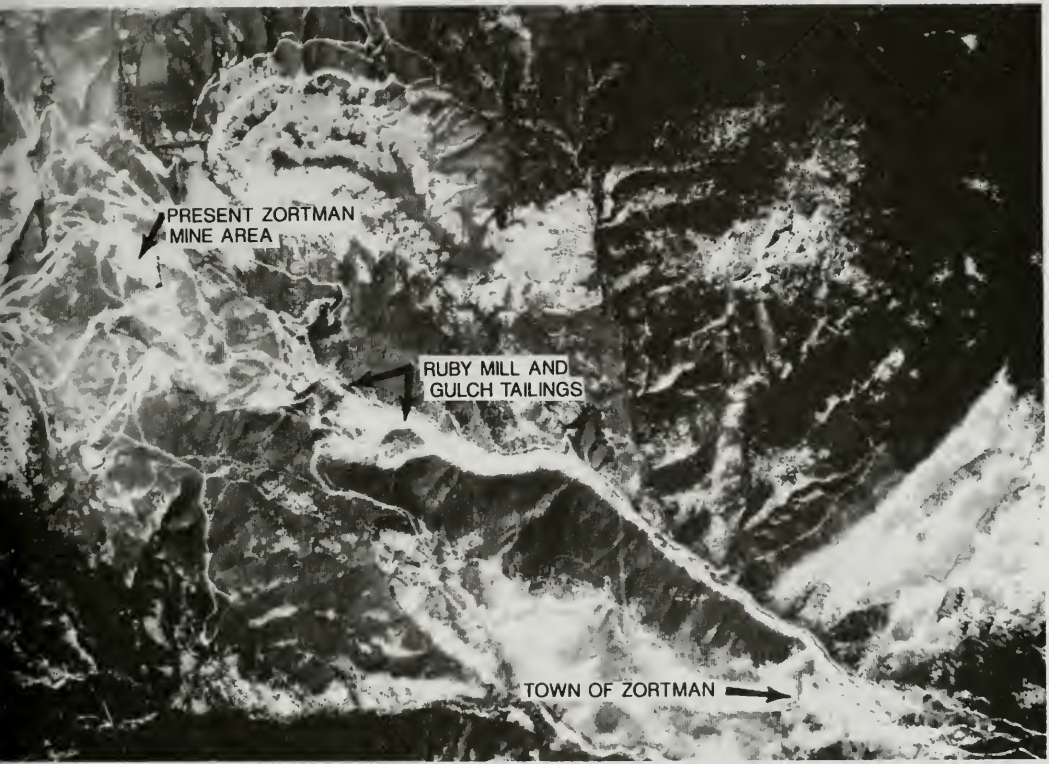


Figure 1-2 The Zortman Mine area (upper left) and town site (lower right, arrow) showing disturbance as of June 1977. Ruby Gulch tailings are in center of photo (ZMI 1994).

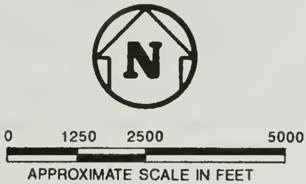


Figure 1-3 The Landusky Mine area (center, with exploration roads) and town site (arrow, bottom) are shown in June, 1977. Minor mining disturbances and remains of the August Mine tailings (top) are noted. (ZMI 1994).

Figure 1-4 Zortman Mine (foreground) and Landusky Mine (background) showing areas of disturbance (as of 1993) in the Little Rocky Mountains, looking west. Roads and cleared areas from past logging, forest fires, and mineral exploration are also shown (ZMI 1993).

273 acres; and of the Landusky Mining Company (Wharf Resources) to develop 256 acres. Baseline conditions were described and impacts assessed for the physical, biological, and social and economic environments. These early documents formed much of the basis for the discussion of impacts 1979-present, as analyzed in this current Draft EIS.

A permitting history of each mine is also useful to an understanding of the current situation, as presented in the next sections.

1.1.1 Zortman Mine

Zortman Mining, Inc. (ZMI), a wholly-owned subsidiary of Pegasus Gold Corporation of Spokane, Washington, holds an approved Federal Plan of Operations MTM-77778; and State Operating Permit No. 00096 to mine and recover gold and associated minerals at the Zortman Mine. The original State permit authorizing mining at the Zortman Mine was issued by the DSL in 1979. Subsequent revisions to the operating and/or reclamation plans have been analyzed pursuant to the Montana and National Environmental Policy Acts (MEPA and NEPA) to allow increases in the disturbance area to that shown on Figure 1-4. These actions are summarized in Table 1-1.

1.1.2 Landusky Mine

At the Landusky Mine, ZMI holds an approved Federal Plan of Operations MTM-77779 and State Operating Permit No. 00095 for mining and reclamation activities. As shown in Table 1-2, ZMI's State Operating Permit 00095 was originally issued June 6, 1979. Subsequent revisions to the operating and/or reclamation plans at Landusky have also been analyzed in this EIS pursuant to MEPA and NEPA to allow increases in the disturbance area to that shown on Figure 1-4.

1.1.3 Other Documentation and the Acid Rock Drainage Issue

Other events are worthy to note regarding acid rock drainage (ARD), one of the key EIS issues. A chronology is as follows:

- May 1992 - ZMI submits Zortman Mine Life Extension Application.
- Summer 1992 - Based on ongoing field inspections and a review of water quality monitoring data (1985-1992), BLM and DSL note that ZMI's approved operating and reclamation plans are not adequate to address ARD.
- November 1992 - BLM (1992a) transmits a letter to ZMI, and ZMI responds, regarding development of low pH in effluent from various facilities.
- January-February 1993 - DSL (1993a) send two letters to ZMI with situation reports requiring changes in mine operations to address ARD. ZMI responds with proposed changes regarding water quality problems.
- April 1993 - BLM State Director issues decision (1993a) requiring modification of Zortman and Landusky Mine plans to prevent unnecessary and undue degradation from ARD.
- July 1993 - ZMI provides remediation plans for Landusky Mine and revises Zortman expansion plans to include remediation of existing facilities.
- November 1993 - Supplemental EA for Landusky, specifically addressing ARD control, is issued (DSL/BLM 1993a).
- March 1994 - The Decision Record on corrective measures to address ARD at Landusky (DSL/BLM 1994a) is issued, withholding approval of final long-term reclamation and closure designs until this EIS is prepared. The agencies also decide to include corrective measures for the Landusky Mine within the scope of the environmental impact analysis for the Zortman Mine extensions.

TABLE 1-1

AMENDMENTS TO OPERATING PERMIT 00096 AND PLAN OF OPERATIONS MTM-77778 (ZORTMAN)

Permit or Amendment No.	Year	Purpose[1]
Operating Permit 00096 and Plan of Operations MTM-77778	1979	Includes pit, 79, 80/81 leach pad, process plant, ponds, OK dump; total disturbance 273 acres, permit boundary encloses 619 acres
Amendments		
001	1979	Access road up Ruby Gulch - total permitted disturbance 276 acres
002	1980	6300 foot haul road - increase disturbance to 281 acres
003	1980	New location for process plant and ponds - no change in disturbance - total permitted disturbance 281 acres
004	1982	Correction for nondisturbance - total permitted disturbance 155 acres
005	1982	83/84 leach pad - total permitted disturbance 186 acres
006	1983	83/84 leach pad expansion - total permitted disturbance 267 acres
007	1984	Expansion of pit, pads, and dumps - total permitted disturbance 391 acres
008	1984	85/86 leach pad - total permitted disturbance 436 acres
009	1987	Land application area, increase in permit boundary to enclose 961 acres - total permitted disturbance 436 acres
009A	1987	Storm water ponds - no change in total permitted disturbance 436 acres
010	1988	89 leach pad and correction for nondisturbance - 401 acres total permitted disturbance
011	1989	Revised reclamation plan, no new disturbance - 401 acres total permitted disturbance - permit boundary encloses 961 acres

Notes:

[1] The project areas and features are explained and mapped in detail in Chapter 2 of this Draft EIS.

Source: DSL 1995a.

TABLE 1-2

AMENDMENTS TO OPERATING PERMIT 00095 AND PLAN OF OPERATIONS MTM-77779 (LANDUSKY)

Permit or Amendment No.	Year	Purpose[1]
Operating Permit 00095 and Plan of Operations MTM-77779	1979	Permit boundary encloses 530 acres; total allowable disturbance 256 acres
Amendments		
001	1980	Leach pad expansion - increase disturbance to 267 acres
001A	1982	Decrease disturbance to 163 acres due to increased resolution of aerial mapping
002	1982	Soil stockpile and access road; increase disturbance to 282 acres
002A	1982	Decrease disturbance to 194 acres due to increased resolution of aerial mapping
003	1983	Montana Gulch leach pad and pit expansion - increase disturbance to 251 acres
004	1984	Montana Gulch waste rock dump and pit expansion - increase disturbance to 383 acres
005[2]	1985	
006	1985	Queen Rose pit expansion - increase permit area to 830 acres
007	1986	Mill Gulch (87) leach pad
008	1988	Mill Gulch waste rock dump
009	1990	Mill Gulch leach pad expansion
010	1990	Sullivan Park (91) leach pad (total permit area 1,287 acres and total disturbance area 814 acres)
---	1994	Interim reclamation and corrective measures approved

Notes:

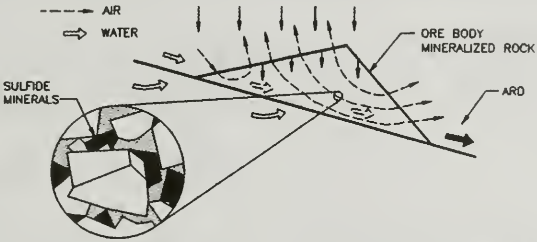
[1] The project areas and features are explained and mapped in detail in Chapter 2 of this Draft EIS.
[2] Amendment was not issued.

Source: DSL/BLM 1991a.

Acid Generation

Acid produced by Acid Rock Drainage (ARD) or Acid Mine Drainage (AMD), is a key issue of concern at the Zortman and Landusky Mines. It is also a problem for miners and officials responsible for mine restoration and environmental protection throughout the United States, North and South America, and the world. In the U.S., our regulatory environment is now focusing attention on ARD issues at many mining sites.

Simply stated, ARD is produced when rock containing sulfides (such as iron sulfide, or the "fools gold" familiar to many of us) is exposed to air and water during mining operations. Water traveling through the rock becomes acidic, and sometimes contains metals such as lead, arsenic, zinc, copper, and silver. Bacteria present in mine water can accelerate the rate of acid generation, because of their ability to oxidize sulfide-bearing metals.



Many gold ore bodies, such as those at the Zortman and Landusky Mines, have the right conditions for ARD (which has been detected in many facilities). Impacts can occur to aquatic plants and small animals, fish, and humans, as they are affected by degraded water quality in surface streams and drinking water wells.

Sources: See *Suggested Readings* in the References Section regarding articles and reports on acid generation. Figure above adapted from Hutchinson and Ellison 1992.

1.2 PROPOSED ACTION

1.2.1 General Description

At the Zortman Mine, the current permit area encloses 961 acres of land, of which 401 acres are currently disturbed. ZMI has submitted a new application seeking approval for expanded mining and reclamation activities. The proposed project includes mining an additional 80 million tons of ore and 60 million tons of waste rock, as well as enhanced reclamation for existing disturbances. Projected production is 21 to 28 million tons per year. Mining is proposed to proceed at these rates for approximately 5 to 8 years.

At Landusky, the current permit area encloses 1,287 acres and 814 acres of disturbance. The proposed expansion includes mining an additional 7.6 million tons of ore and 7 million tons of waste rock, and enhanced reclamation of existing pits, leach pads, and waste rock dumps.

Approximately 597 additional acres of BLM lands (of the total new disturbance of 955 acres) would be affected by the Company Proposed Actions for the Zortman and Landusky mine extensions and reclamation activities. This is in addition to the 1,215 acres presently classified as disturbed by both mines. Therefore, up to 63 percent of the new total surface disturbance could occur on BLM lands.

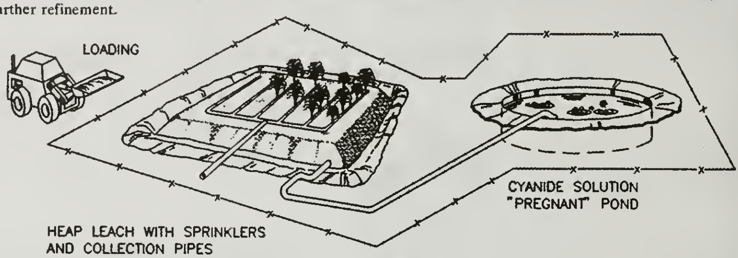
1.2.2 Zortman Mine

Under the proposed action to expand the Zortman Mine, existing mine pits would be widened and deepened, and a new waste rock would be constructed. A conveyor system to transport ore would extend from the mine process area southeast approximately 11,000 feet to a new leach pad in Goslin Flats. Open-pit mining methods would continue to be used to remove gold, as well as silver oxide and sulfide ores. Approximately 60,000 to 80,000 tons of ore would be processed per day, 350 days per year.

Zortman Mining, Inc. submitted the proposed amendment to the Zortman Plan of Operations MTM-77778 and Operating Permit No. 00096 to the agencies in May, 1992, requesting a modification to the Zortman mining permit. DSL and BLM reviewed the application and notified ZMI that the application was

Cyanide Use in Mineral Processing

Cyanide heap leaching is a relatively new technology in mining that is used for recovery of microscopic gold particles typically found in low-grade ore deposits. The ore zones at the Zortman and Landusky Mines contain such microscopic gold. Past and current mine activities, and proposed mining, include the use of this process to extract gold from the host rock. Simply stated, low grade ore is drilled, blasted loose, crushed, and loaded into trucks or conveyors for transfer to the leach pad. The pad is not just an ore dump, but a carefully constructed series of flat-topped heaps. It is lined with plastic and/or clay to prevent loss of cyanide solution. The leach pad is further constructed in lifts, which are sequentially sprayed with a cyanide solution using a surface sprinkler system, much like those used to keep big lawns irrigated. A "pregnant solution" containing the gold particles is collected, processed in tanks or treatment cells, and heated in a furnace to form impure gold/silver doré bars for further refinement.



Environmental concerns regarding cyanide use include harmful concentrations of cyanide in water. Occasionally, low levels of cyanide have been detected in groundwater at the Zortman and Landusky mine sites. Properly-managed cyanide use will not produce harmful effects to wildlife and humans. Cyanide releases to the environment, whether gas or liquid, can degrade quickly into less harmful ammonium, nitrate or carbon dioxide. Various treatment processes are used at the mines to detoxify the cyanide heaps, ponds and other facilities; and nets are used on ponds to prevent use by waterfowl and shorebirds.

Sources: See *Suggested Reading* in the References Section regarding articles on cyanide use and management.

incomplete and requested additional information regarding the proposed action. After further rounds of information submittal by ZMI, and requests for clarification or additional information by DSL and BLM, the application was determined to be complete on July 9, 1993. A final decision on the amendment application will be made after this EIS is completed.

1.2.3 Landusky Mine

At the Landusky Mine, an additional 7.6 million tons of ore and 7 million tons of waste rock would be mined as part of the overall mining and reclamation plan.

ZMI would continue to use open-pit mining and heap-leach mineral processing to extract gold and silver from ore. The quantity of ore to be mined under this application would constitute slightly less than one year of additional mining at the facility. No additional workers are anticipated to be hired under this expansion proposal.

The mined material would come from the August and South Gold Bug pits (see detailed figures in Chapter 2.0). Various tables in Chapter 2.0 provide a summary of currently permitted and disturbed acreages, proposed increases in disturbance area, and tons of ore and waste, both mined and proposed to be mined. A final decision on modifications to Plan of Operations MTM-77779 and Operating Permit No. 00095 for Landusky will similarly await completion of this EIS.

1.3 PURPOSE AND NEED FOR ACTION

Gold is produced and used on a world-wide basis. Global gold supply in 1993 was estimated to be 3,538 tons (Goldfields Mineral Services, Ltd. 1994). Domestic mines continued to produce at near record levels during 1994, maintaining the United States' position as the world's second largest gold-producing nation, after the Republic of South Africa. U.S. production of 330 tons in 1994 accounted for about 15 percent of world-wide gold production (USDI Bureau of Mines 1995). In the U.S. in 1994, gold was produced from about 200 lode mines, about a dozen large placer mines, and numerous small placer mines.

Global demand has increased significantly since 1980. Jewelry is the largest single use, involving an estimated 70 percent of the gold supply. Gold held for investment was the second largest use (gold jewelry often doubles as an investment). Other uses, such as electronics, dental, coinage and other miscellaneous industrial uses, comprised about 15 percent of total demand (Goldfields Mineral Services, Ltd. 1994).

Approval of ZMI's applications for permit modifications at Zortman and Landusky as a result of this environmental impact analysis would allow continued extraction (mining), beneficiation (heap leaching), and recovery of gold and other metals from the two mines for a period of 5 to 8 more years. ZMI has cited the mines' beneficial economic impact on tax revenues and the communities near both mines. The mine extensions would continue to employ approximately 260 persons through project construction and mine operation, as the existing operations phase out. An additional 5-25 persons would be employed during the approximate 10-year post-operations reclamation period (see Section 4.10, Socioeconomics).

The agencies' purpose and need for this action is to address two basic issues: (1) <u>mineral development</u> needs; and (2) <u>environmental protection</u> needs. In the first matter, the lands in the project area are either private lands or public lands open to mineral development and the operator has properly filed for approval of mineral development activity under relevant state and federal laws and regulations. Secondly, the agencies have determined that existing operation and reclamation plans are not adequate to prevent unacceptable impacts from ARD. As stated previously (Section 1.1.3), modified reclamation plans are required.

The agencies' consideration of the permit modifications proposed by ZMI, as detailed above, constitute state and federal actions which may significantly affect the quality of the human environment under MEPA and NEPA, necessitating the preparation of an EIS.

This Draft EIS presents the agencies' analysis of environmental impacts under NEPA and MEPA regulations and guidelines. The DEQ and BLM will use the analysis in this Draft EIS to make final decisions regarding issuance of the Operating Permit and Plan of Operations. The responsibilities of each agency are described further in the sections which follow. Other state and federal agencies may use this Draft EIS as the NEPA/MEPA document required for their permit decisions.

1.4 THE EIS PROCESS

The Montana Environmental Policy Act requires that a detailed statement regarding environmental impacts, alternatives, and other requirements be prepared for proposals of projects or major actions which significantly affect the quality of the human environment (§75-1-201(1)(b)(iii), MCA). DEQ (formerly DSL) rules implementing MEPA at ARM 26.2.644 require preparation of an EIS if impacts associated with a proposed action may have a significant adverse effect. Similarly, NEPA requires that if any major action taken by a federal agency might significantly affect the quality of the human environment, an EIS must be prepared (NEPA, P.L. 91-190, 42 U.S.C 4321 <u>et seq</u>., Section 102(2)(c)). DEQ and BLM have determined that an EIS is required in order to make a permitting decision regarding ZMI's application.

The steps in development of the Zortman and Landusky EIS, and where such steps are addressed in this document, are shown on Figure 1-5.

1.5 REGULATORY AUTHORITY AND RESPONSIBILITIES

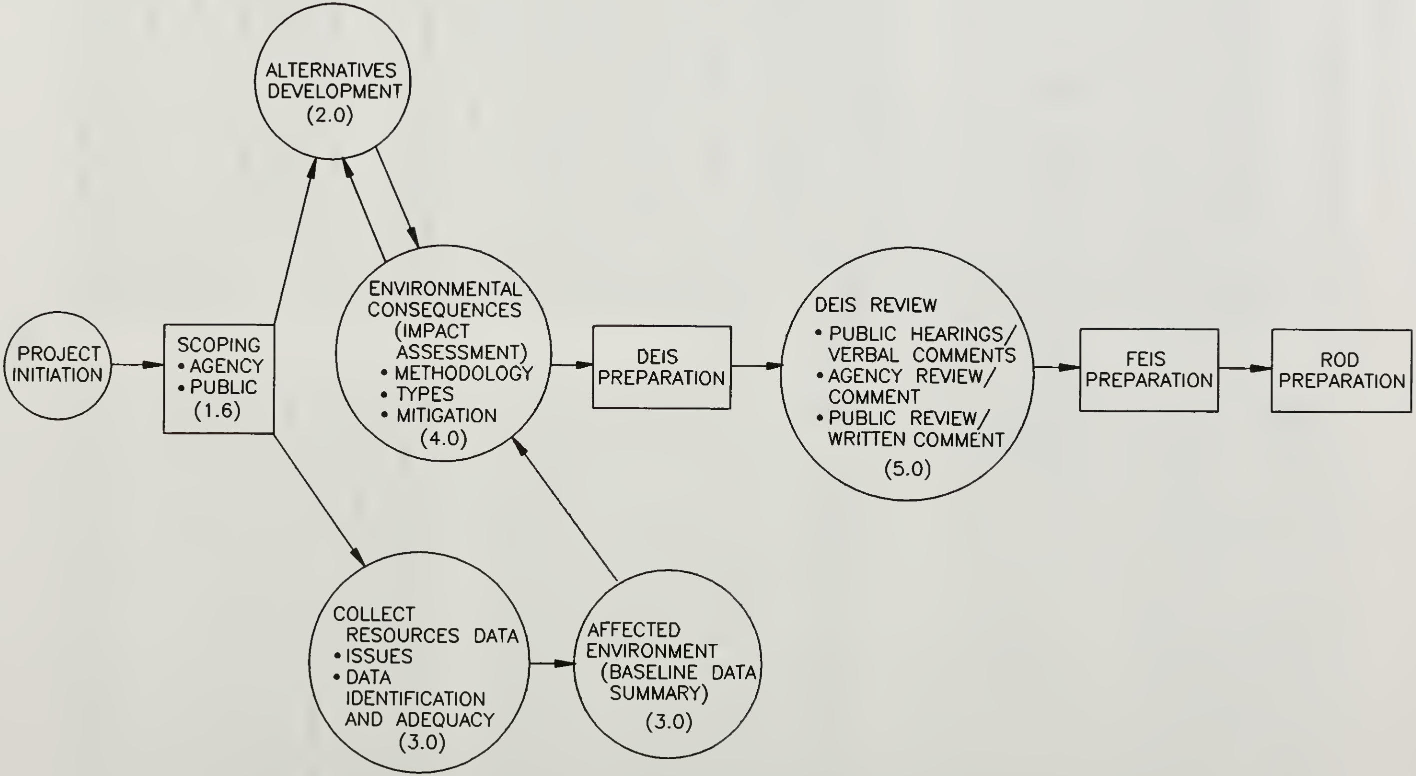
DEQ and BLM (in this document, referred to as "the agencies") are the joint lead agencies responsible for preparation of the Draft EIS, and for issuing a final decision regarding the mine permit application. For purposes of impact evaluation, technical expertise was provided by an independent third-party consultant selected by, and working under the direction of, DEQ and BLM. The agencies will consider the proposed action and alternatives presented in this EIS and issue a decision on the permits and approvals required from the agencies for the Zortman and Landusky mine extension projects. The final decisions and rationale will be presented in a document or documents known as the Record of Decision(s) (ROD). More details concerning various lead and supporting agency responsibilities are presented below.

1.5.1 Montana Department of Environmental Quality, Hard Rock Bureau (formerly Montana Department of State Lands)

The purpose of the 1971 Montana Metal Mine Reclamation Act is to ensure that the usefulness, productivity and values of lands and waters disturbed by mining receive the greatest reasonable degree of protection and reclamation to a beneficial use. This Act applies to all lands within the State of Montana, whether

FIG. 1–5

MAJOR PHASES OF THE EIS PROCESS



( ) SECTION OF THIS EIS DOCUMENT WHERE THIS ITEM IS ADDRESSED.

federal, state, or private. Under this Act, the DEQ has the authority (a) to issue an operating permit, (b) to inspect facilities and operations for compliance with the permit and applicable laws, and (c) to check the company's self-monitoring. Before the DEQ Hard Rock Bureau can issue an operating permit, a reclamation bond must be posted with the agency, and must be of sufficient amount for the state to complete reclamation in the case of default by the operator.

Bonds for reclamation of lands disturbed under a mine operating permit are based on requirements for water treatment, demolition and removal of surface facilities, earth moving, soil replacement, seedbed preparation including amendments, and revegetation. An itemized list of costs for applicable tasks is prepared using information derived from the approved operating and reclamation plan. Bond amounts are subject to review at least every five years. In addition, the BLM can require a reclamation bond if it deems the State's bond inadequate.

The current reclamation bond amount is $25 million for both mines ($10 million for Zortman, $15 million for Landusky). Once the preferred alternative has been selected, a new reclamation bond amount would be calculated based upon the cost for the agencies (not the operator) to implement the approved reclamation plan. Release of the reclamation bond on BLM surface is made by DEQ subject to BLM concurrence upon completion of successful reclamation.

Some reclamation costs are not appropriately covered by performance bond. Costs for water treatment or facility maintenance which extend for an indefinite period are examples. In these cases, the State requires the mining company to establish a trust fund which is of sufficient size that annual interest income meets anticipated annual expenditures for as long as is required. This trust is in addition to normal reclamation bonding.

Mine pit reclamation is also regulated by DEQ under 82-4-336 *et. seq.* MCA, wherein authority is granted DEQ to require mine reclamation plans.

Pit reclamation is considered in this EIS in several places. Section 2.1 identifies pit reclamation as a significant issue related to mine pit expansion. Section 2.3.5 contains a summary of alternatives reviewed and either eliminated from further consideration or included as a component of one of the seven final alternatives analyzed in this document. Partial backfill, complete backfill, and pit highwall reduction are considered in this section. In addition, all of the alternatives developed for further consideration in the impact analysis (Chapter 4.0) contain provisions for pit reclamation, including varying degrees of pit backfill.

The DEQ Open Cut Bureau, under 82-4-422 *et seq.*, MCA, issues another permit regarding open cut mines for shale, clay, and other industrial minerals extraction. For Zortman and Landusky, amendments to the permit are in process to address the old and new Williams and Seaford clay pits. A reclamation bond and plan are required.

1.5.2 Bureau of Land Management

Under the United States mining laws, claimants and operators have been authorized to develop locatable mineral resources on public lands that are open to operation of the Mining Law. The majority of the BLM lands in the Little Rocky Mountains are open to operation of the Mining Law in conformance with the Judith-Valley-Phillips Resource Management Plan EIS (BLM 1992a; see pp. 10, 11, 88, and 89).

Section 302(b) of the Federal Land Policy and Management Act of 1976 (FLPMA) directed the Secretary of the Interior to: "by regulation, or otherwise, take any action necessary to prevent unnecessary or undue degradation of the lands." In 1981 the BLM promulgated regulations under Title 43, Code of Federal Regulations, Section 3809, to implement the FLPMA requirements for mining activities on BLM-administered lands. These "3809" regulations detail the requirements for approving a Plan of Operations, or a significant modification to an already approved Plan of Operations, which is the case for the Zortman and Landusky Mines. BLM must review the operator's proposed Plan of Operations to determine whether it would result in unnecessary or undue degradation of the federal lands. Measures needed to prevent unnecessary or undue degradation are required as conditions of approval.

Unnecessary or undue degradation was not defined in FLPMA, but is defined in the BLM regulations at 43 CFR 3809.0-5(k); and briefly means: (1) Surface disturbance greater than what would normally result when activity is being accomplished by a prudent operator; (2) failure to take into consideration the effects of operations on other resources and land uses; (3) failure to initiate and complete reasonable mitigating measures, including reclamation; and (4) failure to comply with applicable environmental statutes and regulations. If it is determined that the action would not cause unnecessary or undue degradation then BLM is required to approve the Plan of Operations. A final determination as to the adequacy of the proposed mine plan, or a preferred alternative, in preventing unnecessary or undue degradation will be made in a Record of Decision. This will be based on the impacts identified during the EIS process and the requirements of the 3809 regulations.

While approval of a Plan of Operations that does not cause unnecessary or undue degradation is nondiscretionary (i.e., BLM must approve such a plan), it is a federal action which must be analyzed under NEPA. The approval of the Plan of Operations by BLM only applies to BLM lands; however, NEPA requires that the environmental analysis address impacts of the approval on both private and public lands.

In addition to hardrock mining, the BLM administers the sale and removal of mineral materials such as sand, gravel, and other industrial minerals under the Materials Act of 1947 and the Surface Resources Act of 1955. Limestone proposed to be mined from public lands for use in reclamation capping and drainage construction would require a separate mineral material sale contract to be issued in accordance with BLM regulations at 43 CFR 3610. These regulations include requirements for reclamation of the quarries and posting of a performance bond. This EIS will serve as the NEPA document for limestone mining associated with the Zortman and Landusky Mines.

The BLM's 3809 regulations provide that the Authorized Officer may require the operator to furnish a bond to insure that the reclamation is completed. The reclamation bond is an enforcement tool used to insure that the approved reclamation plan would be implemented should the operator be unable or unwilling to do so. As such, the reclamation bond is based on the reclamation plan.

In Montana, the DEQ's Hard Rock Bureau has similar authority. By Memorandum of Understanding (MOU) reclamation bonds for hardrock mining are held by the State of Montana on behalf of both BLM and DEQ. This is done to prevent "double-bonding" for the same disturbance since both agencies' regulations require reclamation bonding.

Prior to approving a Plan of Operations, BLM must comply with Section 106 of the National Historic Preservation Act (NHPA), as amended. Section 106 of the NHPA does not prevent or prohibit the disturbance of historic properties by a federal action, but it does require specific steps to be taken by the federal agency before approving such an action. In brief, compliance with the NHPA involves four basic steps: (1) identifying historic properties which might be affected; (2) assessing the effects to those properties; (3) consultation with the State Historic Preservation Office and interested parties; and (4) comment by the Advisory Council on Historic Preservation if historic properties will be affected.

The American Indian Religious Freedom Act (AIRFA) was passed as a joint resolution of Congress and has no implementing regulations. The resolution states that it shall be the policy of the United States to protect and preserve for the American Indian the inherent right of freedom to believe, express, and exercise their traditional religions, including, but not limited to access to religious sites, use and possession of sacred objects, and freedom to worship through ceremonies and traditional rites. BLM complies with this act by seeking and considering the views of Native American traditional leaders when a proposed land use might conflict with traditional Native American religious beliefs or practices.

1.5.3 Cooperating and Coordinating Agencies

While DEQ and BLM share overall EIS responsibility for this project, several other Federal and State agencies, and local authorities, may require permits, approvals or licenses for the proposed project. The following sections summarize regulatory and permitting authority for these entities. Table 1-3 contains a list of the major permits, licenses and approvals that may be required by cooperating and coordinating agencies.

1.5.3.1 Cooperating Agencies

Three agencies are cooperating for this EIS pursuant to the Federal Council on Environmental Quality (CEQ) NEPA regulations at 40 CFR 1501.6. This regulation provides that the lead agency may request any other federal agency to serve as a cooperating agency, if the agency has jurisdiction or special expertise regarding an environmental issue or issues that should be addressed in a NEPA document. Formal EIS cooperating agencies for the Zortman-Landusky mine extension are:

- Montana Department of Environmental Quality (formerly Montana Department of Health and Environmental Sciences), Water Quality Division
- U.S. Environmental Protection Agency
- U.S. Army Corps of Engineers

A Memorandum of Understanding (MOU) is in place to outline roles and responsibilities of the various cooperating agencies (DSL/BLM 1993b).

TABLE 1-3

MAJOR PERMITS, LICENSES, AND APPROVALS POTENTIALLY REQUIRED FOR THE ZORTMAN AND LANDUSKY MINE EXTENSIONS[1]

Agency	Permit, License or Review	Authority	Purpose/Status
Montana Department of Environmental Quality, Hard Rock Bureau (formerly Montana Department of State Lands)	• State Operating Permit (Metal Mine Reclamation Act)	Title 82, Chapter 4, Part 3, *et seq.*, MCA; ARM §26.4.101 *et seq.*	To allow mining while adequately providing for the subsequent beneficial use of the lands to be reclaimed. Approval is documented in a Record of Decision.
	- Reclamation Bond	§82-4-338, MCA	Required of Proponent to assure sufficient reclamation funding is available at mine closure or abandonment.
	- Monitoring Plans	§82-4-335(4)m, MCA	To assure compliance with state and federal environmental resource standards and criteria; coordinate with other governmental agencies.
	• Open Cut Permit	§82-4-422 *et seq.*, MCA	For excavation of shale and clay pits; includes reclamation plan and bond.
U.S. Bureau of Land Management[2]	• Approved Plan of Operations	43 CFR §3809	To allow for mineral exploration and development on U.S. lands administered by BLM. Approval incorporates management requirements to minimize or eliminate effects on other BLM resources. Approval is documented in a Record of Decision.
	- Monitoring Plans	43 CFR §3809	To assure compliance with state and federal environmental resource standards and criteria: coordinate with other governmental agencies.
	- Reclamation Plan	43 CFR §3809; BLM Solid Minerals Reclamation Handbook No. H-3042-1	In coordination with DEQ, to ensure all reclamation activities meet the guidelines in the Resource Management Plan and BLM Manual Section 3042.
	• Material Site Permit	43 CFR §3610; Mineral Material Regs.	Material sale contract to establish fair market value and reclamation procedures for limestone from proposed quarry.

TABLE 1-3 - MAJOR PERMITS, LICENSES, AND APPROVALS
(Continued)

Agency	Permit, License or Review	Authority	Purpose/Status
Montana Department of Environmental Quality (formerly Montana Department of Health & Environmental Sciences), Water Quality Division	• Montana Pollutant Discharge Elimination System Permit (MPDES)	ARM 16.20.1301 *et seq.*	To control discharge (including stormwater runoff) to surface waters by setting water quality limitations and requiring self-monitoring. Conditions for MPDES permits for the Zortman and Landusky mines are under negotiation in 1995.
	• 401 Certification	Sec. 401, Federal Clean Water Act (33 USC 1341); Montana ARM 16.20.1701 *et seq.*	Required prior to the U.S. Corps of Engineers being able to issue a 404 Permit; and is applicable to all federal activities which result in a discharge to state waters.
Montana Department of Environmental Quality (formerly Montana Department of Health & Environmental Sciences), Air Quality Division	• Permit for Construction and Operation of Air Contaminant Source	Montana Clean Air Act, ARM §16.8.11 *et seq.*	To control emissions of more than 25 tons per year of particulate matter.
U.S. Environmental Protection Agency	• Review and approval authority for various programs, including 404 permit	Section 309 of Clean Air Act; Clean Water Act; other environmental statutes	Various NEPA review, environmental enforcement and oversight authorities.
U.S. Army Corps of Engineers	• Section 404 Permit for placement of fill or dredged material in wetlands or waters of the U.S.	Section 404 of the Clean Water Act	To control discharge of dredged or fill material into waters or wetlands of the United States; including intermittent streams where a bed and bank are recognizable.
U.S. Fish & Wildlife Service	• Biological Assessment	Section 7, Endangered Species Act, Migratory Bird Act	For Endangered Species Act compliance. If it is determined that adverse effects would occur to threatened or endangered species as a result of the Zortman and Landusky Mine extensions, the lead agencies would consult with USFWS to determine if measures could be developed to protect the affected species.

TABLE 1-3 - MAJOR PERMITS, LICENSES, AND APPROVALS (Concluded)

Agency	Permit, License or Review	Authority	Purpose/Status
Montana State Historic Preservation Office	• Review of project for compliance with regulations governing protection of cultural and historic resources	Section 106 of the National Historic Preservation Act; 36 CFR Part 800	If historical, archaeological, or other cultural resources are located in the project area, the State Historic Preservation Officer would advise the lead agencies on impact mitigation of sites eligible for nomination to the National Register of Historic Places.
Montana Department of Natural Resources and Conservation	• Water Rights Permit	Montana Water Use Act, Title 85, Chapter 2, MCA	Required if the Proposed Action would use or extract, through surface water diversion or groundwater withdrawal, state water in an amount exceeding 100 gallons per minute.
Phillips County	• Floodplain Development Permit	Title 76, Chapter 6, Part 113, MCA	Required for construction of facilities within designated 100-year floodplains.
Montana Hard Rock Mining Impact Board and "Affected" Local Government Units	• Fiscal Impact Plan	Hard Rock Mining Impact Act: Title 90, Chapter 6, Parts 3-4, MCA	To mitigate fiscal impacts on local government services; (not required for ZMI extensions.)
Phillips County Conservation District	• 310 Permit	Natural Streambed and Land Preservation Act, Title 87, Chapter 5, Sections 501-509, MCA	For any activity that physically alters the bed or banks of a stream. MDFWP provides recommendations and consultation.

[1] Note: It is the responsibility of the operator to have knowledge of, and obtain, any federal, state or local permits, licenses, approvals or reviews required by such entities for construction, operation, or closure of these projects. This tables does not present an exhaustive list; several other actions will likely be required for project permitting. Expected hazardous materials for the Zortman/Landusky sites, including provisions for spills, are detailed in Sections 3.14 and 4.14.

[2] BLM, as the lead federal agency in the mine permitting action, and the steward for the federal lands impacted by the mining activities, would be responsible for ensuring that permitted actions comply with a number of federal statutes and regulations implementing those laws, including: the American Indian Religious Freedom Act (Public Law 95-341), the Archaeological Resources Protection Act (Public Law 96-95); the National Historic Preservation Act (Public Law 89-665); the Archaeological and Historic Preservation Act (Public Law 93-291); and the Endangered Species Act (Public Law 93-205).

Montana Department of Environmental Quality (DEQ)

Water Quality Division (WQD)

The Water Quality Division (WQD) of the DEQ is responsible for administration of Title 75, Chapters 5 and 6, MCA, better known as the Water Quality Act (WQA) and the Public Water Supply Act (PWSA), respectively. The WQD is also responsible for administering several programs under the Federal Clean Water Act (CWA) pursuant to delegation agreements with the U.S. Environmental Protection Agency (EPA). Two of these programs are the National Pollutant Discharge Elimination System (NPDES), delegated pursuant to 40 CFR 123; and water quality standards pursuant to 40 CFR 131. Facilities which discharge to State water must obtain a state discharge permit and comply with both State and Federal regulatory requirements as administered by the WQD.

Zortman Mining, Inc. holds a Montana Pollutant Discharge Elimination System (MPDES) permit (MT-0024864) for the Landusky mine, which authorizes discharge of storm water into King Creek; and another permit (MT-002485) for discharge of treated water into Ruby Gulch and Glory Hole Creek. MPDES permits must be renewed every five years. ZMI requested that these permits be renewed in late 1991 and the WQD issued a Public Notice on March 9, 1992 with the intent to renew these permits. After reviewing the Zortman Mining, Inc. - 1991 Annual Water Resources Report, the WQD became concerned about deteriorating water quality in the vicinity of the Zortman and Landusky Mines. During the ten years Zortman held valid discharge permits (1981 to 1991), the company had reported no discharge on their Discharge Monitoring Reports (DMR) submitted to the WQD. Despite this condition, water quality monitoring showed decreasing pH values and increasing concentrations of metals and sulfate in State waters.

In April 1993, the WQD sent Zortman Mining, Inc. a request for additional information and completed an on-site inspection of the mine site. The EPA also sent ZMI a request for information under Section 308 of the Federal Clean Water Act (CWA). The WQD and EPA conducted a joint inspection of the mine sites in May, 1993 and identified several water quality violations. On July 18, 1993 EPA sent formal notification to the WQD and ZMI of violations of the Federal CWA. (Under delegation provisions of the Federal CWA, the DEQ/WQD has primary authority for enforcement of violations of the CWA.)

On August 30, 1993, the Montana Department of Health and Environmental Sciences (DHES) filed a Civil Complaint and Application for Injunction (Cause No. BOV 93-1511) in District Court in Lewis and Clark County, Montana, naming Pegasus Gold Corporation and Zortman Mining, Inc. (Pegasus/ZMI) as defendants. The Complaint alleges violations of the Montana WQA in each of seven drainages. These violations include: the placement of wastes in a location likely to cause pollution of State waters; discharge of wastes to State waters without a valid permit; and, violations of Montana Water Quality Standards in both surface and groundwater. The Complaint seeks a prohibition of all waste discharges and further mining activities unless ZMI: (1) submits and implements an WQD approved Improvement Plan providing for corrective measures and monitoring; (2) makes application for an MPDES permit or stops discharging wastes to State waters; and (3) pays civil penalties as specified in the WQA. The complaint was later amended on October 13, 1993.

In May 1994, the District Court ruled on several preliminary motions in this case. One of these motions granted intervenor status to Island Mountain Protectors (IMP). On February 15, 1995, the Montana Supreme Court ruled on the motions in favor of DHES.

ZMI submitted an expanded MPDES permit application in the fall of 1993 and a Improvement Plan in March 1994. The Improvement Plan has undergone several revisions and is still under review by WQD, EPA, and IMP (as of June, 1995). A negotiated settlement to implement the Improvement Plan may be presented to the court in 1995. In processing the discharge permit application, the WQD determined that adequate hydrologic and water quality baseline data did not exist prior to the current mining activities. This information is necessary to develop water quality-based effluent limits in the discharge permit. Therefore, the Improvement Plan has been expanded to include additional data collection. A discharge permit may not be issued for several years. A court-approved Improvement Plan and Schedule would replace the discharge permit and establish interim effluent limits and conditions until a MPDES permit could be developed.

In 1994, ZMI began construction of a waste water treatment facility at the Zortman mine to treat acid rock drainage. Both the Water Quality Act and the Public Water Supply Act required WQD approval of wastewater treatment systems prior to construction, operation, and discharge. Typically, these approvals are through the issuance of an MPDES permit. However, because sufficient information was not available to develop MPDES permit limits, the WQD issued ZMI an Administrative Order on September 28, 1994 authorizing the construction and discharge from the Ruby Gulch water treatment plant. Interim effluent limits and monitoring requirements are contained in this order.

Regarding the Clean Water Act Section 401 (State Water Quality Certification for discharge to State waters) this certification can be based on State water quality standards, or the State can conditionally waive standards. Before the WQD will issue a 401 certification for Ruby Gulch, that Agency (WQD 1994) will want proof that tailing are non-mineralized (non-acid generating - see discussion in Section 3.2) and not contributing to water contamination.

U.S. Environmental Protection Agency
Section 309 of the Clean Air Act provides the EPA with authority to review and comment on federal actions under NEPA. Therefore, EPA would review the environmental analyses within this DEIS for compliance with NEPA requirements and guidelines of the Council on Environmental Quality. In addition, EPA has overall authority for specific permitting actions which may be required for the Zortman Mine expansion. For instance, although the U.S. Army Corp of Engineers (COE) has authority for Section 404 permits (described below), EPA has a statutory veto power over the COE decision.

EPA has authority for the NPDES program on the Fort Belknap Indian Reservation, should the proposed action or alternative actions require an NPDES discharge permit to streams on tribal land. The EPA also has oversight for, and has delegated authority to, issue NPDES permits in Montana, to the DEQ. The EPA and DEQ, Water Quality Division are taking joint actions to ensure compliance with the CWA and Montana WQA.

On June 5 1995, the EPA filed suit against ZMI in U.S. Federal District Court alleging violations of the Clean Water Act at drainages impacted by mining operations.

U.S. Army Corps of Engineers
ZMI would require a permit issued under Section 404 of the Clean Water Act if the proposed action requires the discharge of dredged or fill material within waters of the United States, including jurisdictional wetlands and intermittent streams where a bank and bed are recognizable. The COE has permitting authority for this program, and is an official cooperating agency for this EIS under CEQ regulations as well. The COE has determined that an individual permit is necessary to implement any of the various alternatives. Appendix B contains the Section 404(b)(1) evaluation necessary for the agencies' preferred alternative.

The 401 State Water Quality Certification (see Section 1.5.4.1 above) is required before the COE can issue a 404 permit. A 401 certification from the State WQD would be issued if the discharge would not "adversely impact existing water quality" (COE 1995).

1.5.3.2 Coordinating Agencies

U.S. Fish & Wildlife Service (USFWS)
The U.S. Fish and Wildlife Service (USFWS) administers the Endangered Species Act, the Migratory Bird Act, and the Bald Eagle Protection Act. To comply with the Endangered Species Act, BLM has prepared a Biological Assessment for issuance with the Draft EIS (see Appendix C), to determine adverse impacts, if any, to threatened and endangered species. If adverse effects may occur, BLM will formally consult with the USFWS to design measures to protect the affected species. The draft Biological Assessment will be revised as final and issued with the Final EIS, following receipt of comments from USFWS.

Air Quality Division (AQD)
The Air Quality Division of the DEQ administers the Montana Clean Air Act. Any proposed project with estimated pollutant emissions (without emissions controls) exceeding 25 tons per year must obtain an air quality permit before commencement of construction. The applicant must apply Best Available Control Technology (BACT) to each emission source, and demonstrate that the project would not violate Montana or Federal Ambient Air Quality Standards. ZMI has a separate air permits for the existing Zortman and Landusky mines, which would require modification to implement the mine extension alternatives.

An air quality permit alteration (modification) was submitted in October 1994 to AQD, for the Zortman extension, or the Company Proposed Action at the Zortman Mine only (MDHES, AQD 1994a). The permit was deemed procedurally complete.

State Historic Preservation Office (SHPO)
Under the Montana Antiquities Act and the National Historic Preservation Act, the SHPO has the responsibility to cooperate with and to advise BLM and DEQ when potentially significant historical, archaeological, or other cultural resources are located in the project area. Part of the advice given may include plans for impact mitigation of sites eligible for the National Register of Historic Places. The SHPO and the Keeper of the National Register of Historic Places have reviewed issues regarding eligibility of the Little Rocky Mountains to the National Register, as a traditional cultural property district.

Rocky Mountains to the National Register, as a traditional cultural property district.

Montana Department of Natural Resources and Conservation (DNRC)

The DNRC administers two acts that may be applicable to mining development in Montana: the Montana Major Facility Siting Act (MFSA) and the Montana Water Use Act. The MFSA requires state approval before construction of any electrical transmission line that exceeds 69 kV or 10 miles in length. A water rights permit is required by the Montana Water Use Act for any surface water diversion or a groundwater withdrawal exceeding 100 gallons per minute (see Chapter 2.0 for details regarding project engineering).

Phillips County

Phillips County has the option to review and issue a floodplain development permit pursuant to 76-1-113, MCA, for any activity that infringes on the 100-year floodplain of a perennial stream with County jurisdiction.

Phillips County Conservation District and Montana Department of Fish, Wildlife, and Parks

Any mining disturbance occurring within the normal high water level of streams inside or outside of BLM boundaries would require the approval of the Phillips County Conservation District. This approval would constitute a "310 permit" under the Natural Streambed and Land Preservation Act. Prior to granting approval, the District would consult with BLM and the Montana Department of Fish, Wildlife and Parks (MDFWP).

Hard Rock Mining Impact Board

The Hard Rock Mining Impact Act (Title 90, Chapter 6, Parts 3-4, MCA) was enacted in 1981 to assist local governments in handling financial impacts caused by large-scale mineral development projects. The legislature recognized that: (1) new mineral development projects may result in the need for local governments to provide additional services and facilities causing a fiscal burden for local taxpayers, before mine-related revenues become available; and (2) some local government units may lack jurisdiction to tax a new development.

Zortman Mining, Inc. is exempt from this requirement for both the Zortman and Landusky mines because the initial application for mine operations in 1979 pre-dated the law (Hard Rock Mining Impact Board 1995). However, social and economic impacts of the proposed action and alternatives are analyzed in this EIS (see Section 4.10).

Montana Department of Fish, Wildlife & Parks

Although the Montana Department of Fish and Wildlife has no statutory authority over mining in Montana, they do act in an advisory capacity to the local conservation districts, when such districts are processing Section 310 permits for developments by private individuals under the Montana Natural Streambed and Land Preservation Act (see previous discussion of Phillips County and MDFWP).

U.S. Bureau of Indian Affairs

The Bureau of Indian Affairs (BIA) is a commenting agency on the EIS. A BIA office is located on the Fort Belknap Indian Reservation.

Fort Belknap Indian Reservation

The Fort Belknap Community on the Reservation is a commenting agency on the EIS.

Blaine County

Blaine County has the option to review and issue a floodplain development permit pursuant to 76-1-113, MCA, for any activity that infringes on the 100-year floodplain of a perennial stream with county jurisdiction. This action is unlikely, since the proposed action and alternatives facilities are all in Phillips County.

1.6 STUDY AREA DEFINITION

The EIS study area is best represented geographically by the Little Rocky Mountains, in north central Montana. The proposed mining operations and areas of disturbance related to the mining (waste rock storage, leach pads, and related facilities) are within the Little Rocky Mountains. Most potential environmental impacts would thus occur to the air, waters, surface resources, or wildlife within the Little Rocky Mountains. However, impacts related to the proposed action and alternatives are not solely limited to the local area. As an example, impacts to wildlife within this area extend far from the mine site, since big game species may travel many miles between winter and summer feeding grounds, and bird species often migrate long distances. Impacts to sites in the Little Rocky Mountains that are culturally important to Native Americans may be felt far from the project area, as some tribal members may travel long distances for plant gathering or spirit quests. Socioeconomic impacts are likely widespread, since many people who would continue to be employed at the Zortman and Landusky mines would commute from communities such as Malta. On the other hand, soil and vegetation impacts may be mostly confined to the Zortman and Landusky extension disturbance areas (Figures 1-2 through 1-4).

Political boundaries are also important. The Zortman and Landusky mines are located on the southwest portion of Phillips County, near the southern boundary of the Fort Belknap Indian Reservation. Various communities on and off the reservation would be impacted by jobs and revenues maintained by the mine extensions and reclamation, and by service demands for those workers and families and support personnel. Some communities near the mine site may be affected by environmental impacts to air, land, water and aesthetic resources. Nevertheless, for the purpose of defining the limits of the environment most likely to be impacted by expanded mining at the Zortman and Landusky mines, the study area is generally considered the Little Rocky Mountains but may vary according to each individual environmental resource.

1.7 ISSUES AND CONCERNS

Public participation is a key requirement of both MEPA and NEPA, and vital to development of alternatives and consideration of impacts in the EIS. The first opportunity for public involvement occurs in the beginning of the EIS process, when scoping is conducted. One purpose of scoping is to compile a list of environmental issues related to the proposed action, and to discuss the relative impact of these issues. The scope of this EIS was established by the agencies' understanding of the proposed action and technical concerns, as well as the issues identified through oral and written comments received from the public and commenting agencies.

To identify issues and concerns related to the proposed action, public scoping undertaken by BLM and DSL included:

- Summer 1992 - An attempt is made by BLM/DSL to form a citizens' advisory group on the Zortman Mine extension EIS; this effort was unsuccessful due to federal administrative procedures.

- December 1992 - A public scoping meeting on the Zortman Mine extension is held in Malta (Phillips County).

- December 1992 - A public scoping meeting on the Zortman Mine extension is held in Dodson (Phillips County, near the Blaine County line).

- December 1992 - A public scoping meeting on the Zortman Mine extension is held in Hays (on the Fort Belknap Indian Reservation in Blaine County).

- April 1993 - A follow-up public scoping meeting on the Zortman Mine extension is held in Lodgepole (on the Fort Belknap Indian Reservation, in Blaine County).

- December 1993 - A public meeting is held in Dodson to receive comments on the Landusky ARD EA.

- December 1993 - A "Dear Reader" letter informs the public of scoping comments on the Zortman Mine extension, and tentative alternatives to be addressed in the EIS.

- March 1994 - The Decision Record is sent to the mailing list of interested public and agencies regarding the Operating and Reclamation Plan modifications to control and remediate acid rock drainage at the Landusky Mine.

- April 1994 - A "Dear Reader" letter discusses inclusion of the Landusky Mine extension within the scope of Zortman Mine extension EIS, and tentative alternatives to be evaluated in the EIS.

- April and July 1995 - Public meetings on a draft MOA for mitigation of impacts to cultural resources are held in Hays, Lodgepole and Landusky.

Comments, suggestions, and concerns about the project and associated EIS were gathered from the efforts above. In addition to the comments received at the public meetings, written comments were also received during the scoping process. A complete discussion of scoping concerns for both the Zortman and Landusky mine extensions is on file with DEQ in Helena, and with BLM in Lewistown and Malta (DSL/BLM 1993c; DSL/BLM 1994b). The issues and concerns raised by the public during scoping were used in the development of alternatives, and are addressed in the baseline and impacts analysis in this Draft EIS.

A summary of these issues and concerns is presented in Table 1-4. Some issues are not addressed in this Draft EIS that were raised in the public scoping sessions, for a variety of reasons. Concern with items such as human rights, the economics of mining, past treaty agreements, government funding, agency budgets and staffing, regulatory standards, permitting issues, and other matters are beyond the scope of the EIS. Additional documentation on issues addressed and not addressed in the EIS is available in BLM and DEQ files.

TABLE 1-4

ISSUES AND CONCERNS

Resource Area	Summary of Issues & Concerns
Acid Rock Drainage	Leaching of acid and metals from mining; impacts of acid rock drainage (ARD) on water quality; adequacy of monitoring and reclamation plan to control ARD; required thickness and type of liner adequate to protect the environment; possibility of the degradation of all streams in the Little Rocky Mountains, such as Ruby Gulch, due to ARD.
Water Resources	Existing and long-term impacts of mining on water quality and water supply; contamination of community water supplies; monitoring and testing of water quality; degradation of surface and ground water quality; cyanide containment.
Geology	Proper procedures for drilling and exploration activities; impacts from the limestone quarry; impacts of lime on water quality; protection of paleontological resources in the Little Rocky Mountains; adequate engineering of the pad and waste dumps; geologic hazards; impacts of blasting on the Azure Cave geologic formations.
Soil & Reclamation	Adequacy of type, amount, and thickness of soil; slope steepness and stability; soil sampling; competence of shale liner at the heap leach pad; adequate monitoring and inspection of the reclamation plan; plan's overall effectiveness and quality.
Land Use	Post-mining land use, based on the cumulative impact of current operations and the proposed expansion (i.e., post-reclamation use for heap leach pads); reduction of land available for recreational use; reduction of land available to Native Americans.
Wildlife	Wildlife protection; long-term effects of mining and chemicals on wildlife; species of concern, such as bats of Azure Cave (numbers and species), bighorn sheep, big game migration routes and corridors, and various birds, including piping plover nests in Phillips County; system of reporting wildlife mortalities to the public and the fencing/netting around ponds and other mine facilities.
Vegetation and Wetlands	Protection of Saddle Butte's rare plant communities recognized by Montana Natural Heritage Program; noxious weed management; need for local, weed-free revegetation seed stock; need to protect any threatened and endangered plants and/or native plants and berries used for medicine by Native Americans; potential need for a riparian study of the area.

TABLE 1-4 - ISSUES AND CONCERNS (Continued)

Resource Area	Summary of Issues & Concerns
Recreation	Impacts of the mine expansion on recreational uses for the Little Rockies, particularly well water contamination at the campgrounds and reduced access to Saddle Butte, Azure Cave, Pony and Alder Gulches, and Beaver and Spring Creek for outdoor recreational activities; closing of public roads; post-reclamation uses for the mining areas.
Engineering	Need for adequate engineering of all facilities at the mine, particularly those with potential human health and environmental impacts (heap leach pad, solution collection ponds, and solution pipelines); potential for leakage of solution pipelines, particularly at off-pad locations, such as along conveyor.
Human Health Risk	Risks to human health (need for blood testing, heavy metal contamination, cyanide and lead in water); overall long-term health hazards to children and pets; need for investigations and monitoring of all spills and leaks; public notification of cleanup procedures.
Cultural Resources	Little Rockies considered sacred mountains to the Native Americans; concern that numerous values are significantly altered by mining activities; concern that existing ethnographic studies and reports were not conducted appropriately, do not adequately express the opinions of Native Americans, do not examine all sacred areas, and exclude interviews with people who are concerned and/or use the area; concern that visual resources will be impacted when viewed from vision quest sites.
Roads & Transportation	Concern over limited access to portions of the Little Rocky Mountains; potential safety hazards to local residents, especially the dangers of haul trucks in populated areas.
Air Quality & Noise	Fugitive emissions from mining operations; use of water and chemicals to suppress dust on haul roads; wind-blown pollutants from pads, ponds, and dumps; impacts from ore crushing process; noise impacts from heavy equipment, trucks, conveyor, and blasting, especially during the Native American Sundance ceremony; noise and air quality impacts from the mine on wildlife and birds; air quality effects of assay lab at Zortman.
Social & Economic Values	Effects of both the proposed mine expansion and the No Action alternative on the economies of Phillips and Blaine Counties and the Fort Belknap Reservation; potential for Native American employment opportunities at the mine; effects of the expansion on community facilities and services (water supplies, roads, electrical power rates); potential effects on property values in the Zortman area; economic implications of the health effects of the existing mine.

TABLE 1-4
(Concluded)

Resource Area	Summary of Issues & Concerns
Visual Resources	Visual impacts of the leach pad, conveyor, and waste dumps; overall aesthetics of the Little Rocky Mountains, including impact of mining and reclamation on the natural shape of the mountains and valleys, ability to restore mountains to original form, and disturbance and landscape changes from mine facilities; disruption of visibility by mine lights at night; effects of visual changes on Native American vision questing.
Environmental Policy and Planning	Comprehensive EIS is required by law; public involvement and the scoping process; objectivity of studies; completeness of data and the permit application; adequacy of past environmental and engineering work; agency coordination and attention to public and special interest group concerns; violations of current permit requirements; applicability of other laws and regulations to proposed mine expansion; reclamation bonding, and concerns over the inadequacy of the current reclamation bond; cumulative impacts of mining activity in the Little Rocky Mountains.
Alternatives	Concerns regarding possible alternatives to the proposed action; support for the No Action Alternative; various suggestions for modified designs or plans; concern that the agencies consider a range of alternatives in the EIS.

Sources: DSL/BLM 1993b; DSL/BLM 1994a.

CHAPTER 2.0
PROPOSED ACTION AND ALTERNATIVES

SUMMARY OF THIS CHAPTER

Chapter 2.0 describes the proposed mine life extensions and revised reclamation plans for the Zortman and Landusky mines. It also describes and summarizes the results of the process used to develop alternatives for the proposed mine expansions and reclamation procedures. The development, evaluation, and selection of project alternatives are necessary and vital parts of the environmental impacts evaluation process as defined in the National Environmental Policy Act (NEPA) and the Montana Environmental Policy Act (MEPA). As described in NEPA, the goal of this process is to "present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decision maker and the public (40 CFR §1502.14)." The process used in reaching a decision point includes:

- Evaluation of all reasonable alternatives including the No Action Alternative,
- Discussion of reasons for eliminated alternatives, and
- Evaluation of appropriate mitigation measures.

Included with the descriptions of alternatives in this chapter are activities considered to be "reasonably foreseeable future actions." These are actions which could be submitted to the agencies at some future time for review and approval. These are not specific proposals, but merely actions or trends that are reasonable to anticipate under the various alternatives considered in this Draft Environmental Impact Statement (Draft EIS) for the purpose of assessing cumulative impacts. As such, they can only be analyzed at a relatively general level. To implement one or more of these reasonably foreseeable future actions, Zortman Mining, Inc. (ZMI) (or some other operator) would have to submit a specific proposal with additional detail for agency review and MEPA/NEPA analysis.

Although the Zortman and Landusky mines are operating under separate mine permits, this Draft EIS provides a comprehensive analysis of proposed extensions of operations and modifications of reclamation procedures at both mines. The Bureau of Land Management (BLM) and Montana Department of Environmental Quality (DEQ) decided to integrate the environmental analysis for these mines because of their similarity in operations, proximity within the Little Rocky Mountains, common mine operator ZMI, and the potential for each mine to contribute to cumulative environmental impacts. The agencies determined that the proposed modifications for the Zortman and Landusky mines should be reviewed in one comprehensive, environmental impact statement. Based on the information submitted by ZMI and the comments received during the scoping process, the DEQ and BLM developed and refined a range of alternatives for evaluation in detail in the Draft EIS. Chapter 2.0 has been organized to present the reader with the following:

- Section 2.1 summarizesthe potentially significant environmental issues associated with proposed future actions, as well as existing environmental problems at the Zortman and Landusky mines,
- Section 2.2 describes the various alternatives to the proposed action, including those the agencies initially considered but later eliminated, along with the justifications for their dismissal from further evaluation,
- Section 2.3 summarizes the environmental impacts associated with each of the seven alternatives,
- Section 2.4 identifies the alternative preferred by the agencies, and
- Sections 2.5 through 2.11 provide complete descriptions of each of the seven alternatives.

2.1 SIGNIFICANT ISSUES

Consideration and evaluation of alternatives to the proposed action is required by the MEPA and NEPA, and regulations of the Council on Environmental Quality (40 CFR §1502.14, and §75-1-201(1)(b)(iii)(C), MCA). The reason for this policy is that some aspects of the proposed action may impact the environment in a manner that could be minimized, mitigated, or even eliminated using an alternative action. Alternatives to ZMI's proposed action have been developed to address (1) environmental concerns raised by the public or commentors during the Zortman and Landusky scoping processes, (2) environmental degradation that has already occurred at one or both of the mine projects, and (3) potential environmental or engineering problems that the agencies have identified during the completeness reviews of the proposed action. The significant issues that have influenced the alternatives development process are summarized below.

- Water Quality (groundwater and surface water) - Concern that existing and/or historic mining operations have impacted and are continuing to impact water quality, and therefore aquatic habitat, in the area has been excessed. Releases of acidic and metal-laden waters from the mines have resulted in the loss of aquatic habitat and have adversely impacted the streams and ground water in the area. Cyanide and metals are mentioned most often as pollutants of concern.

- Traditional Cultural Properties - Areas within the Little Rocky Mountains, and specific sites near the Zortman and Landusky mines, are culturally and historically important to various North American Indian peoples. Many public comments received by the agencies during the scoping meetings for this Draft EIS and previous mine permitting actions have expressed concerns about impacts to cultural resources resulting from mine actions. In response, an analysis of impacts to cultural resources and use of these resources as a result of mine noise, air quality and water resources degradation, and modification of the visual perspective from certain sacred sites has been developed.

- Mine Waste Geochemistry/Acid Rock Drainage (ARD) - This issue is related to the water quality issues discussed above. Concern has been expressed that some of the existing mine, heap leach and waste rock facilities have acidified and are releasing dissolved metals to ground and surface waters. The proposed mine expansion would develop sulfide ore and waste to an extent not contemplated previously for this project. Concerns have been raised regarding both mitigation of existing impacts and possible additional adverse water quality impacts following mine expansion.

- Proposed Heap Leach Pad and Ponds - ZMI has proposed construction of an expanding pad and external solution ponds at the Goslin Flats site below the existing Zortman Mine facilities. Concerns about storage and potential leakage of process solution, visual impacts, access restrictions to the Saddle Butte and Azure Cave areas, effectiveness of heap neutralization prior to closure, heap stability, adequate solution storage and flood diversion, quality of construction, ARD potential and hazards to wildlife from stored process solution have been expressed. In response, alternative sites have been evaluated, along with technical and monitoring modifications to the Company Proposed Action (CPA).

- Pit Expansions - ZMI has proposed development of an expanded open pit operation that would deepen and widen the existing mine pit complexes at both the Zortman and Landusky operations. Concerns have been raised regarding visual impacts; contamination of water in pits and release of that water to surface drainages and groundwater; noise and vibration from blasting and equipment; and ARD and reclamation, including the potential to partially or totally backfill pits.

- Waste Rock Dump - Carter Gulch has been proposed by ZMI as the site of the new waste rock repository for the Zortman Mine. This location has been partially developed as a waste rock dump for existing operations but has sufficient capacity to contain waste rock generated by the proposed expansion. Concerns about waste characterization, waste handling, waste modification, acid rock drainage, dump stability, and reclamation and monitoring of dump performance have been raised. In response, alternative sites have been evaluated, along with construction and reclamation modifications for mitigation.

- Reclamation Plans and Procedures - Some reclamation at the mines has proved to be inadequate and/or ineffective. For instance, acid rock drainage emanating from some heap leach facilities and waste rock dumps may be due to poor reclamation procedures, or a failure to use appropriate materials to prevent water infiltration into the acid-producing materials. ZMI has proposed various rock characterization methods, materials handling procedures, and engineering practices to enhance the potential for successful reclamation. The agencies have adeveloped afacility design lternatives which incorporate construction and reclamation modifications as further protection.

- Ore Conveyance System - ZMI has proposed to use an ore conveyor system to transport ore from the Zortman Mine pit complex to a proposed heap leach facility in Goslin Flats. Concerns have been raised about the environmental effects of this system, particularly generation and release of dust from an uncovered conveyor, visual impacts, problems with access to hunting and recreation lands, and noise generated from the conveyor. An alternative has been developed which would eliminate the need for an ore conveyor, and various mitigations considered to reduce impacts.

- Socioeconomics - The Zortman and Landusky mines have employed a large number of workers during the years 1979 through 1994. This employment represents a significant percentage of the total workforce in the surrounding region. A concern to many people is the socioeconomic impact mine closure would have upon mine workers and the area's economic base.

- Environmental Monitoring Program - The scope and adequacy of the program in effect for environmental monitoring, particularly with respect to water quality and reclamation has been questioned. Additional monitoring requirements in all of the agency-developed alternatives have been developed to address this issue.

The issues described above are by no means the complete list of environmental concerns identified during project review and public scoping. However, they do represent the issues that, because of the potential magnitude, duration, or otherwise significance of their effect on the environment, have played the greatest role in the development of alternatives.

2.2 DEVELOPMENT OF ALTERNATIVES

Reasonable alternative actions pertaining to the proposed Zortman-Landusky mine extension were evaluated based on engineering, environmental, and economic factors. The engineering evaluation included technical implementability and effectiveness, while the environmental evaluation considered potential impacts to the environmental media of air, water, and soil with consideration of subsequent impacts to vegetation, wildlife, and human health. Cost was considered a factor in eliminating an alternative or mine modification only if the alternative or modification would result in an uneconomic mine project. Several alternatives were considered regarding the two major facility components of the Zortman Mine expansion: (1) the waste rock storage facility site and (2) the location for the ore heap leaching facility. The following sections describe considerations evaluated by the agencies in developing alternative sites for these facilities. Section 2.2.5 provides a summary of all alternatives considered and either eliminated or retained for further evaluation.

2.2.1 Zortman Waste Rock Storage Area

Selection criteria used to identify potential waste rock storage areas included (1) sufficient capacity to accept 60 to 80 million tons of waste rock, (2) adequate subsurface and near subsurface foundation conditions, and (3) minimization of seepage potential (i.e., surface water, groundwater, and infiltration considerations).

ZMI's proposed waste rock storage facility (named Carter Gulch Waste Rock Repository) would be located in Carter Gulch, a side drainage of Alder Gulch (Section 2.9.1.5). This site has sufficient volume to store all waste rock generated during mining of the proposed Zortman extension. Additionally, geotechnical studies indicate that subsurface conditions at the site are suitable to allow the storage facility to be constructed, operated, and reclaimed.

Several other alternatives met the basic criteria for the waste rock storage area and were either considered and eliminated or included as alternatives described in Sections 2.5 through 2.11. These were: (1) Ruby Gulch (Upper), (2) Ruby Gulch (Lower), (3) Total or Partial Backfill of Zortman or Landusky Pits, (4) Goslin Flats, (5) Ruby Flats, and (6) Lodgepole Creek. These six alternatives are discussed below:

- *Upper Ruby Gulch* - Based on a review of the alternatives considered, Upper Ruby Gulch offers the advantage of a slightly smaller catchment area than the proposed Carter Gulch, and a location within already disturbed areas near the mine site. However, this location is in a large drainage area and acceptable water control and handling methods could not be developed. In addition, visual impacts associated with construction and operation of a required haul road across Shell Butte offsets potential advantages of the Upper Ruby Gulch alternative.

- *Lower Ruby Gulch* - Hydrological disadvantages, primarily from large base flows, difficulty with interception of upgradient runoff, and high potential for lateral infiltration into the waste rock facility, combined with close proximity to the town of Zortman, made the Lower Ruby Gulch a less desirable alternative.

- *Zortman and/or Landusky Pits* - Complete backfilling of both the Zortman and Landusky pits would require removal and transport of existing pads and waste rock dumps, as well as material generated by the proposed mine life extension. An economic screening (Haight 1995) of the project on the feasibility of backfilling resulted in the following conclusions:

  1) Costs associated with backfilling of the mine pits with spent ore roughly equal or exceed the potential profits obtainable by mining and processing the ore. Requiring the ore to be placed back in the pits after leaching would render the project uneconomic (equivalent to the No Action Alternative) even under a best case scenario that considers the leach pad site alternative in closest proximity to mine pits.

  2) The cost of backfilling the mine pits with waste rock consumes revenues from a commensurate amount of ore. Alternatives requiring backfilling of pits with waste rock are only viable if they do not involve double handling of waste rock in amounts representing a substantial percentage of the ore tonnage. Alternatives that require all waste rock to be placed in the pits render the project uneconomic.

  3) Partial backfilling of pits with waste rock would not make the project uneconomic if material did not require double handling, or if the double handled material was in very close proximity to the backfill locations.

  Partial backfilling of the pits has been considered and incorporated into Alternatives 3, 5, 6, and 7. The Company Proposed Action (Alternative 4) also incorporates partial pit backfilling, but to a lesser degree than Agency-mitigated alternatives.

- *Goslin Flats* - Goslin Flats was determined to be an unsuitable site for a waste rock repository because insufficient capacity would be available without developing multiple waste rock disposal units or filling in Ruby Creek.

- *Ruby Flats* - Ruby Flats just to the east of the Goslin Flats has the capacity for a contiguous waste rock repository, and this site has been incorporated into Alternative 6.

- *Lodgepole Creek* - The Lodgepole Creek site was eliminated from further consideration due to a larger catchment area than the proposed Carter Gulch and the fact that this area is relatively undisturbed.

- *Waste rock on existing facilities* - The area currently occupied by existing Zortman facilities satisfies the three waste rock location selection criteria, namely: sufficient capacity, adequate foundation conditions, and seepage minimization potential. It has been included for analysis in Alternative 7.

2.2.2 Landusky Waste Rock Storage Area

Similar selection criteria were considered for development of waste rock storage alternatives at the Landusky mine:

- *Gold Bug Waste Rock Repository (GBWRR)* - The proposed alternative for waste rock storage involves placement of the waste rock in the existing repository or backfilled in other Landusky pits. This site is currently permitted and provides sufficient capacity for the anticipated volume of material under the proposed mine extension (about 7.6 million tons of waste rock). Furthermore, additional disturbance would be minimized by using an existing facility such as the Gold Bug Area, and double handling of waste from other pits may be minimized.

- *Zortman Pit* - An additional waste rock storage alternative considered was total or partial backfill of the Zortman Pits using waste rock from the Landusky Mine. This option was eliminated from further consideration because of the long, uneconomical haul distance and potential interference with the proposed Zortman Pit extension.

2.2.3 Zortman Heap Leach Area

Selection criteria used to identify potential heap leach pad areas as alternatives to the proposed Goslin Flats site included (1) sufficient capacity, (2) suitable foundation conditions and slopes, and (3) minimization of potential infiltration and seepage.

The heap leach facility proposed by ZMI would be located at Goslin Flats, approximately three miles southeast of the Zortman Mine pit complex. This site is proposed because it has sufficient volume available for placement of all ore from the proposed Zortman pit expansion. Geotechnical studies indicate that subsurface conditions at the site are suitable to allow the heap leach facility to be constructed, operated, and reclaimed (Golder 1993). Additionally, this site would provide the necessary volumes of coversoil for the proposed reclamation plan.

Additional alternatives meeting the basic criteria for a heap leach facility that were considered and eliminated, or included as part of the alternatives discussed in Sections 2.5 through 2.11, are:

1) Ruby Gulch has slightly less catchment area than the Goslin Flats site. However, the reduced catchment area is offset by the disadvantages of requiring fill prior to pad construction, the problems associated with the interception of upgradient run-on, the high potential for lateral infiltration into the facility, and the proximity to the town of Zortman. As a result, the Ruby Gulch site was eliminated from further consideration.

2) The Alder Gulch location is proximal to mine facilities and provides sufficient area for the pad, process facilities, and ponds. This site is considered as part of Alternative 5 (Section 2.9).

3) The Lodgepole Creek site was considered and eliminated based on the relatively undisturbed nature of the site, as well as the increased disturbance and prohibitive costs required to create a heap leach pad in this drainage prior to ore placement.

4) Lack of sufficient capacity made the placement of ore on the existing Zortman and/or Landusky pads unacceptable.

5) In-pit leaching at the existing Zortman and/or Landusky pits was considered and eliminated due to extensive earthwork required for preparation of pad site, and operational interference with proposed pit development.

2.2.4 Landusky Heap Leach Area

Similar selection criteria to that of the Zortman area were considered for the alternative evaluation for a heap leach facility in the Landusky area. The proposed action includes expansion of the existing 1987-1991 pad. This site is proposed based on its sufficient capacity with limited additional disturbance.

Additional alternatives were considered for a heap leach facility and eliminated. These included:

- *1985-1986 Pad Expansion* - This plan was eliminated based on proximity to Montana Gulch stream flows and concern over additional surface water degradation.

- *In-pit Leaching Zortman/Landusky* - These scenarios were eliminated based on extensive earthwork required for pad preparation and operational interference with proposed pit development.

- *Existing Zortman Pads* - These were eliminated from consideration because they are at capacity.

2.2.5 Summary of Alternative Actions Considered

In addition to the two major facility components discussed above, other alternatives were considered for incorporation into an agency-modified alternative. These included mining methods, reclamation, ore transport, beneficiation technology, conveyor route, process solution storage, heap leach type, processing, waste rock transport, and water control. Alternative actions to be evaluated, and those eliminated from further consideration in this Draft EIS, are summarized in Table 2.2-1. The alternative actions shown in this table were developed by considering and evaluating:

- Company Proposed Action (CPA);
- Agency comments on the CPA, generated during completeness reviews;
- Public comments about the proposed extension and reclamation projects, solicited during scoping meetings;
- Experiences at other mining projects;
- Technical literature and the relevant scientific database; and
- Past and present environmental concerns at the Zortman and Landusky mines.

The alternative actions were evaluated based on the following factors:

- Engineering - The engineering evaluation included technical implementability and cost effectiveness.
- Environmental - The environmental evaluation considered potential impacts to the environmental media of air, water, and soil, with consideration of subsequent impacts to vegetation, wildlife, and human health. Particular attention was focused on the significant environmental issues described earlier in Section 2.1.

Actions considered to be acceptable for incorporation into an agency alternative received generally acceptable engineering and environmental ratings. Actions which were eliminated from further evaluation were considered to be unacceptable in terms of engineering feasibility or environmental protection.

2.2.6 Summary of Alternatives

Actions retained for detailed analysis are incorporated into one or more of the Draft EIS alternatives described in detail in Sections 2.5 through 2.11. These alternatives are summarized in Tables 2.2-2 and 2.2-3.

- Alternative 1: No Action - Permitted Operations and Reclamation
- Alternative 2: Mine Expansions Not Approved and Company Proposed Reclamation
- Alternative 3: Mine Expansions Not Approved and Agency-Mitigated Reclamation
- Alternative 4: Company Proposed Expansion and Reclamation (CPA)
- Alternative 5: Agency-Mitigated Expansion and Reclamation with Leach Pad Located in Upper Alder Gulch rather than on Goslin Flats
- Alternative 6: Agency-Mitigated Expansion and Reclamation with Waste Rock Repository Located on Ruby Flats rather than in Carter Gulch
- Alternative 7: Agency-Mitigated Expansion and Reclamation with Waste Rock Repository Located on Existing Mine Facilities rather than in Carter Gulch

2.3 SUMMARY OF POTENTIAL ENVIRONMENTAL CONSEQUENCES

The seven alternatives were evaluated for their potential impact on various environmental, social, and cultural resources. A detailed discussion of these impacts, or environmental consequences, is contained in Chapter 4.

Table 2.3-1 is provided as an impact summary matrix. It contains both quantitative information and/or relative impact rankings for each resource area and for primary issues of concern under the resource areas. Table 2.3-1 also documents where no significant impact is expected for some issues of concern, such as special status species. The rankings shown in Table 2.3-1 are based on professional and technical judgement in view of this particular project, its setting and context, other projects the EIS Team has reviewed, and the effects of this project in both a site-specific and regional sense. More information is available in Chapter 4 regarding methods and criteria used to assess impacts for each resource.

2.4 PREFERRED ALTERNATIVE IDENTIFICATION

Identification of a preferred alternative is required in a Draft EIS to allow the public to review the agencies' preference. The preferred alternative may be changed in the Final EIS based upon comments received on this draft. Rationale for the selection of a preferred alternative will be provided in the Record of Decision.

Alternative 7 has been identified as the agencies' (BLM and DEQ) preferred alternative. Alternative 7 satisfies the purpose and needs described in Chapter 1.

Of the seven alternatives in this Draft EIS, a mine expansion alternative has been identified to meet the need of providing ZMI a means to develop their precious metal deposits at the Zortman and Landusky mines and reclaim both mine facilities. Of the various possible waste rock and leach pad facility locations for mine expansion at the Zortman Mine, Alternative 7 is preferred.

Preferred reclamation measures are described under Alternative 7. The water "balance" approach to reclamation covers is preferred over the "barrier" type construction, for both existing and new facilities. These measures, together with the other mitigations detailed in Alternative 7, would be used to address existing environmental problems, prevent unnecessary or undue degradation, and provide comparable stability and utility.

TABLE 2.2-1

ALTERNATIVES CONSIDERED FOR THE MINE LIFE EXTENSION PROJECT AT THE ZORTMAN AND LANDUSKY MINES

Category	Alternative	Included/Eliminated for Detailed Analysis	Reason for Inclusion or Elimination
Mining Method	Surface	Included (Alts. 5,6,7)	-Viable means of resource extraction for type and grade of ore body.
	Underground	Eliminated	-Uneconomical for extensive low grade ore body. Reduction in surface impacts minimal due to probable surface subsidence during and after mining.
Mine Reclamation	Low Reclamation Effort	Included (Alt. 1,2)	-Not sufficiently effective in preventing unnecessary or undue degradation or providing comparable utility and stability.
	Moderate Reclamation Effort	Included (Alt. 4)	-May be sufficiently effective in preventing unnecessary or undue degradation or providing comparable utility and stability.
	Extensive Reclamation Effort	Included (Alts. 3,5,6,7)	-Likely to be sufficiently effective in preventing unnecessary or undue degradation or providing comparable utility and stability.

TABLE 2.2-1 - ALTERNATIVES CONSIDERED
(Continued)

Category	Alternative	Included/Eliminated for Detailed Analysis	Reason for Inclusion or Elimination
Mine Pit Reclamation	Zortman Pit Complex		
	Complete Pit Backfill	Eliminated	-See Waste Rock Repository Location
	Partial Backfill	Included (Alts. 3,4,5,6,7)	-See Waste Rock Repository Location
	Highwall Reduction	Eliminated	-Area of disturbance nearly doubles if slope reduced to 2H:IV; would not enhance reclamation beyond that provided by partial backfilling and the proposed pit floor and bench reclamation (Alternatives 3, 5, 6, and 7)
	Landusky Pit Complex		
	Complete Pit Backfill	Eliminated	-See Waste Rock Repository Location
	Partial Backfill	Included (Alts. 3,4,5,6,7)	-See Waste Rock Repository Location
	Highwall Reduction	Eliminated	-Area of disturbance nearly doubles if slope reduced to 2H:1V; would not enhance reclamation beyond that provided by partial backfilling and the proposed pit floor and bench reclamation (Alternatives 3, 5, 6 and 7)
Ore Transport	Conveyor	Included (Alts. 4,6,7)	-Efficient long distance transport method with electric power generation capability and low vehicle transport impact potential.
		Eliminated (Alt. 5)	-Inefficient short distance transport method.
		Eliminated (Landusky) (Alts. 4,5,6,7)	-Inefficient short distance transport method.
	Truck Haul	Eliminated (Alts. 4,6,7)	-Inefficient long distance transport method with high vehicle transport impact potential.
		Included (Alt. 5)	-Efficient short distance transport method.
		Included (Landusky) (Alts. 4,5,6,7)	-Efficient short distance transport method.

TABLE 2.2-1 - ALTERNATIVES CONSIDERED (Continued)

Category	Alternative	Included/Eliminated for Detailed Analysis	Reason for Inclusion or Elimination
Beneficiation Technology	Heap Leach	Included (Alts. 4,5,6,7)	-Proven technology for low grade ore with previous applications at this site.
	Milling	Eliminated	-Uneconomical for low grade ore and an impact potential similar to heap leaching.
Conveyor Route	Ruby Gulch	Eliminated	-Passes through community of Zortman.
	Alder Gulch	Included (Alts. 4,6,7)	-Minimizes potential impacts to residential areas.
Process Solution Storage Method	In-Heap	Included	-Moderately efficient storage method with lower loss and environmental exposure for process reagents than external ponds.
	External Ponds	Included	-Very efficient storage method with excess capacity for storage of inflow due to storms and solution drain down.

TABLE 2.2-1 - ALTERNATIVES CONSIDERED (Continued)

Category	Alternative	Included/Eliminated for Detailed Analysis	Reason for Inclusion or Elimination
Heap Leach Location	<u>Zortman Ore</u>		
	Goslin Flats	Included (Alts. 4,6,7)	-Sufficient room for pad, ponds, process facilities, and diversions with reasonable ore depths. Ore transport distance made economical by downhill conveyor transport with power generation capabilities.
	Ruby Gulch	Eliminated	-Large upgradient catchment area in steep terrain requiring extensive surface water diversion ditches and heap underdrains. Pad preparation would require extensive earthwork including imported borrow materials. Close proximity to town of Zortman.
	Alder Gulch	Included (Alt. 5)	-Sufficient room for pad, ponds, process facilities and diversions. Short ore transport distance.
	Lodgepole Creek	Eliminated	-Pad preparation would require extensive earthwork including imported borrow materials. Located in drainage with minimal disturbance from existing mining operations; drainage flows directly into the town of Lodgepole on the Ft. Belknap Indian Reservation.
	Existing Zortman Pads	Eliminated	-Existing pads are filled to capacity. Off-loading would be uneconomical and would provide insufficient storage capacity for new ore.
	Existing Landusky Pads	Eliminated	-Existing pads are nearly filled to capacity. Long distance ore transport and pad unloading are uneconomical.
	In-Pit at Landusky	Eliminated	-Extensive earthwork would be required to prepare the pit as a pad site. Earthwork and ore transport are uneconomical.
	In-Pit at Zortman	Eliminated	-Would interfere with proposed pit development.

TABLE 2.2-1 - ALTERNATIVES CONSIDERED
(Continued)

Category	Alternative	Included/Eliminated for Detailed Analysis	Reason for Inclusion or Elimination
Heap Leach Location (Continued)	Landusky Ore		
	1987-1991 Pad Expansion	Included (Alts. 4,5,6,7)	-Existing 1987-1991 pad complex has sufficient capacity to accommodate the additional ore included in the proposal.
	1985-1986 Pad Expansion	Eliminated	-Proximity to Montana Gulch stream flows and potential impacts to water quality.
	Other Existing Landusky Pads	Eliminated	-Off-loading and reuse may have limited feasibility at a later date, depending on leaching schedules and economics. This has a reasonably foreseeable use but low probability of immediate practical application.
	In-Pit at Landusky	Eliminated	-Extensive earthwork would be required to prepare the pit as a pad site. Would interfere with proposed pit development. May be reasonably foreseeable at a later date.
	In-Pit at Zortman	Eliminated	-Extensive earthwork would be required to prepare the pit as a pad site. Would interfere with proposed pit development. Earthwork and ore transport are uneconomical.
	Existing Zortman Pads	Eliminated	-Existing pads are filled to capacity. Long distance ore transport and pad unloading are uneconomical.
Heap Leach Reclamation	Neutralize and Reclaim In-Place	Included (All Alts.)	-Proven closure/reclamation method for heap leach operations.
	Low Reclamation Effort	Excluded	-Not sufficiently effective in preventing unnecessary or undue degradation or providing comparable utility and stability.
	Moderate Reclamation Effort	Included (Alts. 1,2,4)	-May be sufficiently effective in preventing unnecessary or undue degradation or providing comparable utility and stability.
	Extensive Reclamation Effort	Included (Alts. 3,5,6,7)	-Likely to be sufficiently effective in preventing unnecessary or undue degradation or providing comparable utility and stability.
	Neutralize and Dispose Off-Site	Eliminated	-Uneconomical for low grade ore. This type of mining operation requires in-place leach pad reclamation to be cost-effective.

TABLE 2.2-1 - ALTERNATIVES CONSIDERED (Continued)

Category	Alternative	Included/Eliminated for Detailed Analysis	Reason for Inclusion or Elimination
Heap Leach Type	Reusable Pad	Eliminated	-Requires uneconomic double handling of ore. Best applied when pad space is limited and ore grades can sustain additional cost.
	Flat Pad	Included (Alts. 4,6,7)	-Proven configuration for open areas (Goslin Flats).
	Valley Leach	Included (Alt. 5)	-Proven configuration for locations in steep drainages with limited upgradient catchment (Alder Gulch).
Processing	Cyanide Leach, Carbon Adsorption or Merril Crowe, Electrowinning, Smelting	Included (Alts. 4,5,6,7)	-Proven technology for low grade ore with previous applications at this project.
	Other Leaching Agents and/or Metal Recovery Systems, Smelting	Eliminated	-Experimental technologies, unproven on ore at this location, and/or less efficient technology for metal recovery based on projected pregnant solution characteristics.
Water Control	Diversions	Included (All Alts.)	-Effective method to minimize surface water flowing on to mine site.
	Capture Systems	Included (All Alts.)	-Minimizes potential for offsite flow of contact water and/or process solution and reduces requirement for fresh water makeup.
	Treatment and Discharge	Included (All Alts.)	-Contact water and/or process solution treated to acceptable quality for discharge.
	Land Application	Included (All Alts.)	-Effective method to dispose of excess contact water and/or process solution.

TABLE 2.2-1 - ALTERNATIVES CONSIDERED (Continued)

Category	Alternative	Included/Eliminated for Detailed Analysis	Reason for Inclusion or Elimination
Waste Rock Transport	Conveyor	Eliminated (Alt. 5)	-Inefficient short distance transport method.
		Included (Alt. 6)	-Efficient long distance transport method with electric power generation capability and low vehicle transport impact potential.
		Eliminated (Landusky)	-Inefficient short distance transport method.
	Truck Haul	Eliminated (Alt. 6)	-Inefficient long distance transport method with high vehicle transport impact potential
		Included (Alts. 4,5,7)	-Efficient short distance transport method.
		Included (Landusky) (Alts. 4,5,6,7)	-Efficient short distance transport method.
Waste Rock Facility Reclamation	Low Reclamation Effort	Eliminated	-Not sufficiently effective in preventing unnecessary or undue degradation or providing comparable utility and stability.
	Moderate Reclamation Effort	Included (Alts. 1,2,4)	-May be sufficiently effective in preventing unnecessary or undue degradation or providing comparable utility and stability.
	Extensive Reclamation Effort	Included (Alts. 3,5,6,7)	-Likely to be sufficiently effective in preventing unnecessary or undue degradation or providing comparable utility and stability.

TABLE 2.2-1 - ALTERNATIVES CONSIDERED
(Concluded)

Category	Alternative	Included/Eliminated for Detailed Analysis	Reason for Inclusion or Elimination
Waste Rock Repository Location	Zortman Waste Rock		
	Carter Draw of Alder Gulch	Included (Alts. 4,5)	-Short haul. Reduced visual impact. Portion of facility would occupy existing disturbance.
	Upper Ruby Gulch	Eliminated	-Expanded visual impact. Uphill haul uneconomic.
	Lower Ruby Gulch	Eliminated	-Large upgradient catchment area in steep terrain.
	Total Backfill Zortman Pit	Eliminated	-Insufficient material available from extension for complete backfill. While sufficient quantities are available in existing facilities, it is uneconomic to transport the amount necessary for total backfill.
	Total Backfill Landusky Pit	Eliminated	-Uneconomical due to haul distance.
	Partial Backfill Zortman Pit	Included (Alts. 3,4,5,6,7)	-Reduced potential for surface water inflow and ARD generation.
	Partial Backfill Landusky Pit	Eliminated	-Uneconomic haul distance from Zortman pit to Landusky pit.
	Goslin Flats	Eliminated	-Insufficient area next to ore heap leach facility.
	Ruby Flats	Included (Alt. 6)	-Concentrates waste rock and heap leach facilities at one location. Allows transport of both ore and waste rock by conveyor.
	Upper Lodgepole Creek	Eliminated	-Large upgradient catchment area in steep terrain with extensive surface water diversion requirements. Located in drainage with minimal disturbance from existing mining operations which flows directly into the town of Lodgepole on the Fort Belknap Indian Reservation.
	Landusky Waste Rock		
	Total Backfill Landusky Pit	Eliminated	-Insufficient material available from extension for complete backfill. While sufficient quantities are available in existing facilities, it is uneconomic to transport the amount necessary for total backfill.
	Total Backfill Zortman Pit	Eliminated	-Uneconomic haul distance from Landusky pit to Zortman pit.
	Partial Backfill Landusky Pit	Included (Alts. 3,4,5,6,7)	-Removal, transport of some existing facilities to partially backfill pit economically feasible. Reduced potential for surface water inflow and ARD generation.
	Partial Backfill Zortman Pit	Eliminated	-Uneconomic due to haul distance.

TABLE 2.2-2

SUMMARY OF ALTERNATIVES - ZORTMAN MINE

Project Components	Alternative 1 - No Action (Permitted Operations and Reclamation)	Alternative 2 - Mine Expansion Not Approved and Company Proposed Reclamation	Alternative 3 - Mine Expansion Not Approved and Agency Mitigated Reclamation	Alternative 4 - Company Proposed Expansion and Reclamation (Company Proposed Action or CPA)	Alternative 5 - Agency Mitigated Expansion and Reclamation with Leach Pad in Upper Alder Gulch	Alternative 6 - Agency Mitigated Expansion and Reclamation with Waste Rock Facility on Ruby Flats	Alternative 7 - Agency Mitigated Expansion and Reclamation with Waste Rock Repository Located in Existing Mine Facilities (Preferred)
Mine							
Location	97 acres in 6 pits - Ross Pit - South Alabama Pit - North Alabama Pit - OK Pit - Ruby Pit - Mint Pit	97 acres in 6 pits - Ross Pit - South Alabama Pit - North Alabama Pit - OK Pit - Ruby Pit - Mint Pit	97 acres in 6 pits - Ross Pit - South Alabama Pit - North Alabama Pit - OK Pit - Ruby Pit - Mint Pit	Vertical and lateral expansion of mine pit complex; 103 additional acres	CPA	CPA	CPA
Extraction	No additional mining	No additional mining	No additional mining	Open pit, drill, blast, load - 80 million tons ore - 60 million tons waste rock	CPA	CPA	CPA
Ore Transport	Not applicable	Not applicable	Not applicable	Truck to primary crusher and conveyor to leach pad	Truck haul	CPA	CPA
Waste Rock Transport	Not applicable	Not applicable	Not applicable	Truck haul to Carter Gulch repository	CPA	Conveyor to Goslin Flats and truck haul to Ruby Flats	Stage at mine site, backfill, cover facilities
Ore Prep, Handling, and Storage							
Location	None	None	None	Primary crush below truck shop near 84 leach pad; secondary & tertiary crushing at Goslin Flats	All ore crushing near mine site	CPA	CPA
Crushing	None	None	None	Crush oxide and unoxidized	CPA	CPA	CPA
Stockpile	None	None	None	Separate piles at head of conveyor	At mine site or near Upper Alder leach pad; separate at truck load-out	CPA	CPA
Conditioning	None	None	None	Blend unoxidized ore with oxide ore	CPA	CPA	CPA

TABLE 2.2-2 - SUMMARY OF ALTERNATIVES - ZORTMAN MINE (Continued)

Project Components	Alternative 1 - No Action (Permitted Operations and Reclamation)	Alternative 2 - Mine Expansion Not Approved and Company Proposed Reclamation	Alternative 3 - Mine Expansion Not Approved and Agency Mitigated Reclamation	Alternative 4 - Company Proposed Expansion and Reclamation (Company Proposed Action or CPA)	Alternative 5 - Agency Mitigated Expansion and Reclamation with Leach Pad in Upper Alder Gulch	Alternative 6 - Agency Mitigated Expansion and Reclamation with Waste Rock Facility on Ruby Flats	Alternative 7 - Agency Mitigated Expansion and Reclamation with Waste Rock Repository Located in Existing Mine Facilities (Preferred)
Gre Transport							
Location	Not applicable	Not applicable	Not applicable	Alder Gulch route to Goslin Flats, 2.5 acre conveyor corridor	New truck haul route (Antoine Butte) to Upper Alder leach pad	CPA	CPA
Method	Not applicable	Not applicable	Not applicable	Partially covered overland conveyor to Goslin Flats heap leach pad	Haul trucks	CPA conveyor system	CPA conveyor system
Beneficiation (Heap Leaching)							
Location	116 current acres at 7 existing heap leach sites - 79 pad (inactive) - 80/81 pad (inactive) - 82 pad (inactive) - 83 pad (inactive) - 84 pad (inactive) - 85/86 pad (inactive) - 89 pad (active)	116 current acres at 7 existing heap leach sites - 79 pad (inactive) - 80/81 pad (inactive) - 82 pad (inactive) - 83 pad (inactive) - 84 pad (inactive) - 85/86 pad (inactive) - 89 pad (active)	116 current acres at 7 existing heap leach sites - 79 pad (inactive) - 80/81 pad (inactive) - 82 pad (inactive) - 83 pad (inactive) - 84 pad (inactive) - 85/86 pad (inactive) - 89 pad (active)	Goslin Flats heap leach 205 acres	Upper Alder Gulch, heap leach, 180 acres	Goslin Flats, heap leach, 205 acres	Goslin Flats heap leach, 205 acres
Method	Valley leach	Valley leach	Valley leach	Modified flat pad	Valley leach	CPA	CPA
Process Solution Storage							
Location	Existing facilities	Existing facilities	Existing facilities	Goslin Flats	Upper Alder Gulch	Goslin Flats	Goslin Flats
Method	In heap and external lined ponds	In heap and external lined ponds	In heap and external lined ponds	In heap and external lined ponds	In heap and external lined ponds	In heap and external lined ponds	In heap and external lined ponds

TABLE 2.2-2 - SUMMARY OF ALTERNATIVES - ZORTMAN MINE (Continued)

Project Components	Alternative 1 - No Action (Permitted Operations and Reclamation)	Alternative 2 - Mine Expansion Not Approved and Company Proposed Reclamation	Alternative 3 - Mine Expansion Not Approved and Agency Mitigated Reclamation	Alternative 4 - Company Proposed Expansion and Reclamation (Company Proposed Action or CPA)	Alternative 5 - Agency Mitigated Expansion and Reclamation with Leach Pad in Upper Alder Gulch	Alternative 6 - Agency Mitigated Expansion and Reclamation with Waste Rock Facility on Ruby Flats	Alternative 7 - Agency Mitigated Expansion and Reclamation with Waste Rock Repository Located in Existing Mine Facilities (Preferred)
Processing							
Location	Existing process plant, 8.5 acres, 1 site	Existing process plant, 8.5 acres, 1 site	Existing process plant, 8.5 acres, 1 site	Goslin Flats, 23 acres	Existing process plant	Goslin Flats, 23 acres	Goslin Flats, 23 acres
Method	Existing Facilities	Existing Facilities	Existing Facilities	Cyanide solution, carbon adsorption, electrowinning, smelting	CPA	CPA	CPA
Mine Waste Disposal							
Waste Rock	25 acres in 3 Dumps - Alder Gulch (3,365,000 tons) - Ruby Gulch (850,000 tons) - OK Dump (1,235,000 tons)	25 Acres in 3 Dumps - Alder Gulch (3,365,000 tons) - Ruby Gulch (850,000 tons) - OK Dump (1,235,000 tons)	Alder Gulch, OK and Ruby Dumps backfilled into pit	New repository in Carter Gulch of Alder Gulch, 162 additional acres; truck haul, bottom-up construction	CPA	New repository on Ruby Flats; conveyor transport and truck haul, bottom-up construction lined impoundment	New repository constructed over existing mine facilities
Spent Heap Leach Ore or Tailings	Reclaim in place	Reclaim in place	85/86 leach pad/dike removed for pit backfill; Ruby Gulch tailing removed for pit backfill; Other facilities reclaimed in place	Reclaim facilities in place; portion of 85/86 pad leached on Goslin Flats leach pad	85/86 leach pad & dike removed for pit backfill; Ruby Gulch tailing removed for pit backfill; Other facilities reclaimed in place	85/86 leach pad & dike removed for pit backfill; Ruby Gulch tailing removed for pit backfill; Other facilities reclaimed in place	85/86 leach pad & dike removed for pit backfill; Ruby Gulch tailing removed for pit backfill; Other facilities reclaimed in place
Other Solid Waste	Lab wastes to ASARCO smelter, empty cyanide barrels crushed and buried in heap, sludge from water treatment plant to 89 leach pad	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1

TABLE 2.2-2 - SUMMARY OF ALTERNATIVES - ZORTMAN MINE (Concluded)

Project Components	Alternative 1 - No Action (Permitted Operations and Reclamation)	Alternative 2 - Mine Expansion Not Approved and Company Proposed Reclamation	Alternative 3 - Mine Expansion Not Approved and Agency Mitigated Reclamation	Alternative 4 - Company Proposed Expansion and Reclamation (Company Proposed Action or CPA)	Alternative 5 - Agency Mitigated Expansion and Reclamation with Leach Pad in Upper Alder Gulch	Alternative 6 - Agency Mitigated Expansion and Reclamation with Waste Rock Facility on Ruby Flats	Alternative 7 - Agency Mitigated Expansion and Reclamation with Waste Rock Repository Located in Existing Mine Facilities (Preferred)
Other Facilities							
Access Roads	24 acres existing	24 acres existing	24 acres existing	23 additional acres of access road disturbance	CPA	CPA	CPA
Limestone Quarry	None	None	13 acres, LS-1 site south of Green Mountain	13 acres disturbance, LS-1 site, south of Green Mountain	13 acres disturbance, LS-1 site, south of Green Mountain	13 acres disturbance, LS-1 site, south of Green Mountain	13 acres disturbance, LS-1 site, south of Green Mountain
Clay Pit (borrow)	Seaford Clay Pit, 4.2 acres existing, no additional disturbance	Seaford Clay Pit, 4.2 acres existing, 3.0 acres additional disturbance	Seaford Clay Pit, 4.2 acres existing, 3.5 acres additional disturbance	Seaford Clay Pit, 4.2 acres existing, 10 acres additional disturbance	Seaford Clay Pit, 4.2 acres existing, 11.5 acres additional disturbance	Seaford Clay Pit, 4.2 acres existing, 12 acres additional disturbance	Seaford Clay Pit, 4.2 acres existing, 4 acres additional disturbance
Top Soil Stockpile	Various locations, 15.5 acres	Various locations, 15.5 acres	Various locations, 15.5 acres	Goslin Flats, 48 additional acres	Alder Gulch	CPA and Ruby Flats	CPA and Ruby Flats
Power Corridor	Existing Facilities	Existing Facilities	Existing Facilities	Buried construction, 9 additional acres	CPA	CPA	CPA
Solution Pipeline	Existing Facilities	Existing Facilities	Existing Facilities	10" pipeline along conveyor route	Existing Facilities	CPA	CPA
Reclamation							
Mine Pits	Existing permit requirements	Existing permit requirements	Partial backfill pit and Enhanced Reclamation	Partial backfill pit to drain by gravity, revegetate, divert surface water inflows, cover and revegetate benches and pit floor	Enhanced CPA Reclamation with additional backfill	Enhanced CPA Reclamation with additional backfill	Enhanced CPA Reclamation with additional backfill
Waste Rock Dumps and Repositories	Existing permit requirements	Existing permit requirements, cap modifications	Enhanced reclamation covers, B or C, Modified Alder Gulch and OK dumps used as pit backfill	Concurrent reclamation, capping, revegetation, waste segregation/encapsulation, Covers A, B or C	Enhanced CPA Reclamation, Covers B or Modified C, with OK dump used as pit backfill	Enhanced CPA Reclamation, Covers B or Modified C with OK dump used as pit backfill	Enhanced reclamation water balance covers
Leach Pads	Existing permit requirements	Existing permit requirements, geochemical testing, Reclamation Cover A	Enhanced reclamation Covers B or Modified C on heap leach pads, CPA with minor modifications	Neutralize in-place with fresh water rinses, perforate liner, capping, revegetation	Enhanced CPA Reclamation, Covers B or Modified C on heap leach pads	Enhanced CPA Reclamation, covers B or Modified C on heap leach pads	Enhanced reclamation water balance covers

TABLE 2.2-3

SUMMARY OF ALTERNATIVES - LANDUSKY MINE

Project Components	Alternative 1 - No Action (Permitted Operations and Reclamation)	Alternative 2 - Mine Expansion Not Approved and Company Proposed Reclamation	Alternative 3 - Mine Expansion Not Approved and Agency Mitigated Reclamation	Alternative 4 - Company Proposed Expansion and Reclamation (Company Proposed Action, or CPA)	Alternative 5 - Agency Mitigated Expansion (Zortman Mine Leach Pad in Upper Alder Gulch) and Reclamation	Alternative 6 - Agency Mitigated Expansion (Zortman Mine Waste Rock Facility at Ruby Flats) and Reclamation	Alternative 7 - Agency Mitigated Expansion and Reclamation with Zortman Waste Rock Repository Located on Existing Mine Facilities
Mine							
Location	Existing disturbance of 235 Acres in 5 Pits - Queen Rose Pit - August Pit - Little Ben Pit - Gold Bug Pit - Niseka Pit	Same as Alternative 1	Same as Alternative 1	Vertical expansion of existing South Gold Bug pit	CPA	CPA	CPA
Extraction	Open pit, drill, blast, load; permitted disturbance	Same as Alternative 1	Same as Alternative 1	Open pit, drill, blast, load; additional 7.6 million tons ore & 7.0 million tons waste rock	CPA	CPA	CPA
Ore Transport	Truck to 87/91 heap leach pad	Same as Alternative 1	Same as Alternative 1	Truck to expanded 87/91 heap leach pad	CPA	CPA	CPA
Waste Rock Transport	Truck to Gold Bug waste rock repository	Same as Alternative 1	Same as Alternative 1	Truck to expanded Gold Bug waste rock repository	CPA	CPA	CPA
Ore, Prep, Handling, and Storage	All ore run of mine; no stockpiles, crushing, or conditioning	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Ore Transport							
Location	Existing Roads	Existing Roads	Existing Roads	Existing Roads	Existing Roads	Existing Roads	Existing Roads
Method	Truck Haul	Truck Haul	Truck Haul	Truck Haul	Truck Haul	Truck Haul	Truck Haul

TABLE 2.2-3 - SUMMARY OF ALTERNATIVES - LANDUSKY MINE (Continued)

Project Components	Alternative 1 - No Action (Permitted Operations and Reclamation)	Alternative 2 - Mine Expansion Not Approved and Company Proposed Reclamation	Alternative 3 - Mine Expansion Not Approved and Agency Mitigated Reclamation	Alternative 4 - Company Proposed Expansion and Reclamation (Company Proposed Action, or CPA)	Alternative 5 - Agency Mitigated Expansion (Zortman Mine Leach Pad in Upper Alder Gulch) and Reclamation	Alternative 6 - Agency Mitigated Expansion (Zortman Mine Waste Rock Facility at Ruby Flats) and Reclamation	Alternative 7 - Agency Mitigated Expansion and Reclamation with Zortman Waste Rock Repository Located on Existing Mine Facilities
<u>Beneficiation (Heap Leaching)</u>							
Location	280 Current Acres at 8 Existing Heap Leach Sites - 79 pad (inactive) - 80/81/82 pad (inactive) - 83 pad (inactive) - 84 pad (inactive) - 85/86 pad (leaching) - 87 pad (leaching) - 91 pad (loading & leaching) - 87/91 pad (loading & leaching)	Same as Alternative 1	Same as Alternative 1	87/91 pad expansion	CPA	CPA	CPA
Method	Valley Leach	Valley Leach	Valley Leach	Valley Leach	Valley Leach	Valley Leach	Valley Leach
<u>Process Solution Storage</u>							
Location	Existing Facilities	Existing Facilities	Existing Facilities	Existing Facilities	Existing Facilities	Existing Facilities	Existing Facilities
Method	In Heap and External Lined Pond	In Heap and External Lined Pond	In Heap and External Lined Pond	In Heap and External Lined Pond	In Heap and External Lined Pond	In Heap and External Lined Pond	In Heap and External Lined Pond
<u>Processing</u>							
Location	2 sites - 87 pad - Landusky Plant	2 sites	2 sites	2 sites	2 sites	2 sites	2 sites
Method	Existing facilities, Merrill-Crowe and Carbon Adsorption	Same as Alternative 1	Same as Alternative 1	Same processes as currently used; Merrill-Crowe and Carbon Adsorption	CPA	CPA	CPA

TABLE 2.2-3 - SUMMARY OF ALTERNATIVES - LANDUSKY MINE (Continued)

Project Components	Alternative 1 - No Action (Permitted Operations and Reclamation)	Alternative 2 - Mine Expansion Not Approved and Company Proposed Reclamation	Alternative 3 - Mine Expansion Not Approved and Agency Mitigated Reclamation	Alternative 4 - Company Proposed Expansion and Reclamation (Company Proposed Action, or CPA)	Alternative 5 - Agency Mitigated Expansion (Zortman Mine Leach Pad in Upper Alder Gulch) and Reclamation	Alternative 6 - Agency Mitigated Expansion (Zortman Mine Waste Rock Facility at Ruby Flats) and Reclamation	Alternative 7 - Agency Mitigated Expansion and Reclamation with Zortman Waste Rock Repository Located on Existing Mine Facilities
Mine Waste Disposal							
Waste Rock	171 acres existing disturbance, 184 acres permitted, in 3 facilities - Montana Gulch (8,000,000 tons) - Mill Gulch (17,000,000 tons) - Gold Bug Repository Plus Heap Leach Pad Embankments (14,000,000 tons)	Same as Alternative 1	Same as Alternative 1	Expand Gold Bug Repository; 7.0 million tons generated during expansion used as pit backfill	CPA with additional backfill	CPA with additional backfill	CPA with additional backfill
Spent Heap Leach Ore	Reclaim in place	Reclaim in place	Reclaim in place, enhanced barrier reclamation covers	Reclaim in place, CPA barrier reclamation covers	Reclaim in place enhanced barrier reclamation covers	Reclaim in place enhanced barrier reclamation covers	Reclaim in place water balance reclamation cover.s
Other Solid Waste	Lab wastes to ASARCO smelter, empty cyanide barrels crushed, buried in heap, municipal waste to County landfill	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Other Facilities							
Limestone Quarry	King Creek quarry, 3 acres existing disturbance, no additional disturbance	King Creek quarry, 3 acres existing disturbance, no additional disturbance	King Creek quarry, 3 acres existing disturbance, 19 acres additional disturbance	King Creek quarry, 3 acres existing disturbance, 3 acres additional disturbance	King Creek quarry, 3 acres existing disturbance, 3 acres additional disturbance	King Creek quarry, 3 acres existing disturbance, 3 acres additional disturbance	King Creek quarry, 3 acres existing disturbance, 3 acres additional disturbance
Clay Pit (borrow)	Williams Pit, 26 acres existing disturbance, no additional disturbance	Williams Pit, 26 acres existing disturbance, 6 acres additional disturbance	Williams Pit, 26 acres existing disturbance, 9 acres additional disturbance	Williams Pit, 26 acres existing disturbance, 7 acres additional disturbance	Williams Pit, 26 acres existing disturbance, 9 acres additional disturbance	Williams Pit, 26 acres existing disturbance, 9 acres additional disturbance	Williams Pit, 26 acres existing disturbance, 0 acres additional disturbance

TABLE 2.2-3 - SUMNMARY OF ALTERNATIVES - LANDUSKY MINE (Concluded)

Project Components	Alternative 1 - No Action (Permitted Operations and Reclamation)	Alternative 2 - Mine Expansion Not Approved and Company Proposed Reclamation	Alternative 3 - Mine Expansion Not Approved and Agency Mitigated Reclamation	Alternative 4 - Company Proposed Expansion and Reclamation (Company Proposed Action, or CPA)	Alternative 5 - Agency Mitigated Expansion (Zortman Mine Leach Pad in Upper Alder Gulch) and Reclamation	Alternative 6 - Agency Mitigated Expansion (Zortman Mine Waste Rock Facility at Ruby Flats) and Reclamation	Alternative 7 - Agency Mitigated Expansion and Reclamation with Zortman Waste Rock Repository Located on Existing Mine Facilities
<u>Other Facilities, Continued</u>							
Top Soil Stockpile	Various Locations	Various Locations	Various Locations	Various Locations	Various Locations	Various Locations	Various Locations
Power Corridor	Existing Facilities	Existing Facilities	Existing Facilities	Buried construction, 9 additional acres, line connecting to Zortman Mine	CPA	CPA	CPA
Solution Pipeline	Existing Facilities	Existing Facilities	Existing Facilities	Existing Facilities	Existing Facilities	Existing Facilities	Existing Facilities
<u>Reclamation</u>							
Mine Pits	Existing permit requirements	Existing permit requirements	Partial backfill pit, enhanced reclamation covers, drainage notch to direct surface water to Montana Gulch	Partial backfill pit to drain by gravity, revegetate, divert surface water inflows, cover and revegetate benches and pit floor; surface water to August drain tunnel	Partial backfill pit, enhanced reclamation covers, direct surface water to King Creek	Partial backfill pit, enhanced reclamation covers, drainage notch to direct surface water to Montana Gulch	Partial backfill pit, water balance covers, divert surface water to King Creek; highwall runoff to Montana Gulch
Waste Rock Dumps and Repositories	Existing permit requirements	Existing permit requirements, geochemical testing, Reclamation Cover A	Enhanced Reclamation Covers, B or Modified C on waste rock facilities	Concurrent reclamation, capping, revegetation, waste segregation/encapsulation	Enhanced CPA Reclamation, Covers B or Modified C on waste rock facilities	Enhanced CPA Reclamation, Covers B or Modified C on waste rock facilities	Enhanced reclamation water balance covers
Leach Pads	Existing permit requirements	Existing permit requirements, geochemical testing, Reclamation Cover A	Enhanced Reclamation Covers, B or Modified C on heap leach pads, CPA procedures	Neutralize in-place with fresh water rinses, perforate liner, capping, revegetation	Enhanced CPA Reclamation, Covers B or Modified C on heap leach pads	Enhanced CPA Reclamation, Covers B or Modified C on heap leach pads	Enhanced reclamation water balance covers

TABLE 2.3-1

SUMMARY OF IMPACTS[1]

Resource	ALT. 1	ALT. 2	ALT. 3	ALT. 4	ALT. 5	ALT. 6	ALT. 7
	Z L	Z L	Z L	Z L	Z L	Z L	Z L
WATER RESOURCES							
Surface Water Quality	-H	-H	+L	-M	-M	-L	-L
Groundwater Quality	-H	-H	+L	-M	-M	-L	-L
% Infiltration	Flats 21.4% Slopes 18.8%	19.7% 17.7%	0.12% 10.35%	0.94% 3:1 10.35%	0.12% 10.35%	0.12% 10.35%	0.006% 5%
Volume of Water Requiring Capture and Treatment (gpm average over 20 years)	390-460 gpm	370-440 gpm	250-320 gpm	260-330 gpm	230-320 gpm	270-340 gpm	200-270 gpm
Overall Cumulative Impact Ranking	-H	-M	-L	-M	-M	-L	-L
"Long-Term" Reclamation Success (water quality)	-H	-H	+M	+L	+M	+M	+M
SOIL RESOURCES							
• Soil Disturbance (cumulative; in acres)	1248 ac.	1257 ac.	1293 ac.	2212 ac.	2272 ac.	2422 ac.	2083 ac.
• Soil Productivity	-H	-H	-M	-M	-M	-M	-M
• Soil Erosion	-H	-H	-M	-M	-M	-M	-M
• Total Soil Loss from Major Facilities (tons/acre/year)	3.38	3.38	1.76	1.77	1.63	1.73	1.31
CULTURAL RESOURCES							
• Overall Impact Level	-M	-M	-L	-H	-H	-H	-H
• Relative Ranking (1 = most favorable)	2	2	1	4	3	4	4

TABLE 2.3-1 - SUMMARY OF IMPACTS[1]
(Continued)

Resource	ALT. 1		ALT. 2		ALT. 3		ALT. 4		ALT. 5		ALT. 6		ALT. 7	
	Z	L	Z	L	Z	L	Z	L	Z	L	Z	L	Z	L
WILDLIFE AND AQUATICS														
• Special Status Species	NI		NI		NI		NI		NI		NI		NI	
• Nesting Raptors	NI		NI		NI		NI		NI		NI		NI	
• Habitat Loss (in acres)	1248 ac.		1257 ac.		1293 ac.		2212 ac.		2272 ac.		2422 ac.		2083 ac.	
• Residual Long-term Water Quality Effects	-M		-M		-L		-M		-M		-L		+L	
• Sedimentation Effects	-L		-L		-L		-M		-L/NI		-M		-M	
• Long-term Wildlife Mortality	NI		NI		NI		NI		NI		NI		NI	
• Noise Effects	NI		NI		NI		NI		NI		NI		NI	
• Long-term Reclamation Effects	-H		-M		-L		-L		-L		-L		NI	
• Overall Cumulative Wildlife Impacts	-H		-M		-L		-M		-L/M		-L/M		-L/NI	
VEGETATION AND WETLANDS														
• Special Status Species Habitat	NI		NI		NI		NI		NI		NI		NI	
• Sole Source of Veg. Used by Native Americans	NI		NI		NI		NI		NI		NI		NI	
• Wetland Directly Impacted (in acres)	0		0		0		1.06 ac.		0.02 ac.		1.06 ac.		1.06 ac.	
• Non-Wetland Waters Directly Impacted (in acres)	4 ac.		4 ac.		4 ac.		7.01 ac.		6.01 ac.		6.21 ac.		6.51 ac.	
• Riparian Vegetation Impacted (Cumulative; in acres)	16 ac.		16 ac.		16 ac.		26 ac.		43 ac.		26 ac.		25 ac.	
• Forest Removed (Cumulative; in acres)	1029 ac.		1029 ac.		1029 ac.		1387 ac.		1550 ac.		1245 ac.		1285 ac.	
• Reclamation Plan Revegetation Effectiveness (% revegetation expected)	25%		35%		95%		95%		95%		95%		99%	
• Overall Cumulative Vegetation Impacts	-H		-H		-M		-M		-M		-M		-L	

TABLE 2.3-1 - SUMMARY OF IMPACTS[1]
(Continued)

Resource	ALT. 1		ALT. 2		ALT. 3		ALT. 4		ALT. 5		ALT. 6		ALT. 7	
	Z	L	Z	L	Z	L	Z	L	Z	L	Z	L	Z	L
SOCIOECONOMICS														
Employment														
• Montana employment (cumulative; in job-years)	561		744		909		5,000		4,821		4,524		5,156	
• Phillips County employment (cumulative; in job-years)	437		571		698		3,480		3,356		3,173		3,608	
• Blaine County employment (cumulative; in job-years)	20		26		32		144		139		133		133	
Earnings														
• Montana earnings (cumulative; in millions of 1994 dollars)	$14.8		$19.5		$23.8		$126.4		$121.8		$114.8		$130.6	
• Phillips County earnings (cumulative; in millions of 1994 dollars)	$12.3		$16.0		$19.6		$95.6		$92.2		$87.4		$99.3	
• Blaine County earnings (cumulative; in millions of 1994 dollars)	$0.4		$0.5		$.06		$2.6		$2.5		$2.4		$2.7	
Tax Revenues														
• Montana direct tax revenues (cumulative; in millions of 1994 dollars)	$0.44		$0.44		$0.44		$4.46		$4.30		$3.60		$4.29	
• Phillips County tax revenues (cumulative; in millions of 1994 dollars)	$0.25		$0.25		$0.25		$2.63		$2.57		$2.44		$2.61	
• Malta School Districts direct tax revenues (cumulative; in millions of 1994 dollars)	$0.12		$0.12		$0.12		$1.25		$1.22		$1.15		$1.24	

TABLE 2.3-1 - SUMMARY OF IMPACTS[1] (Continued)

Resource	ALT. 1		ALT. 2		ALT. 3		ALT. 4		ALT. 5		ALT. 6		ALT. 7	
	Z	L	Z	L	Z	L	Z	L	Z	L	Z	L	Z	L
SOCIOECONOMICS - Tax Revenues (Continued)														
• Dodson High School District direct tax revenues (cumulative; in millions of 1994 dollars)	$0.11		$0.11		$0.11		$1.12		$1.10		$1.03		$1.11	
• Landusky School District direct tax revenues (cumulative; in millions of 1994 dollars)	$0.07		$0.07		$0.07		$0.73		$0.72		$0.68		$0.73	
• City of Malta direct tax revenues (cumulative; in 1994 dollars)	Negligible		Negligible		Negligible		<$10,000		<$10,000		<$10,000		$10,000	
• County Hard Rock Trust Reserve district tax revenues (cumulative; in millions of 1994 dollars)	$0.06		$0.06		$0.06		$0.59		$0.57		$0.48		$0.57	
RECREATION AND LAND USE														
Developed Recreation (campgrounds, picnic areas, Pow Wow grounds)	-L	-M	-L	-M	-L	-L	-L/M	-M	-L	-M	-M	-M	-L/M	-M
Disposed Recreation (hiking, sightseeing, ORV, hunting, picnicking)	-M	-M	-L/M	-M	-L	-L	-M	-M	-L	-M	-H	-M	-M	-M
Land Use	-H	-H	-M	-M	-L	-L	-M	-M	-L	-M	-H	-M	-M	-M
VISUAL RESOURCES	-H		-H		-H		-H		-H		-H		-H	

TABLE 2.3-1 - SUMMARY OF IMPACTS[1] (Continued)

Resource	ALT. 1		ALT. 2		ALT. 3		ALT. 4		ALT. 5		ALT. 6		ALT. 7	
	Z	L	Z	L	Z	L	Z	L	Z	L	Z	L	Z	L
TRANSPORTATION														
• Traffic Capacity	-L		-L		-L		-L		-L		-L		-L	
• Accidents	-L		-L		-L		-L		-L		-L		-L	
• Transport of Hazardous Materials	-L		-L		-L		-L		-L		-L		-L	
• Public Access to Parts of the Little Rocky Mountains (duration of impact - until _year_)	-H (until 2001)		-H (until 2001)		-H (until 2002)		-H (until 2008)		-H (until 2008)		-H (until 2007)		-H (until 2008)	
• Safety in Local Communities	-L	-L	-M	-M	-M	-M	-M	-M	-M	-M	-M	-M	-M	NI
(# convoyed truck trips thru town per day; duration in peak year)	0	0	300 trips 12 days	300 trips, 27 days	300 trips, 14 days	300 trips, 35 days	300 trips, 17 days	300 trips, 27 days	300 trips, 25 days	300 trips, 27 days	300 trips, 14 days	300 trips, 27 days	300 trips, 37 days	0
NOISE[2] (in dBA)														
• Cumulative Mine Noise Impacts, Town of Zortman	60 dBA		60 dBA		60 dBA		66 dBA		63 dBA		67 dBA		66 dBA	
• Cumulative Mine Noise Impacts, Town of Landusky	62 dBA		62 dBA		62 dBA		63 dBA		62 dBA		63 dBA		63 dBA	
• Cumulative Mine Noise Impacts, Pow Wow Grounds	55 dBA NI		55 dBA NI		55 dBA NI		59 dBA		59 dBA		59 dBA		59 dBA	
• Cumulative Mine Noise Impacts, Azure Cave	55 dBA NI		55 dBA NI		55 dBA NI		66 dBA		58 dBA		66 dBA		66 dBA	

TABLE 2.3-1 - SUMMARY OF IMPACTS[1] (Continued)

Resource	ALT. 1		ALT. 2		ALT. 3		ALT. 4		ALT. 5		ALT. 6		ALT. 7	
	Z	L	Z	L	Z	L	Z	L	Z	L	Z	L	Z	L
AIR[3] (in $\mu g/m^3$)														
• 24-hour and Annual PM_{10} Mining and Reclamation Impacts, Estimated at Town of Zortman	32 $\mu g/m^3$ NI 8 $\mu g/m^3$ NI		57 $\mu g/m^3$ NI 14 $\mu g/m^3$ NI		68 $\mu g/m^3$ NI 17 $\mu g/m^3$ NI		348 $\mu g/m^3$ 87 $\mu g/m^3$		373 $\mu g/m^3$ 93 $\mu g/m^3$		241 $\mu g/m^3$ 60 $\mu g/m^3$		440 $\mu g/m^3$ 110 $\mu g/m^3$	
• Cumulative 24-Hour PM_{10} Impacts, Estimated at Town of Zortman	134 $\mu g/m^3$ NI		159 $\mu g/m^3$		170 $\mu g/m^3$		402 $\mu g/m^3$		405 $\mu g/m^3$		273 $\mu g/m^3$		472 $\mu g/m^3$	
• 24-hour and Annual PM_{10} Mining and Reclamation Impacts, Estimated at Landusky Mine	85 $\mu g/m^3$ NI 14 $\mu g/m^3$ NI		85 $\mu g/m^3$ NI 25 $\mu g/m^3$ NI		85 $\mu g/m^3$ NI 31 $\mu g/m^3$ NI		85 $\mu g/m^3$ NI 31 $\mu g/m^3$ NI		85 $\mu g/m^3$ NI 32 $\mu g/m^3$ NI		85 $\mu g/m^3$ NI 32 $\mu g/m^3$ NI		85 $\mu g/m^3$ NI 32 $\mu g/m^3$ NI	
• Cumulative 24-Hour PM_{10} Impacts, Estimated at Town of Landusky	110 $\mu g/m^3$ NI		121 $\mu g/m^3$ NI		127 $\mu g/m^3$ NI		115 $\mu g/m^3$ NI		115 $\mu g/m^3$ NI		115 $\mu g/m^3$ NI		115 $\mu g/m^3$ NI	
GEOLOGY														
• Disturbance for Reclamation Materials Clay and Limestone (in acres)	0 ac.	0 ac.	3 ac.	6 ac.	16.5 ac.	28 ac.	23 ac.	10 ac.	24.5 ac.	12 ac.	25 ac.	12 ac.	17 ac.	3 ac.
• Cumulative Disturbance for Reclamation Materials Clay and Limestone (in acres)	4.2 ac.	29 ac.	7.2 ac.	35 ac.	20.7 ac.	57 ac.	27.2 ac.	39 ac.	28.7 ac.	41 ac.	29.2 ac.	41 ac.	21.2 ac.	32 ac.
• Anticipated Gold Production (in Troy ounces)	0 oz.		0 oz.		0 oz.		960,000 oz.		960,000 oz.		960,000 oz.		960,000 oz.	
• Anticipated cumulative Gold Production plus Reasonably Foreseeable (in Troy ounces)	1.3 million oz.		1.3 million oz.		1.3 million oz.		2.42 million oz.		2.26 million oz.		2.42 million oz.		2.42 million oz.	

TABLE 2.3-1 - SUMMARY OF IMPACTS[1]
(Continued)

Resource	ALT. 1		ALT. 2		ALT. 3		ALT. 4		ALT. 5		ALT. 6		ALT. 7	
	Z	L	Z	L	Z	L	Z	L	Z	L	Z	L	Z	L
ACECs (Areas of Critical Environmental Concern)														
• Azure Cave (and associated bat habitat)	NI		NI		NI		-M		NI		-M		-M	
• Prairie Dog Towns	NI		NI		NI		NI		NI		NI		NI	
• Little Rocky Mountains (proposed)	NI		NI		NI		-M		-L		-M		-M	
• Saddle Butte (proposed)	NI		NI		NI		NI		NI		NI		NI	
• Old Scraggy Peak (proposed)	NI		NI		NI		-M		-M		-M		-M	
HAZARDOUS MATERIALS	-L		-L		-L		-M		-M		-M		-M	

Notes:

1 Where applicable, impacts are differentiated by Zortman Mine (Z) and Landusky Mine (L)
2 Significance threshold is 55 dBA, the estimated level above which noise would interfere with outdoor activity.
3 Significance thresholds are the 24-Hour, PM_{10} standard of 50 $\mu g/m^3$; and the Annual PM_{10} standard of 150 $\mu g/m^3$.

Key:
- \- = Negative impact
- \+ = Positive impact
- H = High level of impact (significant)
- M = Moderate level of impact
- L = Low level of impact
- NI = Negligible impact

2.5 ALTERNATIVE 1: NO ACTION

Council on Environmental Quality Regulations at 40 CFR §1502.14(d) requires that environmental impact statements include an evaluation of a No Action Alternative. This alternative serves as a baseline description of the current conditions at the Zortman and Landusky mines, as well as future conditions that would result from the agencies not approving a mine extension and mine reclamation alternative. The No Action Alternative for this Draft EIS means the proposed operation and reclamation plans for the Zortman and Landusky mines would not take place. Figure 2.5-1 shows the existing facilities at both the Zortman and Landusky mines.

This alternative would not void those mine, reclamation, and closure operations that have already been permitted, or alter corrective measures for water quality improvement (See Appendix A). Therefore, the No Action Alternative is described in the following sections as the existing conditions and permitted operations for both the Zortman and Landusky mines. Chapter 4.0 of this Draft EIS presents an evaluation of the environmental impacts already present at the two mines, and those impacts projected to occur given the current permit requirements for the two mines and continued operation under existing permit conditions.

This alternative is presented in six sections:

- Sections 2.5.1 and 2.5.2 describe the operations and reclamation activities, respectively, at the Zortman Mine.
- Sections 2.5.3 and 2.5.4 present similar information for the Landusky Mine.
- Section 2.5.5 describes the monitoring programs in place at the two mines, as well as research programs which have been initiated to evaluate environmental control methods and materials.
- Section 2.5.6 presents the agencies' evaluation of future activities which have a reasonably foreseeable opportunity of occurrence under this alternative.

2.5.1 Zortman Mine: Permitted Operation

The location, currently permitted area, and major facilities of the Zortman Mine are shown on Figure 2.5-1. The Zortman Mine is situated in portions of Sections 7, 17, and 18 of Township 25N, Range 25E, approximately one mile northwest of the town of Zortman in the Little Rocky Mountains. The mine has been in operation since 1979, using open-pit mining and heap-leach mineral processing to extract gold and silver from ore. The major mine facilities are described in the Sections 2.5.1.1. through 2.5.1.6.

Production has varied during the approximately 15 years of mine operation. A total of about 26 million tons of ore and waste rock combined have been mined during that period. No ore has been mined at the Zortman Mine since 1990 although some ore is still being leached to remove the precious metals. The number of workers employed by the mine has varied over the years, depending on the level of mining and reclamation taking place. ZMI employed N.A. Degerstrom, a contract mining firm, from approximately 1979 until 1991. Since that time ZMI has been using its own work force for mining operations at both the Zortman and Landusky mines. The current combined work force for the two mines is about 200 persons, with another 20 or so workers hired for reclamation activities and other seasonal work during the spring and summer months. However, the combined work force has included as many as 250 workers at times, depending on the amount of reclamation, exploration, and mining activity underway.

2.5.1.1 Mine Pit Operation

The Zortman Mine has developed into a single pit complex by connecting six adjacent open pits. The six smaller pits now comprising the pit complex are the

South Alabama, North Alabama, OK, Ruby-Ross, Independant, and Mint pits. Table 2.5-1 shows the estimated area of disturbance under the existing permit conditions, as well as the actual existing disturbance. As noted previously, no ore is being mined at the present time, and all pits are operationally inactive.

Mining Methods

Although ore is not currently being mined from the Zortman pit, a description of the process used to remove rock from the open pit complex follows. Ore was mined via drill, blast, and dump methods using shovels, loaders, and haul trucks. Rotary drill rigs bore blasting holes on ore benches using a grid of approximately 13' by 13' centers. A mixture of ammonium nitrate and fuel oil (ANFO) has been used as the main blasting agent.

Once ore has been extracted from the pits by blasting, loading, and hauling it is taken directly to a heap leach pad. Ore which is deposited directly on a heap leach pad for mineral extraction is known as "run-of-mine" ore. This means the ore is immediately amenable to mineral extraction by heap leaching, without crushing or other pre-leach processing. Typically, this is ore which has been oxidized. Unoxidized ore would require crushing to provide more surface area for the cyanide used in heap leaching to separate minerals from the rock matrix and dissolve the gold and silver minerals into solution. Large volumes of unoxidized ore (also called "sulfide ore") have not been mined at Zortman to date, although proposed future mining would include a significant amount of this type of material (see Section 2.8.1.1).

Rock Characterization

Whether ore at the Zortman mine has been oxidized or not has much practical importance beyond its crushing requirements, for two primary reasons:

1. Oxidation of the ore generally has occurred nearest the surface, and along fractures which have transported surface water deeper into the ore zones. This makes it relatively easy to extract gold and silver from oxidized host rock using heap leaching processes. Unoxidized ore tends to have gold and silver bound up in the geochemical matrix of the rock (called "disseminated" ore), thereby making it more difficult to release the minerals from the ore using heap leaching processes.

2. Oxidized ore is generally less likely to cause problems associated with ARD than unoxidized ore. ARD can be produced when sulfide minerals, such as those which are typically found with gold and silver in the Zortman and Landusky deposits, produce sulfuric acid upon exposure to water and oxygen. This action lowers the pH of the water which, if the pH is low enough, can dissolve heavy metals in the surrounding rock leading to contamination of ground water and/or surface water.

Waste Rock Handling

Approximately 36 percent of the material removed during mine operations at Zortman has been waste rock; in other words, the rock has insufficient content of gold or silver to be worth processing. Waste rock generated during mining has to be removed from the area and dumped or placed in a special facility. Problems have occurred at both the Zortman and Landusky mines because some waste rock has caused the formation of ARD. However, in the past there has been no program for rock characterization at the Zortman Mine to distinguish and selectively handle wastes which have the potential to generate acid drainage. Waste rock was used in construction of leach pads and leach pad dikes, or placed in dumps without regard for acid generating potential.

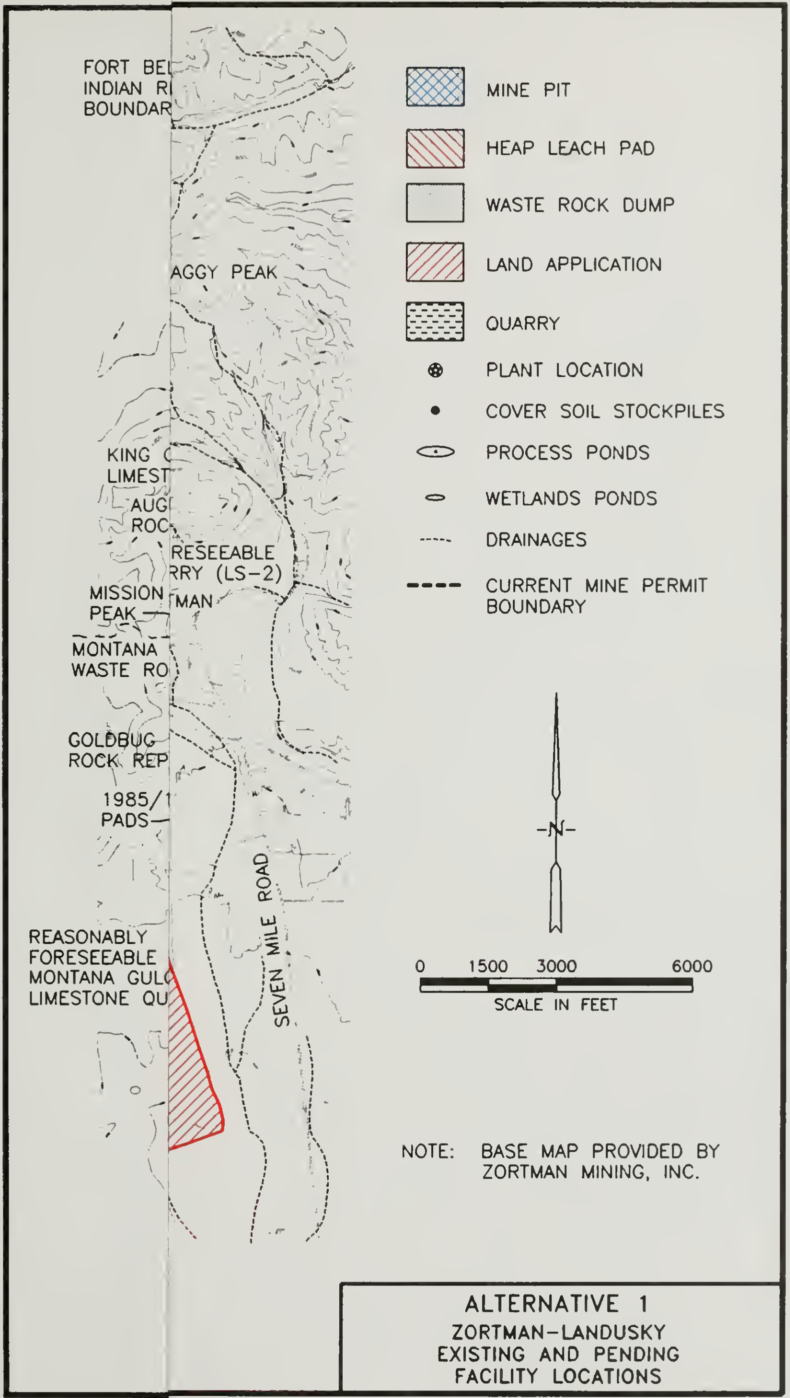
2.5.1.2 Crushing Operation

As described earlier, the ore produced at the Zortman Mine has been run-of-mine ore, such that crushing has not been necessary to prepare the ore for heap leaching. The only crushing operations that have been conducted at Zortman were to prepare a bed of smaller sized ore to place over the bottom of heap leach pads. The smaller ore fragments serve as a layer of protection, to reduce the potential for tears or punctures in the heap leach pad liner. In addition, some crushed waste rock has been used in other construction, such as road bed preparation.

2.5.1.3 Ore Leaching Operation

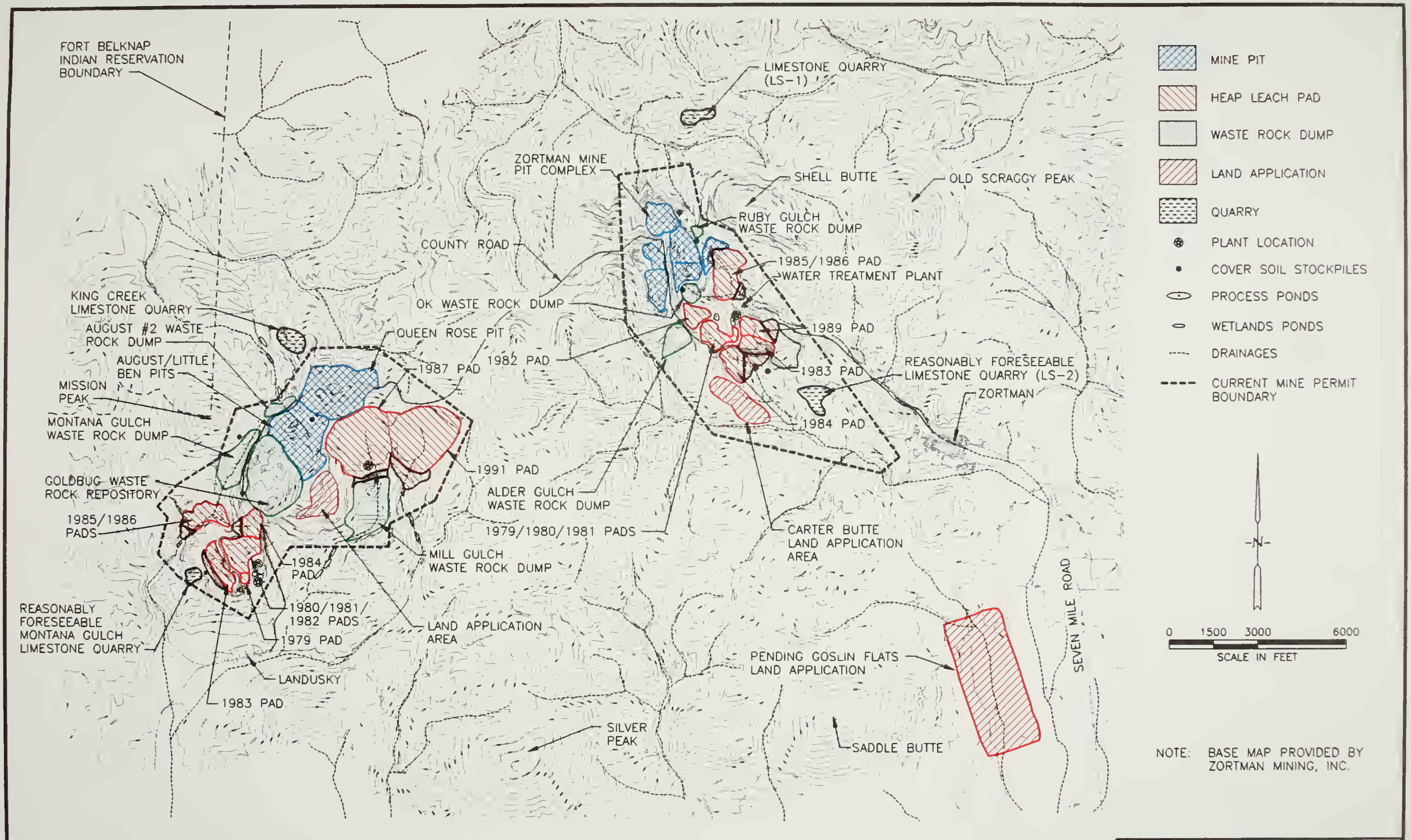
Ore extracted from the open pits has been directly deposited on heap leach pads as run-of-mine ore. Since 1979, seven separate heap leach pads have been used at the mine. Leach pads are named by the year of construction. They are the 79, 80/81, 82, 83, 84, 85/86, and 89 pads. The locations of these leach pads are shown on Figure 2.5-1.

The 79, 80/81, and 82 leach pads are located near ridge tops and do not have dike structures. These pads are free draining. All other pads are lined valley-fill structures with in-heap storage of process solution



ALTERNATIVE 1
ZORTMAN-LANDUSKY
EXISTING AND PENDING
FACILITY LOCATIONS

FIG. 2.5-1



ALTERNATIVE 1: EXISTING MINE FACILITIES ARE SHOWN AS WELL AS THE PENDING GOSLIN FLATS LAND APPLICATION AREA

ALTERNATIVE 1
ZORTMAN-LANDUSKY
EXISTING AND PENDING
FACILITY LOCATIONS

ZLF-ALT1

FIG. 2.5-1

TABLE 2.5-1

SUMMARY OF MINE PIT CONDITIONS
ZORTMAN MINE

Pits	Permitted Disturbance (Area in Acres)[1]	Existing Disturbance (Area in Acres)[1]	Operational Status
Zortman Pit Complex[2]			
OK, Ross & Ruby	66.6	58.7	Inactive
North Alabama & South Alabama	23.3	33.4	Inactive
Mint	6.9	4.3	Inactive
TOTAL	96.8	96.4	

Source:

1 ZMI Revised Application for Amendment to Permit 00096, January, 1994.
2 All pits at Zortman have been connected into one open pit complex.

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TABLE 2.5-1

SUMMARY OF MINE PIT CONDITIONS
ZORTMAN MINE

Pits	Permitted Disturbance (Area in Acres)[1]	Existing Disturbance (Area in Acres)[1]	Operational Status
Zortman Pit Complex[2]			
OK, Ross & Ruby	66.6	58.7	Inactive
North Alabama & South Alabama	23.3	33.4	Inactive
Mint	6.9	4.3	Inactive
TOTAL	96.8	96.4	

Source:

1 ZMI Revised Application for Amendment to Permit 00096, January, 1994.
2 All pits at Zortman have been connected into one open pit complex.

behind a cross-valley dike. Each of these heap leach facilities generally include the following components: (1) the containment dike or buttress; (2) the lined pad; (3) the spent ore on the pad; and (4) the lined contingency ponds.

The first four subsections provide a description of the methods used in constructing and developing these pads, and the current status of the facilities. The fifth, Processing Plant Operation, describes the process used to remove the metals from the leach solution.

Leach Pad Construction

The basic construction method used in development of heap leach pads is as follows. The area to be covered by the heap leach pad is cleared of vegetation, loose rock, and other debris such as historic mine tailing. Cover soil is removed and placed in storage piles. An underdrain system is prepared to transport natural drainage water and runoff which is present beneath the pad. The underdrain is constructed of uniform sized rock that should not decompose or disintegrate when repeatedly wetted. The underdrain and water storage capacity within the pad are designed to be sufficient to handle large storm events from the entire drainage basin.

The heap leach pad and retaining dike are constructed on top of the prepared surface and underdrain. Waste rock is used to fill irregularities and serve as a base for the pad liner. The dike provides stability and helps to contain leaching solutions. A liner is installed at the base of the leach pad, typically consisting of a compacted clay layer upon which is placed a synthetic membrane of polyvinyl chloride. A layer of crushed rock, tailing or other fine grained material is placed on the plastic liner to reduce the potential for puncture. The pad is then ready for ore to be loaded and leached. The 79, 80/81, and 82 pads are lined with compacted clay only. The remaining pads are lined with compacted clay and a synthetic membrane.

Table 2.5-2 provides a summary of the ore capacity for each leach pad, and disturbances associated with the leach pads. Approximately 145 acres have been disturbed by leach pad development. About 20 million tons of ore have been loaded on the leach pads and six of the seven pads have been loaded to the permitted capacity. Ore is still being leached at the 89 pad. A summary of the reclamation for each facility is presented in Section 2.5.2.3.

Leach Pad Operation

The leach pads at Zortman (and Landusky, as well) have generally used the same procedures to remove minerals from ore. Run-of-mine ore is stacked on the pad in 25-foot lifts. Dilute cyanide solution is sprayed or sprinkled on the heaps using a system of hoses and solution distributors similar to an irrigation device. As the cyanide solution trickles down through the heap it leaches gold and silver from the ore. The liquid at the bottom of the heap is collected by wells and either redistributed to the top for additional irrigation or, if it is carrying sufficient quantities of metal, sent to the process plant. The solution sent to the process plant is called "pregnant" solution.

As this process continues, the amount of gold released from the ore to the leach solution is reduced with successive flushes. Eventually, it becomes inefficient to continue leaching that lift and a new load of ore is placed on the heap leach pad.

Process Ponds

The pregnant solution carrying metals is often directed to solution holding ponds prior to further processing. Table 2.5-3 provides the solution capacities and current solution containment within the two process ponds at Zortman. The pregnant pond has a capacity of 4.78 million gallons. The barren pond, so called because it contains a solution which has had the metals removed, has a similar capacity. The 82 contingency pond can also be used for solution storage. Process pond capacity will vary depending upon water balance within the heaps and ponds. All of these ponds are operationally active, since the leach pads are still being used to collect metals in cyanide solution. The pregnant and barren ponds are located adjacent to the 80/81 and 89 leach pads, as shown on Figure 2.5-1.

Leak Detection System

The capability to monitor the existing leach pads depends on the method of construction. Valley fill leach pads have underdrains which are used to monitor for any leakage through the liner. Free draining pads have no specific leak detection system but use adjacent monitoring wells to determine if groundwater below the leach pads has been degraded by solution leaks. The monitoring well network at the Zortman Mine is shown on Exhibit 1 and discussed in Section 2.5.5.

Processing Plant Operation

The ore processing plant is located with the barren and pregnant solution ponds, adjacent to the 80/81 and 89 leach pads (see Figure 2.5-1). The Zortman Mine has used the "Merrill-Crowe" process to remove precious metals from pregnant solution. Pregnant solution is passed through a tower to de-aerate the liquid, then to a set of filters which remove suspended solids. Zinc

TABLE 2.5-2

SUMMARY OF CURRENT HEAP LEACH PAD CONDITIONS
ZORTMAN MINE

Facility	Permitted Disturbance (Area in Acres)	Total Permitted Ore (Tons)[1]	Current Mass Load (% of Total)	Maximum Solution Capacity (10^6 Gal)[1]	Solution In Storage (10^6 Gal)[1,2]	Remaining Solution Capacity (10^6 Gal)[1,2]	Operational Status and History
79	4.7	218,000	100	0	0	0	Reclaimed
80/81	14.0	1,698,000	100	0	0	0	Reclaimed
82	16.1	1,889,000	100	0	0	0	Inactive: Designed to drain into pregnant pond
83	10.9	2,008,000	100	8.94	6.46	2.48	Dike Reclaimed; rinsing
84	17.7	2,389,000	100	10.37	4.69	5.68	Dike Reclaimed; rinsing
85/86	33.7	7,988,000	100	11.96	5.83	6.13	Rinsing
89	18.6	4,000,000	92	17.44	11.91	5.53	Rinsing, dike reclaimed
TOTAL	115.7	20,190,000		48.71	28.89	19.82	

Source:

1 ZMI Revised Application for Amendment to Permit 00096, January, 1995.
2 As of September 1, 1994.

TABLE 2.5-3

SUMMARY OF ZORTMAN SOLUTION PONDS

Facility	Maximum Solution Capacity (10^6 Gallons)[1]	Solution In Storage (10^6 Gallons)[1,2]	Remaining Solution Capacity (10^6 Gallons)[1,2]	Operational Status	History
Process - Pregnant	4.78	3.39	1.39	Active	Used as a flow equalization and retention pond for the Zortman water treatment system.
Process - Barren	4.74	3.86	0.88	Active	
'82 Contingency	5.07	3.77	1.30	Active	
'85/'86 Contingency	--	--	--	Removed	
Ruby Gulch Sediment	0.35	--	--	Active	
Ruby Gulch Capture	1.0	0.0	1.0	Active	Part of the Zortman water treatment system
Ruby Gulch Contingency	6.0	0.0	6.0	Active	Part of the Zortman water treatment system
TOTAL	21.94	11.02	10.57		

Source:
[1] ZMI Revised Application for Amendment to Permit 00096, January, 1995.
[2] As of September 1, 1994.

Key to Types of Ponds
Pregnant (with gold) or Barren (w/o gold) - **Process**
For excess CN solution - **Storage**
Primarily, to collect acid drainage - **Capture**
For additional solution storage - **Contingency**
For stormwater collection - **Sediment**

powder is added, after which the solution passes through another set of filters to precipitate gold and silver. Makeup water, additional cyanide, and lime for pH control are added to the solution in a mixing tank, after which the solution is sent to the barren pond to begin a new cycle of sprinkling, leaching, collection, and processing.

The zinc precipitate is removed from the filters periodically with a caustic (high-pH) solution. The precipitate is then mixed with a flux and smelted in a refinery, located adjacent to the Merrill-Crowe Plant, to produce dore, a mixture of mostly silver and gold. The dore is stored on-site until it is shipped by truck to a commercial refinery for further processing.

2.5.1.4 Waste Rock Facilities

The waste rock facilities at the Zortman and Landusky mines are classified as either a "Dump" or a "Repository." Waste rock dumps are those which have been developed by end-dumping waste rock from an elevated bench. Waste rock repositories are those facilities which have been constructed from the bottom up, by placing waste materials in successive lifts using selective waste rock handling procedures. All of the waste rock facilities at the Zortman Mine are dumps, including the OK, Alder Gulch and Ruby Gulch waste rock dumps, shown on Figure 2.5-1.

Table 2.5-4 provides a summary of the disturbances associated with these facilities. Approximately 33 acres have been disturbed for waste rock storage, and all three dumps have been fully loaded to their permitted capacity. The Alder Gulch and OK dumps have had surface reclamation, while the Ruby Gulch dump is being reclaimed at this time. A description of the reclamation status for each dump is provided in Section 2.5.2.5.

2.5.1.5 Other Features and Facilities

This section describes some of the other important facilities at the Zortman Mine. Table 2.5-5 includes permitted and existing disturbances for some facilities.

Office/Laboratory Facilities

The main office building for Zortman Mining, Inc. is located in the town of Zortman. The main office houses mine management, engineering, geology, environmental, safety, accounting and payroll personnel. Employee parking is provided adjacent to the building. A permitted septic system is dedicated to the office building.

The production assay lab is located across from the main office in a separate building. A sample of blasthole rock cuttings from the mine are brought to the assay lab to determine gold content by cyanide dissolution and atomic absorption assay of the cyanide solution. Additionally, 1 in every 30 samples are fire assayed to determine total gold content and used as a check assay to ensure the cyanide assay is correct. Every third blasthole sample is checked for total sulfur content using a Leco furnace assay. Ventilation hoods are provided over chemical mixing, filtering and cyanide assay stations and vented to a caustic liquid fume scrubber that cleanses the exhaust air prior to release. Runoff solution from the scrubber is contained and collected in barrels and sent to a lined leach pad facility. Cupels from the assay lab are barreled and shipped to Asarco's East Helena smelter for disposal. All lab assay solutions and rock samples are collected and sent to a lined leach pad facility for disposal. Since there is not active mining at the Zortman Mine, virtually all lab work conducted at the laboratory supports existing operations at the Landusky Mine.

A research laboratory, offices, safety training room and record storage "annex" building is housed immediately west of the production lab. The research lab conducts gold extraction testing, acid base accounting and humidity cell testing for predicting acid rock drainage. Chemical mixing areas are ventilated and exhausted. Lab solutions and rock samples are collected and sent to a lined leach pad facility for disposal.

A light vehicle garage is also located adjacent to the production lab. ZMI's small vehicle fleet is serviced here. All spent fuel, solvents, oils and lubricants are collected and transported off site for recycling or disposal by an EPA licensed contractor. A heavy vehicle maintenance garage is located near the 82 leach pad.

Access and Haul Roads

The main access road to the Zortman Mine follows Ruby Gulch northwest from the town of Zortman. ZMI has received permission to move this road out of the streambed to the existing (but largely unused) county road on the east side of the Ruby drainage. This activity is scheduled to occur in 1995. The main access road and other haul and mine access roads are depicted on Figure 2.5-2.

TABLE 2.5-4

SUMMARY OF WASTE ROCK FACILITIES
ZORTMAN MINE

Facility	Permitted Disturbance (in Acres)[1]	Existing Disturbance (in Acres)[1,2]	Permitted Load Capacity (Ton)[1,2]	Current Load (per cent of total)[1,2]	Operational Status
Zortman Waste Rock Dumps					
Alder Gulch Dump	16.0	16.4	3,365,000	100	Reclaimed
Ruby Gulch/ Sulfide Storage Dump	9.4	1.8	2,500,000	34	Reclaiming
OK Dump	8.0	6.8	1,235,000	100	Reclaimed
TOTAL	33.4	25.0	7,100,000	77	

Source:

1 ZMI, Revised Application for Amendment to Permit 00096, January, 1995.
2 As of September, 1994.

TABLE 2.5-5

PLANT AND STORAGE AREAS - SUMMARY OF CURRENT CONDITIONS
ZORTMAN MINE

Facility	Disturbance Area in Acres[1]	Volume of Soil (Cubic Yards)[2]	Operational Status
'82 pad site soil stockpile	4.3	15,000	Inactive
'83 pad dike soil stockpile	1.0	0	Inactive
South Ruby Saddle soil stockpile	0.9	31,573	Inactive
North Ruby Saddle soil stockpile	3.2	135,833	Inactive
Mine Equipment	1.1	n/a	Active
Process Equipment	4.2	n/a	Active
Old Ruby Shop	0.4	n/a	Inactive
Process Plant/Refinery	2.0	n/a	Active
TOTAL	17.1	182,406	

Source:

1 ZMI Revised Application for Amendment to Permit 00096, January, 1995.
2 Annual Progress Report for Operating Permit 00095, June, 1994.

Power and Water Supply

Current water appropriation for the Zortman Mine is permitted by a groundwater appropriation issued by the Department of Natural Resources and Conservation. The appropriation for this permit includes the beneficial use of 530 acre-feet (175 million gallons) of water at 500 gpm during the period of March 1 through November 30 each year. The appropriation is for groundwater as well as net inflows from direct precipitation and surface water runoff/runon. At present, water for mine operations is supplied by two production wells (ZL-102 & ZL-163) located near the water treatment plant (see Exhibit 1). Water is consumed at the project site by ore wetting, spray evaporation and haul road watering to control dust.

A 1500 kV line supplies electrical power to the process plant and mine facilities. This power is obtained from the Zortman grid.

Sewage Treatment

The production lab, "annex" building, and main offices each have septic systems for human waste. Separate septic systems are also in place at the ore processing plant and maintenance buildings.

Construction Materials

ZMI has used waste rock in the construction of facilities during its fifteen year history of mining at Zortman, thereby eliminating the need for development of a gravel pit or quarry. For instance, waste rock has been used to construct leach pad retaining dikes, and Ruby Gulch tailing has been used in the construction of leach pad liner covers and for road base. Waste rock material used in containment dikes typically has ranged in size from one foot to gravel or pea sized. Other construction materials include cover soil and clay.

Cover Soil Stockpiles

Existing cover soil stockpiles are located as shown on Figure 2.5-1, with storage volumes presented on Table 2.5-5. Cover soil stockpiles have been developed by salvaging available topsoil as areas are disturbed during construction of new facilities.

Clay Borrow

Under a permit issued by the DEQ (formerly the Department of State Lands, Open Cut Bureau) clay for leach pad liner construction has been obtained from the Seaford Clay Pit located approximately 7 miles south of the town of Zortman as shown on Figure 2.5-2. The pit has been developed using highwall mining methods. Current disturbance is approximately 4.2 acres. Another clay pit, located near the old Zortman landfill, was also used to provide materials for leach pad construction.

2.5.1.6 Water Handling and Treatment

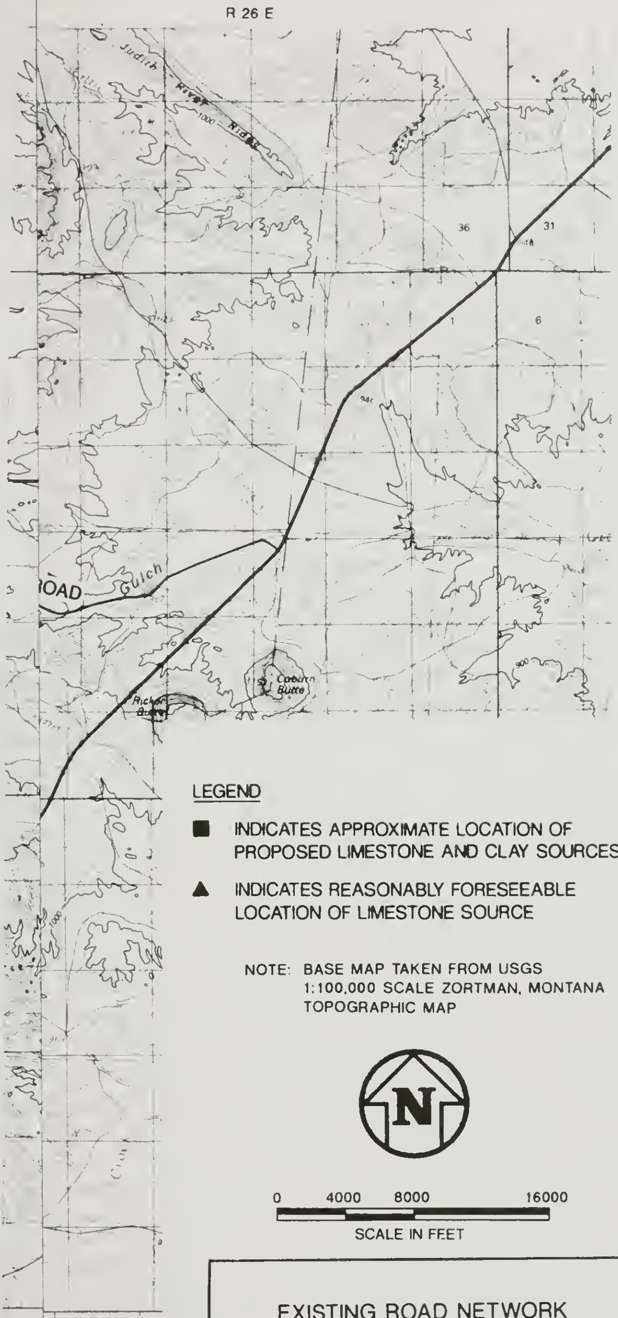
Some of the existing waste and ore leaching facilities at the Zortman Mine are generating acid drainage (Section 3.2 of this Draft EIS provides detail on the surface water and groundwater quality at the Zortman Mine). This section provides information on the Zortman Mine facilities used to collect, control, and treat surface water, groundwater, and mine discharge water.

Water Capture

Three water capture systems have been installed at the Zortman Mine at Ruby Gulch, Alder Spur, and Carter Gulch below the Alder Gulch waste rock dump. The capture systems consist of lined sumps in the drainage from which captured water is gravity fed or pumped through an insulated pipe to a holding tank. When a holding tank reaches capacity (100 to 2,000 gallons), water is pumped, via a pipeline, to the 4 million gallon Zortman water treatment plant flow equalization pond. Figure 2.5-3 shows locations of capture systems and the water treatment plant. Seepage capture ponds and sumps are inspected on a weekly basis for routine maintenance or repairs, if necessary. Additional information concerning the capture systems, including monitoring requirements and systems maintenance, is found in the Summary of the Water Quality Improvement Plan, Appendix A. A brief description of each of the three water capture systems follows.

Ruby Gulch - Ruby Gulch drains most of the eastern portion of the Zortman mine site. Impacted water is currently captured in temporary sumps and holding tanks, pumped to the Zortman mine water treatment plant, and treated using a lime-precipitation treatment process. Treated water is returned to Ruby Gulch below the capture sumps. The DEQ and BLM have approved a 1 million gallon seepage capture pond and a 6 million gallon contingency pond for capture of Ruby Gulch headwall seepage. The DHES (now, DEQ) Water Quality Bureau and U.S. Army Corp of Engineers also reviewed the application and granted approval for construction on September 28, 1994.

The ponds have been sized for a flow rate of 2500 gallons per minute, the estimated flow in the drainage from a 10 year, 24 hour event (2.5 inches) with additional storage capacity of 42 hours in the event of power outage. Slurry cutoff walls above the 1 million gallon and 6 million gallon ponds are used to ensure groundwater along the bedrock interface is collected and routed into the lined ponds. V-shaped diversions sized for the 6 inch, 24 hour event are constructed around the



LEGEND

■ INDICATES APPROXIMATE LOCATION OF PROPOSED LIMESTONE AND CLAY SOURCES

▲ INDICATES REASONABLY FORESEEABLE LOCATION OF LIMESTONE SOURCE

NOTE: BASE MAP TAKEN FROM USGS 1:100,000 SCALE ZORTMAN, MONTANA TOPOGRAPHIC MAP

0 4000 8000 16000

SCALE IN FEET

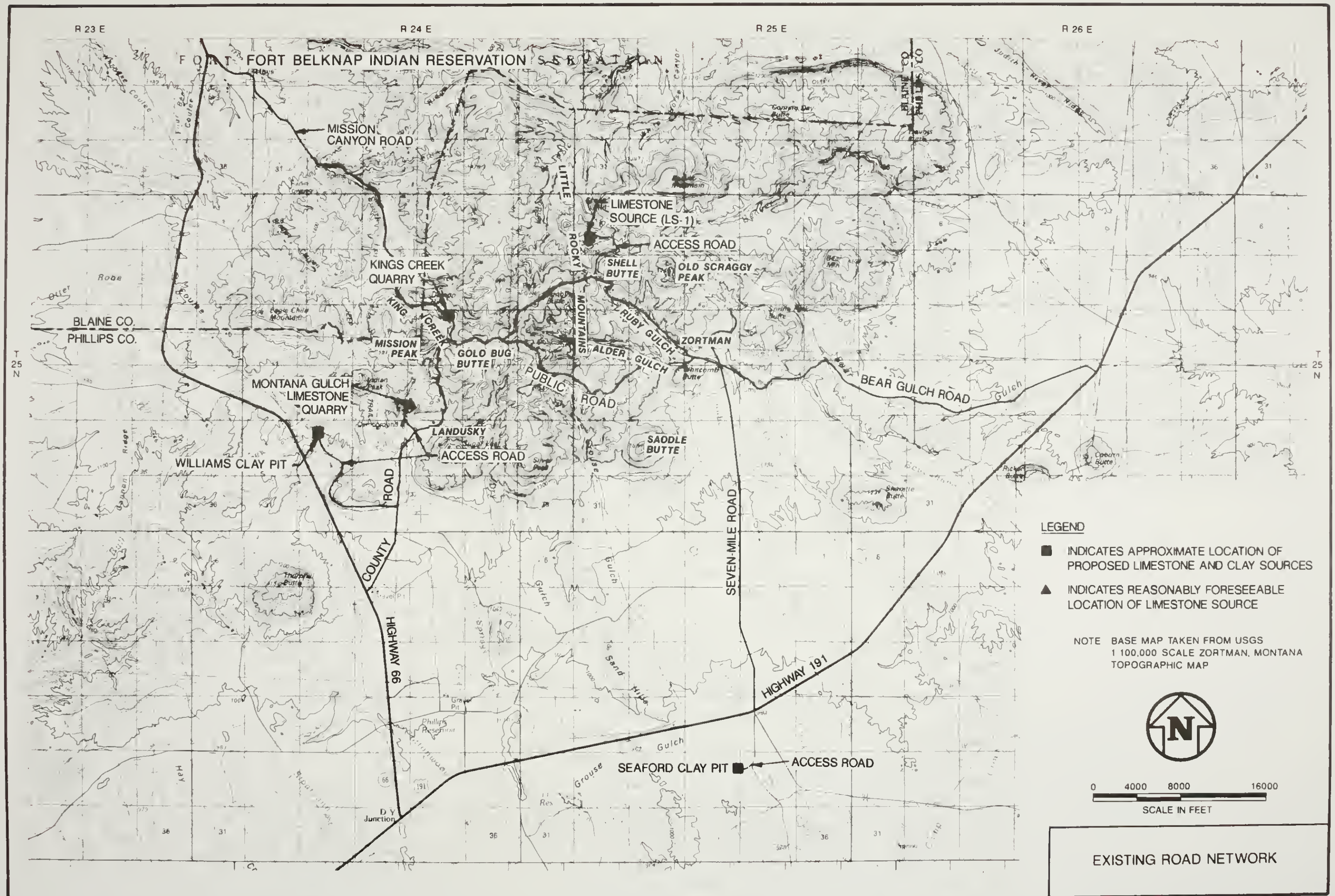
EXISTING ROAD NETWORK

FIG. 2.5-2

DRAINAGE PLAN

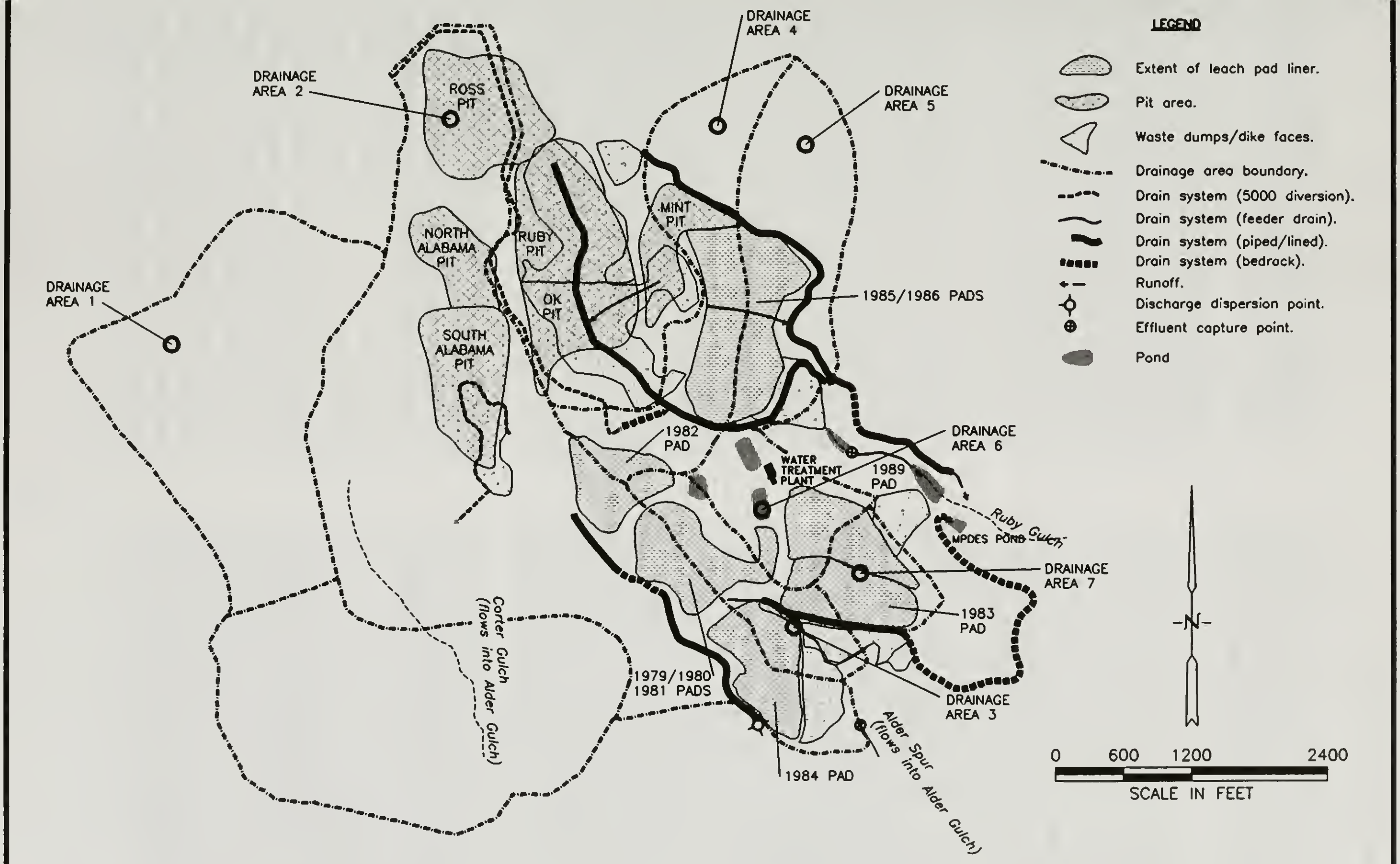
FIG. 2.5-3

SOURCE: ZORTMAN MINING INC., 10/94



EXISTING ROAD NETWORK

FIG. 2.5-2



EXISTING ZORTMAN MINE DRAINAGE PLAN: INDICATES CURRENTLY PERMITTED EXISTING LOCATIONS FOR WATER HANDLING, CAPTURE AND TREATMENT FEATURES

SOURCE: ZORTMAN MINING INC., 10/94

EXISTING ZORTMAN MINE DRAINAGE PLAN

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FIG. 2.5–3

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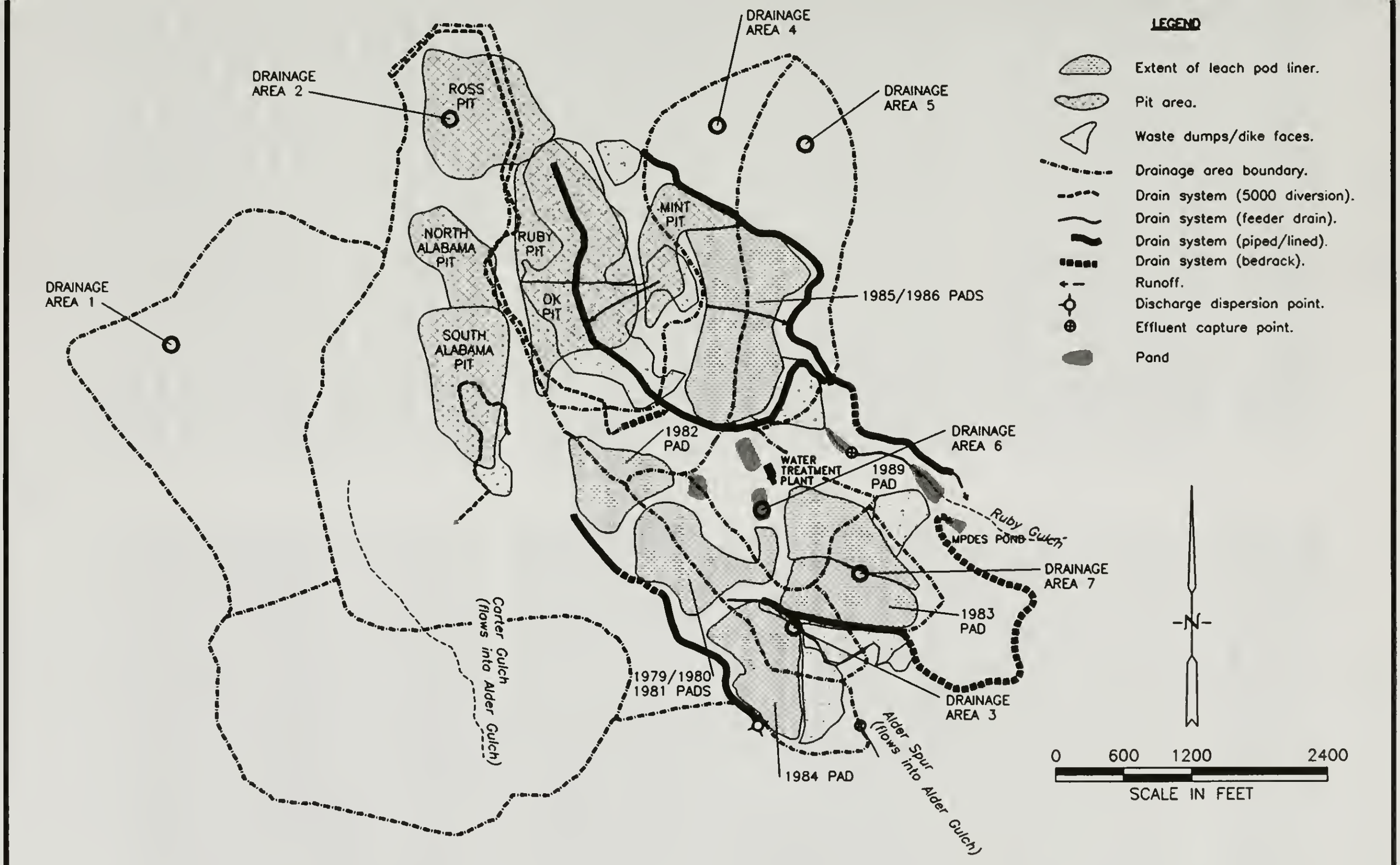

EXISTING ZORTMAN MINE DRAINAGE PLAN: INDICATES CURRENTLY PERMITTED EXISTING LOCATIONS FOR WATER HANDLING, CAPTURE AND TREATMENT FEATURES

SOURCE: ZORTMAN MINING INC., 10/94

EXISTING ZORTMAN MINE DRAINAGE PLAN

FIG. 2.5–3

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edge of the ponds to route storm water away from the ponds. The ponds will require little maintenance as storm water will be diverted around them. Maintenance of the diversion ditches would include removal of sediment buildup and repositioning of rip rap as required.

Tailing within this portion of the Ruby drainage which may contribute to water pollution has been removed and stockpiled until it can be disposed in a waste rock repository or used as backfill in the mine pit.

Alder Spur - Alder Spur originates below the 83 and 84 leach pad's dikes. Seeps and flows from the pad underdrains are currently captured and pumped back to the Zortman mine water treatment plant. Treated water is then released to Ruby Gulch. The pumpback system is sized to collect and pump back a 10 year, 24 storm event (2.5 inches). The pumpback consist of a holding tank and a lined capture sump. Capture seepage flow averages less than 10 gallons per minute. Storm water is diverted away from the seepage capture points with a V-shaped ditch. Maintenance of the pumpback system includes regular inspection of the pumps, sumps, capture tank and pipelines to ensure complete capture.

Carter Gulch - The Alder Gulch waste rock dump is located on the east fork of Carter Gulch. This dump surface was reclaimed in October 1992. Seepage water from small springs beneath the waste rock dump is captured and pumped back to the Zortman water treatment plant. Treated water is released to Ruby Gulch. The pumpback system is sized to collect and pump back seepage from a 10 year, 24 storm event (2.5 inches). The pumpback consists of a holding tank and lined capture sumps. Capture seepage flow averages less than 10 gallons per minute.

Lodgepole Creek - No water management controls have been installed for Lodgepole Creek. Storm water is managed at the mine facilities to prevent discharge to this drainage.

Water Treatment

ZMI constructed a 2,000-gpm water treatment plant in May 1994 to treat seepage water captured at the toe of existing mine waste rock dumps at the Zortman Mine. The plant, located approximately 120 feet west of the refinery, operates at a rate of 200 to 2,000 gpm depending on factors such as precipitation amounts and seasonal operating conditions. The water treatment plant is designed to treat acidic water, such as seepage from waste rock dumps. This effluent typically has a pH ranging from 2.2 to 5.5 and contains significant concentrations of iron, sulfate, and aluminum with lesser amounts of copper, manganese, zinc, nickel, lead and cadmium.

Seepage water is being collected from Ruby, Carter and Alder Spur gulches, and pumped to the 4 million gallon water treatment plant flow equalization pond immediately south of the water treatment plant (Figure 2.5-3). Pumps in the pond deliver the water to the treatment facility which provides treatment using a metal hydroxide precipitation process. The treated effluent is discharged to Ruby Gulch. The precipitated metals form a sludge which is pumped to a containment trench on the 89 leach pad.

The water treatment plant is operated under an Administrative Improvement Order from the DHES Water Quality Bureau. The DHES WQB issued the Administrative Improvement Order on June 29, 1994 authorizing operation of the water treatment plant. Current, interim effluent discharge standards are Best Available Technology (BAT) for mine waters. Under this alternative ZMI would capture and treat seepage and degraded waters according to the Water Quality Improvement Plan (see Appendix A).

Feed Water Collection - Feed water is first collected from the mine site using pumpback systems which are operating in Alder Spur Gulch, Carter Gulch and Ruby Gulch. The feed water then gets pumped back to a flow equalization pond. The majority of the seepage water is collected in Ruby Gulch (80%) while Carter Gulch and Alder Spur Gulch contribute 10% each. Flows are highest during snowmelt runoff and the rainy season and lowest during the winter.

The water treatment flow equalization pond is a collection and storage facility for the seepage water. The water is stored in the pond to smooth out variations in concentrations and flow rates before being pumped to the treatment plant. The pond also serves to collect any recycle streams such as water collected in the treatment building sumps.

Hydroxide Precipitation - Most metals are removed from the water by hydroxide precipitation. Hydrated lime ($Ca(OH)_2$) is added to the water to precipitate the metals. The hydroxide precipitation is accomplished in a series of three continuously mixed tanks followed by a thickener. The first two tanks achieve metals precipitation. The third tank is used to flocculate the resulting solids for subsequent settling in the thickener.

In the first tank, the raw feed water is reacted with lime and recycled sludge to neutralize free acids and to precipitate metals. If the system is saturated with calcium sulfate, a portion of the calcium sulfate will also be precipitated in this step.

The second reactor provides additional residence time to complete the neutralizing reaction of lime and recycled sludge with the feed water. This reactor also provides additional opportunity for supersaturated calcium sulfate to precipitate before entering the flocculation tank.

The flocculation (third) tank allows time for the precipitated solids formed in the first two tanks to react with an ionic polymer flocculent. The flocculating agent aids in settling and clarification in the thickener. The flocculated material then flows to a thickener where the solids settle and are removed for recycle and disposal. Decant water from the thickener will be discharged to Ruby Gulch. About 75% of the sludge from the thickener is recycled to the first reactor where it reacts with the raw feed and lime to neutralize and precipitate metals in the feed water.

Interim Operation - The Zortman water treatment plant is being operated as an interim measure to treat low pH seepage from the toes of existing waste rock facilities and buttresses. Reclamation capping systems and establishment of vegetative growth are proposed to limit infiltration of precipitation through the waste rock and reduce or eliminate seepage of low quality waters from the toes of the waste rock repositories. The water treatment plant will continue to operate until final reclamation measures have successfully produced required water quality standards.

Surface Water Runoff Control

Interim drainages have been constructed throughout the Zortman Mine area to route storm water and runoff around the pit complex, leach pads and waste dumps.

The interim drainages were built to meet immediate needs of ARD control. As such, they were not intended to deal with flows in excess of a 10 year, 24 hour storm event of 2.5 inches. Drains carrying storm water are routed to dispersion points consisting of coarse rock filters or sediment control ponds that overflow into natural drainages. Figure 2.5-3 illustrates locations of bedrock drains and lined drainage channels. The lined drainage channels consist of 6 to 12 inches of compacted clay, which is overlaid with a 10 mil PVC liner, 5 ounce geotextile and 6 to 12 inches of run of mine waste. Bedrock ditches are V-shaped and lined channels are trapezoidal. Maintenance consists of removal of sediment buildup and repositioning of rip rap when necessary.

Mine Pits - The current pit configuration has bedrock diversions constructed to the east and west to route storm water away from the pits. Standing water does not develop in the pits.

Leach Pads - Bedrock diversions around the leach pads are constructed to prevent inflow of storm water.

Waste Rock Dumps - Diversions are constructed to the north and northeast of the Alder Gulch waste rock dump to divert storm water around the dump. The diversions are lined to prevent ditch flow from infiltrating into the waste rock dump.

Land Application Disposal

The Carter Butte land application area soil has been loaded to nearly maximum metal attenuation from past emergency land application disposal. This area is no longer suitable for additional land application. A 205 acre land application area has been proposed for the Goslin Flats in the event an emergency land application disposal would be required. All neutralized effluents would be at or below 0.22 mg/l WAD cyanide prior to land application. The agencies would be notified prior to emergency land application.

Water Quality Improvement Plan

As described in Chapter 1.0, a water quality improvement and monitoring compliance plan has been developed to mitigate water quality impacts from mine facility discharges. Appendix A contains a summary of the proposed water quality improvement plan and the schedule for implementation.

2.5.1.7 Hazardous Materials

A variety of potentially hazardous compounds are used in the mining, ore processing, and mine reclamation activities. The rate of use for these compounds has varied over the years, and some compounds have replaced others to increase operational efficiency or to accommodate operational modifications. For instance, petroleum-based solvents are no longer used at the mine, having been replaced by a citrus-based solvent substitute.

This section briefly describes the chemicals currently used at the Zortman Mine. A detailed discussion of hazardous material use, storage, handling, consumption, and waste is presented in Section 3.14.

Chemical use at the Zortman Mine is presently limited because there is no mining or ore processing occurring. Most chemical use is associated with vehicle use and operation and maintenance of the water treatment plant.

Lime is used for pH control at the water treatment plant. Approximately 500 tons of lime are consumed per year for water treatment purposes.

Flocculent is used at the water treatment plant to help settle sludge out of solution. Nalco 7852 is an aqueous solution of a polyquaternary amine used at the treatment plant. About 100 gallons of this flocculent are used per year.

Gasoline is used to power the mine's light vehicles. Light vehicles are fueled at both the ZMI office in Zortman and at the fuel farm at the Landusky Mine. The estimated annual usage of gasoline is 5,000 gallons at the Zortman Mine.

Hydrogen Peroxide is used at the end of mine life to destroy cyanide in heap leach rinseate solution if natural degradation of cyanide needs to be accelerated. An estimated 10,000 to 20,000 gallons of 70% hydrogen peroxide may be required, depending on the amount of natural degradation of cyanide compounds.

Oil and Lubricants are used for lubrication of mine equipment. Oil products include rock drill oil, lubricant oils, hydraulic fluids, engine oils, and transmission fluids. Annual usage for the Zortman Mine is approximately 1,000 gallons.

Antifreeze is an ethylene glycol used as engine coolant for the mine fleet. Estimated annual usage at the Zortman Mine is 500 gallons.

Citrus-Based Solvent is a non-hazardous, citrus-based solvent for parts washing. Estimated amount used at the Zortman Mine is 200 gallons per year.

2.5.2 Zortman Mine: Permitted Reclamation

This section describes ZMI's existing reclamation plan and procedures for the Zortman Mine. The following information is based in large part on the Zortman Reclamation Plan and Post-Mine Topography (ZMI 1989), update to Operating Permit No. 00096, dated June, 1989, and the Alternative Reclamation Plans for the Zortman Mining Area, dated January 1994 (ZMI 1994a). Additional reclamation requirements for water capture and treatment have been or are being implemented as a result of the DHES' Administrative Order (6/29/94) authorizing operation of a water treatment plant. Actions taken as a result of the Administrative Order were described in Section 2.5.1.6.

The long-term reclamation objective is "..to establish a post-operation environment that is compatible with existing and proposed land uses of the Zortman area. On lands under the administration of the Bureau of Land Management, this will include returning disturbed areas to land uses consistent with those identified in the Resource Management Plan." (ZMI 1989). The specific post-operation land use objectives for the current reclamation plan include:

- Reestablishment of a biological potential suitable for supporting a vegetative cover appropriate to the area
- Permanent protection of air, surface water, and ground water
- Insuring the protection of public safety and health
- Restoration of wildlife habitat
- Design of land configuration compatible with the watershed
- Reestablishment of an aesthetic environment providing visual quality and recreational opportunities

Table 2.5-6 illustrates the permitted reclamation schedule for the Zortman Mine. Reclamation of some facilities is pending a final decision from this EIS. The following sections describe the specific reclamation plans and actions which ZMI is currently permitted to implement for each disturbance area.

TABLE 2.5-6

ZORTMAN MINE RECLAMATION SCHEDULE[1]

Facility/Disturbance	Reclamation
Heap Leach Pads	
79, 80/81	Reclaimed
82	1991
83	1992
84	1992
85/86	1994
89	1997
Dike Faces	
85/86	1988
82	1991
83, 84, 89	Reclaimed
Pit Floors (all)	1991
Waste Rock Facilities	
Ruby Gulch Waste Rock Dump	Reclaiming
Alder Gulch Waste Rock Dump	Reclaimed
OK Waste Rock Dump	Reclaimed
Process Plant	At Project Completion
Cover Soil Stockpile Sites	
82 Leach Pad Site	1991
83 Leach Pad Site	1992
South Ruby Saddle	1994
North Ruby Saddle	At Project Completion
Haul Roads/Access Roads	At Project Completion
Refinery Site	At Completion of Zortman and Landusky Projects
Storage Sites	
Mine Equipment Storage & Service	At Project Completion
Process Equipment Storage	At Project Completion
Old Ruby Shop Site	1991

[1] From Zortman Reclamation Plan and Post Mine Topography, June, 1989

As a preface to the reader concerning reclamation plans and procedures, the agencies use the term "reclaimed" to mean that reclamation procedures have been fully undertaken for a particular disturbance in accordance with existing permit requirements. However, no facility can be considered fully reclaimed until the agencies have certified that reclamation goals and objectives have been achieved, at which time ZMI's reclamation bond would be released. The agencies have not provided final evaluations of reclamation success for disturbances at the Zortman Mine such as the Alder Gulch and OK waste rock dumps, and no reclamation bonds have been released.

2.5.2.1 Reclamation Materials

The primary reclamation material used at the Zortman Mine is cover soil. A layer of cover soil approximately 8 inches thick is to be placed on all disturbed areas prior to revegetative seeding and planting. Cover soil is obtained from one of three stockpiles: the 82 leach pad site, the South Ruby Saddle stockpile, or the North Ruby Saddle stockpile. Approximate volumes of soil available at these stockpiles were shown on Table 2.5-5. Other materials used in reclamation include unconsolidated rock, scree and soil above and below roadway cuts, which are incorporated into the regrading of haul and access roads.

2.5.2.2 Reclamation Testing and Covers

No geochemical testing is required of disturbance areas prior to reclamation. The only material to be placed on disturbance areas consists of 8 inches of cover soil.

2.5.2.3 Mine Pit Reclamation

Overall slope of the final pit walls is required to be approximately 45 degrees (1H:1V) with 30-foot wide flat benches every 60 vertical feet. Pit floors would be sloped and graded to facilitate drainage and alleviate the accumulation of stagnant water. Where possible, pit floors are to be topsoiled and revegetated.

2.5.2.4 Leach Pad Reclamation

Tasks associated with reclamation of the heap leach facilities include heap detoxification, liner perforation, and surface reclamation. The basic procedures associated with each of these tasks is described below, followed by a summary of the reclamation status for each of the heap leach pads at the Zortman Mine.

Surface reclamation has been conducted on the 79 and 80/81 pads, and dike reclamation only on the 83, 84, and 89 pads. Reclamation to date at the 85/86 pad consists of ongoing heap rinsing and removal of acid-producing waste rock from the dike buttress. Current reclamation, by area, is shown on Figure 2.5-4 and described below.

Heap Detoxification

A detoxification process is undertaken on the heap leach pads following the conclusion of ore processing, which ends when the amount of gold and silver collected in the leaching solution is no longer economically recoverable. The detoxification process consists of rinsing the ore on the heap leach pad with cyanide-free water to degrade the cyanide compounds left in the heap. The rinsing solutions are tested after flow through the heap to determine cyanide content and the rate at which detoxification is proceeding. If water rinsing is not successful, oxidizing agents such as hydrogen peroxide may be used to enhance cyanide breakdown. Figure 2.5-5 displays the steps followed in the heap detoxification process.

Heap detoxification is discontinued when the solutions returning from the heap maintain less than 0.22 mg/l cyanide (measured as <u>W</u>eak <u>A</u>cid <u>D</u>issociable or WAD cyanide) for a six-month period which includes a spring, high-flow surface runoff event. At that time the heap solutions remaining after detoxification are pumped to a holding pond and then to a land application disposal area.

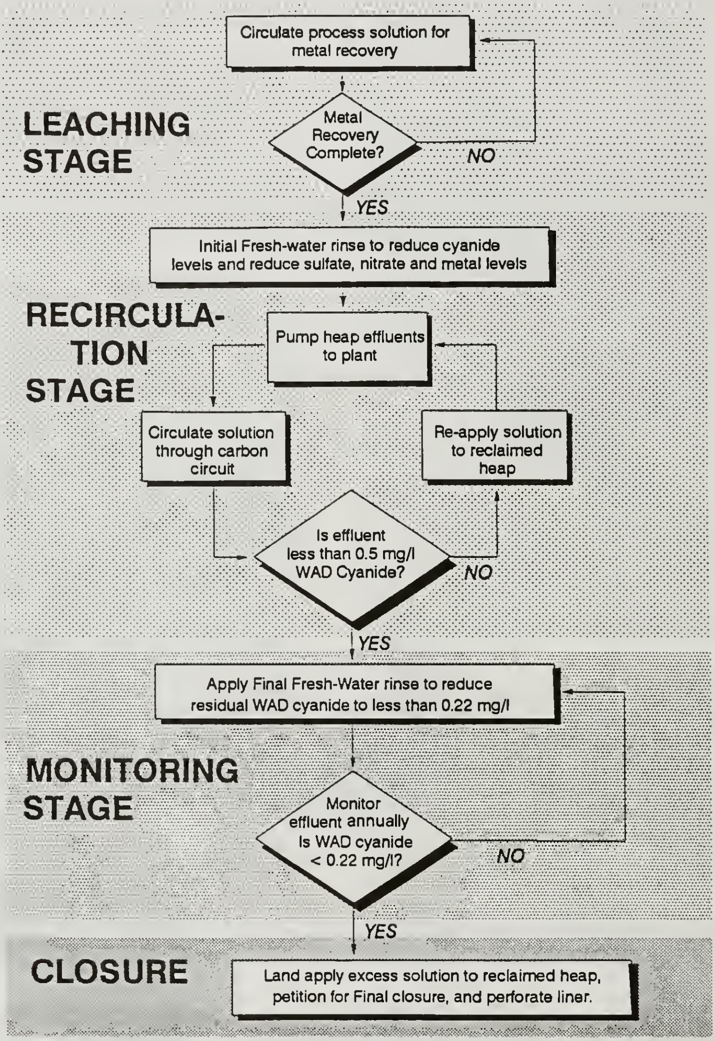
ZMI has committed to consult with the agencies in advance of any land application operation. Carter Butte has been used as a solution land application area in the past, but is probably no longer usable for this purpose (see Section 2.5.1.6). ZMI has proposed to use an area at Goslin Flats for land application. Whichever facility is used, ZMI has collected baseline soil analysis to evaluate the ability of soil in the proposed area to hold onto metals and cyanide. In addition, ZMI would perform annual soil analysis for a three-year period following land application to monitor increases in metals and cyanide concentrations at the land application site.

Liner Perforation

After the leach pad has been detoxified, the pad liner is perforated to reduce storage within the heap of precipitation and surface water runon. Approximately 3 to 4 drain holes, 6-inches in diameter, are drilled into the underlying drainage system to provide an exit for solution within the heap. Each perforated drain hole is backfilled with drain rock to an elevation of at least 5 feet above the liner surface to ensure continued drainage. The drain holes are positioned at the lowest

ZORTMAN MINE
EXISTING RECLAMATION

FIG. 2.5-4



SOURCE: ZMI AMENDMENT TO OPERATING PERMIT 00096 DATED 4/5/93.

SCHEMATIC FLOW CHART DEPICTING SOLUTION TREATMENT AND HEAP DECOMMISIONING

FIG. 2.5-5

elevation in the pad collection basin to provide for adequate drainage and prevent the formation of undesirable hydraulic conditions within the heap.

Surface Reclamation

After the heap leach pad is detoxified and the liner has been perforated, surface grading begins to reduce pad slopes. The present reclamation criterion for spent ore slopes is no steeper than 2H:1V. Slope reduction is performed by track mounted bulldozers pushing ore heap material from the facility crest or top down over the lift slopes, using cut and fill material from each of the heap benches to obtain the desired slope. Preparation for the site includes ripping of compacted areas on the top of the leach pad facility to reduce surface compaction and improve air and water movement through the surface, enhancing revegetation opportunity. However, ripping is not anticipated to be required for most areas on top of the heap since the leach pad is double-ripped during preparation for solution spraying. Leach pad crests, top and slopes are topsoiled and revegetated, as described in Section 2.5.2.9.

Containment dikes for the heap leach pads are constructed of waste rock fill at an overall slope of 2H:1V and are not subject to further slope reduction. The dike faces are topsoiled and revegetated to blend with existing undisturbed contact zones and reestablish vegetation communities.

Leach Pad Reclamation Status

79 Leach Pad - The 79 leach pad was reclaimed in 1989. Topsoil from the South Ruby Saddle stockpile was spread 8 to 12 inches deep and was dozer tracked for seedbed preparation. The site was hydroseeded, fertilized, and mulched in October, 1989. Tree and shrub seedlings were planted in April, 1990 using standard seedling planting techniques.

80/81 Leach Pad - Fresh water flushing of the Zortman 80/81 leach pad was conducted during late summer and early fall of 1990. Rinse cyanide from the heap were reduced below 0.22 mg/l, verified by the sampling and reporting of 10/12/90, and remained below the standard during February and March 1991 sampling events. However, leachate collected from the 79/80/81 pad complex shows elevated specific conductance (>8,000) and depressed pH (<4). These values indicate that ARD is accumulating in the spent ore site (ZMI 1994a). Surface reclamation of the heap included recontouring to a slope of 2H:1V, and application of approximately 8-inches of topsoil. Revegetation was achieved using hydroseeding, fertilizing and hydromulching. In 1992, nearly 12,000 trees and shrubs were planted.

82 Leach Pad - The 82 leach pad is currently inactive and undergoing rinsing during precipitation events. Draining solution, mixed with natural precipitation, is piped to the Zortman process facility.

83 and 84 Leach Pads - The 83 and 84 dike faces were resloped to a slope of 2H:1V, covered with a depth of 8 to 12 inches of topsoil and revegetated. Revegetation took place in August, 1992 and was achieved using hydroseeding, fertilizing, and hydromulching. Once the seed was on the surface, a D10N Cat was used to track the seed into the ground. A pre-rinse was conducted during 1994 on the 84 pad using dilute fluids from within the pad as rinse water.

85/86 Leach Pad - Rinsing of the 85/86 pad began during the 1992 operating season. Cyanide concentrations in the heap effluent have not yet been reduced to below the 0.22 mg/l standard. Topsoiling and revegetation activities have not yet been initiated on the heap. In December of 1992, approximately 200,000 tons of acid- producing material was removed from the buttress of this pad, and placed in the OK pit for storage. During this operation, 2.34 acres of reclamation cover were stripped from the dike face in the areas excavated.

89 Leach Pad - The 89 pad is still under leach so surface reclamation has not been started. The dike face has been topsoiled and revegetated.

2.5.2.5 Waste Rock Dump Reclamation

Waste rock dumps are to be reduced to a final overall slope of 2H:1V. The top of the waste dump is ripped by a tracked bulldozer prior to final reclamation to reduce surface compaction and improve air and water movement through the surface, enhancing revegetation potential. The top and sloped areas of the waste rock dumps are covered with 8 inches of topsoil and revegetated, as described in Section 2.5.2.9.

Reclamation activities were completed at Alder Gulch and OK waste rock dumps in 1992. The Ruby Gulch waste rock dump has not been fully reclaimed, but a significant portion of the northern surface of this area is used for topsoil storage. The "sulfide" stockpile is located in the southern portion of the Ruby dump on the surface of waste rock material, and this area has been reclaimed. Current reclamation, by area, is described below and shown on Figure 2.5-4. The disturbance area and reclamation status for each dump was shown earlier on Table 2.5-4.

Alder Gulch Waste Rock Dump - In 1992, ZMI modified reclamation of this facility because of deterioration in water quality in seeps at the facility toe. The dump was regraded to 2.25H:1V slopes with one 25-foot bench at the mid-elevation. The drainage bench was sloped to drain water off to either side of the repository. Topsoil was placed to a depth of 8 inches and the area was revegetated using a seed mix with an increased proportion of annual grasses to provide for an immediate dense reclamation cover and fertilized. During summer and autumn of 1993, another drainage bench was built at an elevation approximately 100 feet above the toe of the facility, and a pipeline was installed on the south side of the dump to carry runoff from the original drainage bench to the facility toe.

OK Waste Rock Dump - The OK waste rock dump was resloped in 1992. Slopes were regraded to 2H:1V and topsoiled to a cover depth of 8 inches. Revegetation activities were conducted in spring of 1993.

Ruby Gulch Waste Rock Dump - The southern portion of the Ruby Gulch waste rock dump, commonly referred to as the "Sulfide Stockpile" was reclaimed in 1990. Prior to topsoil placement, the surface of the dump was amended with approximately 20,000 pounds of lime (CaO). Topsoil was spread to a depth of 8 inches. Revegetation was achieved in April 1990 by hydroseeding, fertilizing, and mulching.

2.5.2.6 Support Facilities Reclamation

Final reclamation of the Zortman Mine includes the removal of all structures and equipment used in the mining and processing of ore through heap leach operations. Structures and equipment to be removed include the:

- Zortman processing plant, maintenance shop, and support service structures
- Refinery and carbon strip processing plant
- Leach pad pump and electrical structures
- Process spray and return lines
- Electrical power corridors, unless continued use is requested by private, public or regulatory agencies
- Property perimeter fencing
- Storage tanks and facilities

All cement structure footings and pads would be removed and used to help backfill depressions or openings such as ponds, or would be disposed appropriately as solid waste. Additional information for reclamation of other facilities is provided below.

Solution/Process Pond Reclamation

Ponds would be perforated, backfilled, and graded prior to final reclamation. Pond backfill would include fill material from waste rock operations and/or cement materials from structure footings or pads. After backfill, the ponds would be graded, covered with 8 inches of topsoil, and revegetated.

Sludges remaining in ponds at the end of mining operations would be sampled and analyzed to determine if there would be environmental hazards associated with on-site burial. If not, the sludge would be buried with waste rock. If special handling of the sludge is required it would be mixed into cement, with disposal in accordance with regulations of the Solid & Hazardous Waste Bureau. If sludge characteristics preclude in-place neutralization another method of disposal would be used which meets federal and state requirements.

Soil Stockpile Reclamation

Based on the estimated amount available in Zortman Mine stockpiles, a layer of cover soil approximately 4.0 inches thick could be used on all disturbed areas at the Zortman Mine which require reclamation topsoil. Supplemental topsoil from the Landusky Mine stockpiles could increase the cover thickness to approximately 8.0 inches. Therefore, topsoil stockpiles should be almost completely depleted by the time surface reclamation activities are finished. After all necessary cover soil is distributed to the disturbed areas, the stockpile locations would be revegetated.

Access and Haul Road Reclamation

Haulage and access roadways would be reclaimed to establish suitable drainage. Roadways would be ripped to reduce surface compaction and provide additional fill material for grading of the surface. Roadway berms and loose, unconsolidated material above and below the roadway cut would be pulled or dozed into the roadway using a dozer or backhoe. Final graded areas would be topsoiled and revegetated.

Land Application Area

ZMI does not anticipate significant disturbance of the land application areas since limited materials movement would be required. The Carter Butte LAD area will likely not require reclamation measures. However, in the event of substantial vegetation loss due to the toxicity of applied solutions, the following activities would be undertaken to prevent soil erosion, minimize fire hazards, and return the loss to post-operation land use objectives:

- Cutting, stacking, and controlled burning of dead forest areas
- Temporary placement of water bars or other devices to help control soil erosion
- Improve the soil to a condition suitable for revegetation
- Revegetation of the area

Limestone Quarry Reclamation
Some small disturbance has occurred at a quarry near Shell Butte designated LS-1 (see Figure 2.5-2). The amount of limestone removed from this quarry was small, and used for materials testing. Reclamation of this area has yet to be performed, but would be consistent with the reclamation requirements for other disturbed lands.

Seaford Clay Pit Reclamation
The Seaford Clay Pit, located approximately 7 miles south of Zortman (see Figure 2.5-2), has provided liner material for leach pad facilities at the Zortman Mine. This clay pit has been reclaimed in accordance with the permit requirements established by the DSL Open Cut Mine Bureau, although ZMI has not requested bond release for this facility.

2.5.2.7 Reclamation/Post-Reclamation Water Handling and Treatment

Section 2.5.1.6 described the various water and leachate capture systems, and the water treatment activities currently in effect at the Zortman Mine, including operation of a water treatment plan in accordance with the June, 1994 Administrative Order. Under this alternative ZMI would capture and treat seepage and degraded waters according to the Water Quality Improvement Plan (Appendix A). The expected long-term reclamation requirement under the No Action Alternative is for long-term collection of mine waters, treatment to acceptable effluent standards, and discharge of the treated waters into surface drainages.

2.5.2.8 Reclamation Quality Control

ZMI uses an independent consultant to monitor revegetation success. The consultant periodically checks vegetation in reclaimed areas to determine if revegetation species have taken hold at the desired density and sustainable viability. No procedures are specified in the current permit for documenting quality control of reclamation practices.

2.5.2.9 Revegetation Procedures

Areas disturbed at the Zortman Mine are revegetated to stabilize soil and slopes, reestablish communities ecologically comparable to pre-mine conditions, and restore watershed, wildlife, recreational and aesthetic values that meet post-operation land use objectives. The following sections described ZMI's reclamation revegetation program.

Species Selection
Plant species selected for revegetation are based on species occurrence within the project area, land use objectives, presence of the species on pre-mine disturbances, establishment potential, growth characteristics, soil adaptation and stabilizing qualities, wildlife palatability and commercial availability.

Plant species are obtained from dealers within Montana. ZMI has used various mixtures of species during reclamation activities at the mine. These species have varied primarily due to availability and application; for instance, a different species mix may be used on heap leach pad dike faces as opposed to the top surfaces of pads. In addition, post-revegetation monitoring by independent consultants is conducted to evaluate reclamation success and suggest species modifications, where needed. As new species are released for distribution, they are considered for inclusion in the revegetation program.

Seedbed Preparation
Seedbeds are prepared immediately after grading, topsoil cover placement, and fertilizer application. On slopes of 33 percent or less, the seedbed is disced and harrowed along contour to break up large clods. On slopes exceeding 33 percent, sites too narrow to negotiate equipment, or on sites where organic debris has been respread, the soil surface is left in a roughened condition. Seed and mulch are applied to fresh road

cuts and fills in areas subject to erosion as soon after construction as possible.

ZMI uses surface ripping techniques, fertilization, and mulching to enhance revegetation success potential. Ripping is conducted on soil stockpile sites, road surfaces, and other areas where compaction has occurred. Compacted soil on level areas are tilled to break up the soil mass and improve water and air movement through the subsurface.

Seeding Methods

Seeding is coordinated with other reclamation activities to occur as soon after seedbed preparation as possible. Fall seeding is recommended, based on local soil moisture conditions, germination requirements of selected species, and timing of construction activities. Spring seeding is practiced if areas are ready for revegetation and access is possible.

Both broadcast and drill seeding methods are used, although the majority of disturbances are broadcast seeded. Broadcast seeding is used on rocky areas, slopes steeper than 3H:1V, areas where organic debris has been respread, and small disturbances. Seed is broadcast using manually operated cyclone-type bucket spreaders, a mechanical seed blower, or a hydroseeder. Where possible, broadcast seed areas are chained or harrowed to cover the seed. Where slope conditions allow, seeded areas would be dozer-tracked perpendicular to the slope. Seed would be covered by hand raking on smaller, less accessible sites.

Drill seeding would be done along contour wherever the reclamation surface is not level to achieve proper seed placement depth and promote good contact between seed and soil. Drill row spacing would range from 7 to 14 inches. Drill seeding would not be used in areas where reclaimed surface have rocky soil or where organic debris has been re-spread.

Fertilizer mixes and application rates are based on soil tests; rates are formulated to achieve soil macronutrient levels capable of promoting plant growth and productivity. Seed, fertilizer, and mulch typically would be sprayed in one application of about 250 lbs/acre when hydroseeding. When used, mulch is spread evenly over seeded areas at rates dependent on seeding method and slope. Mulch is anchored into the seedbed using a mulch crimper, disc, or tracked dozer. A tackifier is applied on areas that are mulched in the fall and on areas which require prompt stabilization. Where hydromulching is used, a second mulch application accompanied with a tackifier binding would be sprayed along the disturbance at manufacturer's recommended application rates.

Planting Methods

Tree species are planted continuously across slopes such as dike faces, sloped areas of leach pads, and waste dumps, and in clumps along level areas such as plant sites, and the tops of leach pads and waste repositories. Heap leach pads and waste dump tops are planted in islands on level areas, with 10 to 30 percent of the area planted in forest species and the remainder planted in grasses for wildlife grazing. Distribution of the various tree species depends on slope, reclamation surface, and moisture conditions.

ZMI initially plants 400 trees per acre. Based on an anticipated survival rate of 65 percent, the final stocking rate after 15 years would be about 260 trees per acre. The appropriate planting time is determined by site conditions such as soil moisture, soil temperature, air temperature, site accessibility, and previous reclamation planting experiences with trees and shrubs at Zortman Mine disturbances. Tree stock is to be delivered to the site as close to the time of planting as possible, with no stock handled when the air temperature is below freezing and no planting when frost is still in the soil. Hand tools and power-driven augers or similar machines are used to plant trees and shrubs. Mulching may be employed to conserve moisture and reduce competition.

If available, stock inoculated with mycorrhiza is planted to enhance growth and prospects for plant survival. Partial shade from logging debris, snags, or other sources is used to help establish seedlings. If tree seedling survival is less than 65 percent three years after planting, supplemental planting is to be considered.

Interim Revegetation

To reduce erosion and sedimentation during the life of the operation, some disturbances such as soil stockpiles are to be vegetatively stabilized prior to final reclamation. Topsoil is not applied to those areas which are temporarily revegetated. These sites are broadcast seeded or hydroseeded. Mulch and fertilizer are added. Interim revegetation takes place during the first appropriate season after construction is completed. Final reclamation occurs at the completion of operations.

2.5.3 Landusky Mine: Permitted Operation

The location, currently permitted area, and major facilities of the Landusky Mine are shown on Figure 2.5-1. The Landusky Mine is situated in portions of Sections 14, 15, 22, and 23 of Township 25N, Range 24E, approximately one mile north of the community of Landusky in the Little Rocky Mountains. The mine has been in operation since 1979. The mining operation is located on 1,287 acres of land, of which 382 acres are patented mining claims. A total of 814 acres of these lands are permitted for disturbance. The Landusky Mine is an open-pit mine using heap leach mineral processing to extract gold and silver from the ore.

In contrast to the Zortman Mine, ore is being removed from the Landusky Mine at this time. According to ZMI officials the mine had approximately one year of permitted leach pad capacity as of September, 1994 (ZMI 1994b). Present production is approximately 12 million tons of ore and 6 million tons of waste rock per year. The number of workers employed by the mine has varied over the years, depending on the level of mining and reclamation taking place. As described in Section 2.5.1, a contract mining firm was used until several years ago, but ZMI currently has its own workforce and equipment for mining operations. The combined work force for both mines has included as many as 250 workers at times, depending on the amount of reclamation, exploration, and mining activity underway.

2.5.3.1 <u>Mine Pit Operation</u>

The Landusky Mine has developed a number of open pits, including the Little Ben, Surprise, August, Queen Rose, Gold Bug, and South Gold Bug pits. Many of the pits have been enveloped by larger or expanded pits over the years, and all of the pits are contiguous. As shown on Table 2.5-7, ZMI has reached the extent of permitted mine pit disturbance, as approximately 235 acres have been disturbed by the open pits. Ore is currently being mined from the Queen Rose, Little Ben, and South Gold Bug pits.

<u>Mining Methods</u>
Methods used to remove ore from the Landusky Mine are the same as those described for the Zortman Mine. Rotary drill rigs bore blasting holes on ore benches 20 feet deep, using a grid of approximately 13' by 13' centers, with drill depths to approximately 23 feet. ANFO is used to blast rock from the pit. Ore blasted from the pit is hauled by truck directly to the leach pad as run-of-mine ore. It has not been necessary to crush ore at the Landusky Mine prior to heap leaching.

Approximately 117 million tons of ore have been leached to remove gold and silver at the Landusky Mine site since ZMI began operations in 1979. The ore has been removed from zones of significant gold mineralization, corresponding to the locations of the open pits. The ore bodies in the Landusky area are low grade. More information concerning the geology of the area, the rock types encountered and mined, and common mineral associations may be found in Section 3.1.

<u>Waste Rock Characterization</u>
Approximately 50 million tons or 33 percent of the total material removed during mine operations at Landusky has been waste rock. Waste rock generated during mining has to be removed from the area and dumped or placed in a disposal facility. As with the Zortman Mine, problems have occurred at the Landusky Mine because the chemistry of some waste rock has helped to form acid rock drainage. In the past, and in accordance with permit requirements, waste rock has been unselectively end-dumped into waste rock facilities without regard for their potential to cause acid drainage. However, ZMI has implemented a waste rock characterization and handling program to segregate and deposit those waste materials with a significant potential to form acidic drainage. The program is as follows.

Mine wastes are characterized by their total sulfur content, with analyses being conducted using a Leco SC432 sulfur analyzer to measure sulfur contents of every third blast hole drilled during mining operations. To ensure the validity of classification schemes, 300 - 500 check samples are analyzed for total sulfur, and net neutralization potential per year. In addition, kinetic tests are underway or planned for the classes of waste materials described below. Laboratory-scale humidity cells tests and field-scale tests are ongoing.

The principal objective of characterization work is the identification of waste with acid generating potential, so that it can be handled appropriately. A secondary consideration is identification of waste with substantial neutralization potential which can be used for unrestricted construction. Static data from 815 samples are available. Based on these data, correlated with sulfur content of the waste rock analyzed, ZMI has assigned color-coded handling classifications which are described below:

TABLE 2.5-7

SUMMARY OF MINE PIT CONDITIONS
LANDUSKY MINE

Pits	Permitted Disturbance (Area in Acres)[1]	Existing Disturbance (Area in Acres)[1]	Operational Status
Landusky Pits			
Queen Rose and August[2]	109.0	148.5	Active
Gold Bug	86.0	86.4	Backfilling
South Gold Bug	20.0	0.0	Developing
TOTAL	215.0	234.9[3]	

Source:

1 Revisions to Landusky Operating Plan, July, 1995 (ZMI 1995a)
2 Includes Little Ben and Suprise pits
3 Includes haul roads

- **Blue Waste (< 0.2 percent sulfur; Non-Acid Forming)**

  A substantial portion of the blue waste material is composed of felsic porphyries of several different lithologies and calcareous shales of the Emerson Formation.

- **Yellow Waste (0.2 - 0.5 percent sulfur; Uncertain)**

  The bulk of the yellow waste is composed of unoxidized or partially oxidized porphyries, and similarly mineralized and altered amphibolite facies schists and gneisses.

- **Green Waste (> 0.5 percent sulfur; Acid-Forming)**

  The bulk of the green waste materials are partially oxidized felsic porphyries and/or amphibolite-facies felsic gneisses.

The sulfur values of every third blast hole sample are plotted with the gold assays when ore and waste blocks are discriminated. Any ore materials, regardless of sulfur content, which are disturbed during oxide ore mining operations, are taken to the leach pads with the oxide ores. The remaining materials are assigned to blocks which are classified on the basis of the most restrictive waste category included in any given block. This waste rock handling system was given approval by the agencies (DSL/BLM 1994a) for selecting non-acid generating waste rock to be used for interim reclamation of the Mill Gulch and Gold Bug waste rock repositories, and 91 pad dike. This decision was contingent upon the "Blue Waste" also having a net neutralization potential greater than 20 and a NP/AP ratio greater than 3.

Waste Rock Handling

After waste rock is geochemically characterized it is scheduled for placement into a waste rock disposal facility (see later Section 2.5.2.4). ZMI has developed the following waste classification rules for determining appropriate disposition of the waste rock:

- Any block which contains only blue waste blast holes is scheduled as blue waste.

- Any block which contains a mixture of blue waste blast holes and yellow waste blast holes is scheduled as yellow waste.

- Any block which contains any green waste blast holes is scheduled as green waste.

- Any waste of uncertain character is scheduled as green waste.

2.5.3.2 Crushing Operation

The ore produced at the Landusky Mine has been run-of-mine, such that crushing has not been necessary to prepare the ore for heap leaching. The only crushing operations that have been conducted at the Landusky Mine were to prepare liner materials for heap leach pads. In addition, some crushed waste rock has been used in other construction, such as road bed surfacing.

2.5.3.3 Ore Leaching Operation

Ore is extracted from the open pits and deposited directly on the heap leach pad as run-of-mine ore. The method of ore leaching at the Landusky Mine is the same as described for the Zortman Mine in Section 2.5.1.3. Since 1979, seven separate or combined heap leach pads have been used at the Landusky Mine. They include the 79, 80/81/82, 83, 84, 85/86, 87, and 91 pads. The 87 and 91 pads have recently been combined to form the 87/91 pad. The locations of these pads are shown on Figure 2.5-1.

Leach Pad Construction

The 79, and 80/81/82 pads are free draining, while the remaining pads are valley-fill structures. The 79, and 80/81 portion of the 80/81/82 pads are lined only with compacted clay. The remaining Landusky leach pads are lined with both compacted clay and a synthetic membrane of PVC. Table 2.5-8 provides a summary of the ore capacity for each pad, and disturbances associated with the leach pads. Approximately 280 acres have been disturbed by leach pad development. About 107 million tons of ore have been loaded on the leach pads, and all but the 91 and 87/91 have been loaded to their permitted capacity. Ore is still being leached at the 85/86, 87, and 91 pads. A summary of the reclamation status for each facility is presented in Section 2.5.4.3. The general construction method of leach pads at the Landusky Mine is as described for the heap leach facilities at the Zortman Mine (see Section 2.5.1.3). A description of the method used to construct the 91 heap leach pad, typical of leach pad construction at both the Zortman and Landusky mines, follows.

- The pad foundation was stripped of all soil and weathered rock, including removal of vegetation and compressible soil and rock. Approximately 82 acre-feet of soil were salvaged and stockpiled just southwest of the 91 pad for use in final reclamation.

TABLE 2.5-8

SUMMARY OF CURRENT HEAP LEACH PAD CONDITIONS LANDUSKY MINE

Facility	Permitted Disturbance (Area in Acres)	Permitted Ore (Total)[1,2]	Current Mass Load (% of Total)	Maximum Solution Capacity (10^6 Gal)[1,2]	Solution In Storage (10^6 Gal)[2,3]	Remaining Solution Capacity (10^6 Gal)[2,3]	Operational Status
79	7.0	458,000	100	0	0	0	Reclaimed
80/81/82	25.5	3,694,000	100	0	0	0	Rinsing
83	22.0	2,021,000	100	10.56	3.13	7.44	Rinsing
84	13.5	3,301,000	100	9.54	1.44	8.10	Rinsing
85/86	26.1	5,300,000	100	23.21	13.67	9.54	Leaching: Fully loaded, but at 30% original capacity. Loading deferred to 87 & 91 pads to reduce ARD contamination potential
87	82.0	40,000,000	100	116.84	59.49	57.35	Leaching
91	78.5	50,000,000	100	153.61	109.61	44.01	Loading & Leaching
87/91	25.0	11,900,000	17	0	0	0	Loading & Leaching: No additional solution capacity
TOTAL	279.60	116,674,000	83%	313.76	187.34	126.44	

Source:

1 Draft Revisions to Landusky Operating Plan, April 1995 (ZMI 1995a)
2 As of September 1, 1994

Diversion structures were built around the leach pad to prevent surface water from entering the process circuit.

- Underdrains were installed beneath the pad, consisting of rock that would not decompose when repeatedly wetted. This material was placed in all of the minor drainages underlying the leach pad area. The underdrains exit from beneath the leach pad liner below the retaining dike in Sullivan Creek. The pad foundation overlying the underdrains was prepared by cutting or filling areas of the prepared site to provide a smooth, sloping, and consistently compacted surface for liner installation.

- A dike was constructed at the downstream end of the pad site to keep the ore in place. The downstream side of the dike was constructed at a 2H:1V slope and the upstream side a 2.5H:1V slope. Waste rock from mining operations was used to construct the dike.

- A compacted bentonitic shale liner was placed on this foundation in two stages. First, a shale liner was installed in two compacted lifts of nine inches each in the central portion of the pad. Second, the remainder of the shale liner was installed in two compacted six-inch lifts around the outer perimeter of the first stage liner.

- A synthetic, geomembrane liner was placed over the clay liner. This synthetic liner allows internal solution collection upstream of the retaining dike. The liner was composed of 30-mil PVC, with a 10-ounce geotextile on top for stage 1. The stage 2 area also used 30-mil PVC. The overlapping PVC sheets were glued in place to seal the liner.

- A protective layer of 12 to 18 inches of crushed materials, one-inch or less diameter, was placed over the synthetic liner to prevent punctures during ore loading.

- Two contingency ponds, each with a 1.3 million gallon capacity, have been constructed just below the pad to intercept water from the underdrains. The ponds were lined with 12 inches of bentonitic shale and a 36-mil hypalon synthetic liner.

In March, 1994, the agencies issued a Decision Record requiring that ZMI not construct the previously approved 85/86 leach pad extension because of potential impacts to surface and groundwater in Montana Gulch. Instead, the ore remaining to be loaded on this pad was to be placed on an extension of the 87 and 91 pads, effectively connecting the two pads. This new area is designated the 87/91 heap leach pad.

Process Ponds

Pregnant solution carrying gold and silver is directed to solution holding ponds prior to further processing. Table 2.5-9 provides the solution capacities and current solution containment within the three process ponds at the Landusky Mine. The pregnant pond carrying gold and silver has a capacity of about 4.96 million gallons, with approximately 30 percent capacity available for more solution. The Landusky Mine has two barren process ponds, containing solution from which the metals have been removed. These three ponds are all active since ore leaching is still occurring at some of the heap leach pads. Locations of the pregnant and barren ponds are shown on Figure 2.5-1. Process pond capacities vary depending upon water balance within the heaps and ponds.

Leak Detection System

As described for the Zortman Mine operations, the capability to monitor the existing leach pads depends on the method of construction. Valley fill leach pads have underdrains that are monitored to detect any loss of leaching solution. Free draining pads have no inherent leak detection system. In addition, monitoring sites are also used to determine if surface water or groundwater below the leach pads has been degraded by solution leaks. The monitoring well and surface water monitoring network at the Landusky Mine is shown on Exhibit 2.

Processing Plant Operation

Facilities to process cyanide leach solution containing gold and silver are located just north of the 87 leach pad dike (carbon adsorption) and adjacent to the 79 pad (Merrill-Crowe) as shown on Figure 2.5-1. Pregnant solution is pumped from the leach pads via vertical turbine pumps to the Merrill-Crowe and Carbon Adsorption facilities, with a capability to process approximately 5,000 gallons per minute combined. The Merrill-Crowe plant operates as described for the Zortman Mine in Section 2.5.1.3. In the carbon adsorption plant, columns filled with activated carbon collect metals from solution through an adsorption process. Pregnant solution enters a column from the bottom and proceeds upward, contacting carbon along the way which has adsorbed the gold and silver. The solution then overflows into a collection system where it gravity-feeds into the next column. The solution proceeds in this manner through all of the carbon columns, exiting the last one as barren solution void of gold or silver.

TABLE 2.5-9

SUMMARY OF LANDUSKY SOLUTION PONDS

Facility	Maximum Solution Capacity (10^6 Gallons)[1,2]	Solution In Storage (10^6 Gallons)[1,2]	Remaining Solution Capacity (10^6 Gallons)[1,2]	Operational Status	History
Process - Pregnant	4.96	3.54	1.42	Active	
Process - Barren 1	4.60	3.55	1.05	Active	Relined, 1993
Process - Barren 2	7.43	0	7.43	Inactive	Relined, 1994
Upper 91 Contingency and Capture	1.3	0.65	0.65	Active	Constructed, 1991
Lower 91 Contingency and Capture	1.6	0.8	0.8	Active	Constructed, 1994
85/86 Contingency[3]	1.0	1.0	0	Active	Constructed, 1986
87 Contingency/Capture	0.5	0.25	0.25	Active	Constructed, 1993
King Creek Sediment	5.0	0	5.0	Active	Constructed, 1994
'87 Storage Pond A	27.10	23.71	3.39	Active	Located on top of '87 leach pad; to be removed in 1995
'87 Storage Pond B	27.69	26.37	1.32	Active	Located on top of '87 leach pad; to be removed in 1995
TOTAL	81.18	59.87	21.31		

Source:
1 ZMI, 11-15-94 Memo to Woodward-Clyde (ZMI 1994b)
2 As of November 14, 1994
3 Also used to collect Gold Bug Adit discharge

Key to Types of Ponds
Pregnant (with gold) or Barren (w/o gold) - **Process**
For excess CN Solution - **Storage**
Primarily, to collect acid drainage - **Capture**
For additional solution storage - **Contingency**
For stormwater collection - **Sediment**

2.5.3.4 Waste Rock Facilities

Two dumps and one repository have been used for the disposal of most of the waste rock generated at the Landusky Mine, although several much smaller sites have also been used to dispose waste rock. Table 2.5-10 provides a summary of the major disturbances associated with the Montana Gulch Dump, the Mill Gulch Dump, and the Gold Bug repository. These facilities are also shown on Figure 2.5-1. Approximately 171 acres have been disturbed for waste rock disposal (although the Gold Bug repository uses existing mine pit disturbance). The Montana Gulch dump, constructed in 1982, has been loaded to its permitted capacity of approximately 8 million tons over a disturbance area of approximately 22 acres. The Mill Gulch dump, which first began loading in 1988, was originally anticipated by ZMI to hold approximately 35 million tons of waste rock, but the agencies prohibited further placement of waste rock in this facility because of problems with acid drainage (DSL/BLM 1993a,c; DSL/BLM 1994a). No more waste rock is scheduled to be placed on the Mill Gulch dump, which contains approximately 17 million tons of material and covers about 63 acres of disturbance. Since the agencies prohibited use of the Mill Gulch dump, waste rock generated at the Landusky Mine has been loaded as backfill into the Gold Bug pit. As of September, 1994 this repository contained about 10 million tons of waste rock. In addition, ZMI has with approval of the agencies been using waste rock for backfill in the lowest portions of the Queen Rose pit to provide a free-draining pit floor. About 2 to 3 million tons are scheduled for disposal. About 6.5 million tons of waste rock were used in leach pad and buttress construction. A description of the reclamation status for each dump is provided in Section 2.5.4.5.

2.5.3.5 Other Features and Facilities

This section describes other important features and facilities at the Landusky Mine. Table 2.5-11 shows the disturbance areas and operational status for some of the facilities.

Office/Laboratory Facilities

The Landusky Mine also uses the main office building in Zortman to house mine management, engineering, geology, environmental, safety, accounting, and payroll personnel. A description of this and adjacent facilities is found in Section 2.5.1.5.

Access and Haul Roads

The Landusky Mine can be accessed from a few roads, but the primary (restricted) access is on the gravel road east from the town of Landusky, or from the road connecting the Zortman and Landusky mines. Another access road leading to the mine is up the Mission Canyon from Hays, which is located north and west of the Landusky Mine. The mine access roads and other haul roads were shown earlier on Figure 2.5-2.

Power and Water Supply

Water is consumed at the project site by ore wetting, spray evaporation and haul road watering. Fresh water makeup is accomplished through storage of precipitation on the leach pad and water appropriation from the Gold Bug Adit drainage (250 average gallon per minute flow) and a groundwater appropriation of 90 gpm issued by the DNRC. The average makeup water required is 260 gpm, of which 55 gpm is for road watering.

Electrical power is obtained from the Landusky grid, which is supplied by the Big Flat Power Cooperative through an existing 23 kV line. Potable water is obtained from groundwater wells. Process water is obtained from precipitation and groundwater appropriation.

Sewage Treatment

As described for the Zortman Mine, septic systems are in place for human waste generated at the production lab, annex building, and main offices. Separate septic systems are also in place at the ore processing plants and maintenance buildings.

Construction Materials

ZMI has used waste rock in the construction of facilities during its fifteen year history of mining at Landusky, thereby eliminating the need for development of a gravel pit or quarry. For instance, waste rock has been used to construct leach pad retaining dikes such as the 91 pad dike. Waste rock material used in containment dikes typically has ranged in size from one foot to gravel or pea sized. Tailing from the King Creek area has been used as part of the liner cover in the 91 leach pad and as road sand during winter operations. Other construction materials include cover soil and clay.

TABLE 2.5-10

SUMMARY OF WASTE ROCK FACILITIES

LANDUSKY MINE

Facility	Permitted Disturbance (in Acres)[1]	Existing Disturbance (in Acres)[1,2]	Permitted Load Capacity (Ton)[1]	Current Load (per cent of total)[1,2]	Operational Status
Landusky Facilities					
Montana Gulch Dump	27.5	21.3	8,000,000	100	Reclaimed
Mill Gulch Dump	70.0	63.1	17,000,000	100	Reclaiming
Gold Bug Repository	86.4[3]	86.4[3]	18,000,000	72	Active
TOTAL	183.9	170.8	43,000,000	86	

Source:

1 Revisions to Landusky Operating Plan, July, 1995 (ZMI 1995a)
2 As of September, 1994
3 Duplicates pit disturbance

TABLE 2.5-11

PLANT AND STORAGE AREAS - SUMMARY OF CURRENT CONDITIONS

LANDUSKY

Facility	Disturbance Area in Acres[1]	Volume of Soil (Cubic Yards)[2]	Operational Status
Mill Gulch Soil Stockpile	10.1	1,479,265	Active
August/Little Ben Soil Stockpile	5.4	436,568	Active
Gold Bug Soil Stockpile	2.2	75,020	Active
Montana Gulch Soil Stockpile	2.0	180,532	Active
Montana Gulch Maintenance Area	4.5	n/a	Active
Process Plant	26.0	n/a	Active
TOTAL	50.2	2,171,385	

Source:

1 Draft Revisions to Landusky Operating Plan, April, 1995 (ZMI 1995a)
2 Annual Progress Report for Operating Permit 00096, June, 1994

Cover Soil Stockpiles
Existing cover soil stockpiles are located as shown on Figure 2.5-1, with storage volumes presented on Table 2.5-11. Cover soil stockpiles have been developed by salvaging available topsoil as areas are disturbed during construction of new facilities.

Clay Borrow
Under a permit issued by the DSL Open Cut Bureau (now part of the DEQ), clay borrow for leach pad and pond liner and cover construction is obtained from the Williams Clay Pit, located approximately 2 miles west of the town of Landusky, as shown on Figure 2.5-2 The clay pit has been developed using highwall mining methods. Current disturbance is approximately 26 acres, although some of this has been reclaimed.

2.5.3.6 Water Handling and Treatment

Field inspections conducted by DSL and BLM in 1992, and a review of water quality monitoring data generated at the Landusky Mine, showed that ZMI's operating and reclamation plan for the Landusky Mine were not preventing the formation of acid rock drainage. As a result, DSL and BLM prepared a Supplemental EA of ZMI's permit for the Landusky Mine in November, 1993. The purpose of the EA was to evaluate ZMI's proposed modifications to the mine plan to address problems associated with acid rock drainage emanating from several of the mine facilities, including waste rock dumps and ore heap retaining dikes.

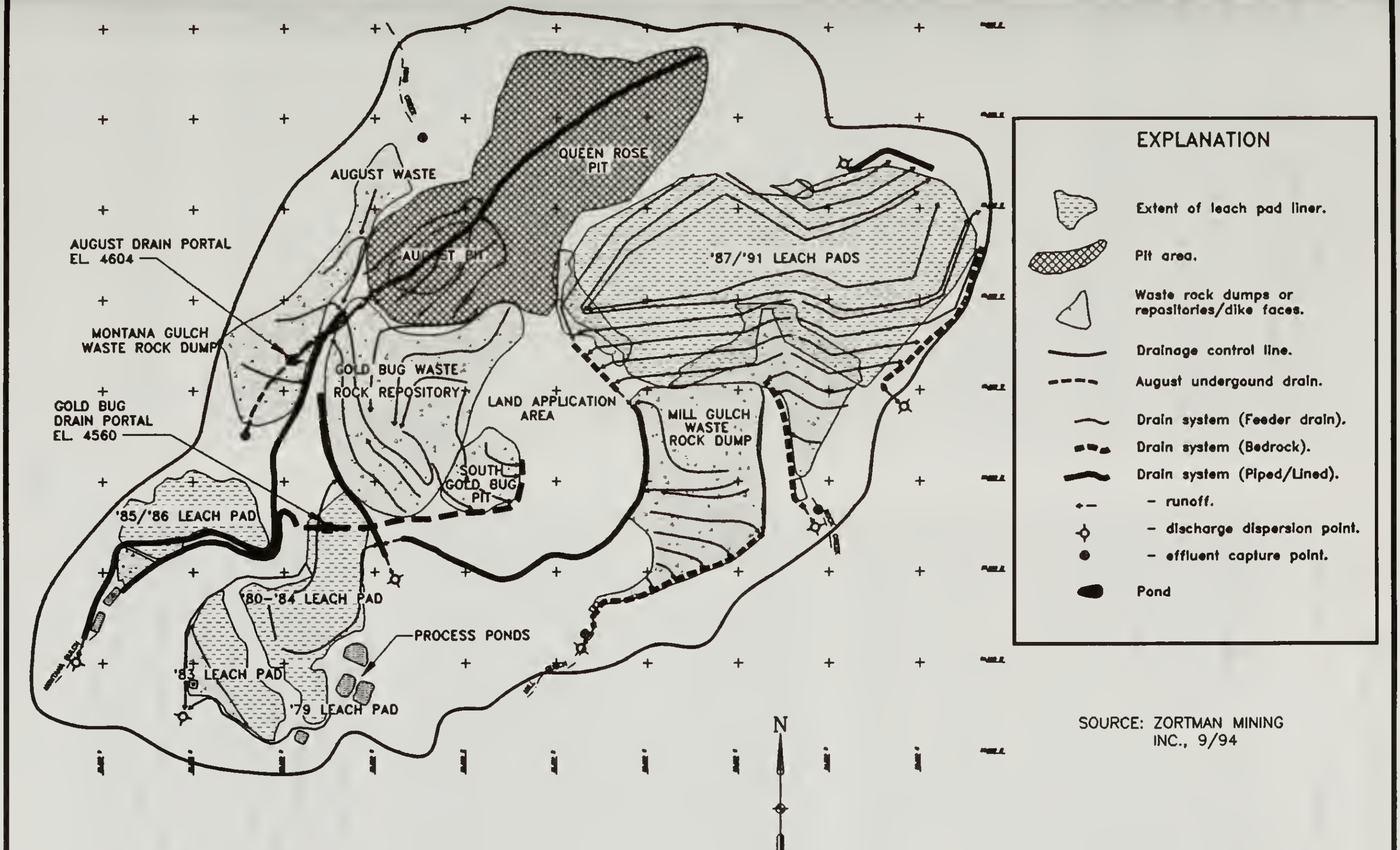
As a result of the acidic conditions which have developed in many areas of the Landusky Mine, a number of modifications have been implemented to the operating and reclamation procedures to mitigate concerns and protect environmental resources, particularly surface water and groundwater. A description follows of the water capture, treatment, and runon/runoff controls in place to mitigate water resources contamination, including discharge capture systems, runoff collection and diversion systems, and an emergency land application area. More detailed information on current and historic water quality problems, and potential impacts to water resources from the various alternatives considered in this EIS, may be found in Sections 3.2 and 4.2, respectively.

Water Capture and Treatment
Seepage water is being collected in Sullivan Park and Mill Gulch using capture ponds and collection sumps (see Figure 2.5-6). Water from the collection sumps is pumped to the capture pond. Captured waters from these drainages are not treated but are pumped via pipeline to the 87 leach pad for use as process makeup water. Water from the Gold Bug Adit is collected in Montana Gulch and aerated in the 85/86 contingency pond to precipitate iron. Water is then evaporated or released through the pond's spillway.

Seepage capture ponds and sumps are inspected on a weekly basis for routine maintenance or repairs, if necessary. A description of the capture systems for each drainage follows.

Sullivan Creek (Headwaters of Rock Creek) - The headwaters segment of Rock Creek downstream of the '91 Pad is called Sullivan Creek. A series of staged collection points have been constructed. The first capture unit is recovery well EN-904 located at the buttress toe (see Exhibit 2). This well captures low pH seepage. The second capture unit is composed of a collection gallery with slurry cutoff walls which diverts shallow surface water into the 1,300,000 gallon contingency pond at the toe of the leach pad's dike. Another 1,300,000 gallon pond was constructed in the spring of 1994 below this pond to capture seepage when the buttress for the 87/91 leach pad expansion is constructed over the original pond. A second capture sump and pumpback tank was constructed downgradient of the 94 pond. Pumpback in this sump is conducted on an intermittent basis, depending on seepage pH. Captured waters are pumped to the 87 leach pad. The ponds capture and store (prior to pumpback) average seepage water flow of 20 gallons per minute. Maintenance requirements for the ponds are minimal as storm water is routed away from the pond area.

Mill Gulch - In 1988 the Mill Gulch waste rock dump was started below the 87 leach pad's dike, which is located at the head of Mill Gulch. Water flowing from the toe of the dump comes from seepage and from a spring present beneath the dump. A seepage capture pond and downstream sump collect impacted waters which are pumped to the 87 leach pad. The 79 through 82 leach pads are located on the ridgetop between Montana Gulch and Mill Gulch; they also drain to the process pond in Mill Gulch. The Mill Gulch capture pond capacity is approximately 500,000 gallons and captures and stores (prior to pumpback) average seepage water flow of 40 gallons per minute. Seepage is captured on an intermittent, as-needed basis when pH falls below 6.0. Maintenance requirements for the



EXISTING LANDUSKY DRAINAGE PLAN:

INDICATES CURRENTLY PERMITTED EXISTING LOCATIONS FOR WATER HANDLING, CAPTURE AND TREATMENT FEATURES

EXISTING LANDUSKY DRAINAGE PLAN

FIG. 2.5-6

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ponds are minimal as storm water is routed away from the pond area.

Montana Gulch - The Montana Gulch waste rock dump, 85/86 Pad, Gold Bug Adit and August Adit are located in the upper reaches of Montana Gulch. The 83 heap leach pad is located at the head of the second ephemeral gulch which enters into Montana Gulch downstream of the Gold Bug confluence. The 84 pad is located in the gulch containing the Gold Bug Adit. Flow from the Gold Bug Adit averages approximately 150 to 250 gallons per minute, most of which is used for road watering. Water from the Gold Bug Adit not used for road dust suppression is collected in a pipeline and routed to an aeration sprinkler in the 85/86 contingency pond, which precipitates iron. The precipitate is pumped onto a trench on the 85/86 leach pad. No other treatment is required at this site. The 85/86 contingency pond capacity is approximately 1,000,000 gallons. Maintenance requirements for the ponds are minimal as storm water is routed away from the pond area.

A 12-inch compacted clay barrier separates the upper Gold Bug waste rock repository from the lower repository at the 4,740 level. The barrier is inclined with a 2 percent grade to direct impounded water to the southwest. A collection trough conveys these waters to the southern end of the repository where they can be collected, treated or placed in the process circuit if necessary.

King Creek - King Creek originates within the mine permit boundary and is a major drainage on the northern side of the mine; it also drains the northern portion of the Montana Gulch waste rock dump. This drainage once contained a large volume of tailing from historic mining operations, which were removed by ZMI. Pumpback facilities are being installed in the event water quality is impacted by mine activities. Reclamation success and maintenance is being monitored in this drainage.

Surface Water Runoff Control

Interim operational drainages have been constructed throughout the Landusky Mine area to route storm water and runoff around the pit complex, leach pads and waste repositories. The interim drainages were built to meet immediate needs of ARD control. As such, they were not intended to deal with flows in excess of a 10 year, 24 hour storm event of 2.5 inches. Drainage systems for the Mill Gulch waste rock dump and Gold Bug waste repository are proposed as final and have been designed for the 6-inch, 24-hour storm event. Maintenance of diversions include removal of sediment buildup and repositioning of rip-rap as necessary. Additional water control structures would be constructed during reclamation activities (see Section 2.5.4).

Mine pit - Diversions have been constructed to route storm water away from pit disturbance limits. Water within the pit disturbance area and associated haul roads is collected in the pit. Because the Gold Bug and Queen Rose pits are being backfilled as part of the current mining operations, only the August/Little Ben portion of the pit will remain as an internally draining basin.

When mining operations are completed under this alternative, runoff from within the Queen Rose/Surprise, and August/Little Ben pits would flow to the bottom of the August pit then out through the August tunnel, an historic adit from upper Montana Gulch which runs beneath the area now occupied by the August pit. Flow entering the tunnel from the pit drainage would discharge beneath the Montana Gulch waste rock dump, seep through the dump, and surface near monitoring site L-38 (see Exhibit 2). This water would then be captured in the 85/86 leach pad underdrain, ultimately resurfacing near the discharge point of the Gold Bug tunnel.

Leach Pad - Diversions around the leach pads are constructed to prevent inflow of storm water.

Waste Rock Facilities - In an effort to reduce the volume of acidic seepage emanating from the toe of the Mill Gulch waste rock dump a cap has been installed to limit surface water infiltration into the dump. Drainage ditches (10-15 feet wide, 2 feet deep, 1-3 percent grade) have been constructed in 4-5 feet of capillary break material. These drainage ditches are lined with a synthetic impermeable barrier, covered with a geotextile, and held in place with 6" or more of non-acid generating material. A synthetic impermeable barrier has been placed at the clay/capillary break interface and covered with a geotextile to serve as a substrate drain. The lateral drain on the east side of the dump will handle flow velocities of greater than 5 feet/sec. Bedrock drainage ditches built for flow velocities greater than 5 feet/sec were constructed using drill and blast techniques to shape the channel. After the channel had been shaped it was cleaned to prevent piping, sediment transport, and debris build up that could lead to damming.

The Gold Bug waste rock repository is constructed with intermediate benches to route storm water away from the active waste disposal area and into Montana Gulch.

The Montana Gulch waste rock dump has a diversion ditch to the east for storm water. The tops of the waste rock dumps at the head of King Creek are graded to drain away from King Creek and into Montana Gulch.

Additional water control structures to be developed for the waste rock facilities are described in Section 2.5.4.

Land Application Disposal

ZMI has been permitted (see Supplemental EA 1991) to use 70.5 acres on Gold Bug Butte for land application of process solutions. This site may be used for emergencies or disposal of final heap draindown solution. All neutralized effluents would be at or below 0.22 mg/l WAD cyanide prior to land application. The agencies would be notified prior to emergency land application.

Water Quality Compliance Plan

As described in Chapter 1.0, and mentioned in the description of Zortman Mine operations (Section 2.5.1.6), a water quality improvement and monitoring compliance plan has been developed to mitigate water quality impacts from mine facility discharges. The compliance plan is also applicable to the Landusky Mine. Appendix A contains a summary of the proposed Water Quality Improvement Plan and the schedule for its' implementation.

2.5.3.7 Hazardous Materials

A variety of potentially hazardous compounds are used in mining, ore processing, and reclamation activities. The compounds and their rate of use have varied over the years, and some compounds have replaced others to increase operational efficiency or to accommodate operational modifications. This section briefly describes the chemicals currently used at the Landusky Mine. A detailed discussion of hazardous material use, storage, handling, consumption and waste disposal is presented in Section 3.14.

The Landusky Mine is currently producing and processing ore, so there are more chemicals used in greater amounts than those described for the Zortman Mine in Section 2.5.1.7.1. The following table provides an estimate of the amount of each compound used at the Landusky operation.

Compound	Estimated Use
Lime	18,000 ton/yr
Zinc	110 ton/yr
Sodium Cyanide	1,750 ton/yr
Gasoline	5,000 gal/yr
Ca/Na Hypochlorite	Contingency use
Hydrogen Peroxide	Contingency use
Anti-Scalants	8,200 gal
Oil and Lubricants	80,000 gal/yr
Antifreeze	8,500 gal/yr
Citrus-base Solvent	800 gal/yr
Diesel Fuel	2.6 million gal/yr
ANFO	4,000 ton/yr

A description of the use for those chemicals not already described in Section 2.5.1.7.1 follows.

Diesel Fuel is used to power the mine vehicles.

Ammonium Nitrate is the main ingredient in the blasting agent "ANFO."

Lime is used during mining operations to control the pH during the metal extraction process.

Sodium Cyanide is used to dissolve the gold and silver in the leaching process.

Hydrochloric Acid (HCl) at a molar concentration of 11 is used to remove scaling on the clarifiers, pump intakes, impellers, spray lines and return lines.

Flocculent is used to settle small particles out of the solution which create problems in the clarifiers in the metal extraction process. Percol 710 is an anionic polymer flocculent used in the ore processing plant.

Calcium and Sodium Hypochlorite is used on a very infrequent basis to neutralize cyanide solution which may have leaked or spilled out of containment systems.

Hydrogen Peroxide is used at the end of mine life to destroy cyanide in heap leach rinsate solution if natural degradation of cyanide needs to be accelerated. An estimated 10,000 to 20,000 gallons of 70 percent hydrogen peroxide may be required, depending on amount of natural degradation of cyanide compounds. Approximately 550 gallons of H_2O_2 are kept at the mine.

Anti-Scalants are used to prevent scaling around the pump intakes, and in the spray and return line.

2.5.4 L[illegible]sky Mine: Per[illegible]tted Reclamation

This secti[illegible]ibes ZMI's permitted reclamation plan and proc[illegible]r the Landusky Mine. The following informa[illegible]ed in large part on the <u>Application for Amendm[illegible]xisting Hard Rock Operating Permit for Life-o[illegible]Operation and Reclamation, No. 00095,</u> Decemb[illegible] In addition, a number of modifications to the re[illegible]ion plans and procedures have been implemented since submittal of that application, as described [illegible] the environmental assessments and suppleme[illegible]s dated 5/11/90, 1/25/91, and 11/93, includin[illegible]n documents implementing those actions.

The pre[illegible] lo[illegible] term reclamation objective is "...to establish [illegible]st-operation environment that is compatib[illegible]xisting and proposed land uses of the Landusky [illegible] On lands under the administration of the Bure[illegible]d Management this includes returning disturbed [illegible] to land uses consistent with those identified [illegible] Resource Management Plan" (ZMI 1989). Th[illegible]fic post-operation land use objectives for the cu[illegible]clamation plan include:

- Reest[illegible]ent of a biological potential suitable for s[illegible]g a vegetative cover appropriate to the area
- Perm[illegible] protection of air, surface water, and grou[illegible]
- Insuring [illegible] protection of public safety and health
- Restoration of wildlife habitat
- Design o[illegible] land configuration compatible with the watershed
- Reestablishment of an aesthetic environment providing visual quality and recreational opportunities

Table 2.5-[illegible] illustrates the permitted reclamation schedule for the Landusky Mine. Reclamation of some facilities is pending a final decision on this EIS. The following sections describe the specific reclamation plans and action[illegible]hich ZMI is currently permitted to implement f[illegible]ch disturbance area.

2.5.4.1 <u>Reclamation Materials</u>

The current reclamation requirement for most facilities at the Landusky Mine is to cover disturbed areas with 8 inches of topsoil, followed by revegetation. Because of concerns with acidic drainage in some areas, BLM and DEQ have required ZMI to used more protective reclamation materials for three areas of concern, the Gold Bug waste rock repository, the Mill Gulch waste rock dump, and the 91 heap leach pad dike (DSL/BLM Decision Record 1994). Under interim approval from the agencies, ZMI is using material it believes to be non-acid forming in conjunction with clay and cover soil, to reduce surface water infiltration into these facilities. A description of the reclamation materials currently used at the Landusky Mine follows.

<u>Non-Acid Forming Waste</u>
Waste rock with less than 0.2 percent total sulfur content is being used as part of the interim caps on the Mill Gulch waste rock dump and in the Gold Bug waste rock repository, and on the 91 heap leach pad dike. Waste rock used in these facilities comes from two sources: existing waste rock stockpiles, and waste rock generated by the ongoing mine operation. This waste rock has been determined by ZMI to have a low potential to generate acid. A definition of the waste rock types and waste rock characterization program is found in Section 2.5.3.1.

<u>Limestone/Dolomite</u>
Limestone and dolomite have been used on a limited basis due to availability at the Landusky Mine. Because of their high carbonate content both of these rock types are useful to neutralize acidic conditions. Dolomite and limestone from outcrops within the mine permit area have most recently been used to provide a 3-foot buffering liner across the floor of the 4,640 bench in the Gold Bug waste rock repository.

<u>Clay</u>
Clay is used as a component layer of the interim caps which have been placed on the Mill Gulch waste rock dump and 91 leach pad dike. The swelling clay helps to reduce the possibility of moisture infiltration into the capped facilities. Clay used in Landusky Mine reclamation comes from the Williams clay pit located approximately 7 miles west of the town of Landusky. The clay is hauled by ZMI truck and loader fleet from the pit over the county road leading to the Landusky Mine, through the town of Landusky and onto the mine site to the area of final placement.

TABLE 2.5-12

LANDUSKY MINE RECLAMATION SCHEDULE[1]

Facility/Disturbance	Final Reclamati
Heap Leach Pads	
79	Already reclaim
80/81/82	1989-90
83 & 84	1991
85/86	1996 to 199
87	1999
91	2000
87/91	At project compl
Dike Faces and Ponds	
79 Pond	1996 to 199
82 Pond	2001
83 Dike	1989
83 Pond	2001
84 Dike	1991
85/86 Dike & Pond	1996 to 199
87 Pond	2000
91 Dike	1992
91 Pond	2001
Pit Floors (all)	Concurrent with M
Waste Rock Facilities	
Montana Gulch Dump	Already reclaim
Mill Gulch Dump	In reclamatio
Gold Bug Repository	Concurrent
Process Plant	At Project Compl
Topsoil Stockpile Sites	
Little Ben	1994
Mill Gulch Site	End of Projec
Montana Gulch Site	1991
Gold Bug Site	End of Proje
Haul Roads/Access Roads	At Project Compl
Refinery Site	Completion of Zo and Landusky Pr
Storage Sites	
Mine Equipment Storage & Service	At Project Compl
Process Equipment Storage	At Project Compl

[1] From Landusky Life-of-Mine Plan, May, 1989

Cover Soil

Cover soil is used on top of all mine disturbances, either as a final lift on the reclamation caps or as 8-inch layers directly overlying disturbed zones. Cover soil is obtained from one of four topsoil storage areas: the Mill Gulch stockpile, part of the Mill Gulch waste rock dump; the Little Ben soil stockpile; the Gold Bug soil stockpile; and the Montana Gulch soil stockpile. Approximate volumes of soil available at these stockpiles were shown on Table 2.5-11. Other, similar materials used for reclamation purposes would include unconsolidated rock, scree and soil above and below roadway cuts, which are incorporated into the regrading of haul and access roads.

2.5.4.2 Reclamation Testing and Covers

No geochemical testing is required of disturbance areas prior to reclamation, under terms of the existing mine permit. With the following exceptions, the "cover" placed on disturbance areas is limited to 8 inches of compacted cover soil. The agencies have stipulated that ZMI must place more protective reclamation covers on the Mill Gulch waste rock dump and 91 heap leach pad dike, as well as on the waste rock dump which has been developed in the Gold Bug pit, with the understanding that these interim reclamation procedures may not suffice as a long-term mitigation. The two reclamation caps being used are designated Reclamation Covers B and C, as shown on Figure 2.5-7, and described as follows:

- **Reclamation Cover B** - Is used on fill slopes with grades greater than or equal to 5 percent which require a barrier cover. The sequence, from the lowest layer to the top, is:

Bottom:	24-36 inches of amended fill with <0.5 percent total sulfur content
	Two 6-inch lifts of compacted clay
	36 inches of non-acid forming material as a capillary break
	8 to 12 inches of cover soil
Top:	Revegetation with seed mixtures, fertilizers, and mulches

- **Reclamation Cover C** - Would be used on fill slopes of less than 5 percent that require a barrier cover. The sequence, from the lowest layer to the top, is:

Bottom:	24-36 inches of amended substrate with <0.5 percent total sulfur content
	3 inches of compacted clay
	One layer of 15 to 20 mil PVC liner material
	One layer of 5 ounce geotextile material (to resist punctures in liner)
	36 inches of non-acid forming material (capillary break)
	8 to 12 inches of cover soil
Top:	Revegetation with appropriate seed mixtures, fertilizers, and mulches

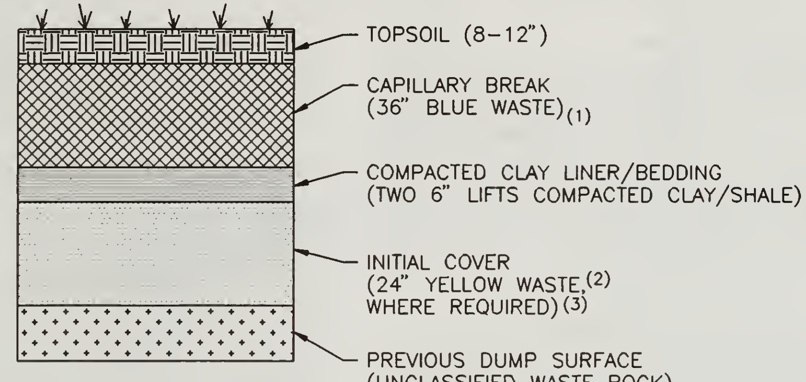
2.5.4.3 Mine Pit Reclamation

Overall slope of the final pit walls is required to be approximately 45 degrees (1H:1V) with 30-foot flat benches every 60 vertical feet. Pit floors are to be sloped and graded to facilitate drainage and alleviate the accumulation of stagnant waters. Where possible, pit floors are to be topsoiled and revegetated concurrent with mining operations. Stipulation No. 7 of the Decision Record for Permit Amendment No. 10 also requires that pit benches revegetated to the extent possible with soil and trees to reduce visual impact (Decision Record 1991). The Gold Bug and Queen Rose pit are being used as a waste rock repository and is constrained by other reclamation requirements.

2.5.4.4 Leach Pad Reclamation

Tasks associated with reclamation of the heap leach facilities include heap detoxification, liner perforation, and surface reclamation. The basic procedures associated with each of these tasks was described in Section 2.5.2.4; procedures for the Landusky Mine are the same as those for the Zortman Mine, except where noted for specific facilities.

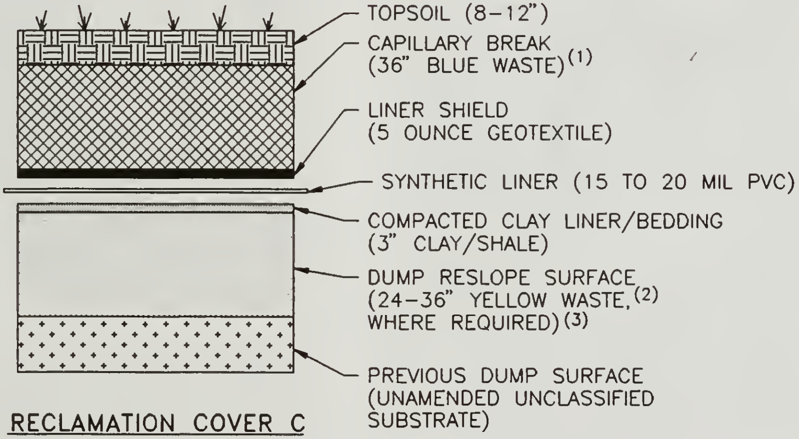
The 79 leach pad has been reclaimed (rinsed, graded, topsoiled, and revegetated) using a minimum 8-inch topsoil cover. The 80/81/82, 83, and 84 pads are still being rinsed. Ore leaching is occurring on the 85/86, 87, and 91 pads, as well as on the 87/91 pad. Current reclamation, by area, is shown on Figure 2.5-8 and described below.



RECLAMATION COVER B

SLOPE COVER MILL GULCH
WASTE ROCK DUMP

SCALE: 1" = 4'



RECLAMATION COVER C

TOP COVER MILL GULCH
WASTE ROCK DUMP

SCALE: 1" = 4'

NOTES:

1. BLUE WASTE – LESS THAN 0.2% TOTAL SULFUR.
2. YELLOW WASTE – 0.2 TO 0.5% TOTAL SULFUR.
3. ONLY NECESSARY IF SUBSTRATE HAS MORE THAN 0.5% TOTAL SULFUR.

TOP AND SLOPE COVERS
MILL GULCH WASTE ROCK DUMP

SOURCE: ZORTMAN MINING INC., 9/94

FIG. 2.5–7

Heap Detoxification

Detoxification of heaps at the Landusky Mine is discontinued when the solutions returning from the heap maintain less than 0.22 mg/l weak acid dissociable cyanide for a six month period which includes a spring, high-flow surface runoff event. The solutions tested for compliance are obtained from recovery wells located within each heap. At that time the heap solutions remaining after detoxification may be discharged or pumped to a containment pond for neutralization and later land application disposal.

Leach Pad Surface Reclamation

While the heap leach pad is being detoxified, or after detoxification is complete, surface grading begins to reduce pad slopes. The general reclamation criterion for pad slopes is no steeper than 2H:1V. However, the agencies have stipulated that the 91 ore heap slopes must be reduced to a maximum slope of 3H:1V with intervening benches every 200 feet of slope.

Slope reduction is performed by track mounted bulldozers pushing ore heap material from the facility crest or top down over the lift slopes, using cut and fill material from each of the heap benches to obtain the desired slope. Preparation for the site includes ripping of compacted areas on the top of the leach pad facility to reduce surface compaction and improve air and water movement through the surface, enhancing revegetation opportunity. Ripping is not anticipated to be required for most areas on top of the heap since the leach pad is double-ripped during preparation for solution spraying. Leach pad crests, top and slopes are topsoiled and revegetated, as described in Section 2.5.4.9.

Containment dikes for the heap leach pads are constructed of waste rock fill at an overall slope of 2H:1V and have typically not been subject to further slope reduction. However, the containment dike for the 91 ore heap must be reduced to a 2.5H:1V slope to limit infiltration of precipitation and surface water (DSL/BLM 1994a). Dike faces are topsoiled and revegetated to blend with existing undisturbed contact zones and reestablish vegetation communities.

Liner Perforation

After the leach pad has been detoxified and reclaimed the pad liner is perforated to reduce storage within the heap of precipitation and surface water runon, if any has made it past the surface water diversions. Approximately 3 to 4 drain holes 6-inches in diameter are drilled into the underlying drainage system to provide an exit for solution within the heap. Each perforated drain hole is backfilled with drain rock to an elevation of at least 5 feet above the liner surface to ensure continued drainage. The exact number and location of these additional drain holes would be established in consultation with the agencies upon review of neutralization monitoring data.

2.5.4.5 Waste Rock Dump Reclamation

Current reclamation of the waste rock facilities, by area, is shown on Figure 2.5-8. The disturbance area and reclamation status for each facility was shown on Table 2.5-10. The top and sloped areas of the waste rock dumps are covered with 8 inches of topsoil and revegetated, as described in Section 2.5.4.9. As previously noted, the agencies stipulated that the Mill Gulch waste rock dump be capped with a more protective composite cover. The agencies also required construction of the Gold Bug waste rock repository.

Mill Gulch Waste Rock Dump

Seven acres of concurrent reclamation were removed during 1992. Reclamation Covers B and C have been placed over the facility to limit the supply of air and water to repository materials. Because of concern over infiltration through the flatter upper portion of the repository, particular attention was directed to developing a surface which reduced infiltration to near zero, both through regrading and through placement of a composite cap upon the facility.

Mill Gulch Waste Rock Dump, Upper Portion - The upper flat portion of the repository was resloped with a nominal 2 percent (1 percent - 4 percent actual) grade draining to the north. The principal barrier for this portion of the repository is a composite clay and synthetic liner system (Reclamation Cover C, see Section 2.5.4.2) covering the portion of the repository with slopes of less than 5 percent.

Clay and rock for the reclamation cover layers were end dumped from Caterpillar 777B and 777C haul trucks and spread with Caterpillar D9N and D10N bulldozers to the above specified thicknesses. The clay layer was compacted by movement of haul trucks, as well as roller compaction to an estimated >95 percent density (visual inspection).

Mill Gulch Waste Rock Dump, Front Slope - The Mill Gulch waste rock dump has been resloped to a nominal 2.5H:1V to 3H:1V slope. This has been accomplished by reducing the upper portion of the repository to 2.75H:1V slopes, and the lower portions of the repository to 2.75H:1V to 3.5H:1V slopes. The resloped surfaces of the repository are completed with barrier covers B or C, depending on the slope of the surface to

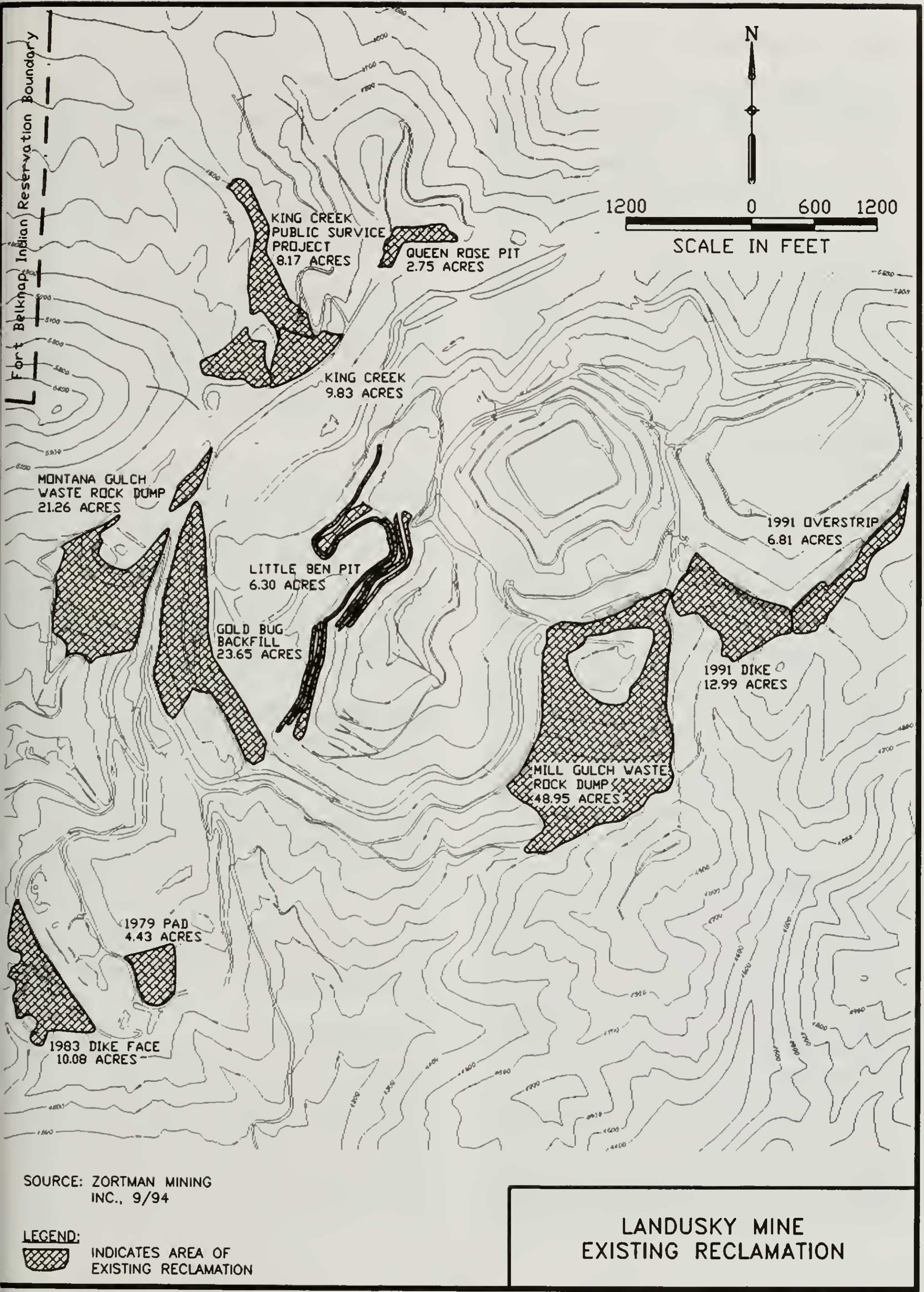

Fort Belknap Indian Reservation Boundary
N
1200 0 600 1200
SCALE IN FEET
KING CREEK PUBLIC SURVICE PROJECT 8.17 ACRES
QUEEN ROSE PIT 2.75 ACRES
KING CREEK 9.83 ACRES
MONTANA GULCH WASTE ROCK DUMP 21.26 ACRES
LITTLE BEN PIT 6.30 ACRES
GOLD BUG BACKFILL 23.65 ACRES
1991 OVERSTRIP 6.81 ACRES
1991 DIKE 12.99 ACRES
MILL GULCH WASTE ROCK DUMP 48.95 ACRES
1979 PAD 4.43 ACRES
1983 DIKE FACE 10.08 ACRES
SOURCE: ZORTMAN MINING INC., 9/94
LEGEND:
INDICATES AREA OF EXISTING RECLAMATION
LANDUSKY MINE
EXISTING RECLAMATION

FIG. 2.5-8

be covered. Every 100 vertical feet a 25 foot bench has been constructed to limit runoff velocities and allow for runoff to be moved to the lateral drain on the east side of the dump. The benches range from 15 to 30 feet wide and are sloped back into the repository with grades of 5 - 10 percent. These benches have been capped in a manner similar to the main portion of the repository.

Gold Bug Waste Rock Repository

During 1993, use of the Mill Gulch waste rock dump was discontinued. The Gold Bug pit was chosen for waste disposal because wastes would be stored outside of a natural drainage and the pit provides a convenient structure on which to construct a leachate collection system.

The objective for construction of this repository has been to limit the potential for acid generation. The base (3 feet deep across the 4640 bench) of the repository was constructed with limestone and dolomite, and amended with 100 tons of lime distributed over the main Gold Bug Shear (see Section 3.1 for a geological explanation of shear zones). Blocks of material which are determined to be as green waste (acid forming waste) are segregated within the repository interior. The margins of the repository are constructed with material which is determined to be yellow waste, containing 0.5 percent or less sulfur. The purpose of the waste segregation scheme is to line the perimeters of the repository with waste which should not cause acidic conditions and may provide some solution buffering capacity. Placement of the waste most likely to cause acid drainage within the interior of the repository will reduce the potential for acid leakage out of the pit. Reclamation Cover B typically is placed on waste rock as each lift is completed. Reclamation Cover C is used on slopes with less than 5 percent grade.

Montana Gulch Waste Rock Dump

Approximately 21 acres were disturbed in development of this dump, which contains about 8 million tons of waste rock. Reclamation took place in 1988 through 1990. About 8 inches of soil were placed on the disturbance. Approximately 36 pounds of seed were mixed per acre of disturbance, with approximately 100 pounds of fertilization per acre. Trees were planted on the reclaimed dump in September 1989 and April, 1990. Final dump slope was approximately 2H:1V.

2.5.4.6 Support Facilities Reclamation

Reclamation of the process plant areas and service structures would include dismantling and removal of all structures, concrete pads, and footings. Concrete materials removed from the structures would be used for backfill materials for pond areas or disposed in accordance with other solid waste disposal commitments. The plant area would be ripped by track mounted dozer to alleviate surface compaction, leveled, and graded to facilitate surface drainage. Final graded areas would be resoiled and revegetated to provide soil stability and reestablish vegetative communities. Other facilities would be reclaimed as follows.

Solution/Process Pond Reclamation

Ponds would be perforated, backfilled, and graded prior to final reclamation. Pond backfill would include fill material from waste rock operations and/or cement materials from structure footings or pads. After backfill, the ponds would be graded, covered with 8 inches of topsoil, and revegetated.

Sludges remaining in ponds at the end of mining operations would be sampled and analyzed to determine if there would be environmental hazards associated with on-site burial. If not, the sludge would be buried with waste rock. If special handling of the sludge is required, cyanide in the sludge would be neutralized with an oxidizing agent and mixed into cement, with disposal in accordance with regulations of the Solid & Hazardous Waste Bureau. If sludge characteristics preclude in-place neutralization another method of disposal would be used which meets federal and state requirements.

Soil Stockpile Reclamation

After all necessary cover soil is distributed to the disturbed areas, the stockpile locations would be ripped and revegetated to establish vegetative communities.

Access and Haul Road Reclamation

Haulage and access roadways would be reclaimed to establish suitable drainage. Roadways would be ripped to reduce surface compaction and provide additional fill material for grading of the surface. Roadway berms and loose, unconsolidated material above and below the roadway cut would be pulled or dozed into the roadway using a dozer or backhoe. Final graded areas would be topsoiled and revegetated.

Land Application Area

Significant disturbance of land application areas is not anticipated since limited materials movement would be required. In the event of substantial vegetation loss due to the toxicity of applied solutions, the following activities would be undertaken to prevent soil erosion, minimize fire hazards, and return the loss to post-operation land use objectives:

- Cutting, stacking, and controlled burning of dead forest areas
- Temporary placement of water bars or other devices to help control soil erosion
- Improvement of the soil to a condition suitable for revegetation
- Revegetation of the area

Williams Clay Pit Reclamation

The Williams clay pit approximately 2 miles west of Landusky has provided liner material for leach pad facilities and cover layer for reclamation caps. This clay pit would be reclaimed in accordance with the permit requirements established by the DSL Open Cut Mine Bureau.

2.5.4.7 Reclamation/Post-Reclamation Water Handling and Treatment

Section 2.5.2.5 described the various water control and leachate capture systems in effect at the Zortman Mine. Many improvements and modifications were made to the Landusky water control and capture systems as a result of actions stipulated in the agencies' March, 1994 Decision Record for Acid Rock Drainage Control and Remediation (DSL/BLM 1994a). Some of the significant requirements of that decision for water control included:

- Improvements to the efficiency and size of the ARD capture and pumpback systems in Sullivan Creek and Mill Creek, including the installation of slurry cut-off walls, increased pumpback capacity, and resizing surge ponds for storm events.
- Construction of drainage or runoff control structures within the mine permit boundary to prevent storm water from contacting acid forming materials, or from disturbing reclamation efforts.
- Enhancement of the water quality monitoring, reporting, and interpretation program.
- Installation of composite covers on various facilities to limit water infiltration and contact with acid forming materials.

Other potential needs to reduce impacts to water resources, such as the use of a water treatment facility, were deferred pending development of this environmental impact statement. A summary of the actions which have been or will be taken to meet the agencies' decision follows.

Mill Gulch Dump

Drainage ditches have been constructed (10-15 feet wide, 2 feet deep, 1-3 percent grade) in 4-5 feet of capillary break material at the intersection of the benches with the repository upslope. These drainage ditches have been lined with a synthetic impermeable barrier, covered with a geotextile, and held in place with at least 6" of non-acid generating material. A synthetic impermeable barrier was also placed at the clay/capillary break interface and covered with a geotextile to serve as a substrate drain. The lateral drain on the east side of the dump was built in bedrock to handle flow velocities greater than 5 feet/sec. Bedrock drainage ditches built for velocities greater than 5 feet/sec were constructed by using drill and blast techniques to shape the channel.

Stormwater control for the Mill Gulch dump was implemented by several techniques: direct run-on is prevented; dozer basins are used to slow water and collect sediment; erosion control benches have been lined to direct runoff to main drainage diversion ditches; a 36" capillary break was placed under the cover soil to convey sub-surface water; and, revegetation will take place with a mulch and tackifier base. If erosion does occur during the first growing season of revegetation the following steps will be taken to ensure that the erosion does not reach the clay barrier: regrading of the wash, revegetation, placement of erosion control matting in the wash area, and/or straw bale placement for velocity control and sediment trap.

Gold Bug Waste Repository

Benches are placed every 100 vertical feet to keep drainage off the main repository face and control soil erosion. Benches are from 15 to 30 feet wide and sloped back into the repository at grades of 5 - 10 percent. These benches have been capped with clay or synthetic liner in a similar manner to the main portion of the repository. A drainage ditch was constructed at the intersection of the bench with upslope portion of the repository. This ditch was lined with a synthetic impermeable barrier, which is held in place with blue waste rock at least 6" in size. The drainage ditches convey runoff from the reclaimed repository and onto sideline ditches. These ditches are two feet deep and four feet wide and have grades which vary from 33 to 50 percent. The liner for these ditches is a synthetic impermeable barrier bedded upon 6" of clay to gravel sized natural material. The liner was secured in place with at least 6" blue waste material.

The drainage system for the Gold Bug waste repository is shown on Figure 2.5-6. All primary storm water drains are expected to remain functional for a number of years following completion of mining operations. Final drain designs would accommodate the 6-inch, 24-hour storm event with an additional built-in safety factor.

Drains carrying storm water are routed to dispersion points (ponds, or coarse rock filters). Mine discharges are routed to contingency ponds (500,000-1,500,000 gallon ponds with associated pumping equipment), and added to the process circuit. Most drainage channels are lined with 6 - 12 inches of compacted clay, which is overlaid with a 10 mil PVC liner, 5 ounces geotextile and a 6-12 inches of run of mine waste. An additional 20 acres of disturbance was required to upgrade existing drains.

A geotextile fabric such as Trevira 1120 would be used under rip-rap in surface water channels. The use of geotextile is preferred to a graded filter material due to ease of installation on steep slopes (as compared to placement of gravel), requires minimal soil preparation, minimizes soil erosion, has a long filter life and is resistant to creep.

2.5.4.8 Reclamation Quality Control

ZMI uses an independent consultant to monitor revegetation success. The consultant periodically checks vegetation in reclaimed areas to determine if revegetation species have taken hold at the desired density and sustainable viability. ZMI has used an outside consultant to verify clay compaction to 95 percent density using geophysical instruments. No procedures are specified in the current permit for documenting quality control of other reclamation practices.

2.5.4.9 Revegetation Procedures

Areas disturbed at the Landusky Mine are revegetated to stabilize soil and slopes, reestablish communities ecologically comparable to pre-mine conditions, and restore watershed, wildlife, recreational and aesthetic values that meet post-operation land use objectives. The Landusky revegetation procedures are essentially as those described for the Zortman Mine in Section 2.5.2.9. Tables identifying the various species mixes used on reclaimed areas at the Landusky Mine may be found in Table 3.5 in the Life-of-Mine Amendment No. 10 (February 1990). As new species are released for distribution, they are considered for inclusion in the revegetation program.

2.5.5 Monitoring Programs and Research Studies

2.5.5.1 Water Resources

Surface and groundwater monitoring programs in place at the Zortman and Landusky mines consist of (1) quarterly water resources monitoring, with data analyzed by an outside laboratory, and (2) more frequent operations monitoring, performed by ZMI employees. The primary objective of the monitoring programs is to detect any leakage from the process circuit or seepage from mine waste facilities.

The current water resources monitoring program consists of quarterly monitoring of 57 surface water and 58 groundwater stations around the mining complex (Zortman and Landusky mines). Operational water monitoring is also conducted at selected surface water and groundwater monitoring sites in the mining and ore processing areas by mine personnel on a daily, weekly, or monthly basis. Exhibits 1 and 2 show the water resources monitoring locations for the Zortman and Landusky mines, respectively.

Water Resources Monitoring

A summary of groundwater stations for Zortman and Landusky is presented in Tables 2.5-13 and 2.5-14. In 1993 the Zortman area groundwater monitoring sites included 30 monitoring wells, a community supply well (Z-8A) and an industrial water supply well (ZL-163). 1993 Landusky sites consisted of 33 groundwater monitoring stations including 29 monitoring wells, 3 private wells and 1 community supply well (TP-3).

Surface water monitoring includes spring and fall collection of water quality samples and measurements or estimates of flow for streams, springs and seeps. A total of 57 stations (30 Zortman sites, 27 Landusky sites) were included in the water resources monitoring program during 1993. Tables 2.5-15 and 2.5-16 provide a summary of surface water stations for the Zortman and Landusky areas.

Samples are collected by an outside consultant in the spring and fall, while ZMI collects winter and summer samples. All spring samples are analyzed for major cations and anions, metals, cyanide, and physical parameters ("complete" analysis). Either complete, or an abbreviated "indicator" analysis are conducted during summer, fall, and winter events. Monitoring wells along

TABLE 2.5-13

ZORTMAN GROUNDWATER MONITORING SITES[1]

Site	Site Description	Site	Site Description
AG-200	Alder Gulch above confluence with Tributary	ZL-144	Lower Ruby Gulch Monitoring Well above Zortman
AG-201	Alder Gulch above confluence with Tributary	ZL-145	Ruby Creek
AG-202	Alder Gulch below Pony Gulch	ZL-146	Ruby Creek
AG-203	Alder Gulch Bedrock Well	ZL-147	Goslin Gulch
RG-99	Ruby Gulch above Process Pond Area	ZL-148	Lower Goslin Gulch
RG-110	Ruby Gulch Alluvium	ZL-149	Lower Goslin Gulch
RG-111	Ruby Gulch Bedrock	ZL-151	Upper Goslin Gulch
ZL-8A	Zortman Services Water Assoc.	ZL-152	Upper Goslin Gulch
ZL-102	300 feet east of ponds	ZL-153	Goslin/Ruby Creek
ZL-110	Tributary of Alder Gulch	ZL-154	Goslin Gulch on terrace
ZL-134	Below 1989 Leach Pad	ZL-163	Zortman Mine supply
ZL-135	Shallow well below 1989 Leach Pad	ZL-200	Ruby Ross Pit Well
ZL-142	Lower Ruby gulch Monitoring Well above Zortman	ZL-201	Mint Pit Well
ZL-143	Lower Ruby Gulch Monitoring Well above Zortman	ZL-202	OK Pit Well
		ZL-207	OK Pit Well
		ZL-209	Glory Hole Gulch
		ZL-210	Glory Hole Gulch

[1] Exhibit 1 shows the groundwater monitoring sites around the Zortman Mine.

TABLE 2.5-14

LANDUSKY GROUNDWATER MONITORING SITES[1]

Site	Site Description	Site	Site Description
ZL-105	Tributary to Mill Gulch	ZL-133	Lower Rock Creek
ZL-108	60 ft south of Barren Pond	ZL-136	Lower Mill Gulch Monitoring Well
ZL-109	Tributary to Mill Gulch	ZL-137	Lower Mill Gulch Monitoring Well
ZL-112A	Replacement for ZL-112	ZL-138	Lower Mill Gulch Monitoring Well
ZL-113	Tributary to Montana Gulch	ZL-139	King Creek
ZL-114R	Tributary to Montana Gulch	ZL-155	Mill Gulch below Containment
ZL-115	Tributary to Montana Gulch	ZL-156	Mill Gulch below Containment
ZL-116	Tributary to Montana Gulch	ZL-157	Mill Gulch below Containment
ZL-118	20 ft NW of Barren Pond	ZL-158	Landusky Yard Well
ZL-119	Montana Gulch downstream 1985 Leach Pad Dike	ZL-159	Landusky Yard Well
		ZL-160	Landusky Yard Well
ZL-123	Montana Gulch below Containment pond south of dike	ZL-161	Landusky Yard Well
ZL-124	Montana Gulch below Containment pond south of dike	ZL-162	Montana Gulch, below pond
		TP-1	Mobile Home Well
ZL-125	Montana Gulch below Containment pond south of dike	TP-2	Landusky Private Well
ZL-131	Rock Creek below Containment Pond	TP-3	Domestic Water Supply
		TP-4	Landusky Private Well
ZL-132	Rock Creek below Containment Pond		

[1] Exhibit 2 shows the groundwater monitoring sites around the Landusky Mine.

TABLE 2.5-15

ZORTMAN SURFACE WATER MONITORING SITES[1]

Site	Site Description	Site	Site Description
Z-1	Ruby Gulch below historic mill site	Z-18	Ruby Creek Tributary
Z-1B	Ruby Gulch above town of Zortman	Z-19	Goslin Gulch
Z-2	Alder Gulch below Carter confluence	Z-20	Goslin Gulch Tributary
Z-3A	Alder Gulch above Tributary	Z-21	Goslin Gulch Spring
Z-5	Glory Hole Creek at Mouth	Z-22	Lower Goslin Gulch
Z-6	Spring in upper Lodgepole Creek	Z-27	Tributary to Beaver Creek
Z-6A	Tributary above Alder Gulch	Z-28	Tributary to Lodgepole Creek
Z-7	Lodge Pole Cr. above Reservation	Z-29	Lodgepole Creek
Z-8	Alder Gulch at former Kalal water supply intake	Z-30	Upper Lodgepole Creek
		Z-31	Beaver Creek below Tributary
Z-13	Tributary to Alder Gulch	Z-32	Ruby Creek above Goslin
Z-14	Tributary to Alder Gulch	Z-33	Spring on Lower Ruby Creek
Z-15	Ruby Gulch at Permit Boundary	Z-34	Spring on Ruby Creek Tributary
Z-16	Alder Gulch	Z-35	Dev. Spring on Goslin Gulch
Z-17	Ruby Creek below Zortman	Z-36	Section-32 Cistern
		Z-37	Pumpback System below Dike

[1] Exhibit 1 shows the surface water monitoring sites around the Zortman Mine.

TABLE 2.5-16

LANDUSKY SURFACE WATER MONITORING SITES[1]

Site	Site Description	Site	Site Description
L-1	Rock Creek at Kolczak Road	L-20	Seep above Tributary to South Big Horn Creek
L-2	Montana Gulch at County Road	L-21	Tributary to South Big Horn Creek
L-3	Gold Bug Adit Discharge	L-22	Spring in Mill Gulch above town of Landusky
L-4	Rock Creek at town of Landusky	L-23	Rock Creek above Landusky
L-5	King Creek Spring	L-27	Upper Rock Creek below Contingency Pond
L-6	King Creek at Upper Beaver Ponds	L-28	Upper Rock Creek Leach Pad Underdrain
L-7	Mill Gulch at Mouth	L-29	Tributary to Upper Rock Creek
L-8	Spring flow below Process Ponds	L-31	Gold Bug Pipeline Road at Culvert
L-9	Tributary to Mill Gulch	L-32	Gold Bug Pipeline Road at Culvert
L-11	Tributary to Montana Gulch	L-35	Mill Gulch above Contingency Pond
L-12	Tributary to Montana Gulch	L-36	Mill Gulch below Contingency Pond
L-13	Tributary to Montana Gulch	L-37	Sullivan Creek
L-14	Tributary to Montana Gulch	L-38	South Montana Gulch Waste Dump
L-16	Montana Gulch below Leach Pad Dike	L-39	Upper King Creek near Reservation Boundary
L-17	Leach Pad Underdrain		
L-19	Tributary to South Big Horn		

[1] Exhibit 2 shows the surface water monitoring sites around the Landusky Mine.

permit boundaries and below major facilities are analyzed for the complete list during all sampling events. Analyses for the "complete" tests are conducted by an outside laboratory. Quarterly data reports and an annual Water Resources Monitoring Report which include a description of sites monitored and their monitoring frequency, and chemical analyses conducted for all samples, are submitted each year to regulatory agencies. Tables 2.5-17 and 2.5-18 present the indicator and complete parameter list, analytical methods and detection levels for surface water and groundwater samples at the Zortman and Landusky mines.

TABLE 2.5-17

INDICATOR ANALYTES FOR WATER RESOURCES MONITORING

Constituent	Analytical Method	Routine Detection Limit
pH	EPA 150.1	0.1 s.u.
Specific Conductance	EPA 120.1	1 umhos/cm
Total Dissolved Solids	EPA 160.1	1 mg/l
Total Hardness ($CaCO_3$)	EPA 200.7	1 mg/l
Alkalinity ($CaCO_3$)	EPA 310.1	1 mg/l
Total Cyanide	EPA 335.3	0.005 mg/l

Operations Monitoring

Operations water resources monitoring is also conducted in the mining and ore processing areas by mine personnel on a daily, weekly or monthly basis at selected surface water and groundwater monitoring sites. Samples are analyzed for indicator parameters. Operational monitoring data summaries are submitted monthly to the BLM and DEQ by ZMI.

2.5.5.2 Reclamation Surface Performance Study

The Reclamation Surface Performance Study (RSPS) was initiated in 1993 to evaluate measures intended to improve reclamation success for the Mill Gulch waste rock dump and other facilities at the Landusky and Zortman mines. This study consists of four stages:

- Stage 1: Help Model Evaluation
- Stage 2: Preliminary Field Trials
- Stage 3: Comprehensive Field Trial
- Stage 4: Operational Monitoring

The first two stages have been implemented. Stages 3 and 4 are planned for implementation, but it is likely ZMI would not carry forward these research programs if the agencies do not approve mine expansions.

Stage 1: Help Model Evaluation

The initial stage of the program was development of repository water budgets for each of the infiltration trial surfaces using the Hydraulic Evaluation of Landfill Performance (HELP) model. Meteorological data from the Landusky meteorology station was used for model runs. Size distribution data for repository materials was obtained from completed studies on leach pad decommissioning, Zortman Mine Extension studies, and field examination. All model runs used the assumption that a synthetic liner/clay cap cover would be placed over the upper portions of the repository. Results from the HELP modelling indicated that the similarity of performance of the 3 inch, 6 inch, and 12 inch caps in compacted clay simulations suggests that quality control issues in clay liner installation would likely be more important than designed cap thickness.

Additional HELP modeling was conducted for the slope capping scenario consisting of 12 inches of compacted clay, a 36 inch capillary break, and 8 to 12 inches of cover soil. Hydraulic conductivity values for the compacted clay layer of $1x10^{-5}$, $1x10^{-6}$, and $8.5x10^{-7}$ cm/s were used in this comparative evaluation.

Stage 2: Preliminary Field Trials

Stage 2, initiated during the summer of 1994, consisted of short term field trials used to refine cover specifications prior to comprehensive field trials. These tests were conducted using bucket lysimeters which provided immediate field data on infiltration rates. Each infiltration trial was reproduced over four embedded bucket lysimeters (a total of 16 lysimeters).

Due to revisions in capping scenarios and difficulties in construction, results from the original testing program are considered invalid. However, additional short-term field trial test plots are being reconstructed to test trial covers 926, 927, 928, and 929, as shown on Table 2.5-19. These trial covers include the actual systems being installed on the Mill Gulch facility (Trial 926 and 929), as well as other similar systems.

TABLE 2.5-18

ANALYTES FOR WATER RESOURCES MONITORING[1] - COMPLETE ANALYSIS

Constituent	Analytical Method	Routine Detection Limit
TotalSuspended Solids (TSS)	EPA 160.2	1 mg/L
Total Dissolved Solids (TDS)	EPA 160.1	1 mg/L
Turbidity (NTU)	EPA 180.1	0.01 NTU
Specific Conductance (SC)	EPA 120.1	1 μmhos/cm
pH	EPA 150.1	0.1 s.u.
Flow (surface water)	N/A	N/A
Depth to water (wells)	N/A	N/A
Calcium (Ca)	EPA 215.1/200.7	1 mg/L
Magnesium (Mg)	EPA 242.1/200.7	1 mg/L
Sodium (Na)	EPA 273.1/200.7	1 mg/L
Potassium (K)	EPA 258.1/200.7	1 mg/L
Bicarbonate (HCO3)	EPA 310.1	1 mg/L
Carbonate (CO3)	EPA 310.1	1 mg/L
Chloride (Cl)	EPA 300.0	1 mg/L
Sulfate (SO4)	EPA 300.0	1 mg/L
Nitrate + Nitrite as N	EPA 353.2	0.05 mg/L
Total Hardness as CaCO3	EPA 200.7	1 mg/L
Total Alkalinity as CaCO3	EPA 310.1	1 mg/L
Acidity as CaCO3 (if pH < 6.0)	EPA 305.1	1 mg/L
Ammonia	EPA 350.1	0.1 mg/L
Total Cyanide (CN)	EPA 335.3	0.005 mg/L
Cyanide - Weak Acid Dissociable Cyanide (WAD)	ASTM D2036	0.005 mg/L
Free Cyanide	Electrode	0.2 mg/L
Aluminum (Al)	EPA 202.1/200.7	0.1 mg/L
Arsenic (As)	EPA 206.2	0.005 mg/L
Cadmium (Cd)	EPA 213.1/200.7	0.001 mg/L
Copper (Cu)	EPA 220.1/200.7	0.01 mg/L
Chromium (Cr)	EPA 218.1/200.7	0.01 mg/L
Iron (Fe)	EPA 236.1/200.7	0.03 mg/L
Manganese (Mn)	EPA 243.1/200.7	0.01 mg/L
Lead (Pb)	EPA 239.2/200.7	0.01 mg/L
Mercury (Hg)	EPA 245.2	0.001 mg/L
Nickel (Ni)	EPA 249.1/200.7	0.01 mg/L
Selenium (Se)	EPA 270.3	0.005 mg/L
Silver (Ag)	EPA 272.2/200.7	0.005 mg/L
Zinc (Zn)	EPA 289.1/200.7	0.01 mg/L

1 Flow, total suspended solids (TSS) and turbidity omitted for groundwater. All metals analyzed as dissolved in groundwater; as total recoverable in surface water. If total cyanide is not above detection limit then WAD cyanide and free cyanide are not tested.

TABLE 2.5-19

SHORT-TERM RECLAMATION TRIAL COVERS

Trial Cover	Substrate	Barrier	Capillary Break	Top Cover
Trial 926	yellow waste	12 inches clay	36 inches blue waste	12 inches coversoil
Trial 927	yellow waste	12 inches soil	36 inches blue waste	12 inches coversoil
Trial 928	yellow waste	6 in. lime/ limestone	36 inches blue waste	12 inches coversoil
Trial 929	yellow waste	3 in. clay/ 20 mil PVC liner	36 inches blue waste	12 inches coversoil

Stage 3: Comprehensive Field Trial

Stage 3 of the RSPS involves evaluating long-term field trials of reclamation covers by *in situ* monitoring. Stage 3 will evaluate three monitoring locations on two surface covers (926 on waste repository slopes and 929 on the facility top). Monitoring locations include the waste repository top, mid-slope and lower slope. Each site will be instrumented with devices to determine internal water content and flux, temperature, pore gas concentrations, and pore water chemistry.

Several sampling events will be conducted following completions of monitoring site installations. Following the initial calibration period, sampling will be conducted on a quarterly basis. Stage 3 sampling events will likely be conducted during January, April, July, and October. ZMI may implement additional field trials in the future to evaluate alternative reclamation covers or techniques.

Stage 4: Operational Monitoring

Stage 4 involves operational monitoring of overall effectiveness of reclamation on the Mill Gulch waste repository. Routine monitoring will be conducted at instrumented sites over the long-term to assess conditions and changes in water content, internal temperatures and pore gas chemistry. These parameters will be used to evaluate the overall efficiency of the cover system in limiting infiltration and associated oxidation reactions. The major focus of Stage 4 will be identification of long-term trends in these key parameters.

Evaluations will be conducted on vegetation and storm water control performance. Vegetative performance will be evaluated biannually by measurement of canopy coverage. Storm water control and associated erosion will be evaluated by visual inspection.

2.5.5.3 Surface Reclamation Monitoring

At present, reclamation success is qualitatively evaluated with results included in the annual Operating Report submitted to the agencies. Vegetation monitoring studies including test plot studies were conducted in 1988, 1989, 1990, and 1992, and are scheduled for 1995. Zortman intends to initiate biannual vegetation monitoring that would focus on canopy coverage.

2.5.5.4 Air Quality Monitoring

Air quality monitoring and meteorologic data collection for the Zortman and Landusky mining area was initiated in March, 1990. James Gelhaus, Consulting Meteorologist has been responsible for air quality monitoring since initiation of the program.

Ten stations have been established. The station number, elevation, location and a list of parameters monitored are presented in Table 2.5-20. ZMI temporarily decommissioned sites 7, 8, 9, and 10, which were installed to gather baseline data for the extension project, at the end of 1994.

PM-10 sampling is conducted on a winter and summer schedule. Winter samples (November through April) are collected weekly and summer samples (May through October) are collected twice per week. Sites with weather stations (3, 4; when operating also 7, 8, 9, and 10) contain continuous recorders for listed parameters and are downloaded monthly using an electronic data logger. Annual air quality monitoring reports are required to be submitted to the DEQ and BLM.

2.5.5.5 Wildlife Monitoring

Wildlife mortality monitoring is conducted at both the Zortman and Landusky mines. The report does not include mortality information on insects, rodents, or reptiles. Mine personnel conduct weekly inspections of process pond nets and monthly random inspections of minesite and boundary fences. A monthly report for each mine site is submitted to the DEQ and the BLM. These reports contain information on wildlife mortality (if any) during that month, including species identification, number, location, suspected cause of death, and future preventative actions.

2.5.6 Reasonably Foreseeable Future Actions

2.5.6.1 Zortman Mine Activities

While there would be no mine expansion or enhanced reclamation activities, it is reasonable to anticipate future requests for actions needed to improve ARD capture and treatment. Since this alternative does not emphasize ARD source control, construction of permanent ARD capture and treatment facilities are foreseeable.

2.5.6.2 Landusky Mine Activities

Foreseeable actions would be the same as described above for the Zortman Mine.

TABLE 2.5-20

AIR QUALITY AND METEOROLOGICAL MONITORING SITES

Site	Elevation	Location	Parameters Monitored
1	3837	Kolczak Ranch, southwest of Landusky Mine	PM-10 suspended particulates
2	4000	town of Landusky	PM-10 suspended particulates
3	5160	downwind of the Landusky Mine at Gold Bug Butte	Wind Speed, Wind Direction, Wind Sigma, Temperature, Relative Humidity, PM-10 suspended particulates (2), Precipitation
4	5084	Zortman Mine boneyard, west of 84 pad	Wind Speed, Wind Direction, Wind Sigma, Temperature, Relative Humidity
5	4000	town of Zortman	PM-10 suspended particulates
6	4000	downwind of the Zortman Mine southeast of the Zortman school	PM-10 suspended particulates
7	3680	7-mile station, east of the main road to Zortman (decommissioned, 12/94)	Wind Speed, Wind Direction, Wind Sigma, Temperature, Relative Humidity, PM-10 suspended particulates, Precipitation
8	3640	east of Zortman in Beaver Creek (decommissioned, 12/94)	Wind Speed, Wind Direction, Wind Sigma, Temperature, Relative Humidity, PM-10 suspended particulates
9	3400	Lodge Pole (decommissioned, 12/94)	Wind Speed, Wind Direction, Wind Sigma, Temperature, PM-10 suspended particulates
10	3560	Hayes (decommissioned, 12/94)	Wind Speed, Wind Direction, Wind Sigma, Temperature, Relative Humidity, PM-10 suspended particulates

2.5.6.3 Exploration Activities

While this alternative does not preclude future proposals for exploration activities, none are anticipated. Since this alternative would not provide for the mining of already delineated ore reserves, the incentive to explore for additional reserves would be very low.

2.6 ALTERNATIVE 2: MINE EXPANSIONS NOT APPROVED AND COMPANY PROPOSED RECLAMATION

This alternative would not approve additional mining at the Zortman and Landusky mines, but allows those mine activities already permitted, such as ore leaching and rinsing to continue. The difference from the No Action Alternative is that this alternative includes modification of the procedures to be used in reclamation at the two mines. The major reclamation modifications are summarized in Section 2.3 and the Executive Summary. Chapter 4.0 of this Draft EIS presents an evaluation of the environmental impacts projected to occur using the revised reclamation procedures proposed by ZMI for the two mines.

Field inspections of both mines, and reviews of water quality monitoring, provided data that ZMI's operating and reclamation plans were not providing sufficient environmental protection at both mines. In response to agency directives, this alternative was proposed by ZMI in recognition that many of the reclamation procedures which have been used at the Zortman and Landusky mines have not adequately protected environmental resources, particularly groundwater and surface water systems. ZMI submitted a plan to the agencies in January, 1994, which contained the revised reclamation procedures presented in this alternative (ZMI 1994a). ZMI has proposed the same revised reclamation procedures for the Landusky Mine as are described for the Zortman Mine.

Under this alternative, there would not be additional mining and quantities of the non-acid generating waste rock used in Reclamation Covers B and C may be limited. This alternative limits the reclamation requirements and cover capabilities to materials such as cover soils and clay which are available in sufficient quantities without further mining of ore and waste rock at the mines.

This alternative is presented in six sections:

- Sections 2.6.1 and 2.6.3 describe the mine operations at the Zortman and Landusky mines. However, since mining under this alternative would not differ from the mining presented in Alternative 1 (see Sections 2.5.1 and 2.5.3), the description is limited to a summary of permitted mining operations.
- Sections 2.6.2 and 2.6.4 describe the reclamation activities required under this alternative for the Zortman and Landusky mines, with emphasis on those reclamation procedures which are modified from the currently permitted procedures.
- Section 2.6.5 describes the monitoring programs in place at the two mines.
- Section 2.6.6 presents the agencies' evaluation of reasonably foreseeable future activities.

For reference, Figure 2.5-1 shows the current permit boundaries and facilities for both mines.

2.6.1 Zortman Mine: Mine Expansion Not Approved

This alternative would not approve plans for further mining at the Zortman Mine beyond that already authorized under the existing permit. Section 2.5.1 provides a complete description of the currently permitted mining activities, which are summarized below.

No ore has been mined at the Zortman Mine since 1990, and this alternative would not approve further mining. Ore which has already been loaded or is scheduled to be loaded on the 89 heap would be leached to extract gold and silver from the rock matrix. The leaching solution would be stored in the pregnant solution holding pond until it is run through the process plant to remove the metals from solution. Spent or barren solution would continue to be recycled for later used in ore heap leaching after the addition of cyanide. Rinsing of the 84, 85/86, and 89 (after leaching is completed) pads would continue until cyanide concentrations in monitoring locations fall below 0.22 WAD cyanide for a six month period. Final rinsing solution would be disposed at the Goslin Flats land application area.

The water capture systems at Ruby Gulch, Alder Spur, and Carter Gulch below the Alder Gulch waste rock dump would continue to operate indefinitely. Captured water which requires treatment is routed to the Zortman Mine water treatment plant prior to discharge in Ruby Gulch. The water treatment plant would operate as long as captured water requires treatment to meet final discharge standards imposed by the DEQ Water Quality Division.

2.6.2 Zortman Mine: Company Proposed Reclamation

The procedures outlined in this alternative were proposed by ZMI in January, 1994, in response to requirements by the agencies to modify the reclamation plans for the Zortman Mine to address the existing ARD data (ZMI 1994a). The primary objective of the modifications to reclamation procedures proposed by ZMI is to mitigate environmental problems at the mine without relying on additional ore or waste rock mining.

2.6.2.1 Reclamation Materials

The primary reclamation materials to be used under this alternative are cover soil and clay. Cover soil would be placed on those areas which are determined, by testing, to not have a high potential to generate acidic conditions. Clay materials would be used to cap those areas that tests have determined are capable of producing acidic conditions.

Cover Soil

A layer of cover soil approximately 8 inches thick would be placed on all disturbed areas prior to seeding and planting of shrubs and trees. Sufficient soil to cover all disturbances with about 4 inches of soil would be obtained from one of three stockpiles: the 82 leach pad site, the South Ruby Saddle stockpile, or the North Ruby Saddle stockpile. Approximate volumes of soil available at these stockpiles were shown on Table 2.5-5. Additional soil would be obtained from Landusky Mine soil stockpiles. Other materials used in reclamation include unconsolidated rock, scree and soil above and below roadway cuts, which are incorporated into the regrading of haul and access roads.

Clay

Clay would be required for use in those areas where testing determines that sulfur minerals could create acidic conditions. This clay would be mined from the Seaford clay pit approximately 7 miles south of Zortman. Figure 2.6-1 illustrates Reclamation Cover A.

2.6.2.2 Reclamation Testing and Covers

All mine disturbance areas would be tested, on 100 foot centers, to determine the potential for the subsurface to generate acidic conditions. The determination of whether materials would have the potential to generate acidic conditions would be based on sulfur concentrations. Those disturbed areas which have total sulfur concentrations greater than 0.5 percent would be capped with Reclamation Cover A, which consists of 6 inches of clay overlain by 8 inches of cover soil. The testing program and reapplication of covers would also apply to disturbances such as the 79 and 80/81 leach pads which have been reclaimed.

Those disturbance areas which have sulfur concentrations of 0.5 percent or less would be reclaimed with 8 inches of cover soil, as described in Alternative 1.

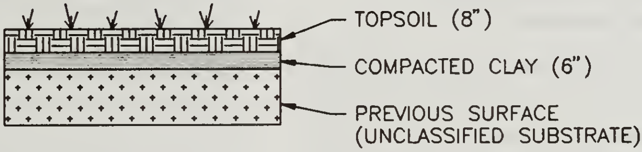
2.6.2.3 Mine Pit Reclamation

Overall slope of the final pit walls would be as described in Alternative 1. Pits walls would be approximately 45 degrees (1H:1V) with 30-foot wide flat benches every 60 vertical feet. Pit floors would be sloped and graded to facilitate drainage and alleviate the accumulation of stagnant water.

ZMI would place 2 feet of non-acid generating material on the floor of the mine pit complex. This action would be conducted to meet the pit reclamation requirements of the Montana Metal Mine Reclamation Act. This material would be covered with 6 inches of compacted clay, topped off with 8 inches of cover soil. The surface would then be revegetated in accordance with the procedures described in Section 2.5.2.9. Figure 2.6-1 illustrates the reclamation cover to be used on pit floors under this alternative.

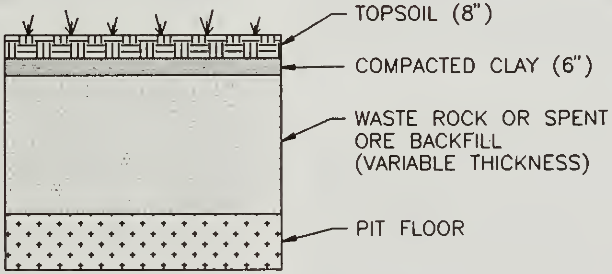
2.6.2.4 Leach Pad Reclamation

Tasks associated with reclamation of the heap leach facilities include slope reduction to at least 2H:1V; heap detoxification to reduce cyanide concentrations in the pad to acceptable levels; liner perforation to allow the pads to drain freely into the subsurface; and surface reclamation including geochemical testing, surface preparation, cover placement, and revegetation. as described in Alternative 1. Geochemical testing as described in Section 2.6.2.2 would be conducted on leach pad facilities. Those areas which have sulfur concentrations greater than 0.5 percent would be capped



WASTE ROCK AND HEAP LEACH FACILITIES COVER

SCALE: 1"=4'



PIT FLOOR COVER

SCALE: 1"=4'

SOURCE: ZORTMAN MINING INC., 9/94

ZORTMAN MINE
RECLAMATION COVER A
ALTERNATIVE 2

FIG. 2.6–1

with Reclamation Cover A. Section 2.5.2.4 provides complete information on the heap leach pad reclamation procedures, and a current status summary for each of the Zortman Mine heap leach pads.

2.6.2.5 Waste Rock Dump Reclamation

The additional procedures for reclamation of waste rock dumps would be to test the disturbance areas as described in Section 2.6.2.2. Those areas which have sulfur concentrations greater than 0.5 percent would be capped using Reclamation Cover A. Current status of the waste rock dumps was described in Section 2.5.2.5.

2.6.2.6 Support Facilities Reclamation

Reclamation of support facilities would not change from that described in Section 2.5.2.6. Final reclamation would include the removal of all structures and equipment used in the mining and processing of ore through heap leach operations. All cement structure footings and pads would be removed and used to help backfill depressions or openings such as ponds, or would be disposed appropriately as solid waste. The footprint of removed facilities would be covered with 8 inches of cover soil and revegetated.

Solution/Process Pond Reclamation

Reclamation of solution and process ponds would not differ from that described in Alternative 1 (Section 2.5.2.6). Ponds would be perforated, backfilled, and graded prior to final reclamation. Pond backfill would include fill material from waste rock operations and/or cement materials from structure footings or pads. After backfill, the ponds would be graded, covered with 8 inches of cover soil, and revegetated. Sludges remaining in the ponds at the end of mining would be sampled for toxics and neutralized, if necessary, then disposed appropriately.

Soil Stockpile Reclamation

Based on the estimated amount available in stockpiles at both mines, a layer of cover soil approximately 8.4 inches thick could be used on all disturbed areas at the Zortman Mine. ZMI has estimated that if cover soil is only available from the Zortman stockpiles, the soil layer could only be 4 inches thick. Cover soil would either be placed directly on graded areas prior to revegetation, or spread over the clay cap in areas with potentially acid generating material. Therefore, cover soil stockpiles should be almost completely depleted by the time surface reclamation activities are finished. After all necessary cover soil is distributed to the disturbed areas, the stockpile footprint would be ripped (if necessary) and revegetated.

Access and Haul Road Reclamation

Haulage and access roadways would be reclaimed to establish suitable drainage. Roadways would be ripped to reduce surface compaction and provide additional fill material for grading of the surface. Haul roads would be tested to determine acid generation potential and covered with clay, if necessary. Roadway berms and loose, unconsolidated material above and below the roadway cut would be pulled or dozed into the roadway using a dozer or backhoe. Final graded areas would be cover soiled and revegetated.

Land Application Area

Reclamation of land application areas would not differ from Alternative 1, as described in Section 2.5.2.6.

Limestone Quarry Reclamation

Reclamation of the limestone quarry would not differ from Alternative 1, as described in Section 2.5.2.6.

Seaford Clay Pit Reclamation

The Seaford clay pit (shown earlier on Figure 2.5-2) has provided liner material for leach pad facilities at the Zortman Mine. Under this alternative, the clay pit would also provide capping materials over those areas containing sulfur concentrations greater than 0.5 percent, which are assumed to be acid generating. Approximately 3 additional acres would be disturbed in the clay pit to obtain the needed quantity of reclamation materials. The clay pit has been reclaimed in accordance with the permit requirements established by the DSL Open Cut Mine Bureau (now, part of DEQ). Additional disturbance would require compliance with reclamation requirements of the Open Cut Act.

2.6.2.7 Reclamation/Post-Reclamation Water Handling and Treatment

Section 2.5.1.6 described the various water and leachate capture systems, and the water treatment activities currently in effect at the Zortman Mine, including operation of a water treatment plant in accordance with the June, 1994 Administrative Compliance Order. Under this alternative ZMI would capture and treat seepage and degraded waters according to the Water Quality Improvement Plan (see Appendix A). The expected long-term reclamation requirement under this alternative is for perpetual collection of mine waters, treatment to acceptable effluent standards, and discharge of the treated waters into surface drainages. The water capture, handling, and treatment requirements under Alternative 2 would be as described for Alternative 1, with the following exceptions:

- Existing captures systems would be maintained, and where necessary expanded, to ensure capacity to contain seepage from a 2.5-inch, 24-hour storm event.

- Captured water not returned to the process circuits would be pumped to the water treatment plant storage pond(s) rather than the leach pads.

- Water treatment would continue to operate to meet and maintain water protection objectives.

2.6.2.8 Reclamation Quality Control

Reclamation quality control procedures are not expected to vary from current requirements, although no procedures are specified in the current permit for documenting quality control of reclamation practices. ZMI has used a third-party contractor to perform moisture and density testing of clay covers during installation. Mine personnel periodically drill through the cover to check that minimum thickness is met. Additional clay is added and compacted where needed to maintain thickness. Drill holes are filled with bentonite. Only a visual assessment of cover efficacy is made on pit bench reclamation. ZMI has prepared a QA/QC Program Implementation plan for all new reclamation projects.

ZMI uses an independent consultant to monitor revegetation success. The consultant periodically checks vegetation in reclaimed areas to determine if revegetation species have taken hold at the desired density and sustainable viability.

2.6.2.9 Revegetation Procedures

Revegetation procedures for this alternative would not be different from those presented in Alternative 1, Section 2.5.2.9. Areas disturbed at the Zortman Mine would be revegetated to stabilize soil and slopes, reestablish communities ecologically comparable to pre-mine conditions, and restore watershed, wildlife, recreational and aesthetic values that meet post-operation land use objectives.

2.6.3 Landusky Mine: Mine Expansion Not Approved

This alternative does not approve further mining at the Landusky Mine beyond that already authorized. Section 2.5.3 provides a complete description of the currently permitted mining activities, which are summarized below.

Mining operations are still taking place at the Landusky Mine. Ore-bearing rock is blasted from the Queen Rose, Little Ben, and South Gold Bug pits and loaded on to the 87/91 heap leach pad for processing. Waste rock generated from the pit is being deposited into the Gold Bug and Queen Rose waste rock repositories in accordance with the waste characterization and handling plan described in Section 2.5.3.1. Ore is loaded onto the 87/91 pad and a cyanide solution is used to extract gold and silver from the rock matrix. The pregnant solution is collected from the bottom of the heap and pumped to a solution storage pond. From there the pregnant solution is processed using Merrill Crowe or carbon adsorption methods to remove dissolved metals from the solution. The gold and silver is collected, refined into dore, and shipped from the mine to another refinery for further processing. The spent cyanide solution is pumped to a barren pond to be reused in the ore leaching circuit.

Ore leaching is still occurring on the 85/86, 87, 91 and 87/91 leach pads, but the only pads still being loaded are the 91 and 87/91. The 80/81/82, 83, and 84 pads are still being rinsed and will continue until cyanide concentrations in monitoring locations fall below 0.22 WAD cyanide for a six month period. Final rinsing solution is to be disposed at the land application area on Gold Bug Butte.

The water capture systems in the Sullivan Park, Mill Gulch, and Montana Gulch drainages would continue to operate until effluent levels meet the approved State discharge standards. Captured water from these systems is either used as makeup water for the leach pads, or aerated to precipitate metals and discharged. Final surface water control systems have been installed at the Mill Gulch waste rock dump and Gold Bug waste rock repository to control stormwater and capture acid rock drainage. These systems are designed to handle a 6-inch, 24-hour storm event. Other surface water control systems to capture and route stormwater or ARD are interim, designed to handle a 2.5-inch, 24-hour storm event. All reclamation activities would be conducted in accordance with the Water Quality Improvement Plan (see Appendix A).

2.6.4 Landusky Mine: Company Proposed Reclamation

The procedures outlined in this alternative were proposed by ZMI in late 1994, in response to requirements of the agencies to modify reclamation plans for the Landusky Mine to address existing ARD problems. The primary objective of the request and response by ZMI was to develop modifications to reclamation procedures which, when implemented, would help to mitigate environmental problems at the mine. As a result of BLM and DEQ analysis, approval of final reclamation standards for the Landusky Mine were deferred pending completion of this EIS (DSL/BLM 1994a). In the interim, ZMI has undertaken some actions to correct environmental problems at the Landusky Mine. Composite, RCRA-type covers have been placed on the Mill Gulch waste rock dump and Gold Bug waste rock repository. Modifications have been made to upgrade surface water capture systems. This alternative describes those additional actions ZMI would undertake to enhance the potential for reclamation success. Reclamation under this alternative relies more on long-term water control and treatment, as opposed to source control.

2.6.4.1 Reclamation Materials

The primary reclamation materials to be used under this alternative are similar to those described in Section 2.5.4.1. Cover soil from existing stockpiles would be placed on those areas which are determined, by testing, not to have a high potential to generate acid conditions. Approximate volumes of available cover soil are shown on Table 2.5-11. Clay materials from the Williams clay pit west of Landusky would be used to cap those areas determined by testing to be capable of producing acidic conditions. The clay is also used in the composite caps on the Mill Gulch waste rock dump, the 91 leach pad dike, and on the Gold Bug waste rock repository.

Dolomite and limestone from outcrops within the mine permit area have most recently been used to provide a 3-foot buffering liner across the floor of the 4,640 bench in the Gold Bug waste rock repository. Non-acid forming waste rock from existing stockpiles have been used as an interim cap on the Mill Gulch waste rock dump and in the Gold Bug waste rock repository, and as a cap on the 91 heap leach pad dike. These interim caps would be left as permanent covers under this alternative.

2.6.4.2 Reclamation Testing and Covers

All mine disturbance areas would be tested, on 100 foot centers, to determine the potential for the subsurface to generate acidic conditions. The determination of whether materials would have the potential to generate acidic conditions would be based on sulfur concentrations. Those disturbed areas which have sulfur concentrations greater than 0.5 percent would be capped with Reclamation Cover A (6 inches of clay overlain by 8 inches of cover soil). The testing program and reapplication of covers would also apply to disturbances such as the 79 leach pad which have reclaimed surfaces. The interim covers already placed on the Mill Gulch waste rock dump, 91 leach pad dike, and Gold Bug waste rock repository would remain as permanent caps (see Figure 2.5-7).

Those disturbance areas which have sulfur concentrations of 0.5 percent or less would be reclaimed with 8 inches of cover soil, as described in Alternative 1.

2.6.4.3 Mine Pit Reclamation

Overall slope of the final pit walls would be as described in Alternative 1. Pit walls would be approximately 45 degrees (1H:1V) with 30-foot flat benches every 60 vertical feet. Pit floors would be sloped and graded to facilitate drainage and alleviate the accumulation of stagnant waters. Drainage would flow toward the August adit with runoff discharging beneath the Montana Gulch waste rock dump. Where possible, pit floors would be cover soiled and revegetated concurrent with mining operations, using trees to the extent possible to reduce visual impact. The Gold Bug and Queen Rose pits are being filled with waste rock. Reclamation of these facilities is discussed in Section 2.6.4.5.

2.6.4.4 Leach Pad Reclamation

Tasks associated with reclamation of the heap leach facilities include regrading slopes to a minimum 2H:1V; heap detoxification to reduce cyanide concentrations in the pad to acceptable levels; liner perforation to allow the pads to drain freely into the subsurface; and surface reclamation including geochemical testing, surface preparation, cover placement, and revegetation, as described in Alternative 1. The testing and cover modifications from Alternative 1 are applied to surface reclamation. Geochemical testing as described in Section 2.6.4.2 would be conducted on leach pad facilities. Those areas which have sulfur concentrations greater than 0.5 percent would be capped using Reclamation Cover A. This cover would prevent acidic materials from contracting the cover soil and inhibiting vegetative cover. The current status of heap leach pads at the Landusky Mine was also described in Section 2.5.4.4, and summarized on Table 2.5-8.

2.6.4.5 Waste Rock Dump Reclamation

Reclamation requirements for the waste rock dumps would be similar to that described in Section 2.5.4.5, except that geochemical testing would be required on all disturbance areas. Those disturbances with sulfur concentrations greater than 0.5 percent would be capped using Reclamation Cover A to prevent acidic materials from contacting cover soil and inhibiting vegetative cover. Waste rock dumps are to be reduced to a final overall slope of 2H:1V. The reclamation cover on the Mill Gulch waste rock dump and Gold Bug waste rock repository would remain as a permanent cap and surface geochemical testing would not be required. The disturbance area and reclamation status for each waste rock facility was shown on Table 2.5-10.

2.6.4.6 Support Facilities Reclamation

Reclamation of support facilities would not change from that described in Section 2.5.4.6. Final reclamation would include the removal of all structures and equipment used in the mining and processing of ore through heap leach operations. All cement structure footings and pads would be removed and used to help backfill depressions or openings such as ponds, or would be disposed appropriately as solid waste. The footprint of removed facilities would be covered with 8 inches of soil and revegetated.

Solution/Process Pond Reclamation

Reclamation of solution and process ponds would not differ from that described in Alternative 1 (Section 2.5.4.6). Ponds would be perforated, backfilled, and graded prior to final reclamation. Pond backfill would include fill material from waste rock operations and/or cement materials from structure footings or pads. After backfill, the ponds would be graded, covered with 8 inches of cover soil, and revegetated. Sludges remaining in the ponds at the end of mining would be sampled for toxics and neutralized, if necessary, then disposed appropriately.

Soil Stockpile Reclamation

Based on the estimated amount available in stockpiles, sufficient cover soil exist at the Landusky Mine to be used in surface reclamation of all facilities. Cover soil would either be placed directly on graded areas prior to revegetation, and spread on top of the clay cap where potentially acid generating material is to be capped. After all necessary cover soil is distributed to the disturbed areas, the stockpile locations would be ripped (if necessary) and revegetated.

Access and Haul Road Reclamation

Haulage and access roadways would be reclaimed to establish suitable drainage. Roadways would be ripped to reduce surface compaction and provide additional fill material for grading of the surface. Haul roads would be tested to determine acid generation potential and covered with clay, if necessary. Roadway berms and loose, unconsolidated material above and below the roadway cut would be pulled or dozed into the roadway using a dozer or backhoe. Final graded areas would be cover soiled and revegetated.

Land Application Area

Reclamation of land application areas would not differ from Alternative 1, as described in Section 2.5.4.6.

Williams Clay Pit Reclamation

The Williams clay pit (shown earlier on Figure 2.5-2) has provided liner material for leach pad facilities and cover material for composite caps at the Landusky Mine. Under this alternative the clay pit would also provide capping materials for those areas containing sulfur concentrations greater than 0.5 percent, which are assumed to be acid generating. Approximately 9 additional acres would be disturbed in the clay pit to obtain the needed quantity of reclamation materials. The clay pit would require reclamation in accordance with permit conditions of the DEQ.

2.6.4.7 Reclamation/Post-Reclamation Water Handling and Treatment

Section 2.5.3.6 described the various water control and leachate capture systems in effect at the Landusky Mine. That section also summarized the improvements and modifications made to the Landusky water control and capture systems as a result of actions stipulated in the agencies' March, 1994 Decision Record for Acid Rock

Drainage Control and Remediation (DSL/BLM 1994a). Under this alternative ZMI would be required to capture and treat seepage and degraded waters according to the Water Quality Improvement Plan (see Appendix A). The expected long-term reclamation requirement under this alternative is for long-term collection of mine waters, active or passive treatment to reach acceptable effluent standards, and discharge of the treated waters into surface drainages. The water capture, handling, and treatment requirements under Alternative 2 would be as described for Alternative 1.

2.6.4.8 Reclamation Quality Control

Reclamation quality control procedures are not expected to vary from current requirements, although no procedures are specified in the current permit for documenting quality control of reclamation practices. ZMI has used a third-party contractor to perform moisture and density testing of clay covers during installation. Mine personnel periodically drill through the cover to check that minimum thickness is met. Additional clay is added and compacted where needed to maintain thickness. Drill holes are filled with bentonite. Only a visual assessment of cover efficacy is made on pit bench reclamation. ZMI has prepared a QA/QC Program Implementation plan for all new reclamation projects.

ZMI uses an independent consultant to monitor revegetation success. The consultant periodically checks vegetation in reclaimed areas to determine if revegetation species have taken hold at the desired density and sustainable viability.

2.6.4.9 Revegetation Procedures

Revegetation procedures for this alternative would not be expected to differ from those presented in Alternative 1, Section 2.5.4.9. Areas disturbed at the Landusky Mine are and would be revegetated to stabilize soil and slopes, reestablish communities ecologically comparable to pre-mine conditions, and restore watershed, wildlife, recreational and aesthetic values that meet post-operation land use objectives.

2.6.5 Monitoring Programs and Research Studies

Monitoring programs and research studies already in place or required under the Zortman and Landusky mines operating permits would not be substantively affected by this alternative. Therefore, the description of monitoring programs and research studies provided in Section 2.5.5 is applicable to this alternative. Potential changes or modifications to those programs are briefly presented in the following sections.

2.6.5.1 Water Resources

The monitoring program for groundwater and surface water would continue as described in Section 2.5.5.1. The only modification anticipated would be the relocation of some monitoring wells or surface water monitoring sites as a result of actions taken to reduce heap leach facility slopes.

2.6.5.2 Reclamation Surface Performance Study

No changes are anticipated to the reclamation surface performance study as a result of implementation of this alternative. It is assumed that Stages 3 and 4 of the RSPS would not be carried forward, for the reasons described in Section 2.5.5.2.

2.6.5.3 Other Monitoring Programs

No changes are anticipated to the remainder of the monitoring programs from the descriptions provided in Section 2.5.5.

2.6.6 Reasonably Foreseeable Future Actions

2.6.6.1 Mine Activities

Opportunities for future mining would be as described for Alternative 1 in Section 2.5.6. While this alternative does not preclude proposals for additional mining at either the Landusky or Zortman mines, none are foreseeable.

2.6.6.2 Exploration Activities

While this alternative does not preclude future proposals for exploration activities, none are anticipated. Since this alternative would not provide for the mining of already delineated ore reserves, the incentive to explore for additional reserves would be very low.

2.7 ALTERNATIVE 3: MINE EXPANSIONS NOT APPROVED AND AGENCY MITIGATED RECLAMATION

This alternative would not approve expansion of the Zortman and Landusky mines, but allows those mine activities already permitted, such as ore leaching and rinsing, to continue. The difference from the No Action Alternative is that this alternative includes modifications to the currently approved reclamation procedures at the two mines. Chapter 4.0 of this Draft EIS presents an evaluation of the environmental impacts projected to occur using the Agency mitigated reclamation procedures at the two mines.

The agencies developed this alternative because of the recognition that the reclamation procedures proposed by ZMI in Alternative 2 may not adequately address the potential impacts of ARD emanating from some mine facilities. The agencies believe additional measures would be needed to adequately protect the environment and reclaim the land for post-mining uses.

The emphasis of this alternative, as opposed to the previous "No Expansion" alternatives, is on source control. Many of the reclamation mitigations in this alternative are designed to prevent water contamination by reducing or eliminating contact between water and those waste materials which may react to cause acidic drainage. However, this alternative would not alter corrective measures for water quality improvement which may be imposed under a Water Quality Improvement Plan (see Appendix A).

An important consideration of this alternative, even more so than Alternative 2, is that the quantity and availability of suitable reclamation materials may be limited since no further mining would occur to generate non-acid generating waste rock. For example, non-acid generating waste rock is a significant component of the capillary break in reclamation covers B and C (See Figure 2.5-7), which would be placed on most disturbed areas. However, without expansion approval there may be insufficient waste rock of this type available at the mines to construct the caps. As a result, suitable reclamation materials would have to be generated from off-site sources and transported to the mines. The agencies would stipulate that maximum use be made of materials available at the two mines, but it is anticipated that supplemental reclamation materials would have to be imported.

This alternative is presented in six sections:

- Sections 2.7.1 and 2.7.3 describe the mine operations at the Zortman and Landusky mines. However, since mining under this alternative would not differ from the mining presented in Alternative 1 (see Sections 2.5.1 and 2.5.3), the description is limited to a summary of permitted mining operations.

- Sections 2.7.2 and 2.7.4 describe the reclamation activities required under this alternative for the Zortman and Landusky mines, with emphasis on the agencies' mitigated reclamation procedures and modifications from currently permitted practices.

- Section 2.7.5 describes the monitoring programs in place at the two mines.

- Section 2.7.6 presents the agencies' evaluation of reasonably foreseeable future activities.

2.7.1 Zortman Mine: Mine Expansion Not Approved

This alternative would not approve plans for further mining at the Zortman Mine beyond that already authorized under the existing permit. Section 2.5.1 provides a complete description of the currently permitted mining activities, which are summarized below.

No ore has been mined at the Zortman Mine since 1990, and this alternative would not approve further mining. Ore which has already been loaded or is scheduled to be loaded on the 89 heap would be leached to extract gold and silver from the rock matrix. The leaching solution would be stored in the pregnant solution holding pond until it is run through the process plant to remove the metals from solution. Spent or barren solution would continue to be recycled for later used in ore heap leaching after the addition of cyanide. Rinsing of the 84, 85/86, and 89 (after leaching is completed) pads would continue until cyanide concentrations in monitoring locations fall below 0.22 mg/l WAD cyanide for a six month period. Final rinsing solution would be disposed at the Goslin Flats land application area.

The water capture systems at Ruby Gulch, Alder Spur, and Carter Gulch below the Alder Gulch waste rock dump would continue to operate indefinitely. Captured water which requires treatment is routed to the Zortman Mine water treatment plant prior to discharge in Ruby Gulch. The water treatment plant would operate as long as captured water requires treatment to meet final discharge standards imposed by the DEQ Water Quality Division.

2.7.2 Zortman Mine: Agency Mitigated Reclamation

The agencies have developed modifications to ZMI's proposed Zortman reclamation plan, presented in Alternative 2, which would: 1) reduce infiltration into areas with the potential to cause acidic drainage, 2) remove waste rock dumps and other sources currently causing degradation of surface water or groundwater, and 3) implement the Water Quality Improvement Plan to further mitigate effects of ARD should reclamation procedures fail to adequately protect environmental resources. The major reclamation modifications are summarized below.

- Reclamation Cover C would be modified to include 6 inches of compacted clay (as opposed to 3 inches of compacted clay) between the bottom substrate and the PVC liner. The PVC liner thickness would be increased to 30 mil. For the purpose of discussion in this and future alternatives, this cover will be known as "Modified Reclamation Cover C."

- With the exception of the 89 leach pad dike, all facilities not used as pit backfill are assumed to be potentially acid generating and require re-reclamation using Reclamation Covers B or Modified C. Cover soil on the facilities would be removed, stockpiled, and reused. The 89 leach pad dike would be tested for sulfur content as described in Section 2.8.2.2, and re-reclaimed if sulfur exceeds 0.2% in more than 10% of the material tested.

- With the exception of leach pad dikes, existing facilities would be reclaimed to a 3H:1V slope with constructed benches every 200 feet of slope length. In order to achieve the slope reductions while minimizing additional land disturbance, some material may have to be off-loaded from existing facilities and backfilled into the pit.

- In order to classify as "Non-Acid Generating" and be used without restriction in construction and reclamation, waste rock or other material:

  1) Cannot be composed of igneous breccia, felsic gneiss, monzonite, quartzite, or trachyte lithologies;

  2) Amphibolite, mafic gneiss, shale, dolomite, or limestone must have a total sulfur content less than 0.8%, and a paste pH of 6.0 or greater;

  3) If syenite, must have a total sulfur content less than or equal to 0.2%, a paste pH of 6.5 or greater, <u>and</u> a NNP greater than or equal to 0 with an NP:AP ratio greater than or equal to 1;

  4) Must meet the criteria above as demonstrated by sampling and analyzing lithologies from every blasthole providing non-acid generating material.

- Material used for as capillary break/drainage layers in reclamation covers may be obtained from an area limestone source or non-acid generating waste rock.

- The existing Alder Gulch waste rock dump would be used to backfill the pit complex. The cover soil would be re-salvaged and the waste rock footprint reclaimed using this material.

- After detoxification, the 85/86 leach pad and dike would be removed to create a free draining surface and placed in the pit as backfill material prior to pit floor reclamation.

- The OK waste rock dump would be removed and used to backfill the pit complex or used as reclamation material. Cover soil would be re-salvaged and the waste rock footprint reclaimed.

- The tailing in Ruby Gulch above the town of Zortman would be removed from the drainage and placed in the pit complex. The drainage would be restored as mitigation for existing disturbance to waters of the United States by other Zortman and Landusky mines facilities.

- The sulfide storage area would also be removed and used as backfill in the pit complex.

- The back-filled pits would be graded so that runoff freely drains, without impoundment in the pit, into the Ruby Gulch drainage.

- Reclamation viability, as described in Section 2.7.5, would be monitored by ZMI until the agencies have approved final closure and released the mine reclamation bond.

- The reclamation requirements of this EIS and the Water Quality Improvement Plan (see Appendix A) would be used as a basis for determining reclamation success and directing any further corrective measures.

- To minimize the risk of long-term contamination of soil and water resources, a comprehensive Environmental Site Assessment would be carried out that covers the entire Zortman mine permit area. This site assessment would include inspection of all locations where hazardous materials were stored and used and would identify evidence of spills or accidental releases that may have contaminated soil and groundwater. This site assessment would include soil and groundwater sampling should evidence of contamination be identified.

2.7.2.1 Reclamation Materials

Reclamation materials would be required for construction and installation of reclamation caps, and for use in construction of drains and diversions. The primary reclamation materials to be used under this alternative are cover soil, clay, limestone, and non-acid generating waste rock. These materials would be used in construction of the reclamation covers to be placed on all disturbed facilities, unless otherwise noted. A brief description of the uses for and availability of each of these materials follows.

Non-Acid Forming Material

Non-acid forming materials would be used in reclamation covers on all disturbed areas. The reclamation covers used in this alternative require a capillary break of 36 inches to be composed of a suitable non-acid generating waste rock or limestone. It is likely that material for capillary break in reclamation covers would have to come from an area limestone source. It is also possible that waste rock from the Landusky Mine could be used to supplement materials needs at the Zortman Mine.

Limestone

Limestone used in reclamation covers would be mined from LS-1, a quarry location (as yet undisturbed) south of Green Mountain in the NW1/4 of the SE1/4 of Section 6, T25N, R25E (see Figure 2.5-2). Limestone would be mined using drill and blast mine methods. Mine trucks or a mine contractor would haul the limestone from the quarry to the Zortman Mine along the route shown in Figure 2.5-2. Approximately 5,300 feet of road would be upgraded and about 2,565 feet of new road would be constructed, for a total road disturbance of about 7,865 feet. Road upgrade and new construction would include pushing the cover soil downhill and using it as a catch bench on slopes no steeper than 2H:1V. The road would then be cut to an approximate 50 foot width. In areas steeper than 2H:1V no cover soil would be placed in side cuts.

Clay

Clay materials from the Seaford clay pit south of Zortman would be used in the construction of all reclamation caps. This alternative requires the use of Reclamation Covers A, B, and Modified Reclamation Cover C on mine facilities.

ZMI mine trucks or a mine contractor would use Seven Mile Road to haul clay from the Seaford pit to the Zortman Mine facilities (see Figure 2.5-3). The fleet of 85-ton haul trucks would have a 9.5-mile-one-way haul from the Seaford pit to the Zortman Mine through the town of Zortman. The round trip haul time would be approximately one hour. Trucks would be grouped at the clay pit and final destinations, and travel as a convoy under the direction of front and rear pilot vehicles.

Cover Soil

Cover soil is obtained from one of three stockpiles: the 82 leach pad site, the South Ruby Saddle stockpile, or the North Ruby Saddle stockpile. Approximate volumes of soil available at these stockpiles were shown on Table 2.5-5. Another source of cover soil is the material salvaged during re-reclamation activities on facilities which have already been cover soiled and revegetated.

Other materials used in reclamation include unconsolidated rock, scree and soil above and below roadway cuts, which are incorporated into the regrading of haul and access roads.

2.7.2.2 Reclamation Covers

The reclamation covers stipulated under this alternative are similar to the covers used during re-reclamation of the Mill Gulch waste rock dump and 91 leach pad dike, and reclamation of the Gold Bug waste rock repository at the Landusky Mine (see Section 2.5.4.2), with some important modifications.

First, the clay layer in Modified Reclamation Cover C would have a compacted thickness of at least 6 inches, as opposed to the 3 inch minimum requirement described in Alternative 1. The purpose for this modification is the understanding that it is probably impossible to spread and compact a layer of clay only 3 inches thick. Difficult field conditions, rough terrain, and the heavy equipment used in reclamation all work against being able to achieve this level of quality control. The agencies believe that areas of thin clay would exist, as would breaks in the cover. A 6-inch layer would provide more assurance of complete cover.

A geofabric would be installed between the soil cover and the capillary break. The geofabric would reduce the potential for fine-grained particles to infiltrate into the capillary break. The capillary break will serve another important function as a drainage layer as long as fine-grained materials do not clog the inter-rock pores.

The other modification to reclamation covers is in the definition of "non-acid generating" material. The criteria for material to be suitable for use in capillary break were described at the beginning of Section 2.7.2. Certain rock types would be excluded from use and those not excluded must demonstrate a sufficiently high Paste pH, sufficiently low sulfur content, and appropriate neutralization potential. All waste rock considered for use as non-acid generating material must come from blastholes which have been characterized according to these criteria.

Under this alternative, all disturbed areas not scheduled as pit backfill (with the exceptions noted such as haul roads, the 89 leach pad dike, and building-type facilities) are assumed to be acid generating and would be covered using Reclamation Covers B and/or Modified C, depending on the slope of the disturbance.

2.7.2.3 Mine Pit Reclamation

This alternative requires that waste rock and spent ore from a number of facilities be placed as backfill into the Zortman pit complex. The purpose of this action would be to remove those facilities known or suspected to be contributing to contamination of water resources in the vicinity of the Zortman Mine. The facilities to be off-loaded and backfilled into the Zortman pit include:

Facility	Estimated Load
Alder Gulch waste rock dump	3.4 million tons
Ruby Gulch tailing	1/2 million tons
Ruby Gulch sulfide storage	0.9 million tons
85/86 leach pad and dike	8.5 million tons
OK waste rock dump	1.2 million tons

The addition of this material would backfill the pit to an elevation above 5,000 feet mean sea level (msl), creating a surface which freely drains out of the pit into Ruby Gulch where water capture systems could collect runoff and, if necessary, route it to the Zortman water treatment plant prior to discharge. Pit walls not covered by backfill would be cover soiled and revegetated where possible, to include tree planting to reduce visual impacts of highwalls.

2.7.2.4 Leach Pad Reclamation

Leach pad reclamation would differ significantly from the procedures described for Alternatives 1 and 2. As described above, the entire 85/86 heap leach pad and dike would be removed and placed as backfill into the Zortman pit complex. The footprints from this facility would be tested on 100 foot centers. Those areas with total sulfur content >0.5% sulfur would be capped with Reclamation Cover A and revegetated. Areas with lower sulfur contents would be scarified, covered with 8 inches of soil, and revegetated.

Reclamation Covers B or Modified C would be placed on all other existing leach pads, including those such as the 79 and 80/81 pads which have been reclaimed under existing reclamation requirements. Leach pad slopes would be reduced to 3H:1V to further limit surface water infiltration, stabilize cover soil, and enhance the potential for successful revegetation. Leach pad dikes would be reduced to a slope sufficient to allow placement and retention of Reclamation Cover B. Other tasks associated with reclamation of the heap leach facilities include heap detoxification and liner perforation, as described below.

Heap Detoxification

Heap detoxification for this alternative would be similar to that described in Section 2.5.2.4. In summary, the spent ore on the leach pad would be rinsed repeatedly with cyanide-free water to enhance degradation of cyanide compounds left in the heap. Heap detoxification is discontinued when the solutions returning from the heap maintain less than 0.22 mg/l cyanide (measured as Weak Acid Dissociable or WAD cyanide) for a six month period which includes a spring, high-flow surface runoff event. Heap draindown solutions could be transported via pipeline to the Landusky Mine for use in the processing circuit, since ore leaching will continue for a longer period at that mine. Alternatively, heap solutions remaining after detoxification would be pumped to a containment pond for neutralization and later land application disposal. The use of a land disposal facility for heap draindown solutions would be planned and conducted in accordance with the procedures described in Section 2.5.2.4.

Surface Reclamation

After the existing heap leach pads are detoxified, or concurrent with detoxification, surface grading begins to reduce pad slopes to a 3H:1V slope. Constructed benches must be placed every 200 feet of slope length. Slope reduction is performed by track mounted bulldozers pushing ore heap material from the facility crest or top down over the lift slopes, using cut and fill material from each of the heap benches to obtain the desired slope. To achieve the desired 3H:1V slopes, off-loading of material would likely be required from some facilities. This would be done using loaders and haul trucks, and the off-loaded material would be dumped into the pits as backfill. Leach pad crests, top and slopes would be capped with Reclamation Cover B (on slopes greater than 0.5%) or Modified C (on slopes 0.5% or less).

Heap retaining dikes would be reduced to a nominal slope of 2.5H:1V, or sufficient to allow placement and retention of Reclamation Cover B. The dike faces would be capped with Reclamation Cover B and revegetated to blend with existing undisturbed contact zones and reestablish vegetation communities.

Liner Perforation

After the leach pad has been detoxified and the surface reclaimed the pad liner is perforated to reduce storage within the heap of precipitation and surface water runon. ZMI would conduct the following activities prior to liner perforation:

1. Water in the sumps of reclaimed leach pads would be sampled on an annual basis. These samples would be analyzed for the complete list of analytes shown on Table 2.5-18. Additional sampling of sump water monthly would include analysis for sulfates, total cyanide, pH, conductivity, total dissolved solids, total hardness as $CaCO_3$, and alkalinity as $CaCO_3$.

2. The rate of phreatic surface rise would be monitored on a monthly basis for the first three years prior to liner perforation by measurement of phreatic surface elevations. Based on these measurements, the rate of infiltration into a reclaimed leach pad would be calculated. Monitoring frequency may be reduced if sufficient data has been collected to establish the in-heap hydraulic conditions.

3. After 10 years, if it is determined that water quality management objectives would be met for a given leach pad, the liner for that facility would be perforated.

4. If monitoring indicates that water quality management objectives would not be met, or if the rate of accumulation is such that dewatering of the leach pads becomes necessary before the 10-year monitoring period is reached, heap waters would be treated and/or discharged using the land application area.

It is estimated that 3 to 4 drain holes 6-inches in diameter would be drilled into the underlying drainage system to provide an exit for solution within the heap. Each perforated drain hole is backfilled with drain rock to an elevation of at least 5 feet above the liner surface to ensure continued drainage. The drain holes would be positioned at the lowest elevation in the pad collection basin to provide for adequate drainage and prevent the formation of undesirable hydraulic conditions within the heap. The number of perforation holes drilled in each leach pad liner would be sufficient to ensure that the in-heap water level completely drains within 48 hours of reaching the static level. This is to ensure that water collected in leach pads during storm events does not remain in extended contact with acid generating minerals or residual cyanide compounds. In addition, this would help reduce the potential for failure of pad retaining structures caused by hydraulic pressure.

2.7.2.5 Waste Rock Dump Reclamation

All waste rock currently in dumps at the Zortman Mine would be removed and placed as backfill into the existing pit complex. It is estimated that 5.5 million tons of material would be excavated and backfilled. The footprints from the waste rock dumps would be tested on 100 foot centers. Those areas with total sulfur content >0.5% sulfur would be capped with Reclamation Cover A and revegetated. Areas with lower sulfur contents would be scarified, covered with 8 inches of soil and revegetated.

2.7.2.6 Support Facilities Reclamation

Unless otherwise noted in the following sections, reclamation of support facilities would not change from that described in Section 2.5.2.6. Final reclamation would include the removal of all structures and equipment used in the mining and processing of ore through heap leach operations. All cement structure footings and pads would be removed and used to help backfill depressions or openings such as ponds, or would be disposed appropriately as solid waste. The footprint of removed facilities would be covered with 8 inches of cover soil and revegetated.

Solution/Process Pond Reclamation

Reclamation of solution and process ponds would not differ from that described in Alternative 1 (Section 2.5.2.6). Ponds would be perforated, backfilled, and graded prior to final reclamation. Pond backfill would include fill material from waste rock operations and/or cement materials from structure footings or pads. After backfill, the ponds would be graded, covered with 8 inches of cover soil, and revegetated. Sludges remaining in the ponds at the end of mining would be sampled for toxics and neutralized, if necessary, then disposed appropriately.

Process Plant Site Reclamation

Final reclamation would include the removal of all structures and equipment used in the mining and processing of ore through heap leach operations. All footprints from these facilities and areas contaminated by spillage of non-oxide ore would be tested on 100-foot centers for total sulfur prior to reclamation activities. Surfaces found to contain >0.5% sulfur would be capped with Reclamation Cover A and revegetated. Other areas would be capped with 8 inches of cover soil and revegetated. An expanded discussion of reclamation requirements for the process plant sites is found in Section 2.8.2.6.

Soil Stockpile Reclamation

Based on the estimated amount available in stockpiles, a layer of cover soil approximately 8.4 inches thick could be used on all disturbed areas at the Zortman Mine. Cover soil would either be placed directly on graded areas prior to revegetation, or spread on top of the clay cap where potentially acid generating material is to be capped. Therefore, cover soil stockpiles may be depleted by the time surface reclamation activities are finished. The footprints from the soil stockpiles would be tested on 100 foot centers. Those areas with total sulfur content >0.5% sulfur would be covered with 6 inches of clay, followed by 8 inches of cover soil, and revegetated. Areas with lower sulfur contents would be scarified, covered with 8 inches of soil and revegetated.

Access and Haul Road Reclamation

Haulage and access roadways would be reclaimed to establish suitable drainage. Roadways would be ripped to reduce surface compaction and provide additional fill material for grading of the surface. Roads would be tested to determine acid generation potential and covered with clay, if necessary. Roadway berms and loose, unconsolidated material above and below the roadway cut would be pulled or dozed into the roadway using a dozer or backhoe. Other sampling, reclamation, and revegetation requirements for haul and access roads would be as described in Section 2.8.2.6.

Land Application Area

Reclamation of land application areas would not differ from Alternative 1, as described in Section 2.5.2.6.

Limestone Quarry Reclamation

It is anticipated that a significant amount of limestone could be required to supplement the materials available for use as capillary break in Reclamation Covers B and Modified C. This limestone would be mined from a quarry near Shell Butte designated LS-1 (see Figure 2.5-2). Up to 13 acres would be disturbed at this locale if all capillary break material consists of limestone. The final topography, reclamation requirements, and drainage features for this quarry, including access roads, would be as described in Section 2.8.2.6.

Seaford Clay Pit Reclamation

The Seaford clay pit, shown earlier on Figure 2.5-2, has provided liner material for leach pad facilities at the Zortman Mine. Under this alternative the clay pit would also provide material for reclamation covers. Approximately 3.5 additional acres would be disturbed at the clay pit to support this alternative. Those areas in the clay pit already disturbed and reclaimed from previous operations would undergo additional disturbance and reclamation. A 3H:1V slope would be left after grading to allow runoff to proceed naturally downhill into the current drainage system. Cover soil would then be spread at an average of 18 inches, and a minimum cover of 12 inches, with vegetative seeding occurring during a seasonal period of higher precipitation. Follow up inspections would take place after reclamation work has been completed.

2.7.2.7 Reclamation/Post-Reclamation Water Handling and Treatment

Section 2.5.1.6 described the various water and leachate capture systems, and the water treatment activities currently in effect at the Zortman Mine, including operation of a water treatment plant in accordance with the June, 1994 Administrative Compliance Order. Where applicable, these actions and requirements of the anticipated Improvement Plan for water discharge from the Mine supersede the reclamation requirements for water management described in previous regulatory actions for the Zortman Mine. The emphasis in this alternative is to institute source controls, including removal of acid generating facilities from drainages and installation of protective covers, which may eliminate or reduce the need for perpetual water collection and treatment. In the interim, water and leachate collected in capture systems and ponds would continue to be routed to the water treatment plant to help meet water quality protection goals. This alternative contains additional mitigations for water quality protection, as described below.

Water Quality Improvement Plan

A concern raised during scoping for the proposed Zortman Mine expansion was that no performance criteria had been established by which to judge the efficacy of ZMI's water resources protection program. Under this alternative ZMI would be required to capture and treat seepage and degraded water according to the Water Quality Improvement Plan (see Appendix A) and implement agency directed corrective measures when water quality criteria are exceeded.

Water Capture and Control Systems

Where possible, existing capture and treatment systems would be expanded to retain and treat seepage associated with a 100-year, 24-hour storm event. This action would constitute an upgrade from the current capacity of most facilities at the Zortman Mine to retain and treat the runoff from a 2.5-inch, 24 hour storm event. Captured water not returned to the process circuits would be pumped to the water treatment plant storage pond(s) rather than the leach circuit.

Backfilling of the Zortman pit complex would establish free-draining conditions and prevent significant infiltration of surface water through the pit, thereby reducing the potential to generate acid seepage in Ruby Gulch. Runoff from the pit would be directed to Ruby Gulch and discharged, if of acceptable quality, or collected and treated at the water treatment plant.

2.7.2.8 Reclamation Quality Control

ZMI or a mine contractor would place the clay cap used in reclamation covers. This process would be monitored by a qualified, independent third party engineering firm.

The clay cover would be composed of a clay soil, hauled from the Seaford clay pit, with an in-place compacted permeability of $1x10^{-7}$ cm/sec. This would be accomplished using the following specifications. A test fill would be constructed to establish construction procedures and measure the performance and proper ties of the compacted clay. If the permeability requirement is not met in a test fill at the time of reclamation, then the specifications would be modified to accomplish this requirement. The final specification would be proved in a certified laboratory prior to adoption.

The clay soil would be a clay (CL) or sandy clay (SC) according to the Unified Classification System, ASTM D2487, and meet the following requirements:

• Passing a No. 200 sieve	20% maximum
• Larger than a No. 4 sieve	10% maximum
• Maximum size	2 inches
• Plasticity index	PI = 10 to 35

The clay soil would be placed as follows:

- Moisture content (ASTM D698), Optimum -1% to +3%
- Lift loose thickness = 8" maximum (6" compacted)
- Density after compaction (ASTM D698), 95% minimum
- The clay would be premoistened in a borrow or thoroughly mixed after placement with appropriate equipment such that all moisture contents fall within the above range. There would be no frozen or deleterious materials and placement would not

occur when the ground temperature or air temperature is below freezing.

- The surface on which the fill is to be placed would be compacted to produce a firm foundation. Each lift of fill would be compacted with a sheepsfoot roller weighing not less than 40,000 pounds, or equipment of equivalent weight, which would leave a rough surface to provide bonding between lifts. For Modified Reclamation Cover C, placement would be horizontal lifts. In other words, placement of this cover on slopes steeper than 5% would not be permitted. Placement of Reclamation Cover B would be carefully controlled to obtain maximum compaction.

- The top clay lift would be rolled smooth after compaction is completed, using a rubber tired and/or steel wheeled roller. This lift would be covered immediately to prevent desiccation.

Placement testing would include the following:

Test Type	Designation	Frequency of Tests/Cu.Yd
Fines Content	ASTM D1140	1/2000
Particle Size	ASTM D422	1/2000
Plasticity Index	ASTM D4318	1/2000
Water Content	ASTM D4643, 2216, or 3017	1/2000
Density Sand Cone	ASTM D1556	1/2000
Density Nuclear[1]	ASTM D2922	1/2000
Standard Proctor	ASTM D698	1/5000

[1] Nuclear method could be used as an alternate test method for up to 80% of the required tests.

Installation of the 30 mil synthetic liner used in Modified Reclamation Cover C would also be monitored by a third party inspector. Seams would be air-lanced to ensure a good bond was achieved between field seamed PVC sheets. Areas having inadequate bonding, cuts or punctures would be repaired and tested until passed by the third party inspector. The entire area would be visually inspected and passed prior to cover with geotextile.

ZMI, or a mine contractor overseen by ZMI personnel, would install the capillary break. The capillary break thickness would be 3 feet over 95% of the area covered, with a minimum thickness of 2.5 feet at any location. The capillary break would consist of material which meets the rock type and geochemical characteristics for non-acid generating material described in Section 2.7.2.1. The capillary break would be covered with a 10 ounce/yd^2 nonwoven, needle punch geofabric.

Monthly construction reports with testing results would be provided to the agencies.

2.7.2.9 <u>Revegetation Procedures</u>

Revegetation procedures for this alternative would not be expected to differ from those presented in Alternative 1, Section 2.5.2.9. Areas disturbed at the Zortman Mine are and would be revegetated to stabilize soil and slopes, reestablish communities ecologically comparable to pre-mine conditions, and restore watershed, wildlife, recreational and aesthetic values that meet post-operation land use objectives.

2.7.3 Landusky Mine: Mine Expansion Not Approved

This alternative does not approve further mining at the Landusky Mine beyond that already authorized. Section 2.5.3 provides a complete description of the currently permitted mining activities, which are summarized below.

Mining operations are still taking place at the Landusky Mine. Ore-bearing rock is blasted from the Queen Rose, Little Ben, and South Gold Bug Pits and loaded on to the 87/91 heap leach pad for processing. Waste rock generated from the pit is being deposited into the Gold Bug waste rock repository in accordance with the waste characterization and handling plan described in Section 2.5.3.1. Ore is loaded onto the 87/91 pad and a cyanide solution is used to extract gold and silver from the rock matrix. The pregnant solution is collected from the bottom of the heap and pumped to a solution storage pond. From there the pregnant solution is processed using Merrill Crowe or carbon adsorption methods to remove dissolved metals from the solution. The gold and silver is collected, refined into dore, and shipped from the mine to another refinery for further processing. The spent cyanide solution is pumped to a barren pond to be reused in the ore leaching circuit.

Ore leaching is still occurring on the 85/86, 87, 91, and 87/91 leach pads, but the only pads still being loaded are the 91 and 87/91. The 80/81/82, 83, and 84 pads are still being rinsed and will continue until cyanide concentrations in monitoring locations fall below 0.22 mg/l WAD cyanide for a six month period. Final rinsing solution is to be disposed at the land application area on Gold Bug Butte.

The water capture systems in the Sullivan Park, Mill Gulch, and Montana Gulch drainages would continue to operate until effluent levels meet approved discharge standards. Captured water from these systems is either used as makeup water for the leach pads, or aerated to precipitate metals and discharged. Final surface water control systems have been installed at the Mill Gulch waste rock dump and Gold Bug waste rock repository to control stormwater and capture acid rock drainage. These systems are designed to handle a 6-inch, 24-hour storm event. Other surface water control systems to capture and route stormwater or ARD are interim, designed to handle a 2.5-inch, 24-hour storm event. All reclamation activities would be conducted in accordance with the Water Quality Improvement Plan (see Appendix A).

2.7.4 Landusky Mine: Agency Mitigated Reclamation

Modifications to the reclamation plan proposed by ZMI for the Landusky Mine are included in this alternative. These modifications would reduce infiltration into areas with the potential to cause acidic drainage, remove waste rock dumps and other sources currently causing degradation of surface water or groundwater, and establish a program to implement further corrective measures should reclamation procedures fail. The major reclamation modifications are summarized below.

- Reclamation Cover C would be modified to include 6 inches of compacted clay (as opposed to 3 inches of compacted clay) between the bottom substrate and the PVC liner. The PVC liner thickness would be increased to 30 mil. This cover is described as Modified Reclamation Cover C.

- The 91 leach pad dike would be re-reclaimed using Reclamation Covers B and/or Modified C, as appropriate. Other facilities not used as pit backfill would be tested for sulfur content. If greater than 10% of the material contains sulfur in concentrations exceeding 0.2%, the facility would be re-reclaimed using Reclamation Covers B and/or Modified C. Cover soil on the facilities would be removed, stockpiled, and reused.

- With the exception of leach pad dikes, the Gold Bug repository and the Mill Gulch waste rock dump, existing facilities would be reclaimed to a 3H:1V slope with constructed benches every 200 feet of slope length. In order to achieve the slope reductions while minimizing additional land disturbance, some material may have to be off-loaded from existing facilities.

- In order to classify as "Non-Acid Generating" and be used without restriction in construction and reclamation, waste rock or other material:

  1) Cannot be composed of igneous breccia, felsic gneiss, monzonite, quartzite, or trachyte lithologies;

  2) Amphibolite, mafic gneiss, shale, dolomite, or limestone must have a total sulfur content less than 0.8%, and a paste pH of 6.0 or greater;

  3) If syenite, must have a total sulfur content less than or equal to 0.2%, a paste pH of 6.5 or greater, <u>and</u> a NNP greater than or equal to 0 with an NP:AP ratio greater than or equal to 1;

  4) Must meet the criteria above as demonstrated by sampling and analyzing lithologies from every blasthole providing non-acid generating material.

- Material used for capillary breaks may be obtained from an area limestone source or non-acid generating waste rock.

- Reclamation viability, as described in Section 2.7.5, would be monitored by ZMI until the agencies have approved final closure and released the mine reclamation bond.

- The reclamation requirements of this EIS and the Water Quality Improvement Plan (see Appendix A) would be used as a basis for determining reclamation success and directing any further corrective measures.

- The pits would be backfilled to a minimum elevation of 4,900 ft (at the midpoint of the drainage ditch) to create a surface which will freely drain into Montana Gulch. Approximately 13 million tons of backfill would be required to reach this level. Material used in backfill would come from existing waste rock dumps and leach pads.

- Prevent runoff from the Queen Rose/Suprise and August/Little Ben pit areas from flowing into the August tunnel by constructing a drainage notch between the August/Little Ben pit and Montana Gulch, and directing surface water to Montana Gulch immediately below the waste rock dump.

- To minimize the risk of long-term contamination of soil and water resources, a comprehensive Environmental Site Assessment would be carried out that covers the entire Landusky mine permit area. This site assessment would include inspection of all locations where hazardous materials were stored and used and would identify evidence of spills or accidental releases that may have contaminated soil and groundwater. This site assessment would include soil and groundwater sampling should evidence of contamination be identified.

2.7.4.1 <u>Reclamation Materials</u>

The primary reclamation materials to be used under this alternative are cover soil, clay, limestone, and non-acid generating waste rock. These materials would be used in construction of the reclamation covers to be placed on disturbed facilities, unless otherwise noted. A brief description of the uses for and availability of each of these materials follows.

<u>Non-Acid Forming Waste</u>

Non-acid forming material would be used primarily as a capillary break/drain layer in reclamation covers, and to a lesser extent as rip-rap and in drains. Non-acid forming waste rock is being used as an interim cap on the Mill Gulch waste rock dump and in the Gold Bug waste rock repository, and as a cap on the 91 heap leach pad dike. Waste rock used in these facilities comes from existing stockpiles and that generated by the ongoing mine operation. Significant additional quantities of non-acid generating material would be used in reclamation covers on mine areas. Some of this material could come from waste rock generated at the South Goldbug pit. Approximately 38 million tons of waste rock are now contained within dumps at the Landusky Mine, and it is possible some of this material is not acid generating and could be used in reclamation covers. However, it is only recently that ZMI has begun segregating waste material at the Landusky Mine based on acid generating potential, and it would likely be very inefficient to attempt to separate out suitable waste rock. In addition, the geochemical requirements for waste to be classified as suitable in capillary break are more stringent than the waste handling and segregation strategy ZMI has used.

<u>Limestone/Dolomite</u>

Limestone and dolomite have been used on a restricted basis at the Landusky Mine. Because of their high carbonate content both of these rock types are useful to neutralize acidic conditions. Dolomite and limestone from outcrops within the mine permit area have recently been used to provide a 3-foot buffering liner across the floor of the 4,640 bench in the Gold Bug waste rock repository. Limestone and dolomite from the mine pits could also be used as capillary break material in the reclamation covers. Because there is likely insufficient suitable non-acid forming waste rock available for use in reclamation covers, limestone and/or dolomite would be needed as capillary break. A source of limestone exists at the King Creek quarry, located in NE1/4, Section 15, T25N, R24E on 10 acres north of the Landusky Mine (see Figure 2.5-2). Section 2.8.4.1 provide more detail on the final topography and reclamation and revegetation requirements for the King Creek quarry.

<u>Clay</u>

Clay is used as a component layer of the caps which have been placed on the Mill Gulch waste rock dump and 91 leach pad dike. The swelling clay helps to reduce the possibility of moisture infiltration into the capped facilities. Two six-inch lifts of clay would be used in disturbed areas where Reclamation Cover B is installed, and one six-inch lift of clay would be used in areas capped by Modified Reclamation Cover C. A six inch layer of clay is also used in Reclamation Cover A, to be placed on some haul road disturbances and pit benches. Clay used in Landusky Mine reclamation comes from the Williams clay pit located approximately 2 miles west of the town of Landusky. The clay is hauled by ZMI truck and loader fleet from the pit over the county road leading to the Landusky Mine, through the town of Landusky and onto the mine site to the area of final placement.

<u>Cover Soil</u>

Cover soil would be used on top of all mine disturbances, either as a final lift on the reclamation caps or as 8-inch layers directly overlying disturbed zones which are determined by testing not to have significant acid generating potential. Cover soil is obtained from one of four cover soil storage areas: the Mill Gulch stockpile, part of the Mill Gulch waste rock dump; the Little Ben soil stockpile; the Gold Bug soil stockpile; and the Montana Gulch soil stockpile. Approximate volumes of soil available at these stockpiles are shown on Table 2.5-11. Other, similar materials used for reclamation purposes would include unconsolidated rock, scree and soil above and below roadway cuts, which are incorporated into the regrading of haul and access roads.

2.7.4.2 Reclamation Testing and Covers

The reclamation covers stipulated under this alternative are similar to the covers used during re-reclamation of the Mill Gulch waste rock dump and 91 leach pad dike. These covers were described in Section 2.5.4.2. The agencies have made four important modifications to these covers. These modifications were described in Section 2.7.2.2, and summarized below.

First, the clay layer in Modified Reclamation Cover C would be at least 6 inches thick when compacted, as opposed to the 3 inch minimum requirement described in Alternative 1. The second modification is that the PVC liner thickness would be increased to 30 mil. In addition, a geofabric would be installed between the soil cover and the capillary break.

The final modification to reclamation covers is in the definition of "non-acid generating" material. The criteria for material to be suitable for use in capillary break were described at the beginning of Section 2.7.4. Certain rock types would be excluded from use and those not excluded must demonstrate a sufficiently high Paste pH, sufficiently low sulfur content, and appropriate neutralization potential. All waste rock considered for use as non-acid generating material must come from blastholes which have been characterized according to these criteria.

Haul roads would not be subjected to the reclamation covers described above. The haul roads would be tested, on 100 foot centers, to determine the potential for the subsurface to generate acidic conditions. This determination would be based on total sulfur concentrations. Those areas disturbed for haul roads with sulfur concentrations greater than 0.2% would be capped with Reclamation Cover A. Haul road disturbances with lower sulfur concentrations would be covered only with 8 inches of cover soil.

The 91 leach pad dike would be tested in the same fashion as the haul roads. If sulfur concentrations exceed 0.2% this dike would be covered with Reclamation Cover B or Modified C.

No testing would be conducted on other disturbances, such as leach pad surfaces or waste rock dumps which are not scheduled for backfill. These are assumed to have the potential to generate acidic conditions and would be capped with Reclamation Cover B or Modified C. The interim covers already constructed on the Mill Gulch waste rock dump and 91 leach pad dike would remain as permanent reclamation caps provided that the performance criteria are met. Additional soil could be added to these covers to achieve water infiltration criteria that the agencies stipulate.

2.7.4.3 Mine Pit Reclamation

A number of mitigations in this alternative modify pit reclamation requirements. The pits would be backfilled to a minimum elevation of 4,900 feet, measured at the midpoint of the drainage ditch, in order to create a surface which will freely drain into Montana Gulch. This action would reduce the potential for surface water to enter the pits and contact sulfide-bearing zones, thereby increasing the potential to create acidic drainage. Material used as backfill would come from the Montana Gulch waste rock dump, the 85/86 leach pad, and formation of a drainage cutout to Montana Gulch, described below.

A drainage cutout would be constructed across the bedrock divide between the August/Little Ben pits and Montana Gulch, thereby preventing surface water from infiltrating to the August tunnel and redirecting flow to the area between the Montana Gulch waste rock dump and the 85/86 leach pad (see Section 2.7.4.7). Rock removed during construction of the drainage notch would be backfilled into the August pit. The cutout excavation would continue until materials balance to achieve an average gradient of 2% throughout the constructed drainage. This balance would be met near the 4,900 foot level, resulting in the development of a notch up to 100 feet deep and concurrent backfill in the August pit of about 300 feet thick. It is estimated 1 to 2 million tons of rock would be removed from the notch for this project. Any ore-grade material encountered during excavation of the notch could be transported to the 87/91 leach pad for processing.

Overall slope of the final pit walls would be approximately 45 degrees (1H:1V) with 30-foot flat benches every 60 vertical feet. Pit floors are to be sloped and graded to facilitate free drainage, as described above. The final pit floor (i.e., the backfilled surface) would be covered with Reclamation Cover B to prevent surface water infiltration. This alternative also requires the placement of Reclamation Cover A on pit benches prior to revegetation (where revegetation is possible), which should include the use of trees to the extent possible to reduce visual impacts.

2.7.4.4 Leach Pad Reclamation

Leach pad reclamation would differ significantly from the procedures described for Alternatives 1 and 2. These modifications include:

- Reclamation Cover B or Modified C would be placed on all leach pad disturbances, including those such as the 79 which have been reclaimed under existing reclamation requirements.
- Where possible, leach pad slopes would be reduced to 3H:1V to further limit surface water infiltration, stabilize cover soil, and enhance the potential for successful revegetation. Constructed benches must be placed every 200 feet of slope length.
- Spent ore collected during slope reduction activities would be used to backfill the pits.
- Leach pad dikes would be reduced to a slope sufficient to allow placement and retention of Reclamation Cover B. The reclamation cover which has been approved for the 91 heap dike would remain as the permanent reclamation cap.

Other tasks associated with reclamation of the heap leach facilities include heap detoxification, surface reclamation, and liner perforation. The basic procedures associated with each of these tasks for this alternative were described in Section 2.7.2.4 and apply to this alternative; procedures for the Landusky Mine are generally the same as those for the Zortman Mine. Some additional stipulations from previous regulatory decisions include:

- Additional drain holes must be constructed in the 87 and 91 ore heaps to prevent accumulation of solution within the leach pad collection pool areas (see Decision Record 1991). The exact number and location of these additional drain holes would be established in consultation with the agencies upon review of neutralization monitoring data.
- The 91 ore heap slopes must be reduced to a maximum slope of 3H:1V with intervening benches every 200 feet of slope.
- The containment dike for the 91 ore heap must be reduced to a 2.5H:1V slope or less to limit infiltration of precipitation and surface water (DSL/BLM 1994a).

2.7.4.5 Waste Rock Dump Reclamation

Part of the Montana Gulch waste rock dump could be removed and used as backfill in the pit. The remaining footprint would be tested and reclaimed with Reclamation Cover A if sulfur concentrations exceed 0.5%. The interim cap placed on the Mill Gulch waste rock dump would remain as a permanent cover. Reclamation Cover C would continue to be used on the Gold Bug waste rock repository and backfilled pit. Reclaimed surfaces would be revegetated in accordance with Section 2.8.4.9, except where modified as described in Section 2.7.4.9.

2.7.4.6 Support Facilities Reclamation

Unless otherwise noted in the following sections, reclamation of support facilities would not be likely to change from that described in Section 2.5.4.6. Final reclamation would include the removal of all structures and equipment used in the mining and processing of ore through heap leach operations. All cement structure footings and pads would be removed and used to help backfill depressions or openings such as ponds, or would be disposed appropriately as solid waste. The footprint of removed facilities would be covered with 8 inches of soil and revegetated.

Solution/Process Pond Reclamation

Reclamation of solution and process ponds would not differ from that described in Alternative 1 (Section 2.5.4.6).

Process Plant Site Reclamation

Final reclamation would include the removal of all structures and equipment used in the mining and processing of ore through heap leach operations. All footprints from these facilities and areas contaminated by spillage of non-oxide ore would be tested on 100-foot centers for total sulfur prior to reclamation activities. Surfaces found to contain >0.5% sulfur would be capped with Reclamation Cover A and revegetated. Other areas would be capped with 8 inches of cover soil and revegetated. An expanded discussion of reclamation requirements for the process plant sites is found in Section 2.5.4.6.

Soil Stockpile Reclamation

Based on the estimated amount available in stockpiles, sufficient cover soil exists at the Landusky Mine to be used in surface reclamation of all facilities. Cover soil would either be placed directly on graded areas prior to revegetation, or spread on top of the clay cap where potentially acid generating material is to be capped.

The footprints from the soil stockpiles would be tested on 100 foot centers. Those areas with total sulfur content >0.5% sulfur would be covered with 6 inches of clay, followed by 8 inches of cover soil, and revegetated. Areas with lower sulfur contents would be scarified, covered with 8 inches of soil and revegetated.

Access and Haul Road Reclamation

Haulage and access roadways would be reclaimed to establish suitable drainage. Roadways would be ripped to reduce surface compaction and provide additional fill material for grading of the surface. Roads would be tested to determine acid generation potential and covered with clay, if necessary. Roadway berms and loose, unconsolidated material above and below the roadway cut would be pulled or dozed into the roadway using a dozer or backhoe. Other sampling, reclamation, and revegetation requirements for haul and access roads would be as described in Section 2.8.4.6.

Land Application Area

Reclamation of land application areas would not differ from Alternative 1, as described in Section 2.5.4.6.

Limestone Quarry Reclamation

It is anticipated that a significant amount of limestone could be required to supplement the materials available for use as capillary break in Reclamation Covers B and Modified C. This limestone would be mined from a quarry north of the Landusky Mine known as the King Creek quarry. Up to 19 additional acres would be disturbed at the limestone quarry in order to obtain sufficient capillary break material for reclamation covers (under the assumption that no suitable waste rock would be available for this purpose). The final topography, reclamation requirements, and drainage features for this quarry, including access roads, would be as described in Section 2.8.4.6.

Williams Clay Pit Reclamation

Addition disturbance of the Williams clay pit, located 2 miles west of Landusky (see Figure 2.5-2), would take place to provide clays for all reclamation covers. Up to 9 additional acres of disturbance would take place at the clay pit to provide sufficient reclamation materials for this alternative. A slope no steeper than 3H:1V would be left after grading to allow runoff to proceed naturally into the current drainage system to the southeast of the clay pit. Cover soil would be spread at an average of 12 inches, and a minimum cover of 9 inches, with vegetative seeding occurring during a seasonal period of higher precipitation. All areas would be revegetated as described in Section 2.8.4.9, except where modified by Section 2.7.4.9.

2.7.4.7 Reclamation/Post-Reclamation Water Handling and Treatment

Section 2.5.2.6 described the various water control and leachate capture systems in effect at the Landusky Mine, and Section 2.5.4.7 provided an overview of the improvements and modifications made to the Landusky water control and capture systems as a result of actions stipulated by the agencies in previous decisions. The improvements made and under construction at the Landusky Mine have been designed to handle runoff and seepage generated by at least a 6-inch, 24-hour storm event. The agencies' emphasis in this alternative is to institute source controls, including removal of acid generating facilities from drainages and installation of protective covers, which may eliminate or reduce the need for perpetual water collection and treatment. Until such time as water quality compliance standards are met and maintained, water and leachate collected in capture systems and ponds would be routed to either the Zortman water treatment plant or a new water treatment plant at the Landusky Mine.

Water Capture and Treatment

No changes are proposed for seepage water capture and treatment upon cessation of mining and leaching activities from those already implemented or as described in following sections. Water treatment would continue until final reclamation is established and water quality is acceptable. As water quality meets discharge standards and the appropriate agencies approve of release of the waters, capture ponds, sumps and pumpbacks would be dismantled and reclaimed.

Water Quality Improvement Plan

A concern raised during scoping for the proposed Landusky Mine expansion was that no performance criteria had been established by which to judge the efficacy of ZMI's water resources protection program. Under this alternative ZMI would be required to capture and treat seepage and degraded waters according to the Water Quality Improvement Plan (see Appendix A) and implement agency directed corrective measures when water quality criteria are exceeded.

Mine Pit Runoff Control

A drainage cutout would be constructed across the bedrock divide between the August Pit and Montana Gulch, thereby reducing the amount of surface water infiltrating to the August tunnel and redirecting flow to capture ponds by the 85/86 leach pad (see Section 2.7.4.3). Upon exiting the cutout notch from the pit, runoff would be routed through a channel constructed along the existing haul road route around the Montana Gulch waste rock dump and 85/86 leach pad. This water would flow into settling and/or treatment ponds prior to discharging into Montana Gulch. The ponds would be constructed below the 85/86 leach pad and could also serve as treatment and/or settling ponds for the Gold Bug adit discharge. The channel would be sized to handle runoff from a 100-year, 24-hour storm event within the pit drainage basin, with storm surge control provided by the August pit basin. All discharge would be handled and treated in accordance with requirements of the Water Quality Improvement Plan.

Leach Pad Runon Control
Under this alternative diversions would be constructed around the leach pads and laterally across the buttresses, sized for the 100-year, 24-hour storm event. That portion of the 85/86 leach pad and dike blocking surface flow from the west tributary in Montana Gulch would be removed.

Waste Rock Repositories Runoff Control
No changes are proposed to the existing drainage control features for the Gold Bug and Mill Gulch waste repositories. The dumps at the head of King Creek and at Montana Gulch would probably be removed entirely for backfill under this alternative. Drainage from these areas would be directed into Montana Gulch.

2.7.4.8 Reclamation Quality Control

The quality control procedures and specifications for installation of reclamation covers described in Section 2.7.2.8 would apply to the Landusky reclamation.

2.7.4.9 Revegetation Procedures

Revegetation procedures would be essentially as described in Section 2.5.4.9. However, no trees would be used in revegetation except on a limited basis for visual impact mitigation. Only grasses, forbs and shrubs would be used to enhance wildlife habitat. Another change is that the agencies would not allow the use of Crested wheatgrass in the reclamation seed mix. Areas disturbed by mining-related operations would be revegetated to stabilize soil and slopes, reestablish communities ecologically comparable to pre-mine conditions, and restore watershed, wildlife, recreational and aesthetic values that meet post-operation land use objectives. Vegetative cover must achieve 90% of that demonstrated in adjacent, natural communities of similar composition and location to be considered acceptable. Stock grazing would be restricted in revegetated areas until the vegetation canopy is 90% or greater of the reference area.

2.7.5 Monitoring Programs and Research Studies

Monitoring programs and research studies already in place or required under the Zortman and Landusky mines operating permits would not be substantively affected by this alternative. Implementation of the Water Quality Improvement Plan, designed to identify degradation of water resources and trigger corrective action, should not substantively alter the basic water quality monitoring programs already required. A reclamation monitoring program would be instituted to provide ongoing evaluation of surface reclamation viability. Otherwise, the description of monitoring programs and research studies provided in Section 2.5.5 is applicable to this alternative. Potential changes or modifications to those programs are briefly presented in the following sections.

2.7.5.1 Water Resources

The monitoring program for groundwater and surface water would continue as described in Section 2.5.5.1. Some monitoring wells or surface water monitoring sites could be relocated as a result of actions taken to reduce heap leach facility slopes. All monitoring required by the water quality improvement program would be incorporated into this alternative.

In addition, ZMI would be required to establish a monitoring program for operation and maintenance of land application disposal areas. This program, to be submitted to the agencies for review and approval prior to land application of spent solutions, would include at a minimum the following elements:

- Analysis of barren solution samples prior to land application and during, to determine optimum hydrogen peroxide content and metals loading to soil.

- Installation of suction lysimeters at varying depths with the land application area.

- Collection of pore water samples (from lysimeters) and chemical analysis to include at least cyanide, arsenic, cadmium, copper, selenium, zinc, and lead.

- Daily or more frequent monitoring of land application operations by mine personnel to check for runoff from the area, or new groundwater seeps.

- Immediate sampling of all new seeps or discharges, or solutions found discharging from the area, and analysis for metals and cyanide.

Should any discharges from the area be detected, in the form of solution runoff or new seeps, all land application procedures would be stopped. The agencies must be informed immediately of any such occurrence and approve corrective measures prior to re-start of land application.

2.7.5.2 Reclamation Surface Performance Study

Some expansion of the reclamation surface performance study would result from implementation of this alternative. ZMI would monitor seepage from waste rock facilities on a frequency sufficient to develop long-term hydrographs for each site. The hydrographs would be used to assess and predict how and when seepage responds to high flow seasons or storm events. The hydrographs would also provide a tool for predicting opportunistic sampling events to evaluate changes in seepage quality.

2.7.5.3 Surface Reclamation Monitoring Programs

ZMI would implement a program to monitor long term viability of surface reclamation until such time as the Agencies release the Mine Reclamation Bond. The program must evaluate the continued performance of such features as:

- Reclamation covers
- Revegetation success and permanence
- Erosion control measures

The reclaimed facilities would be monitored for excessive erosion including rilling and gullying. Excessive erosion would be that level which endangers the overall efficacy of the reclamation features and could hinder the achievement of reclamation goals or environmental compliance requirements. Soil loss could not exceed 2 tons per acre per year. ZMI would be required to notify the Agencies of such concerns with the reclamation systems, and propose and implement approved corrective measures to alleviate concerns.

ZMI would be required to submit a surface reclamation monitoring plan to the Agencies for review and approval.

2.7.5.4 Other Monitoring Programs

No changes are anticipated to the remainder of the monitoring programs from the descriptions provided in Section 2.5.5.

2.7.6 Reasonably Foreseeable Future Actions

2.7.6.1 Mine Activities

Opportunities for future mining would be as described for Alternative 1 in Section 2.5.6.1. While this alternative does not preclude proposals for additional mining at either the Landusky or Zortman mines, none are foreseeable.

2.7.6.2 Exploration Activities

While this alternative does not preclude future proposals for exploration activities, none are anticipated. Since this alternative would not provide for the mining of already delineated ore reserves, the incentive to explore for additional reserves would be very low.

2.8 ALTERNATIVE 4: COMPANY PROPOSED EXPANSION AND RECLAMATION

Alternative 4 is the proposal by ZMI for additional mining beyond that currently permitted at the Zortman and Landusky mines, and proposed revisions to the reclamation plans at each mine. Collectively, these activities are known as the Company Proposed Action (CPA). Figure 2.8-1 displays the existing facilities at each mine and the proposed new facilities.

A summary of the major actions proposed for the Zortman Mine includes lateral expansion and deepening of the pit complex to remove about 80 million tons of ore, construction and operation of a heap leach facility at Goslin Flats, construction and operation of an ore conveyor system through Alder Gulch to Goslin Flats, removal of the existing Alder Gulch waste rock dump, and construction of a new waste rock repository in Carter Gulch. ZMI would also implement enhanced reclamation practices for new facilities and those facilities already disturbed which may be creating acid drainage.

A summary of the major actions proposed for the Landusky Mine includes lateral expansion and deepening of the Queen Rose and August Pits, and mining in the South Gold Bug pit, to extract approximately 7.6 million additional tons of ore, expansion of the 87/91 leach pad by increasing the total pad capacity to approximately 19.5 million tons, development of a quarry in the King Creek drainage to obtain limestone for use in drains and reclamation systems, and construction of operational drainages to manage stormwater around leach pads, waste rock facilities, and the pit complex. ZMI would also implement enhanced reclamation practices for new facilities and those facilities already disturbed which may be creating acid drainage.

The proposed mine expansions are presented in Sections 2.8.1 and 2.8.3, followed by the proposed reclamation plan modification for each mine as described in Sections 2.8.2 and 2.8.4. Monitoring programs and research studies which ZMI would commit to undertaking for both mines are described in Section 2.8.5. Section 2.8.6 contains an assessment of other activities which are reasonably foreseeable should Alternative 4 be implemented.

2.8.1 Zortman Mine: Company Proposed Expansion

The location of the Zortman Mine and the proposed expansion facilities are shown on Figure 2.8-1. The total new disturbance for the Zortman expansion would be approximately 1,292 acres, which would include 405 acres previously disturbed under the existing permit and about 877 acres of proposed disturbance. Disturbance areas for the existing mine and proposed expansion facilities are summarized in Table 2.8-1.

ZMI would continue to use open-pit mining and heap-leach mineral processing to extract gold and silver from ore. Approximately half of the material proposed to be mined under the CPA would be low grade oxide ores, with the remainder consisting of higher grade, unoxidized material. The CPA would include mining up to a maximum of 80 million tons of ore and 60 million tons of waste rock. ZMI has projected production levels of 21 to 28 million tons of material per year, of which 12 to 17 million tons would be ore. Mining is proposed to proceed at these rates for approximately 5 to 8 years based on current economics and gold prices. A general flow sheet of the proposed process is shown on Figure 2.8-2.

The proposed expansion involves:

- Lateral expansion and deepening of the existing mine pit.
- Construction of additional heap leach capacity at Goslin Flats.
- Use of a crushing facility for ore preparation.
- Use of a conveyor for ore transport.
- Installation of a solution pipeline along the coveyor route.

TABLE 2.8-1

DISTURBANCE FOR THE COMPANY PROPOSED ACTION - ZORTMAN

Facility	Proposed Total Disturbance[1] (acres)	Already Disturbed Area[2] (acres)	Proposed-Previously Undisturbed[3] (acres)
Mine Pits	200	97	52
Heap Leach Facilities	348	145	205
Waste Rock Storage	180.4	33.4	162
Roads	48.3	24.2	22.5
Conveyor Corridor	25	--	25
Processing Area	31.5	8.5	23
Coversoll Stockpile	50	15.5	48
Lime Quarry	10	--	10
Power Corridor	9	--	9
Land Application Area	350	65	285
Primary Ore Crushing	3.5	--	3.5
Ore Crushing/Handling	22	--	22
Storage Area	6.3	6.3	0
Shop	6.3	6.3	0
Wetlands (To Be Disturbed)	(0.97)	0	(0.97)
Replacement Wetlands	1.79	0	1.79
TOTAL DISTURBED ACREAGE	**1,292.1**	**401.2**	**868.8**
Seaford Clay Pit[4]	--	4.2	8.5

1 "Proposed Total Disturbance" refers to the total disturbance from the current and proposed operations.

2 "Already Disturbed Area" refers to the area disturbed under the current Operating Permit 00096.

3 "Proposed Previously Undisturbed" refers to currently undisturbed ground proposed for disturbance under this Amendment.

4 Seaford Clay Pit administered under MDSL Open Cut Bureau and has not been included in the total disturbance acres.

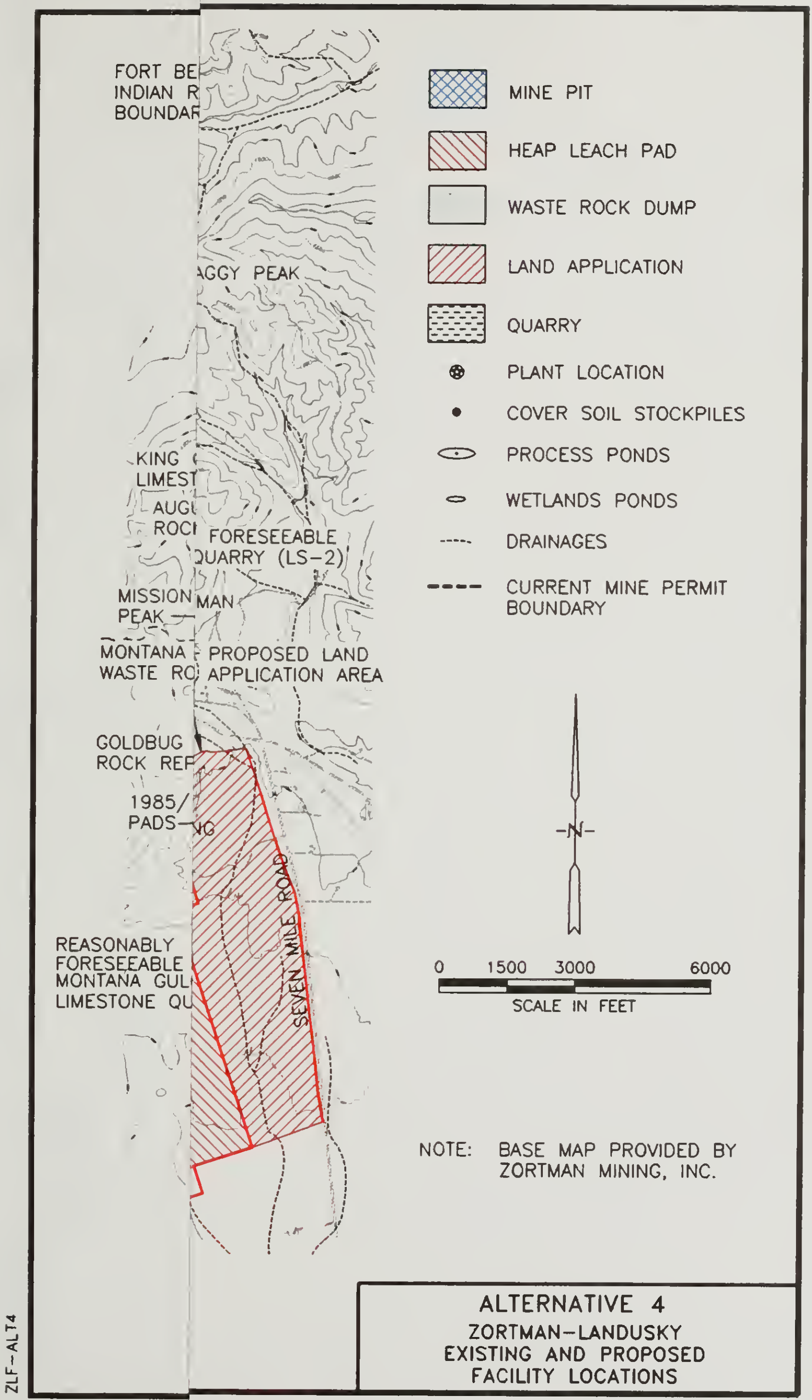
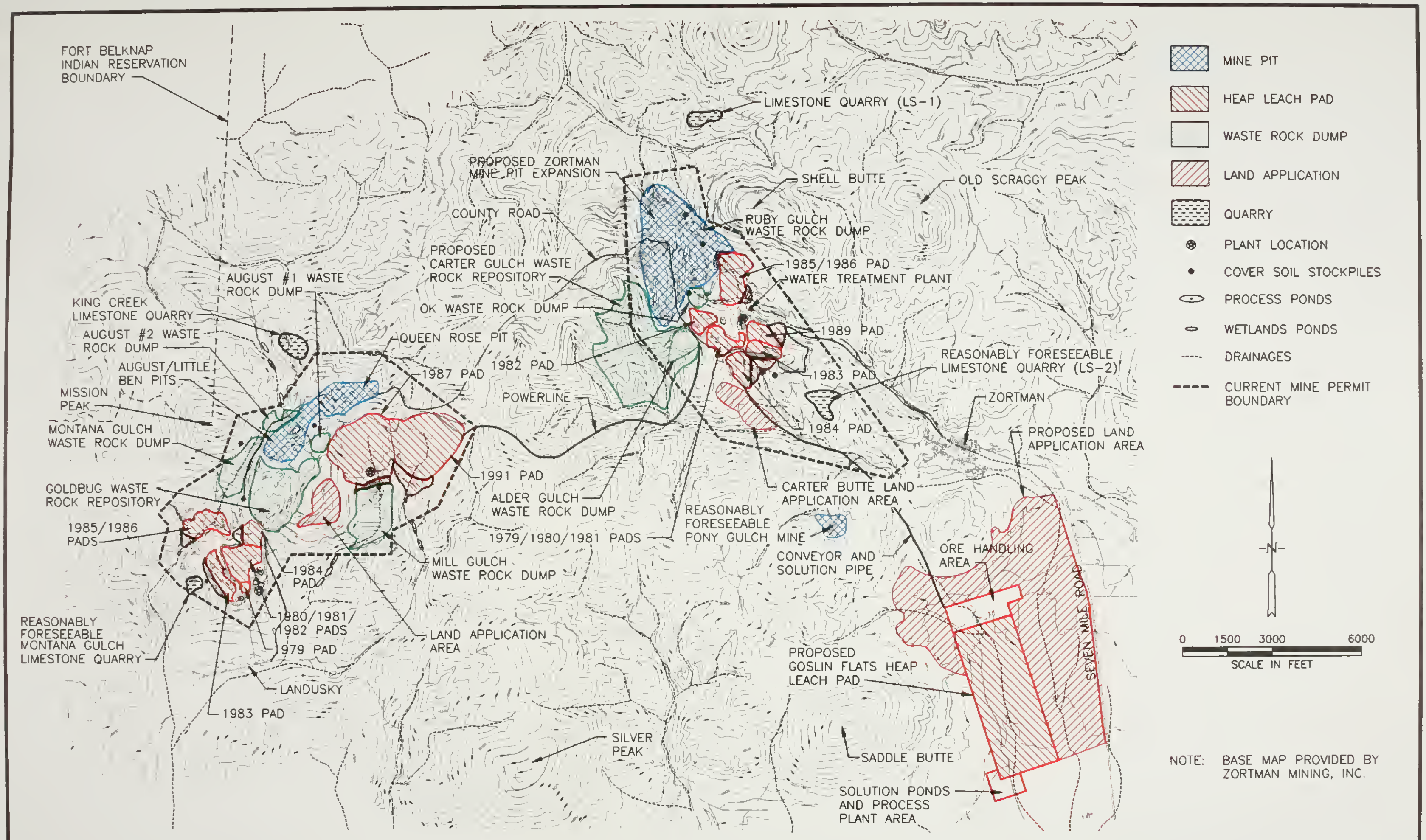


FIG. 2.8-1

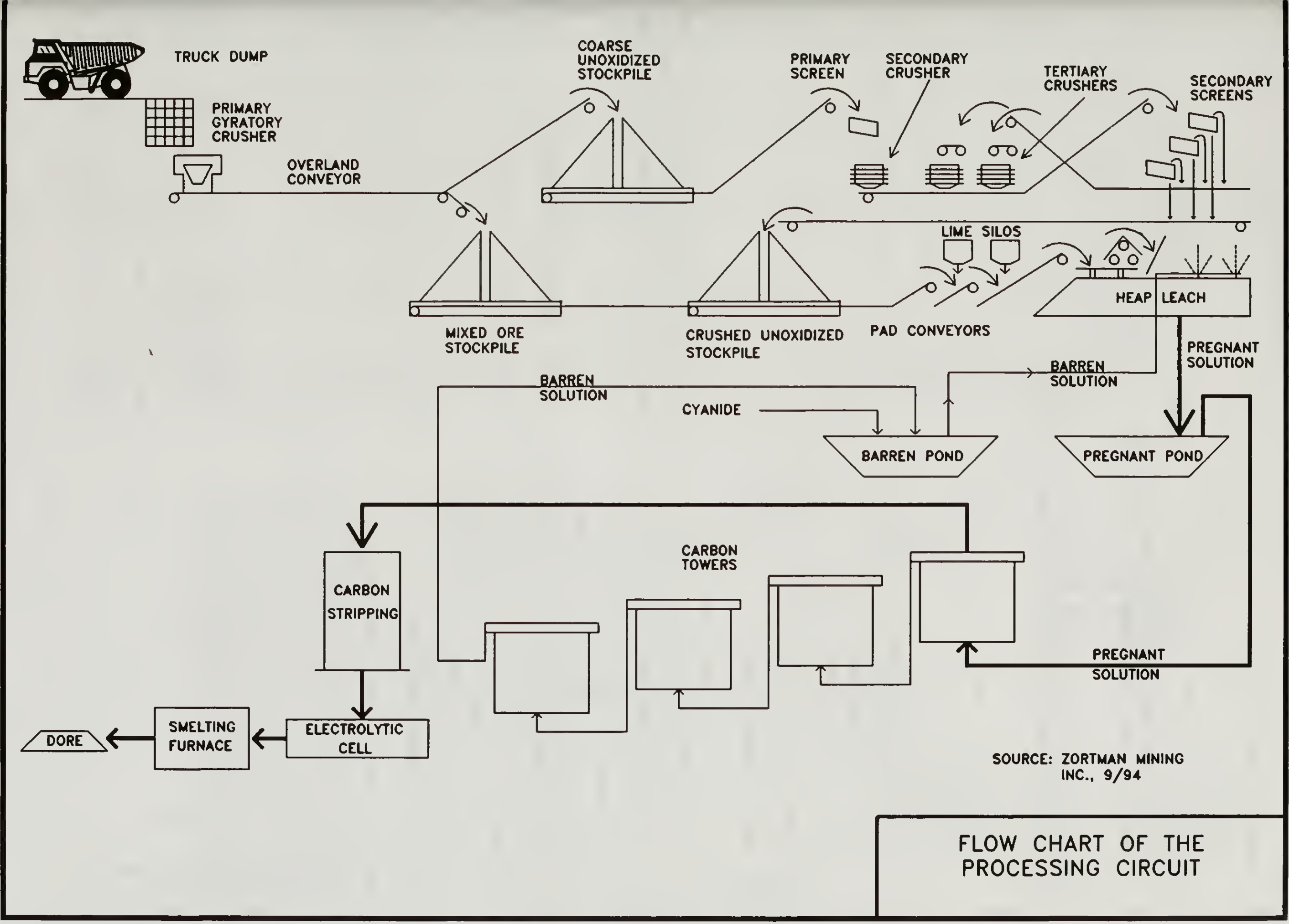
FIG. 2.8-2



ALTERNATIVE 4: MAJOR NEW FACILITIES INCLUDE THE GOSLIN FLATS HEAP LEACH PAD, THE CARTER GULCH WASTE ROCK REPOSITORY, AND THE ZORTMAN MINE PIT EXPANSION.

ALTERNATIVE 4
ZORTMAN-LANDUSKY
EXISTING AND PROPOSED
FACILITY LOCATIONS

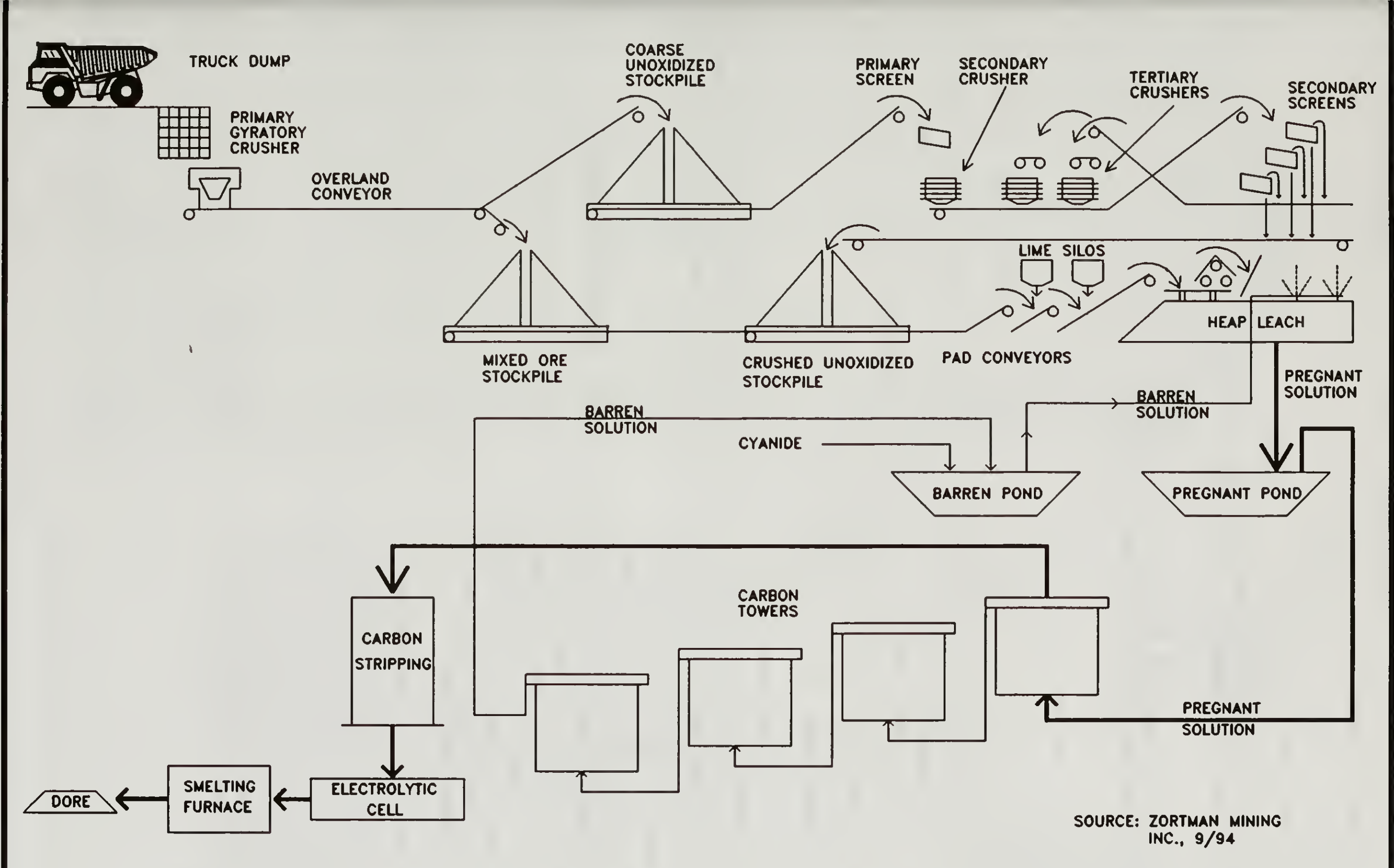
FIG. 2.8-1



FLOW CHART OF THE PROCESSING CIRCUIT

FIG. 2.8-2

173E0008



FLOW CHART OF THE PROCESSING CIRCUIT

173E0008

FIG. 2.8–2

- Development of a solution process plant, strip circuit, and refinery near the heap leach pad.

- Removal of the existing Alder Gulch waste rock dump, for processing on the Goslin Flats heap leach pad.

- Removal of the existing Ruby Gulch sulfide stockpile for processing on the Goslin Flats heap leach pad.

- Construction of a new waste rock repository in Carter Gulch.

- Rerouting of the County road between Zortman and Landusky over Antoine Butte, construction of an underground power line between the Zortman and Landusky mines, upgrading of haul roads, and development of a new cover soil stockpile.

- Expansion of the Seaford clay pit for bentonitic shale to be used for soil liner construction and various reclamation needs.

- Development of a limestone source (LS-1), south of Green Mountain, for use during reclamation.

The ore crushing and ore conveyance systems represent a change from the current processing operations at Zortman, where run-of-mine ore was transported to the leach pad by truck. Production is proposed at approximately 60,000 to 80,000 tons per day, with mining and leaching operations performed on a year-round basis. Table 2.8-2 summarizes currently permitted and disturbed acreages, proposed increases in disturbance area, and tons of ore and waste rock already mined and proposed to mine. The summary is based on currently approved ore and waste tonnages through Amendment No. 11 to the Zortman Mine Permit.

Mining and related operations would take place 7 days a week, 24 hours per day, 350 days per year. ZMI projects that the CPA work force would be similar to current operations, with approximately 260-280 full time employees, depending on seasonal requirements. (This figure, however, is based on operation of only one mine since the Zortman and Landusky mines share work a force. If both mines are operating, approximately 360 to 380 full time employees would be required.)

TABLE 2.8-2
EXISTING AND PROPOSED
DISTURBANCES - ZORTMAN

Description	Currently Permitted	Proposed Additional[1]	Proposed Total
Permit Boundary (Acres)	961	4,794	5,755
Permitted Disturbance Area (Acres)	401	1092	1,493
Total Ore (Tons)	20,200,000	80,000,000	100,200,000
Total Waste Rock (Tons)	11,300,000	60,000,000	67,800,000

[1] Includes buffer zones for contingency modifications.

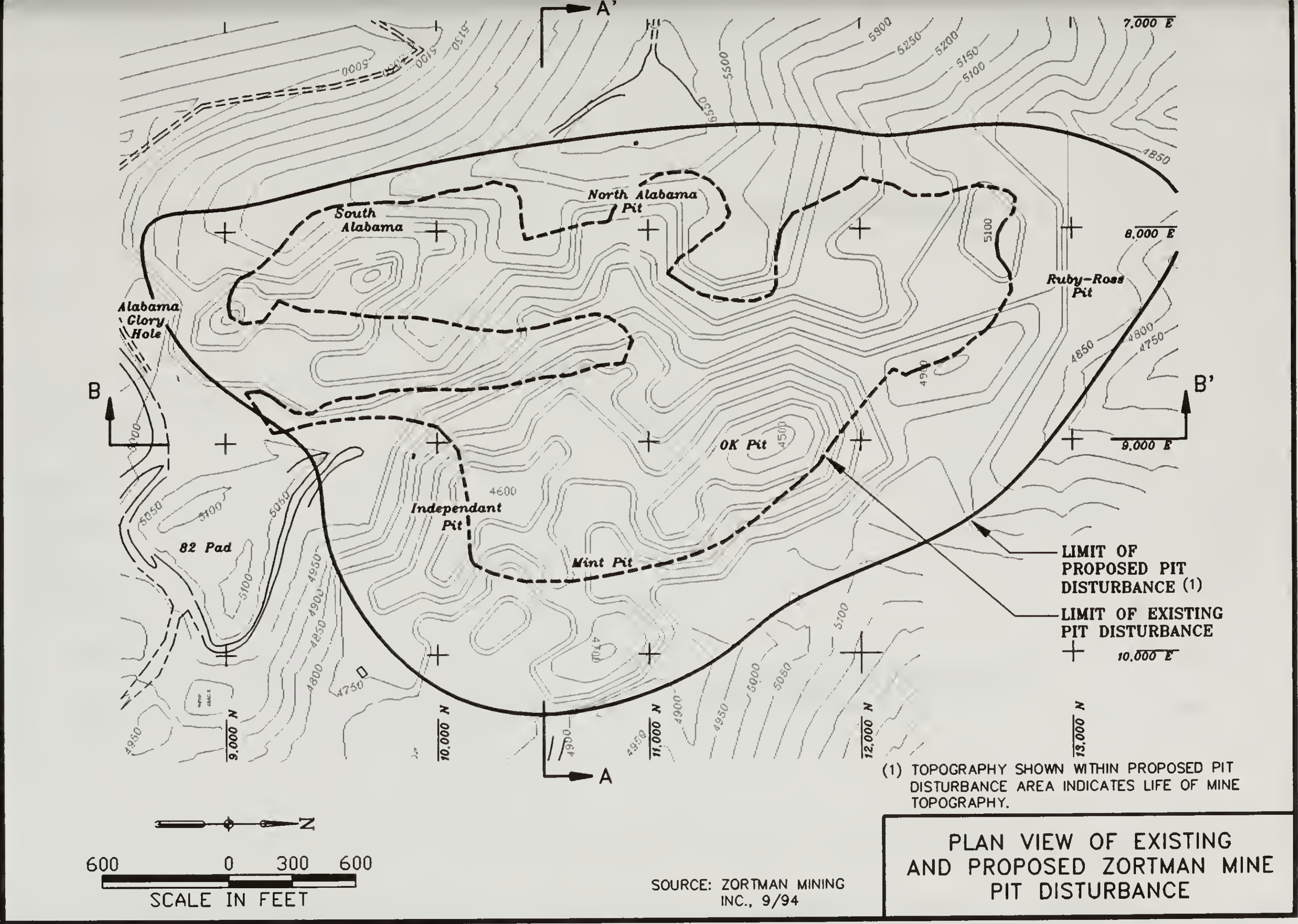
The material handling, crushing, overland conveyor, heap stacking and solution carbon adsorption systems are designed to operate 24 hours per day, 7 days per week, 52 weeks per year. The carbon stripping system and metals refinery are designed to operate 8 hours per day, 5 days per week, 50 weeks per year.

2.8.1.1 Mine Pit Expansion

The CPA would involve lateral and vertical expansion of the open pit complex at the Zortman mine (the South Alabama, North Alabama, OK, Ruby, Ross, and Mint pits combined). Proposed mining would access ore and waste which are located both adjacent to and in deeper portions of the existing pit complex. In some areas, the outer edges of the pit would be extended up to 600 feet or more laterally. The pit would be deepened approximately 500 feet in some ore zones, to an elevation of about 4,500 ft. A plan view of the pit complex is shown on Figure 2.8-3. Typical cross-sections of the pit area are shown on Figures 2.8-4 and 2.8-5.

Mining Methods

Material is proposed to be mined from previously permitted and new pit areas. An overall 0.68:1 to 0.75:1 waste/ore stripping ratio is expected. Mine operations associated with the expanded orebody would follow conventional open pit methods presently used. Ore would be mined via drill, blast and transport methods using haul trucks, loaders and shovels. Blasting would



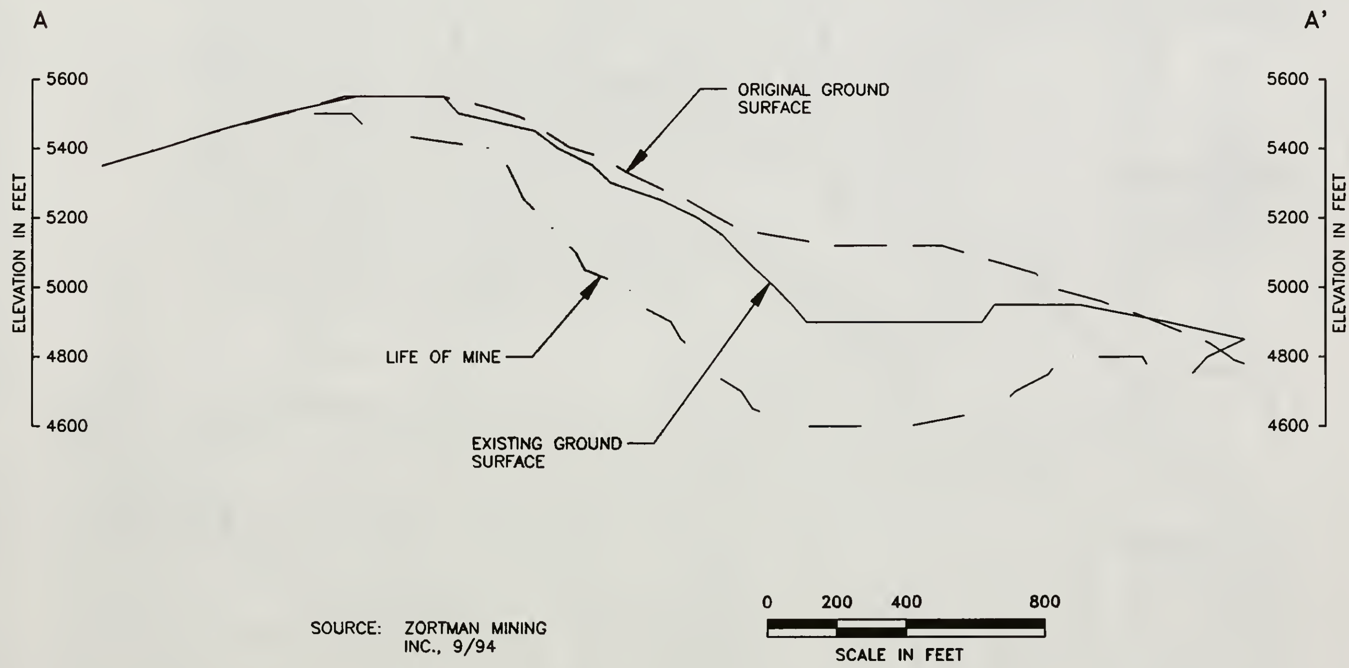
(1) TOPOGRAPHY SHOWN WITHIN PROPOSED PIT DISTURBANCE AREA INDICATES LIFE OF MINE TOPOGRAPHY.

SOURCE: ZORTMAN MINING INC., 9/94

PLAN VIEW OF EXISTING AND PROPOSED ZORTMAN MINE PIT DISTURBANCE

FIG. 2.8–3

173E0010

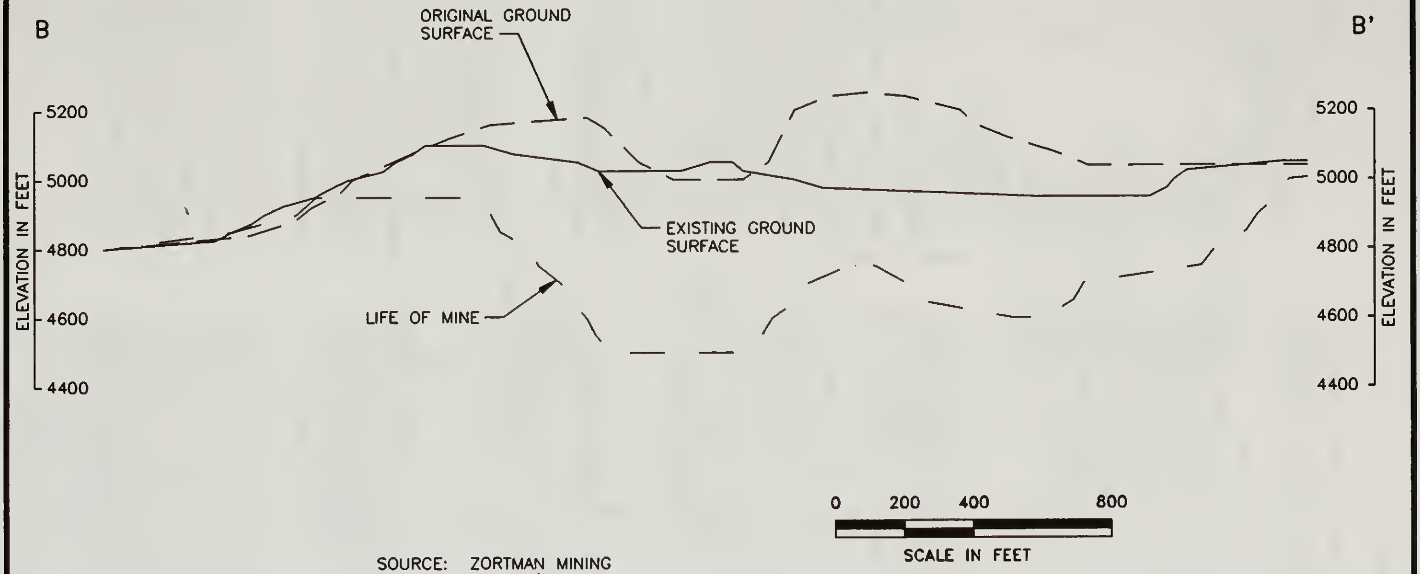


SOURCE: ZORTMAN MINING INC., 9/94

NOTE: SEE FIGURE 2.8-3 FOR CROSS-SECTION LOCATION

TYPICAL E-W SECTION (10,500N SECTION) AT ZORTMAN MINE

173EZA-A



SOURCE: ZORTMAN MINING INC., 9/94

NOTE: SEE FIGURE 2.8-3 FOR CROSS-SECTION LOCATION

TYPICAL N-S SECTION (9000E) AT ZORTMAN MINE

FIG. 2.8-5

173EZB-B

be accomplished using rotary drills with holes drilled on approximately 13' by 13' centers. A mixture of ammonium nitrate and fuel oil (ANFO) would be used as the main blasting agent.

After blasting, oxidized ore would be loaded onto haul trucks and transported to a primary crusher, located at the crushing area near the pit. After an initial crushing the ore would be transported via a conveyor system to a stockpile adjacent to the heap leach operation. Unoxidized ore would also pass through the primary crusher and conveyed to a separate stockpile. The crushed unoxidized ore would pass through secondary and tertiary crushing in an enclosed facility near the leach pad (see Section 2.8.1.2).

Rock Characterization

The materials and their relative amounts to be mined during expanded operations at the Zortman Mine are as follows. (See Section 3.1 for a description of the geology of the area, including descriptions of rock types and typical mineral associations.)

- **Tertiary Intrusives** - Tertiary syenite porphyries comprise the largest percentage of rock to be mined from the Zortman pit complex, at about 64% of the total rock volume. Quartz monzonite is another Tertiary intrusive, making up about 7% of the rock mined. The Tertiary intrusives would contribute approximately 70% of the ore processed, with the remainder classifying as waste rock.

- **Archean Metamorphics** - Approximately 21% of the rock to be mined would consist of metamorphic rocks from the Archean, primarily amphibolites (13%) and felsic gneisses (8%). Slightly more than half of this material would be suitable for ore processing, with the remainder classifying as waste rock.

In addition to the rock types listed above, minor amounts (2%) of quartzite, breccia, and Cambrian shale would be mined, with approximately one half of this material suitable as ore. The major rock types and their relative ore and waste percentages are presented in Table 2.8-3, below.

ZMI has estimated that about 43% of the material removed during expanded mining operations would be classified as waste rock; in other words, the rock has insufficient content of gold or silver to be worth processing, and it would be placed in the waste rock repository. The presence of sulfide minerals in mining waste is of concern due to their potential to form acid rock drainage (ARD) and for metals to be introduced to adjacent waters. However, the sulfide content is also important as it can be used to predict the potential of waste material to form ARD, and the ability to develop effective ARD source control measures is dependent on an ARD prediction program. A geochemical sampling and testing program has been proposed by ZMI for the Zortman Mine expansion to minimize the risk of ARD from the proposed waste and heap leach facilities (see Figure 2.8-6).

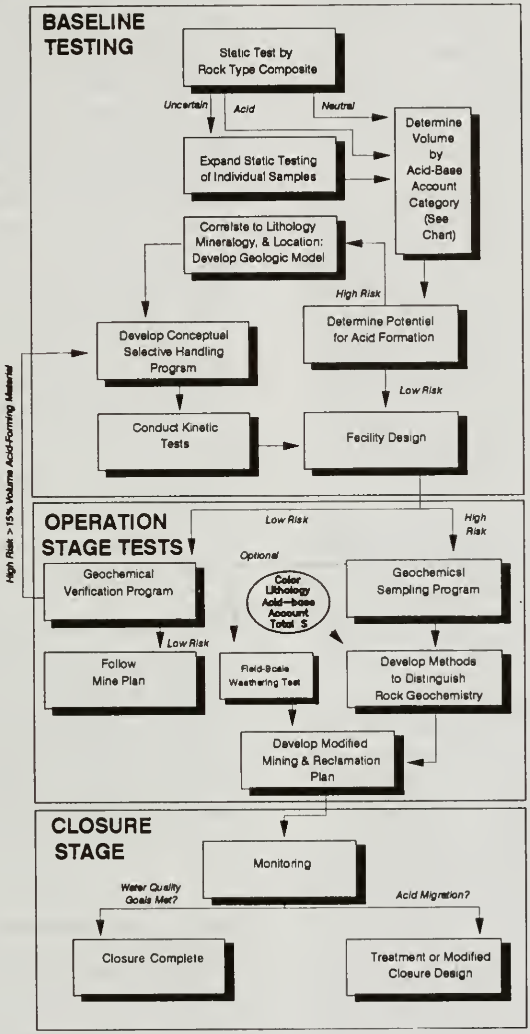
TABLE 2.8-3
ORE AND WASTE ROCK TYPES

Relative Age and Rock Type	Percent of Rock to be Mined	Percent Ore	Percent Waste
Tertiary: Syenite Porphyries	64%	35%	29%
Archean: Amphibolites	13	6%	7%
Archean: Felsic Gneisses	8%	6%	2%
Tertiary: Monzonite	7%	5%	2%
Quartzite, Breccia, & Cambrian Shale	2%	1%	1%
Unclassified	6%	4%	2%
Total	100%	57%	43%

Geochemical sampling and testing of ore and waste materials was initiated prior to permit application submittal, and is on-going. These studies include Schafer and Associates 11/92, and Schafer and Associates 6/94.

Using results of the geochemical studies, ZMI has established a database that includes information on sample lithology, degree of weathering, color (and other readily observable field characteristics), and total sulfur content. The database is continually updated with additional sample information. The purpose of the database is for comparison of field characteristics to total sulfur values so that potentially acid forming and non-acid forming rocks can be readily identified in the field.

The geochemical sampling program would continue during mining to identify suitable (non-acid forming) and unsuitable (acid forming) waste rock. For the expansion project, a composite sample would be collected from every third drillhole (i.e., every 39 feet x 39 feet per 20 foot bench; about one sample per 1100 yd^3) and analyzed for total sulfur content.



SOURCE: ZORTMAN MINING INC., 9/94

GEOCHEMICAL EVALUATION FLOWCHART FOR PREDICTING THE ACID-FORMING POTENTIAL OF WASTE AND ORE FOR THE PROPOSED ZORTMAN PROJECT

FIG. 2.8-6

Additionally, a split from approximately one in one hundred drill hole samples would be submitted for complete ABA analysis. Data from these tests would be used to correlate total sulfur values to ABA values. Other field parameters would also be correlated to ABA values when possible. Sample splits would also be submitted for complete acid base accounting analysis when material exhibiting unusual lithologic or mineralized characteristics is encountered.

A database has been established which contains the above described information. Since sulfur content may be estimated in the field (while ABA values can not), total sulfur contents have been established to correspond to ABA values which characterize non-acid forming (ABA typically > +20); acid forming (ABA typically < -20); and uncertain waste types (ABA typically -20 to +20). The information developed in the rock characterization program would be used in determining how various waste rock types would be handled and segregated at the proposed waste rock repository in Carter Gulch, as described in the following section.

Waste Rock Handling

Waste rock would be hauled by truck to the Carter Gulch waste rock repository. Placement of the waste rock within the repository would be dependant on the material's potential to create acid drainage. Use of waste rock in facility construction and mine reclamation, and disposition of the waste rock, would depend on it's sulfur content, as shown in Table 2.8-4.

TABLE 2.8-4
WASTE ROCK SEGREGATION AND ANTICIPATED VOLUMES

CATEGORY[1]	TOTAL SULFUR[2] (%)	WASTE GENERATED, IN TONS & PERCENT
"Blue" Waste Rock (Non-Acid Forming)	0 - <0.2	7.43 million (12%)
"Yellow" Waste Rock (Uncertain Waste)	0.2 - 0.5	20.4 million (34%)
"Green" Waste Rock (Acid Forming)	>0.5	28.7 million (49%)

[1] A color coding scheme has been used to categorize waste rock for ease of identification and tracking

[2] Total sulfur would be assessed during materials testing as described below.

ZMI proposes a mine waste classification and selective handling plan based on total sulfur content. Non-acid forming, or "blue" waste, would contain less than 0.2% total sulfur and could be used in construction without restriction on the basis of geochemical properties. This waste would be stored alongside the waste rock repository. Uncertain, or "yellow" waste, would contain 0.2 to 0.5% total sulfur and would be used in construction over which an impermeable cover would be placed. This waste may be used in reclamation and would be stored around the margins of the waste rock repository within the volume of waste to be protected by barriers. Acid forming, or "green" waste, would have greater than 0.5% total sulfur and would not be used in any construction. Green waste rock would be placed in the core of the waste rock repository.

Waste handling would rely on the following steps:

1. Any block which contains only blue waste blast holes would be scheduled as blue waste.

2. Any block which contains a mixture of blue waste and yellow waste blast holes would be considered yellow waste.

3. Any block which contains any green waste blast holes would be scheduled as green waste.

4. Any waste of uncertain character would be considered green waste.

2.8.1.2 Crushing Operation

Metallurgical testing at Zortman has shown that unoxidized ore must be crushed to facilitate gold recovery. Crushing reduces the size of individual ore fragments, thereby increasing the surface area upon which the heap leach chemicals will act to separate gold from the rock matrix. Figure 2.8-2, shown earlier, illustrates the crushing systems and other processes used to move ore from the pit and prepare it for leaching. A brief description of the crushing procedure follows.

Ore would be hauled from the mine pit in trucks and placed in a truck dump hopper, located at the crushing area near the pit. In the event the hopper or conveyor system are inoperable, the ore would be placed in a stockpile adjacent to the primary crusher. Oxide ore would be crushed to less than 6" in diameter by a primary crusher, then conveyed to a mixed ore (both oxidized and unoxidized ore) stockpile located near the Goslin Flats leach pad. Unoxidized ore would also be processed through the primary crusher, and then pass through additional crushing mechanisms in an enclosed facility near the leach pad. The unoxidized ore requires additional crushing since it needs to be in smaller fragments than the oxide ore for the leaching process to extract gold and silver.

Unoxidized ore would be placed in a coarse ore stockpile near the leach pad and fed into the secondary and tertiary crushing mechanisms. These crushers would be located in two buildings connected by conveyors. The secondary and tertiary crushers would operate continuously with a pass-through rate of approximately 1,000 tons/hour, although up to 2,000 tons/hour could be processed if necessary. The crushed, unoxidized ore coming out of the tertiary crusher would be fed into either the mixed ore stockpile or placed in a third stockpile containing only crushed, unoxidized ore.

Therefore, three stockpiles would be developed near the Goslin Flats leach pad to hold ore. The mixed ore stockpile, with an 87,500 ton capacity, would contain approximately 70% oxide ore and up to 30% crushed unoxidized ore. The remaining crushed unoxidized ore would be placed in a second stockpile with a capacity of 19,400 tons. Both the mixed ore stockpile and the crushed unoxidized ore stockpile would be used to hold ore pending transport to the heap leach pad. The third stockpile, with a capacity of 68,100 tons, would be used to hold coarse (only crushed once in the primary crusher) unoxidized ore pending additional crushing. The crushing facilities and ore stockpiles by the leach pad would encompass about 22 acres of disturbance.

The truck dump, primary crusher and ore stockpile area adjacent to the mine pit would be illuminated using mercury vapor or similar type bulbs directed downward from dusk to daylight, seven days per week. Six to eight lights fixed 15 to 40 feet above ground level would be required in this area. The ore stockpiles and secondary and tertiary crusher areas near the leach pad would be illuminated using mercury vapor or similar type bulbs directed downward from dusk to daylight, seven days per week. Five to eight lights fixed 15 to 40 feet above ground level would be required in this area.

2.8.1.3 <u>Conveyor System</u>

An overland conveyor system would be used to connect mine operations at the open pit complex with the heap leaching facilities at Goslin Flats. As illustrated on Figure 2.8-1, the conveyor would originate near the 84 leach pad, travel southeast through Alder Gulch, and enter Goslin Flats through the gap just west of Whitcomb Butte.

The overland conveyor would be about 12,000 feet long with an elevation drop of about 1,000 feet. The conveyor would, in most areas, be five and one-half feet (5.5') from ground level to the top of the dust-control covers at the two transfer points, and have approximately two feet (2') of clearance below the bottom belt. Seven bridge sections are proposed that would have bridge heights ranging from 9 to 90 feet. Spans would range from 15 feet to 650 feet.

The conveyor belt would be approximately 42 inches wide with dust-control covers placed at the ore transfer points near the primary crusher and at the stockpiles near the secondary and tertiary crushers (see Appendix C, Air Quality Permit Application, for a description of proposed dust suppression measures on the conveyor and other mine facilities). The conveyor would travel at about 800 feet per minute with a design capacity of approximately 2,000 tons per hour. The conveyor would generate 1200 kV of power, which would be sent back into the local utility power grid. A roadway would be constructed along the conveyor route, where possible, for maintenance access. A 200-foot corridor with an average disturbance of 50 feet would be required for the conveyor and roadway.

The conveyor corridor would be fenced with four strand barbed-wire to limit public access. Security patrols of the corridor would further minimize public access to conveyor facilities. Public access to the southern range of the Little Rocky Mountains through Pony Gulch would be maintained. Due to the steep terrain involved on the route, fencing would not be possible the entire length of the conveyor.

The overland conveyor would be illuminated at two transfer points, one near the primary crusher by the mine and the other near the ore splitter adjacent to the ore stockpiles. Lighting would be provided by mercury vapor or similar type bulbs directed downward dusk to daylight, seven days per week. Two to four lights located 15 to 40 feet above ground would be required at each transfer point. Lighting would also be required from the mixed ore and crushed unoxidized feed conveyors to the stacker from dusk to daylight, seven days per week. Lighting would be provided by mercury vapor or similar type bulbs spaced every 15 feet, affixed 3 to 5 feet above the conveyor belt.

An emergency surge hopper would be placed at the end of the overland conveyor near the heap leach pad site. This hopper would be used to contain material discharged from the overland conveyor during any abnormal conveyor stoppage.

Transfer conveyors would feed material to the self propelled stacker on the heap leach pad. Lime for pH control and barren process solution for dust control would be added to the material on the transfer conveyors. Areas where barren process solution is added would be lined with drainage directed toward the pad or solution capture system. Blended ore would be stacked onto the leach pad in multiple lifts using the self propelled stacker operating on top of the heap. The heap stacking process would be repeated until the maximum capacity of the heap leach pad is reached.

2.8.1.4 Goslin Flats Heap Leach Pad

The heap leach pad and adjacent facilities, shown on Figure 2.8-7, would cover approximately 250 acres situated in the Goslin Gulch drainage, a natural bowl created between Saddle Butte, Whitcomb Butte and the Ruby Creek drainage. Surface water diversions would direct natural flows away from the leaching facility toward the Ruby Creek drainage. The leach pad would be approximately 5,200 feet long by 1,800 feet wide and would be sized to contain 80 million tons of ore, the presently anticipated reserves. The heap leach pad liner design includes layers of compacted clay, a synthetic PVC (polyvinyl chloride) membrane, and a crushed rock protective layer. Ore would be stacked in 25 foot lifts to a maximum depth of approximately 200 feet.

The Goslin Flats heap leach pad is designed as a modified flat leach pad (see Figure 2.8-8). Unlike conventional flat leach pads the proposed pad would incorporate in-heap impoundment of solution to reduce pond costs and to aid cold weather operation. As shown on Figure 2.8-8, the leach pad design includes a composite liner and internal and external berms to contain and segregate the solutions. The perimeter berms would be approximately 5-feet high with approximate 2.5H:1V side slopes. Internal berms would be 4 feet high with 2.5H:1V slopes. Low dikes would also be constructed at the middle and lower end of the heap. The dikes would allow solution to collect in the heap. A surge capacity of about 30 million gallons of solution would be available as in-heap impoundment. An operational head (hydrologic pressure) of about 20 feet would be maintained on the liner at the dikes during normal operations. The system could handle a maximum of 40 feet of head.

The perimeter of the pad and process area would be fenced with 6 ft Page wire (similar to field fence, a 9 to 12 gauge woven wire). These fences would have 7½' steel posts and 8' set posts 6" in diameter. All posts would be placed 15' apart and the Page wire reaches 6' high. The pad and process area perimeter, as well as the ponds within the perimeter, would be fenced to ensure wildlife protection. The ponds would also be netted to keep birds from landing on the ponds.

The Goslin Flats location would also be used to contain up to 1,000,000 cy^3 of cover soil salvaged during construction of the pad and plant facilities. The soil from leach pad construction would be stockpiled on approximately 48 acres next to the leach pad. This cover soil would later be used in reclamation activities.

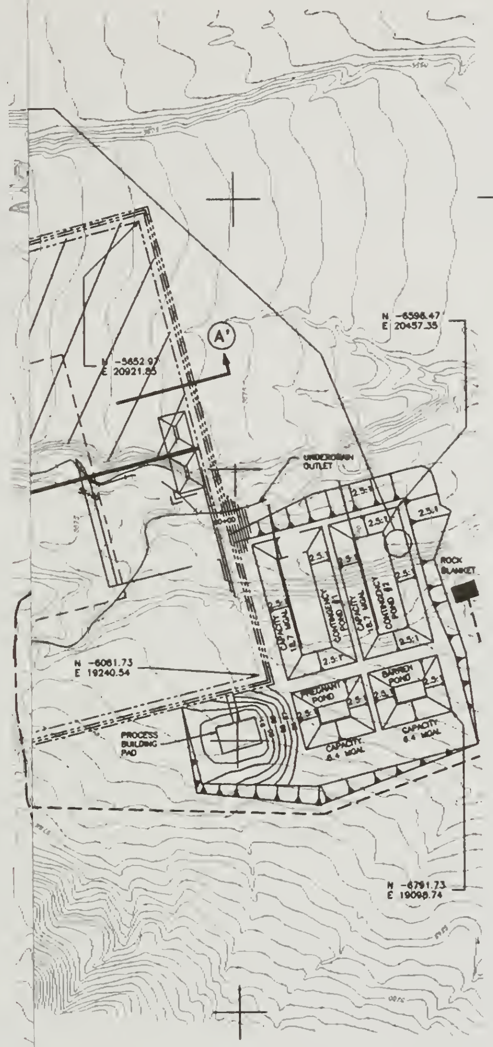
Leach Pad Construction

The following sections describe the construction and operation of the heap leach pad and how leaching solution is processed.

Foundation - Cover soil from Goslin Flats salvaged during construction of the heap leach pad would be picked up in two lifts and stockpiled separately, one for cover soil and the other for subsoil. The subsurface would be regraded to create a stable foundation surface and to ensure effective leach solution drainage from each cell to the retention pond. Materials considered unsuitable for the pad foundation, such as wet, frozen or soft soil, would be excavated and stockpiled. Structural fill would be required in some areas of the leach pad foundation to attain the desired grades; in other words, to make sure that the leach pad is sloped from north to south, so that solution would drain to the pregnant and contingency ponds. Subsurface testing of on-site alluvial/colluvium clayey silts, sands, and gravels has confirmed that they are suitable for use as structural fill (Golder Associates Inc. 1993). In addition, since much of the native soil and subsoil under the proposed leach pad area contains calcium carbonate it would be used in construction or reclamation without restriction (see Section 2.8.2.1). Internal berms, sumps and external berms would be constructed using the compacted native material. Filter drains would be installed to prevent a buildup of groundwater beneath the leach pad that might affect liner stability and integrity. Structural fill would be placed in loose lifts of 8 inches and compacted to at least 95% of the Standard Proctor laboratory dry density, a standard unit of measurement employed to maintain quality control as construction progresses.

Dike and berm foundations would be prepared as described above. Interior bank and dike slopes would be no steeper than 2.5H:1V. Internal berms would maintain a minimum crest width of 10 feet, while the heap (outer) embankment would be at least 50 feet wide.

Liner - The leach pad liner system would consist of approximately 12 inches of compacted clay, mined from the Seaford clay pit, overlain by a textured, 30-mil PVC geomembrane. Approximately 347,000 yd^3, or 451,000 tons, of clay would be required for liner construction. The clay would be placed in 6-inch loose lifts and compacted to at least 95% of the Standard Proctor laboratory dry density. Liner detail was presented on



SOURCE: DRAWING ENTITLED "FACILITIES LAYOUT" DATED MARCH 1993 BY GOLDER ASSOCIATES, INC., DENVER, COLORADO. PROVIDED BY ZORTMAN MINING INC., 9/94.

PROPOSED GOSLIN FLATS
HEAP LEACH PAD PLAN

173E0011

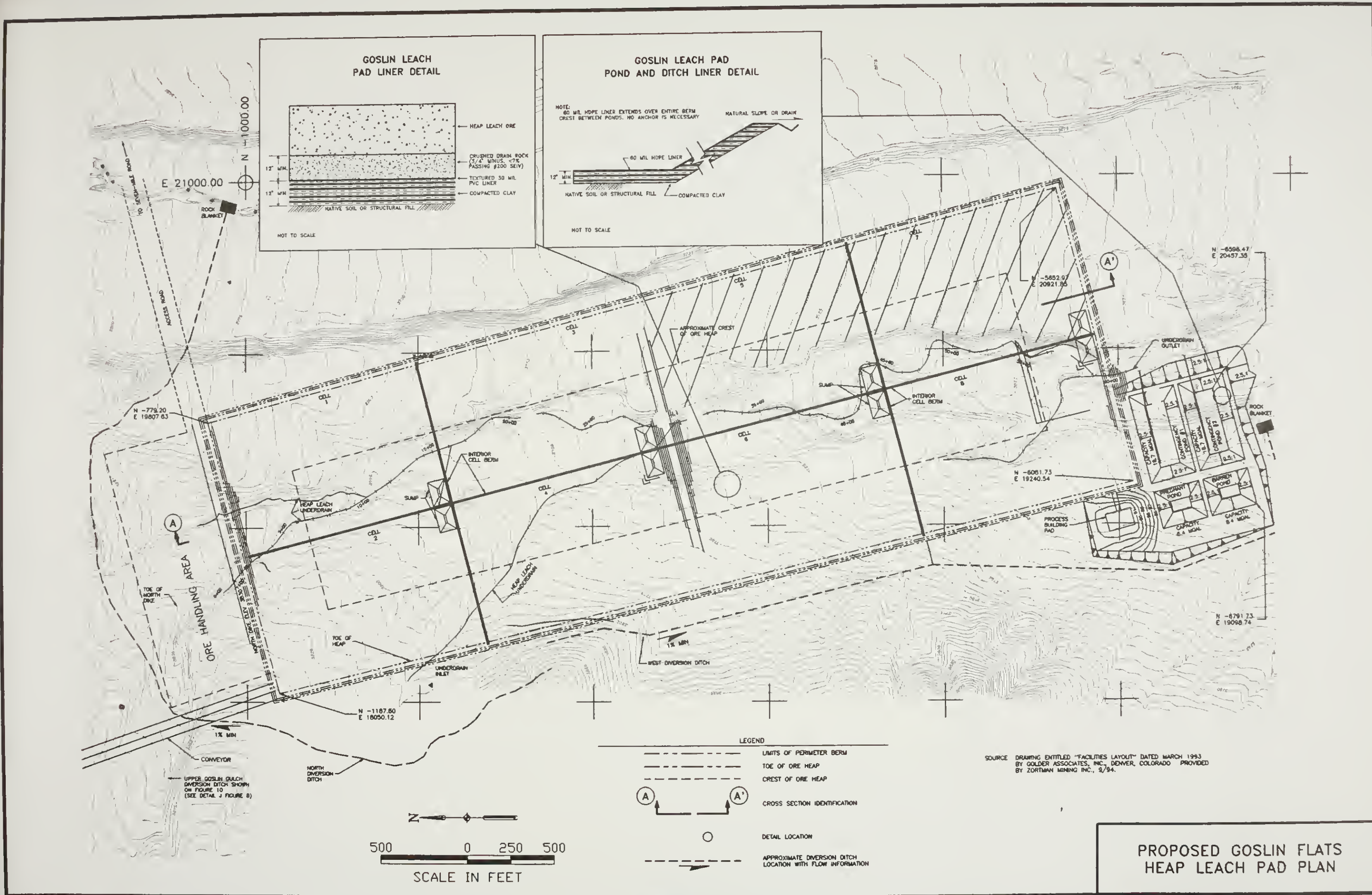
FIG. 2.8-7

HEAP LEACH PAD
CROSS SECTION A-A'

SOURCE: ZORTMAN MINING, INC. 11/94

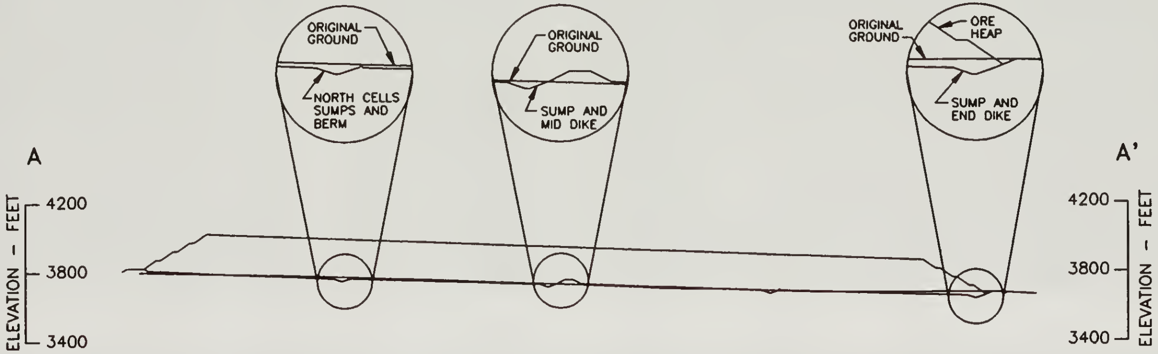
FIG. 2.8-8

173EGA.



173E0011

FIG. 2.8-7



CROSS SECTION A–A': SHOWS TYPICAL SECTION THROUGH PROPOSED GOSLIN FLATS HEAP LEACH PAD WITH DETAILS OF CELLS AND SUMPS TO PROVIDE IN–HEAP IMPOUNDMENT OF SOLUTION TO REDUCE POND COSTS AND AID IN COLD WEATHER OPERATION.

SOURCE: ZORTMAN MINING, INC. 11/94

GOSLIN FLATS
HEAP LEACH PAD
CROSS SECTION A–A'

FIG. 2.8–8

173EGAA1

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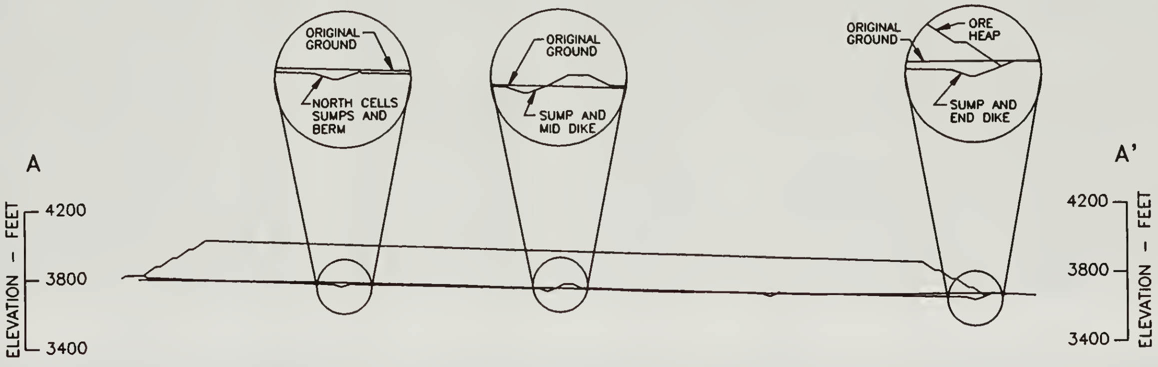


<u>CROSS SECTION A–A'</u>: SHOWS TYPICAL SECTION THROUGH PROPOSED GOSLIN FLATS HEAP LEACH PAD WITH DETAILS OF CELLS AND SUMPS TO PROVIDE IN–HEAP IMPOUNDMENT OF SOLUTION TO REDUCE POND COSTS AND AID IN COLD WEATHER OPERATION.

SOURCE: ZORTMAN MINING, INC. 11/94

GOSLIN FLATS
HEAP LEACH PAD
CROSS SECTION A–A'

FIG. 2.8–8

173EGAA1

Figure 2.8-7. Clay would be hauled approximately 5.5 miles from the Seaford pit to Goslin Flats using ZMI trucks or a contractor fleet. Clay hauled to the leach pad would not require transport through the Zortman townsite. Trucks would be grouped at the clay pit and travel as a convoy under the direction of front and rear pilot vehicles.

A minimum 12 inches of 3/4 inch or smaller crushed rock would be placed on the PVC liner to protect it from potential punctures and tears during ore placement operations, and to provide an effective drainage horizon for solution transfer to the solution collection system. This material would consist of select, competent ore or waste rock which has been crushed and screened to less than 3/4 inch size. No greater than 7% of the material would be silt or clay sized particles.

Ponds - The pregnant, barren, and two contingency ponds would be constructed by balanced cut and fill methods. Interior and exterior side slopes would be 2.5H:1V. Underdrains would be installed to direct groundwater away from the ponds. Fill material would be placed and compacted in lifts and a 12-inch layer of compacted clay placed over the interior. A synthetic liner, consisting of 60 mil High Density Polyethylene (HDPE), would be placed over the clay. The pregnant and barren ponds would each hold approximately 6 million gallons of solution. The contingency ponds would be sized to hold the calculated leach pad runoff from a 24-hour, six-inch precipitation event plus the 36-hour draindown of the leach pad in the event power was lost during the storm event. Therefore, each contingency pond would hold approximately 19 million gallons in storage. All solution ponds would be enclosed with 6-foot wire fencing and covered with netting to keep birds from landing on the ponds.

Birdnetting would be obtained from A&S Tribal Industries using their 1 5/8" by 1 5/8" uv protected pvc. The bird net system consists of 1/8" grid support cable weaved through the netting and anchored by 4" steel casing set in the ground and cemented in place. The bird netting weave points will be placed on 16' centers. Pond netting to be installed would be received in 17' widths. The netting material would be overlapped 6" on each side and laced together with 1/8" weave cable.

Construction Quality Control - Construction of the heap leach pad would begin on the northern-most section of the leach pad (the "upper end") and proceed southerly to the extent of the ultimate design. ZMI would retain a professional engineer or engineering company as an independent inspector to monitor leach pad construction. This inspector would be responsible for monitoring and reporting on all phases of construction to assure that design specifications are met, and that field modifications are justified and summarized. The inspector would perform or oversee material inspections and compaction tests, including compactions tests on structural fill material and the soil liner, permeability tests on the soil liner, strength tests of the soil liner, and grain size analysis of solution underdrain material. The inspector would also prepare daily reports. An as-built report and drawings of the facility would be submitted to the agencies for review.

An independent third party engineering firm would monitor and oversee installation of the synthetic liner, including deployment of the liner to the site. Liner panels would have a minimum overlap of 6 inches and be welded together with an adhesive-bodied solvent on a clean seaming surface. All field seams would be tested using a 30 psi air lance along the entire seam. Where air pockets or riffles are observed, they would be marked, repaired, and air lanced again to ensure proper bonding. The entire liner area would be inspected. Wrinkles, punctures, or defects that may be detected would be repaired and tested in order to ensure proper bonding. Additionally, seam analysis samples would be collected and sent to a certified laboratory for peel adhesion and bonded seam strength (shear) to confirm field testing and observation. Quality control reports and drawings of the facility would be submitted to the agencies for review.

Leach Pad Operation

Generally, facility operation at the Goslin Flats site would include: the leaching of ore stacked on the pad; collection of pregnant solution at the bottom of the heap in one of eight operating sumps; transfer of the pregnant solution to ponds for storage prior to metal extraction; the metal extraction process itself; and the storage of barren solution in a pond for re-application to the ore heap.

Leach solution would be sprayed onto the heap at an average application rate of 0.005 gal/min/sq ft (approximately 1/2 inch per hour). A system of pipes and valves would allow the solution that is retrieved from the collection sumps to be redistributed to the heap or sent to the process plant. Ore materials placed on the leach pad would vary from less than 1/2 inch to less than six inches in size. An oxide/un-oxide blend would be leached on the pad with lime added at a rate of approximately 4-8 lbs/ton of ore prior to loading. The mix of ore would typically be approximately 50% oxide/un-oxide, although there would be occasions where only oxide or only unoxidized ore would be loaded. Lime addition would increase pH values to enhance ore leaching.

The elevation of the bottom of the heap leach pad would be constrained by the requirement for gravity to control leach solution drainage to the pregnant and contingency ponds. Solution collection casings would be placed in the bottom of each of the internal collection sumps and solution removed by pumps installed in the sumps. Pumps would transfer solution to the main lines where the solution would either be redistributed on another area of the heap or advanced to the pregnant pond. Solution from the heap that is of sufficient grade to send to the processing plant would be placed in a separate line to carry the solution to the pregnant pond. Solution exiting the process plant would flow to the barren pond before reapplication on the heap. Reagent quantities in the barren solution would be adjusted and the solution reapplied to the heap via the distribution header leading to the spray hubs.

Solution Management

Figure 2.8-7 shows the location of the processing facilities, including the process plant and ponds to collect, store and control processing solutions. No discharge of solution entering the processing facilities is proposed as part of the normal operations, other than that solution which enters the atmosphere as evaporate.

The volume of solution required for ore processing would be maintained by adding makeup water during periods of net solution deficit (i.e., dry months), and by temporarily storing solution during periods of net solution surplus (i.e., higher precipitation months). Temporary solution at the Goslin Flats leach pad would be stored within the heap, in the pore space of the ore in the sumps and behind dikes, or in surface ponds. The average external makeup water rate is expected to be 140 gallons per minute.

Pond Capacity - The barren and pregnant solution ponds would be sized to store approximately one day's maximum anticipated process plant requirements plus one million gallons contingency. Based on a maximum process flow rate of 3,500 gallons per minute, the barren and pregnant ponds would be sized to retain approximately 6 million gallons each.

The total in-heap storage capacity is approximately 30 million gallons, with 14 million gallons impounded by the middle dike and 15 million gallons in the south dikes and their associated sumps. The contingency ponds have been sized to store a total of approximately 38 million gallons of solution. In total, the system (barren, pregnant and contingency ponds, and middle and south dike retention ponds) would have a solution storage capacity of approximately 80 million gallons.

Heap Draindown - Heap draindown is the process through which the moisture content of the ore at the time leaching is conducted is reduced to an amount which the ore can retain after leaching stops. This reduction in moisture content adds free solution to the system, thereby increasing storage requirements and reducing storage capacity. A certain amount of operational draindown occurs through the heap leaching process, as active leaching advances from one portion of the ore heap to another, thereby isolating some ore from the active leach cycle.

It is possible that a heap leach facility's solution pumps could become inoperable, thereby removing some or all of the ore being leached from the active leach cycle. In such instances, excess solution drains from the ore. This circumstance is known as emergency draindown. Should an emergency draindown occur during the a design storm event (6-inch, 24-hour) excess solution would accumulate at the rate of approximately 1.4 million gallons per hour. ZMI has proposed a Goslin Flats leach pad design to accommodate a design storm and pump shutdown duration of 36 hours.

Solution Pipeline - A 10-inch steel, Schedule 40 grade B pipeline, double-lined with a 12-inch ADS pipe, would be constructed along the conveyor route. The pipeline would transport excess, weak cyanide solution of less than 25 mg/l WAD from the existing Zortman and Landusky mine facilities down to the Goslin Flats process plant where it can be used in the process circuit (see Figure 2.8-1 for pipeline route). Additional information concerning the use of weak cyanide solution can be found in section 2.8.2.

The pipeline would be placed next to the conveyor line on the cut side of the maintenance roadway where underlying material is very competent. The double-lined pipe would follow the conveyor route on the roadway and over bridges, including the Alder Gulch crossing at a constant grade. Flow monitoring in the pipeline would be accomplished through the use of pressure or flow sensors that would automatically activate valve closures and pump shutdown, in the event pressure or flow fluctuated above or below a normal operating range due to leakage or rupture of the steel pipeline. The double-lined pipeline would convey leakage, if present, into the lined process ponds at Goslin Flats.

Processing Plant Operation

A plant encompassing approximately 23 acres (including ponds) would be constructed at the southwest toe of the leach pad where solution from the pregnant pond would be processed to extract gold and silver. Five columns filled with activated carbon would collect the metals through an adsorption process, which means the metals would drop out of solution by fixing to the carbon particles. An average flow of 2,500 gpm of pregnant solution would pass through the columns, although the plant would be sized to handle up to 3,500 gpm. Pregnant solution would enter the first carbon column from the bottom, contact carbon as it proceeds upward, and overflow into a collection system where it would gravity-feed into the next column. Flow would continue in this way through all five columns, and exit the last column as barren solution. Eventually carbon in the first column would reach a maximum loading and the carbon would not be able to adsorb any more metals. When this occurs the "loaded" carbon from the first column would be transferred to the carbon stripping circuit, described below.

Precious metals would be removed from each batch of loaded carbon in the stripping system. In this process, the temperature and pressure are elevated to about 210°F and 15 psi, respectively. A caustic solution is introduced into the carbon which strips the metal from the carbon. After gold and silver have been removed from the carbon, the solution would be pumped through an electrolytic cell. A current running through this cell transfers or "plates" the metals onto steel wool cathodes. The cathodes would then be sent to the refinery, mixed with a flux, and smelted in a furnace to produce dore. The dore would be stored until shipment to a commercial refinery for furthering purification.

ZMI expects to collect about four tons of "loaded" or metal-laden carbon per day of operation. The carbon can be reused after the metals have been stripped, but after repeated cycles impurities build up on the carbon which cannot be completely removed by acid washing and elution. These impurities reduce the ability of the carbon to adsorb metals. To regain this capacity, the carbon would be reactivated by heating in the presence of steam in a slightly oxidizing atmosphere. Wet carbon would be loaded into a rotary gas-fired reactivation kiln where it would be heated to about 1300°F. This process would oxidize organic impurities in the carbon and create new micro-pores to restore most of the adsorption capability.

The processing plant yard and pregnant, barren and contingency pond areas would be illuminated using mercury vapor or similar type bulbs directed downward from dusk to daylight, seven days per week. Lighting would be spaced every 25 to 50 feet, 15 to 40 feet above the ground. Approximately 15 to 20 lights would be required in the process plant and pond area.

Reagent Handling

Major reagents, including cyanide for leaching and lime for pH control, are proposed to be consumed at a rate of approximately 1 lb. and 4-8 lbs/ton of ore, respectively. Lime in the form of calcium oxide would be shipped at a rate of approximately 5 trucks per day, with an annual usage of approximately 36,000 tons per year. Lime would be stored in silos near the leach pad. Cyanide, in the form of sodium cyanide, would be brought in at a rate of one truck every other day with an annual usage of approximately 6,000 tons per year. Sodium cyanide used in ore leaching would be mixed in an agitation tank at the processing plant. Barrels of dry cyanide are also used in the carbon strip plant. The estimated annual use is approximately 82 tons per year.

Because cyanide is a potentially toxic compound ZMI has prepared a contingency plan in the event of a cyanide spill at the Zortman or Landusky mines. This plan contains information on spill discovery, notification, containment, neutralization, cleanup and reporting (ZMI August 1991). Calcium hypochlorite would be used to neutralize spilled cyanide solution where the spill pH is greater than 10 and the cyanide concentration is less than 500 mg/l. If the pH is less than 10 or the cyanide is in a concentrated solution, lime would first be added to raise pH and dilute the concentration. Dry or highly concentrated cyanide solutions would never be treated with calcium hypochlorite due to the potential formation of cyanogen chloride (a toxic gas), and if water comes in contact with dry cyanide hydrogen cyanide gas could be released. Dry cyanide spills would be swept or shoveled into containers by cleanup personnel wearing suitable protective equipment. The material could then be disposed into the barren pond. The ore processing facilities are designed to contain all spills within the buildings with a drain trench connected to the process ponds. The ore processing building would have a containment curb sized to hold at least the solution capacity of the carbon columns and holding tanks.

More information on the use of chemicals in mining and ore processing operations is found in Sections 2.8.1.8 and 3.14, Hazardous Materials.

2.8.1.5 Carter Gulch Waste Rock Repository

Prior to construction of the new Carter Gulch waste rock repository, ZMI would remove all of the waste rock, approximately 3.4 million tons, from the existing Alder Gulch Waste Rock Dump. The existing material in Alder Gulch is seeping poor quality water from the toe of the dump, and removal of the material would reduce impacts to the drainage. This material would be relocated to the leach pad at Goslin Flats for further processing as ore.

The proposed new waste rock repository would be constructed in Carter Gulch, a fairly steep side drainage to Alder Gulch (see Figure 2.8-1). Approximately 162 additional acres would be needed to store the waste rock generated by the CPA. The waste rock repository would be designed to hold 78 million tons, although ZMI's proposed action would generate approximately 60 million tons. The additional repository capacity is proposed for two reasons. First, the amount of waste rock generated could be greater than anticipated due to the variations in the stripping ratio. In addition, some potential exists for mining beyond that proposed in this action, and additional waste rock storage could be required under this reasonably foreseeable development (see Section 2.8.6).

Repository Construction

Construction of the waste rock repository would begin at the design toe. The first lift of waste would be end-dumped approximately 125 feet in height to compensate for the limited access to the toe area. Following completion of this lift, successive 25-foot lifts (see Figure 2.8-9) of waste rock would be placed on a one percent grade and backsloped so that surface water can be diverted away from the face of the waste rock storage area. Temporary diversion channels would be constructed as necessary to further reduce the volume of water coming in contact with waste rock during construction.

Waste rock would be managed according to its potential to generate acid rock drainage. Material with the least potential for ARD would be placed in contact with the valley floor and scree slopes. Acid forming material (as determined by the in-pit geochemical characterization program) would be isolated within the center of the repository.

ZMI proposes to use the natural scree slopes at depths of five feet or more to allow for natural drainage beneath the waste rock. In areas where scree depths are insufficient, mainly in the valley floor, rock/finger drains would be constructed out of selected coarse oxide material designated as non-acid forming by the materials handling plan. Every 100 vertical feet (4 lifts) the face of the waste rock storage area would be regraded to 3H:1V from the 4800 ft elevation to the 5100 ft elevation. This would include a 25 ft bench every 100 vertical feet with a slope angle between benches of 2.75H:1V. The slope below the 4800 ft elevation would remain at an overall slope of 2H:1V. Reclamation covers would be placed on all regraded areas. Depending upon the time of year, vegetation would also be planted. For every 100 feet vertical, a 25-foot bench/access road would be left to allow for drainage and energy dissipation of surface flow. The bench would be backsloped and would drain laterally towards the waste rock storage area margin at 1 percent grade using a low-permeability drainage ditch constructed to convey surface water while minimizing infiltration. The completed waste rock face would have an overall slope of approximately 2.20:1. Additional information concerning reclamation of the waste rock repository is found in section 2.8.2.5.

The completed first lift of the reclaimed waste rock facility would be monitored to evaluate the field performance of the proposed waste handling and facility design approach. See section 2.8.5 for additional information on ZMI's proposed field performance monitoring program.

2.8.1.6 Other Features and Facilities

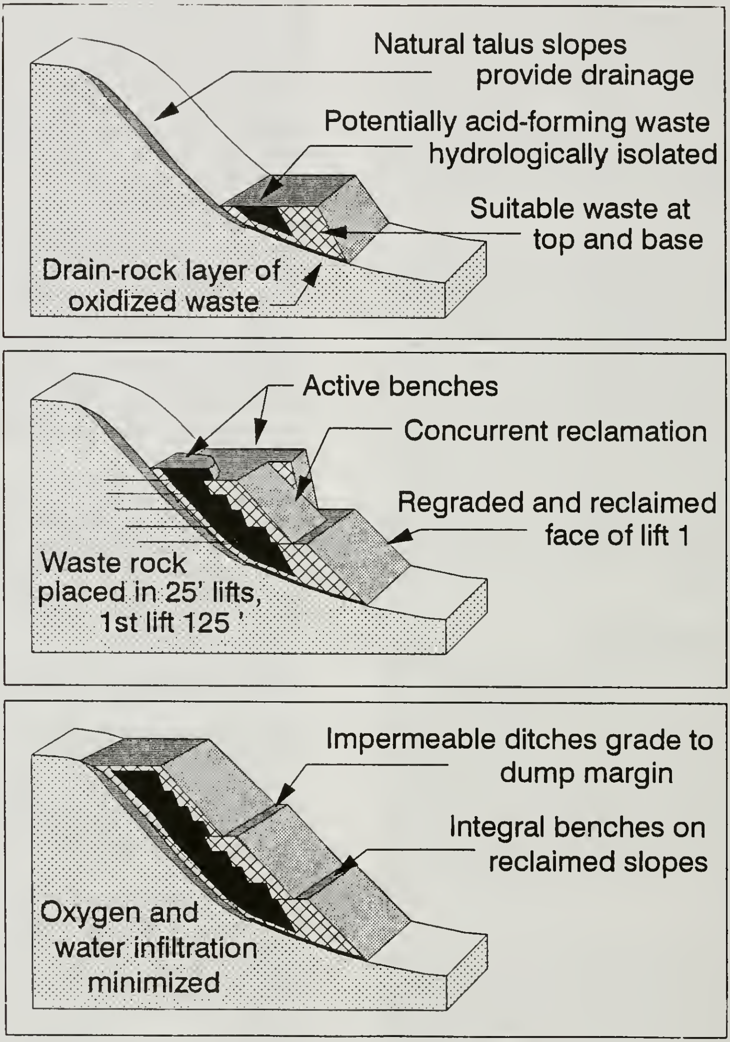
Office/Laboratory Facilities

The main office building for ZMI is located in the town of Zortman. The production assay lab is located across the street from the main office in a separate building. The laboratory and office functions would continue as described in section 2.5.1.6.

Access and Haul Roads

A road network map was presented on Figure 2.5-2, showing access and haul roads that would be active during the mining operation. A brief description of roadways follows.

Access Roads - The Zortman to Landusky road would be re-routed due to the expansion of the mine pit. Access road grades are designed to be 10 percent or less. Access road construction techniques for the proposed leach pad would be the same as access roads in the presently permitted areas. Access roads would be constructed using balanced cut-and-fill methods and are proposed to be approximately 30 to 50 ft wide where



SOURCE: ZORTMAN MINING INC., 9/94

TYPICAL CONCEPTUAL CROSS-SECTIONS OF THE PROPOSED ZORTMAN PROJECT WASTE REPOSITORY AREA

FIG. 2.8-

needed. Road beds would be compacted with construction equipment and topped with coarse gravel or fine oxide waste material. All roads would be sloped to allow for drainage away from the pad and waste rock storage areas. Drainage would be provided by sloping the roads as they are constructed so the drain ditches would handle runoff. Also, a berm would be placed on the outside edge of the road. Access roads would not cross any major drainages so culverts are not expected to be necessary. In the event that it becomes necessary, ZMI would install the required culverts to prevent erosion and channeling problems.

All access roads would be maintained as required for traffic, with road graders used as the primary maintenance equipment. All roads would be maintained throughout the life-of-mine.

Haul Roads - Haul roads would be constructed to allow a 70-foot running width from the inside edge to the inside toe of the safety berm. All haul roads would be constructed on the daylight edge of the pit, which is the lowest area on the pit perimeter. Haul roads would be left on the remaining daylight edge after the pit is mined. One new haul road leading from the pit to the limestone quarry is proposed to be constructed outside of the pit boundaries. The limestone quarry haul road would have a running width of 50 feet.

Power and Water Supply

Power requirements for the mine expansion and ore processing facilities would be supplemented by connecting the power supply at the Landusky Mine with the Zortman Mine. This would allow for any additional power needed at one operation to be allocated from the other. The powerline would be buried and follow the approximate route shown in Figure 2.8-1. An overhead power line would be erected adjacent to the access road connecting the county road with the ore handling area. An overhead power line would also be run from the county road to the process plant and pond area across Ruby Creek.

An average water supply of 190 gpm would be obtained from groundwater wells for the expansion. ZMI has an appropriation from the Department of Natural Resources and Conservation to obtain this makeup water, using supply wells ZL-102 and ZL-163 (see Exhibit 1). Peak water requirements from pumped groundwater are expected during winter months when less effective precipitation is received. Estimated average volume requirements for specific purposes include 140 gpm for ore-wetting and evaporative losses from the processing circuit, and 50 gpm for road dust control.

Septic Treatment

An additional septic treatment facility with a drainfield would be placed at the Goslin Flats process plant. Six full time employees are expected to work at the plant. A standard 1000 gallon, precast concrete, two compartment septic tank would be used. The drainfield would be designed to DHES requirements found in Circular WQB-2, "Design Standards for Wastewater Facilities." The septic system would be installed by licensed and certified contractors.

2.8.1.7 Water Handling and Treatment

Diversions and capture systems would be constructed to allow capture of mine-impacted waters and prevent deterioration of water quality in those drainages not already impacted. Storm water would be segregated from mine-impacted water. Impacted water would not be released to surface water prior to treatment. Data would be collected in accordance with the monitoring plan to regularly monitor water quality.

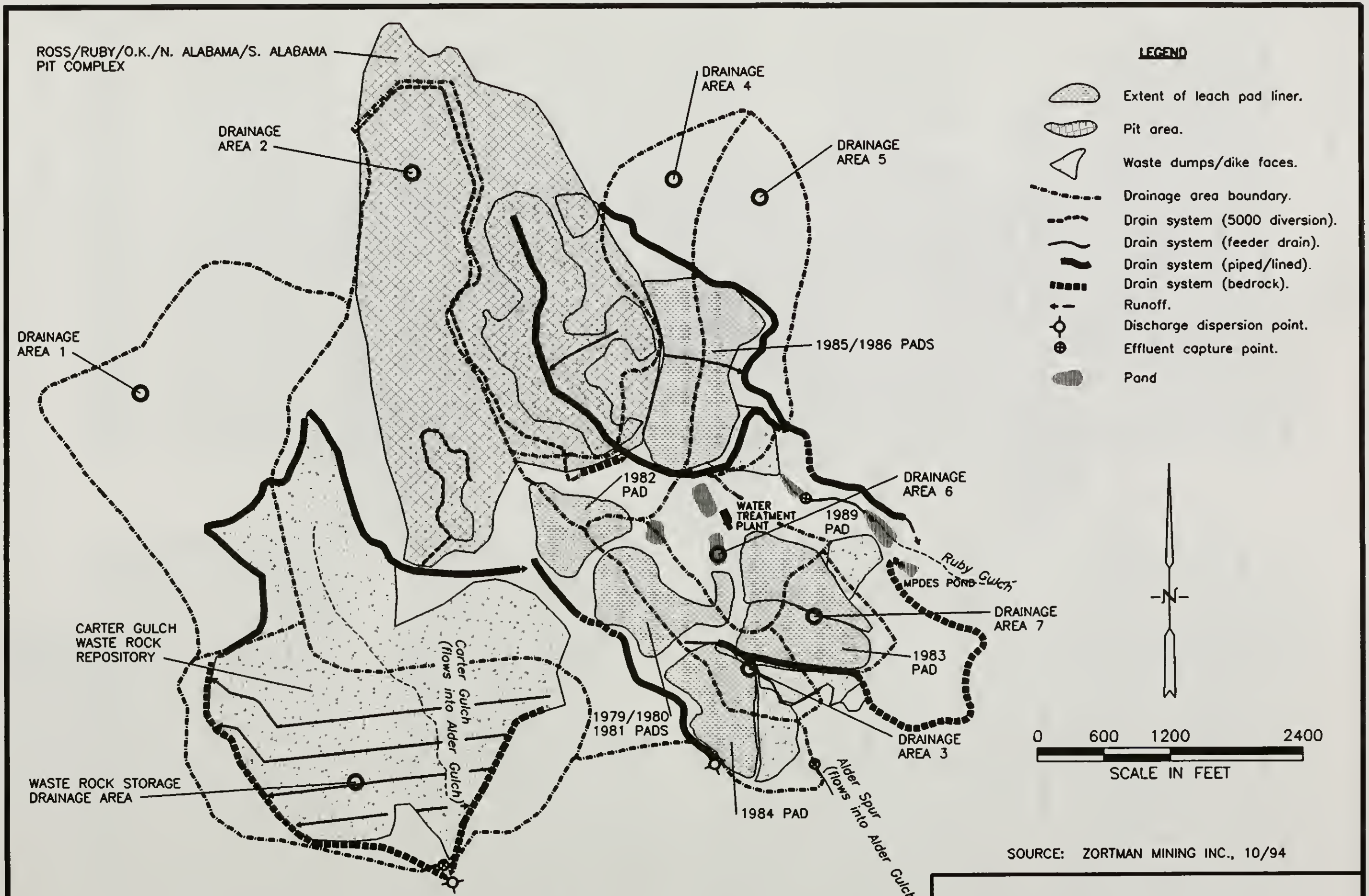
Water Capture and Treatment

No changes are proposed to the Ruby Gulch capture systems. A Carter Gulch capture system would be located further downstream of the toe of the proposed Carter Gulch waste repository during construction of the waste rock storage area. A capture pond would be constructed to contain seepage from the 6-inch, 24-hour storm event in the event seepage waters were impacted by the repository prior to final reclamation. Seepage volume is anticipated to be low since reclamation would take place concurrent with repository construction. Captured seepage water would be pumped to the Zortman water treatment plant for treatment and released into Ruby Gulch. Little maintenance would be required in the pond as storm water would be diverted around the lined area. The Alder Spur capture system would be re-sized for the 6-inch, 24-hour event.

Surface Water Runoff Control

Surface runoff was modeled for each specific subdrainage affected by the project. The runoff model used is based on the SCS National Engineering Handbook, Section 4, Hydrology (NEH-4). The model results were used to determine diversion ditch design, location, and rip-rap size. Figures 2.8-10 and 2.8-11 show the location of subdrainage areas for the mine and leach pad sites, respectively.

A 24-hour storm event producing 6.0 inches of precipitation (total) was selected as the design storm to be modeled through each subdrainage in the mine and



SOURCE: ZORTMAN MINING INC., 10/94

ZORTMAN MINE DRAINAGE PLAN: INDICATES SURFACE WATER CONTROL FEATURES AND LOCATIONS OF MINE SUBDRAINAGE AREAS WHICH CONTRIBUTE TO THESE CONTROL FEATURES

ZORTMAN MINE DRAINAGE PLAN

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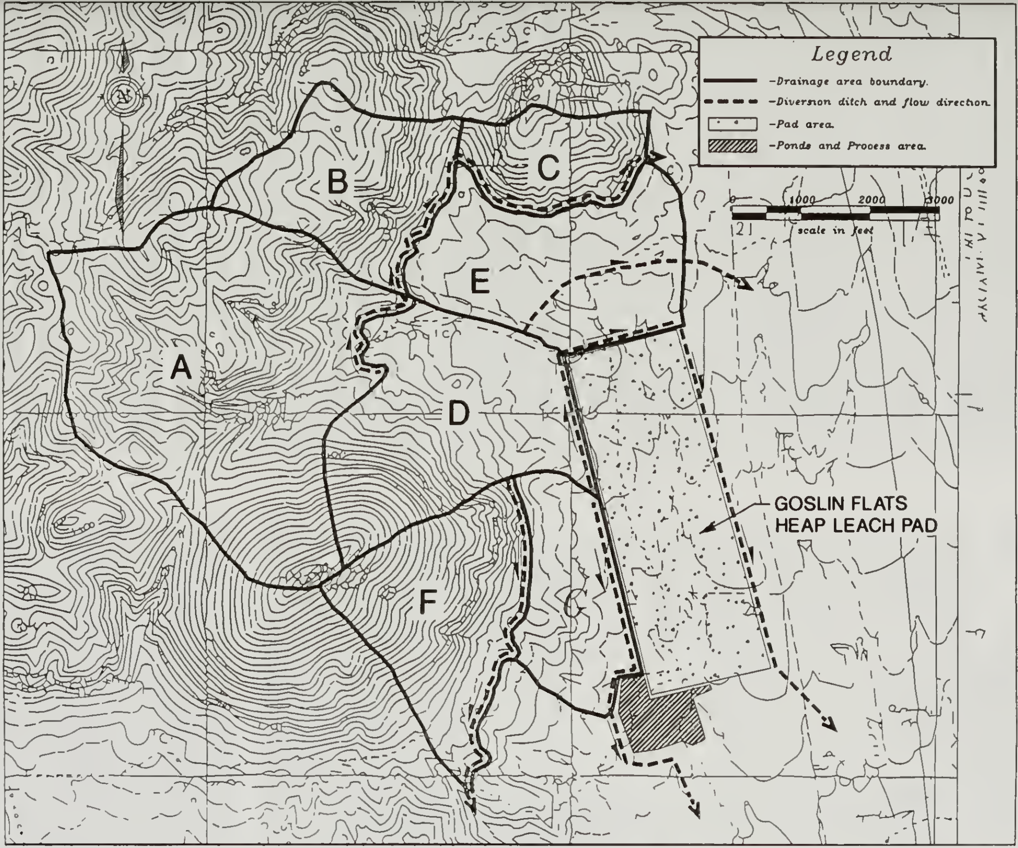

CATCHMENT BASINS:

INDICATES SURFACE WATER CONTROL FEATURES AND CATCHMENT AREAS FOR PROPOSED GOSLIN FLATS HEAP LEACH PAD SITE

SOURCE: ZMI AMENDMENT TO OPERATING PERMIT 00096 DATED 4/5/93.

CATCHMENT BASINS FOR THE GOLSIN FLATS HEAP LEACH PAD SITE

FIG. 2.8-11

leach pad areas. A storm simulated a Soil Conservation Service Type II thunderstorm event. Results of the modeling are presented in Table 2.8-5.

TABLE 2.8-5

MODEL OF 6-INCH, 24-HOUR PRECIPITATION EVENT

Mine Site[1] SubDrainage	Peak Flow (cfs)[2]	Pad Site[1] SubDrainage	Peak Flow (cfs)[2]
1	116	A	293
2	408	B	118
3	110	C	79
4	161	D	193
5	100	E	99
6	86	F	146
7	77	G	93
Waste Repository Benches	27		
Alabama	45		

[1] See Figures 2.8-10 and 2.8-11 for a key to the numbered and lettered drainages.
[2] cubic feet per second

Surface runoff during operations would be controlled with constructed drainage diversion channels. Runoff would enter constructed channels and be directed to settling basins, natural drainages, or rock underdrains. Several sizes of diversion channels are proposed for flows ranging from 27 - 408 cubic feet per second. The design includes maintenance of a minimum 12-inch freeboard during anticipated peak channel flow to accommodate any increased precipitation during operations.

The proposed channel for drainage areas 1, 3, 4 and 5 is a trapezoid shaped section with a four foot bottom, 2H:1V sides and a maximum flow depth of 1.5 feet. The proposed channel for drainage area 2 is a trapezoidal channel with a 10 foot bottom, 2H:1V side slopes and a flow depth of 2.0 feet. The proposed channel for drainage areas 6 and 7 is a V-ditch with a channel depth of 3.25 feet and a flow depth of 2.0 feet. The proposed channels for the Goslin Flats leach pad area are trapezoidal channels with 12 foot bottoms, 2H:1V side slopes and a flow depth of 3.25 to 4.75 feet.

The ditches would be lined with a geotextile fabric to prevent piping and covered with durable, non acid forming rock rip-rap ranging in size from 4 to 30 inches, dependent on the individual drainage area requirements.

All diversion ditches (except some above pit diversions) would have road access for maintenance. Maintenance would consist of removal of sediment load and repositioning of rip-rap as required. Sediment would be disposed in the waste rock repository.

Rip-rapped channels or existing scree slopes would be proposed for outfall structures. A rock blanket would be constructed at diversion discharge points in existing natural drainages. The rock blanket channel would consist of a geotextile lined diversion channel rip-rapped with 1.5 to 5.0 feet of durable, non acid forming rock. Scree slope outfalls would be used where discharge points occur above the existing natural drainage.

The pit, waste rock repository, primary crusher and portions of the conveyor corridor are included in subdrainages for the "mine site". The mine site subdrainages collect runoff from an area of 0.86 square mile and have slopes ranging from 8.8 to 25.9%.

Mine Pit

Above-Pit Diversions - Berms and V-ditches would be used to direct storm water flow on the haul roads away from the pit, where possible. Berms and V-ditches would be constructed above pits where possible to prevent storm water run-on.

5000-Ft Diversion - A diversion would be constructed during operations at approximately the 5000 foot elevation to reduce the amount of storm water runoff into the mine pit below this level. The "5000 diversion" would begin at the north side of the pit area, near the Ruby-Ross pit, with a beginning elevation of 5060 feet. The diversion would be constructed with a 2% gradient and would direct flow southward where it would combine with flows from the waste rock repository and Alabama pit areas. The bottom of the diversion elevation would be approximately 4990 feet near this confluence. From here, the diversion would route flow to the southeast until it enters a diversion basin, and ultimately, Alder Gulch.

The 5000 diversion, above the confluence with the Alabama Pit and waste rock repository contributions, would be sized to handle runoff from a 6 inch, 24 hour design storm (a maximum of 201 cfs).

Pit Floor Diversion - Although standing water in the pits has not been an operational problem in the past, there is a potential for periodic water in the pits. Water originating from groundwater seepage and precipitation would be collected in a sump and pumped to the treatment plant. If practical, this water would be directed out of the pit by gravity flow. In the event that this cannot be achieved, water would be pumped to a point where gravity flow can be used as a means to direct the water away from the pit area and to the treatment plant.

Leach Pad
Surface runoff water diversion ditches would be constructed upslope of the Goslin Gulch leach pad and on the uphill (western and northern) perimeter of the pad, to divert runoff away from the facility. Diversion ditches would be sized for the 6 inch, 24 hour event. See Figure 2.8-7 for the locations of these runoff control systems.

Waste Rock Repository
Permanent diversions associated with the proposed waste rock repository are designed to minimize flow into or onto waste rock. Concurrent reclamation and temporary diversions, where feasible, are also planned as a means to limit infiltration of storm waters. Benches would be constructed with a 10H:1V backslope into the repository with a 1% gradient to the edge of the waste rock repository. The backsloped bench forms a channel designed to direct the 6-inch, 24-hour event off the facility to the natural drainage below the toe.

Land Application Disposal (LAD) Area
A total of 456 acres has been identified as suitable for use as a land application area while two hundred and eighty five (285) acres near the Goslin Flats heap leach pad have been proposed for use as land application disposal sites during closure activities (see Figure 2.8-12). ZMI identified the area near Goslin Flats as part of a field reconnaissance study to locate a candidate land application site. Soil samples were collected from the site, analyzed for chemistry, and testing using treated barren solution to determine the soil's ability to adsorb and attenuate metals and cyanide. The soil was also tested for hydraulic conductivity to evaluate solution migration to the subsurface. A solution balance was calculated to determine metal loading and solution application parameters. This study is documented in Volume 7, Appendix 27, of the Zortman Mine Permit Application (Schafer and Assoc. 1993a).

No operational land application disposal is planned as part of the CPA. In the event that emergency land application of solutions is required, the land application area permitted for closure activities would be used. All neutralized effluents for disposal would have cyanide concentrations at or below 0.22 mg/l WAD. ZMI would notify the agencies prior to emergency land application.

2.8.1.8 Hazardous Materials

A variety of potentially hazardous compounds would be needed for mining, ore processing, and reclamation activities. Some of these compounds have been described in Alternative 1, Sections 2.5.1.7 and 2.5.3.7. This section identifies the potentially hazardous materials and their projected use at the Zortman Mine. A detailed discussion of the hazardous material usage, storage, handling, consumption, and waste disposal is presented in Section 3.14. The chemicals and their rate of use would be similar to historic uses, except that lime would replace sodium hydroxide for pH control, and the amount of flocculent would decrease.

Compound	Estimated Use
Lime	36,000 ton/yr
Sodium Cyanide	6,000 ton/yr
Gasoline	60,000 gal/yr
Hydrochloric Acid	33,000 gal/yr
Ca/Na Hypochlorite	Contingency use
Hydrogen Peroxide	Contingency use
Anti-Scalants	37,000 gal
Oil and Lubricants	40,000 gal/yr
Antifreeze	9,300 gal/yr
Flocculent	100 gal/yr
Citrus-base Solvent	800 gal/yr
Diesel Fuel	1.4 million gal/yr
ANFO	7,000 ton/yr

In addition, the following chemicals would also be used for the Zortman Mine expansion.

Sodium Hydroxide (caustic soda) is used in the stripping circuit to aid in desorption of gold and silver from the loaded carbon. The annual usage of caustic soda would be about 5,000 gallons.

Coagulant is used to settle small particles out of solution which can otherwise create problems in the clarifiers in the Merril Crowe plant. Since the new process ore processing system would rely solely on carbon adsorption, it is unknown how much coagulant would be needed to serve the same function in the carbon stripping circuit.

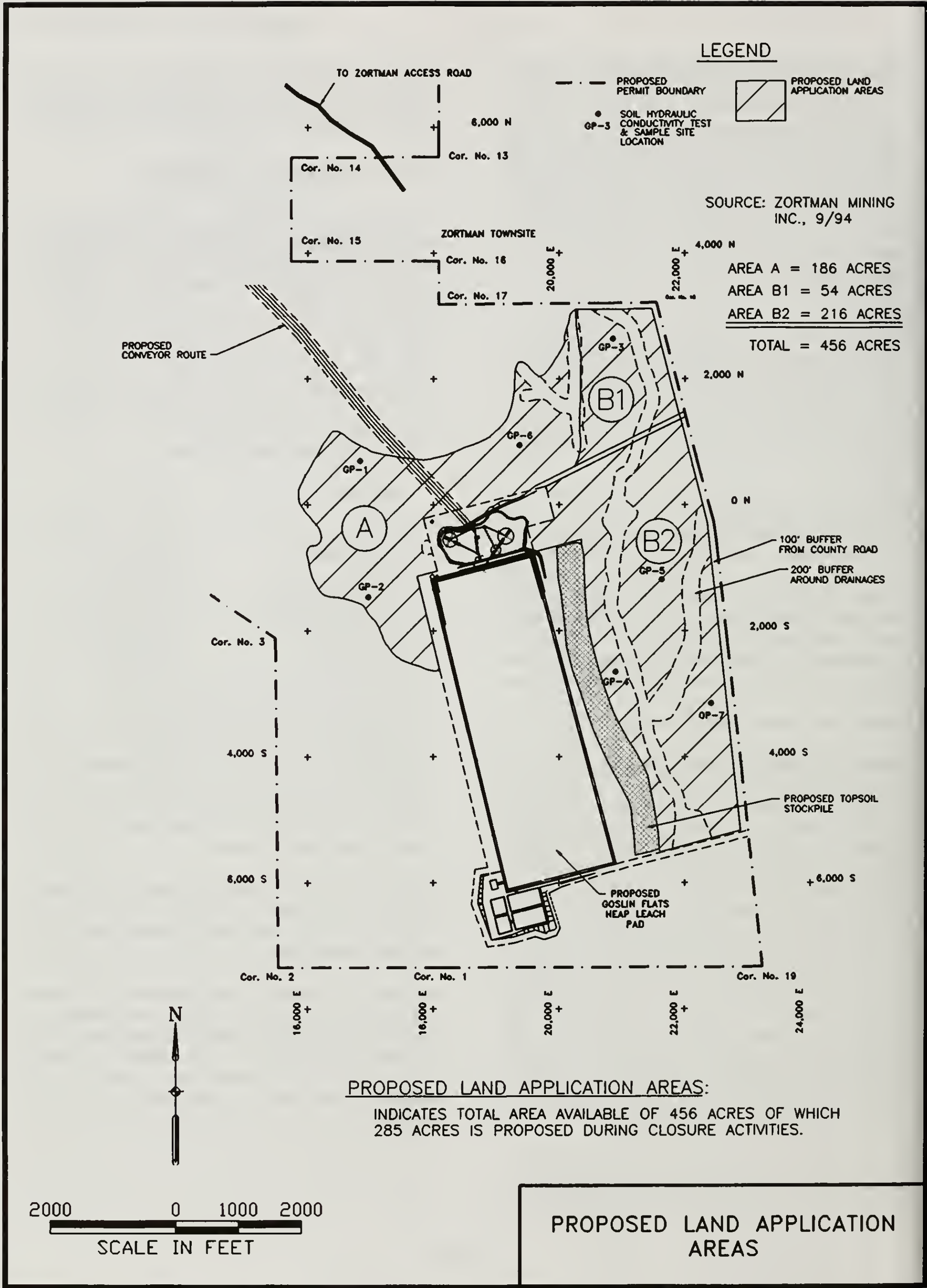

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FIG. 2.8–12

2.8.2 Zortman Mine: Company Proposed Reclamation

ZMI's proposed reclamation plan includes actions to reclaim areas which have already been disturbed by previously permitted mine activities. The reclamation plan also describes actions for reclamation of disturbance which would be associated with the proposed expansion (described in Section 2.8.1). ZMI's reclamation plan includes the following land use objectives:

- Re-establishment of a vegetative cover appropriate to the area
- Permanent protection of air, surface water, and groundwater
- Protection of public safety and health
- Restoration of habitat compatible for grazing livestock and wildlife
- Design of land configuration compatible with the watershed
- Re-establishment of an aesthetic environment providing visual quality and recreation opportunities

Table 2.8-6 illustrates the proposed operating and reclamation schedule for the Zortman Mine. Final reclamation of all facilities is anticipated to be completed within 3 years after the Goslin Flats leach pad has been detoxified and liner perforated. Reclamation of individual facilities is contingent upon a number of economic and operational factors, and scheduling variations within the overall timeframe could occur. Reclamation activities are submitted to the DEQ on an annual basis and reflect the most recent operating and reclamation schedule.

The following sections describe the specific reclamation plans and actions proposed by ZMI for each of the major disturbance areas.

2.8.2.1 Reclamation Materials

Reclamation materials would be required for construction and installation of reclamation covers, and for use in construction of drains and diversions. The primary materials to be used in reclamation covers would include non-acid forming waste rock and alluvial sediments, limestone, clays and cover soil. The following sections describe these materials.

Non-Acid Forming Material

Non-acid forming material would be used primarily as a capillary break, although it would also be used as rip-rap in diversion ditches. The non-acid forming material would be mined as waste rock and stockpiled at the Carter Gulch waste rock repository for use during reclamation.

Reclamation of the Goslin Flats leach pad would require non-acid forming material. This material would be transported using the ore conveyance system from the stockpile at the Carter Gulch waste rock repository to the leach pad.

Limestone

Limestone, and other carbonate materials such as dolomite and calcareous shales, would be used without restriction in reclamation because of their potential to neutralize acidic solutions. Approximately one million tons of limestone would be mined from LS-1, south of Green Mountain (see Figure 2.5-2). Limestone mining and access road preparation to the quarry were described in Section 2.7.2.1. Limestone or other carbonates for reclamation or construction of the Goslin Flats pad site would be transported from the mine site on the conveyor.

Clay

Clay would be used as a liner material for the heap leach pad to contain the leaching solution, as well as cover material on waste rock repositories, heap leach pads, haul roads, and pit benches and floors to prevent moisture infiltration. Clay required for the Goslin Flats leach pad and reclamation would be mined from the Seaford clay pit. This source is on private property located approximately four miles south of the leach pad site and is permitted by the DEQ Opencut Bureau. ZMI has previously used the Seaford pit as a clay source for leach pad liner construction.

Surface area disturbances and reclamation in the clay pit to date have totaled 4.2 acres. Clay would be extracted using the highwall mining method. An additional 4.3 acres would be disturbed under the proposed action, for a total disturbance of 8.5 acres. The entire disturbance area, including that which has already undergone some reclamation, would be reclaimed at closure.

The haul route and haul methods to bring clay to the Zortman Mine from the Seaford pit were described in Section 2.7.2.1. The haul fleet would have a 5.5 mile one way haul from the Seaford pit to the Goslin Flats leach pad. Clay hauled to the leach pad would not require travel through the town of Zortman. This trip would take about 30 minutes. Trucks would be grouped

TABLE 2.8-6

ZORTMAN MINE RECLAMATION SCHEDULE

Facility/Disturbance	Final Reclamation (in years after approval)
Heap Leach Pads	
79, 80/81	Reclaimed
82	1
83	2
84	7 - 10
85/86	1
89	2
Goslin Flats Pad	7 - 10
Dike Faces	
82	7 - 10
83, 84, 85/86, 89	Reclaimed
Goslin Flats	1
Pit Complex	Concurrent with Operation
Waste Rock Facilities	
Ruby, Upper Alder Gulch, 82 Leach Pad Site	Reclaimed
Alder Gulch	Concurrent with Operation
Process Plant/Pond Sites	
Existing	7 - 10
Goslin Flats	7 - 10
Cover Soil Stockpile Sites	As used
Crusher Facility, Ore Storage Site, Conveyor Corridor, & Solution Pipeline	6
Limestone Quarry	7 - 10
Clay Pits	
Zortman Dump Site	Reclaimed
Seaford Clay Pit	7 - 10
Haul Roads/Access Roads	6 - 10
Refinery Site	7 - 10
Storage Sites	
Mine Equipment Storage & Service	7 - 10
Process Equipment Storage	7 - 10
Old Ruby Shop Site	2
Power Corridor	1

at the clay pit and final destinations, and travel as a convoy under the direction of front and rear pilot vehicles.

Cover Soil

The cover soil stockpile located in Goslin Flats would provide the majority of cover soil for reclamation covers. The material would be hauled from the Goslin Flats stockpile to the mine site using ZMI or contractor equipment. The haul route would go through the town of Zortman and be approximately 4 miles. Trucks would be grouped at both the cover soil stockpile and mine site, and travel as a convoy under the direction of front and rear pilot vehicles. The round trip haul time would be approximately 30 minutes.

Cover soil would be salvaged as available during construction and reclamation activities at other facilities. The same equipment used for mining would be used to salvage soil, except at Goslin Flats where scrapers would be used to salvage suitable soil.

2.8.2.2 Reclamation Testing and Covers

All existing waste rock dumps, leach pads, buttresses, pit backfill and haul roads would be tested to determine if enhanced reclamation covers are required. Surface testing would occur on 100 foot centers on both a coarse (+1/8 inch) and fine fraction (-1/8 inch). Reclamation covers would not be used on surfaces and areas having little or no potential for acid generation. Reclamation would consist of regrading (if necessary), coversoil and revegetation. An area having little or no potential for acid generation is proposed as one with no more than 10% of the tested material containing greater than 0.2% total sulfur.

Existing facilities containing more than 10% of rock with a total sulfur content of greater than 0.2% would be covered with the proposed Reclamation Cover A, B, or C. If surface sampling shows the material to contain less than 10% of 0.2% or less total sulfur, records would be checked to determine what material was placed in the facility based on mine modeling and production records. If records cannot be correlated, or results inconclusive, results of humidity cell testing (based on similar materials or materials taken from the facility) would be used to predict potential for acid generation. If humidity cell testing indicates the potential for deleterious impacts to water quality such as low pH and elevated metal content, the facility would be capped with the following covers.

ZMI would use one of three different reclamation cover designs, depending on the reclamation tests and slope of the reclaim surface. These covers, designated as Reclamation Cover A, Reclamation Cover B, and Reclamation Cover C, are depicted on Figure 2.8-13. A brief description of each cover and its potential application follows.

- Reclamation Cover A - Would be used on reclaimed haul roads and pit benches where acid forming material is identified in the cut surface. This cover consists of a barrier layer between the material covered and the overlaying salvaged soil. The sequence in this cover, from the lowest layer to the top, is:

  Bottom: Unamended substrate (the material covered)
  6 inches of compacted clay
  8 to 12 inches of cover soil

  Top: Revegetation with seed mixtures, fertilizers, and mulches

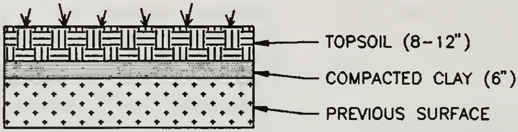
- Reclamation Cover B - Would be used on fill slopes with grades greater than or equal to 5% which require a barrier cover. The sequence, from the lowest layer to the top, is:

  Bottom: Fill or cut substrate with <0.5% sulfur (areas with >0.5% sulfur would be covered with 24 inches of yellow waste prior to capping)
  Two 6-inch lifts of compacted clay
  36 inches of non-acid forming material as a capillary break
  8 to 12 inches of cover soil

  Top: Revegetation with seed mixtures, fertilizers, and mulches

- Reclamation Cover C - Would be used on fill slopes of less than 5% that require a barrier cover. The sequence, from the lowest layer to the top, is:

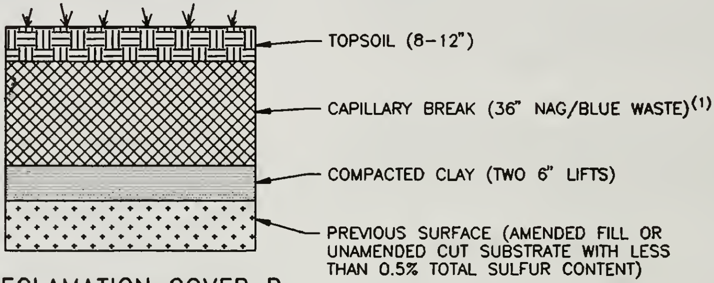
  Bottom: Fill or cut substrate with <0.5% sulfur (areas with >0.5% sulfur would be covered with 24 inches of yellow waste prior to capping)
  3 inches of compacted clay
  One layer of 15 to 20 mil PVC liner material
  One layer of 5 ounce geotextile material (to resist punctures in liner)



RECLAMATION COVER A

COVER FOR POTENTIALLY ACID GENERATING SECTIONS OF HAUL ROADS

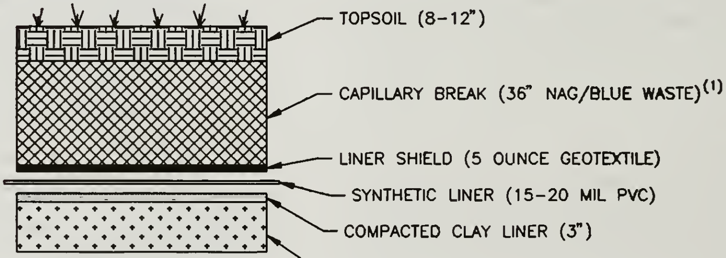
SCALE: 1"=4'



RECLAMATION COVER B

COVER FOR SLOPES 5 PERCENT OR MORE ON WASTE ROCK AND HEAP LEACH FACILITIES

SCALE: 1"=4'



RECLAMATION COVER C

COVER FOR SLOPES LESS THAN 5 PERCENT ON WASTE ROCK AND HEAP LEACH FACILITIES

SCALE: 1"=4'

NOTE:

1. NAG – NON ACID GENERATING
   BLUE WASTE – LESS THAN 0.2% TOTAL SULFUR.

SOURCE: ZORTMAN MINING INC., 9/94

ALTERNATIVE 4
RECLAMATION COVERS FOR ZORTMAN MINE WASTE ROCK AND HEAP LEACH FACILITIES AND SELECTED SECTIONS OF HAUL ROAD

FIG. 2.8-13

173E004A

36 inches of non-acid forming material (capillary break)
8 to 12 inches of cover soil

Top: Revegetation with appropriate seed mixtures, fertilizers, and mulches

2.8.2.3 Mine Pit Reclamation

Overall slope of the pit walls would be approximately 45 degrees (1H:1V) with 30-foot wide (flat) safety benches positioned every 60 vertical feet. Pit walls would be tested for acid generating potential by use of total sulfur analysis, static and leachate extraction tests. Surface water diversions would be installed to preclude runoff from contacting those portions of the pit walls that are potentially acid forming and which are too steep to be covered. Approximately 9 million tons of backfill material would be required to construct a pit floor with a free draining surface. An estimated 5 to 6 million tons of waste material would be scheduled as backfill during mine operations. The remaining 3 to 4 million tons of backfill would come from the Carter Gulch waste rock repository and spent ore (approximately 100,000 to 500,000 tons) from the 85/86 leach pad after mining ceased and the pad has been detoxified. Information on grading, characterization, backfilling and cover of the pit floor is presented below.

The final pit floor would be covered with Reclamation Cover B (as described in Section 2.8.2.2 and shown on Figure 2.8-14). After the pit floor is cover soiled it would be revegetated with native grasses and forbs chosen to enhance bighorn sheep habitat.

Safety benches above the 5000 foot diversion would be reclaimed concurrently with mining operations. Reclamation would include placing an average of 8 inches of cover soil on each bench and revegetation with a mixture of native grasses and forbs. Safety benches identified as potentially acid-forming below this elevation would be covered with Reclamation Cover A (see Section 2.8.2.2 and Figure 2.8-14) and revegetated with appropriate seed mixtures, fertilizers and mulches.

2.8.2.4 Leach Pad Reclamation

Tasks associated with the reclamation of the heap leach facilities include heap detoxification, surface reclamation, and liner perforation.

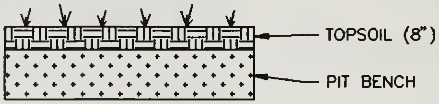
Heap Detoxification

Leached ore would be detoxified and reclaimed following the conclusion of processing. The detoxification process would take place in three steps: 1) an initial fresh water flush , 2) circulation of degraded pad effluents back through the system, and 3) a final circulation of cyanide free water to degrade and flush residual cyanide complexes from the heap. Figure 2.8-15 presents a flow chart depicting the leach pad detoxification process.

After ore leaching is completed, spent leach pad facilities would be decommissioned and flushed with fresh water to dilute process solution volumes contained within the pad. This fresh water flush would begin when recoverable precious metal concentrations are exhausted, and continue for a 1 to 2 week period until pad effluents have been reduced to approximately 50% of the normal process cyanide concentration.

Pad effluent solutions from the heap after the initial flushing cycle would be recirculated from the pad to plant processing facilities. Carbon recovery would be used in cyanide degradation by collection and containment of trace metal weak-acid dissociable (WAD) cyanide complexes such as copper or zinc. Solutions pumped through the carbon columns would also be exposed to oxygen sources, promoting further cyanide decay through oxidation and volatilization. These solutions would be processed through the conventional carbon adsorption circuit used during operations for metal recovery. Solutions from the plant would then be recirculated to the decommissioned pad and applied to the heap surface through a riser sprinkler system.

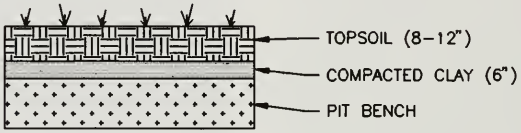
The riser application system would also be used to aerate the effluent solution, promoting additional cyanide degradation by oxidation and volatilization. Recirculation of the decommissioned pad effluent would be conducted in batches, with periodic rest cycles to enhance natural cyanide degradation. An on/off spray schedule would be established during the spring, summer, and fall months to maximize cyanide degradation and solution evaporation. Due to the inability to predict precipitation events during these seasons, this schedule would have to be season specific so spray and rest cycles coincide with the seasonal precipitation. This spray schedule would continue until pad effluent concentrations maintain or fall below 0.5 mg/l WAD cyanide. When the solutions returning from the heap maintain less than or equal to 0.5 mg/l WAD cyanide, the heap would be flushed with cyanide-free water. Fresh water (cyanide free) flushing would continue until pad effluent concentrations remain at or below the 0.22 mg/l WAD cyanide guidelines.



PIT BENCH COVER

ABOVE 5000 FEET – ZORTMAN

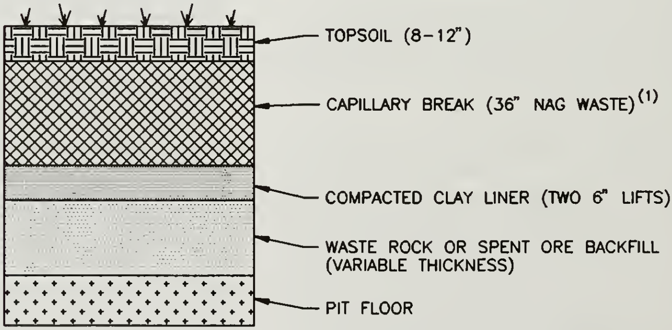
SCALE: 1"=4'



PIT BENCH COVER

BELOW 5000 FEET – ZORTMAN

SCALE: 1"=4'



PIT FLOOR COVER

ZORTMAN
(RECLAMATION COVER B)

SCALE: 1"=4'

NOTE:

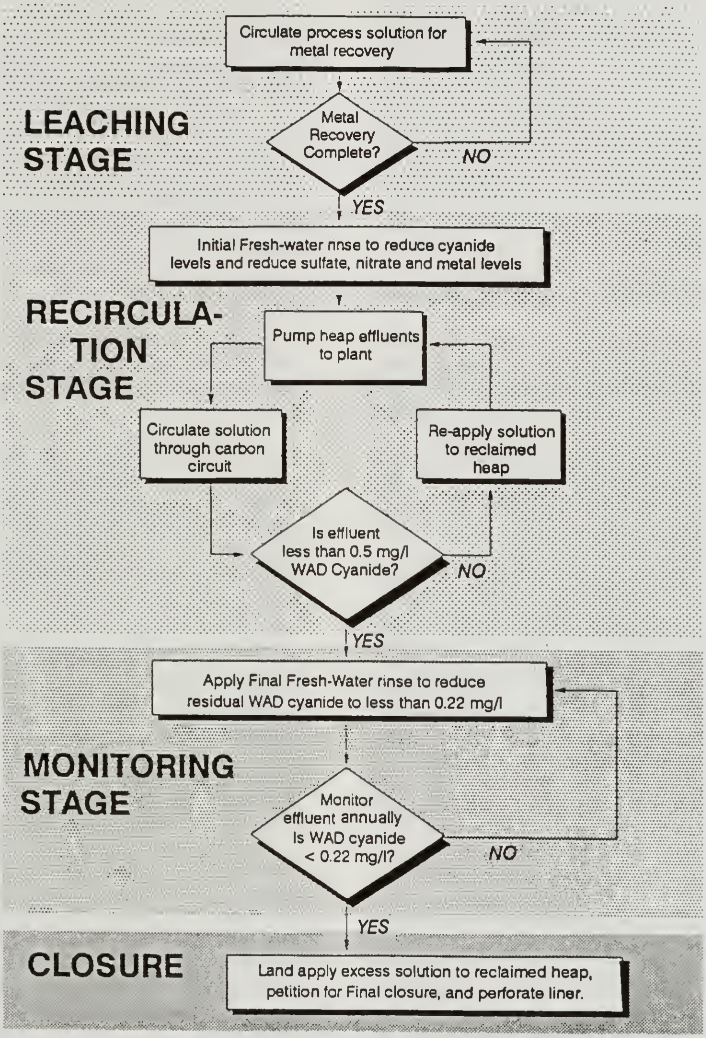
1. NAG – NON ACID GENERATING

SOURCE: ZORTMAN MINING INC., 9/94

ALTERNATIVE 4
RECLAMATION COVER FOR
ZORTMAN MINE PIT
BENCH AND FLOOR

173E005A

FIG. 2.8–14



SOURCE: ZMI AMENDMENT TO OPERATING PERMIT 00096 DATED 4/5/93.

SCHEMATIC FLOW CHART DEPICTING SOLUTION TREATMENT AND HEAP DECOMMISIONING

FIG. 2.8-15

The heap would be considered neutralized after the effluent concentrations remain at or below the 0.22 mg/l WAD cyanide guideline for a six-month period including one winter and spring runoff cycle. Heap solutions remaining after neutralization would be pumped from the heap to a pond for land application as a final solution disposal mechanism. Modifications to this plan could be made by ZMI as neutralization technology advances, and/or results of field neutralization further defines natural degradation and flushing efficiency of leach pad materials. Modifications in leach pad and solution neutralization would only be made after consultation with and approval of the appropriate regulatory agencies.

Surface Reclamation - Goslin Flats Leach Pad

Containment dike reclamation would be conducted concurrently with completion of dike construction. Dike slopes would be coversoiled with an average cover of 12-inches and revegetated to blend with adjacent undisturbed contact zones and to reestablish vegetative communities. The slope of the containment dike around the Goslin Flats leach pad would not be reduced after ore processing ceases and would remain at an overall slope of 2.5H:1V.

Upon heap detoxification leach pad slopes would be graded from the constructed 2H:1V slope to 2.5H:1V, and 3H:1V where topography allows. Slope reduction would be performed by track mounted dozers pushing the detoxified spent ore from the material crest or top down over the lift slopes utilizing cut and fill material from each of the facility benches. Spent ore would be pushed off containment to achieve the 2.5H:1V slope. Narrow, one-way haul roads to transport materials to the top of the heap leach facility during reclamation would be constructed. These haul roads would be reclaimed following completion of all other reclamation activities. Reclamation Cover B would be used on leach pad slopes greater than or equal to 5%, while Reclamation Cover C would be used on leach pad slopes less than 5%. The reclaimed pad surfaces would be revegetated with native prairie grasses, forbs and shrubs to complete final reclamation. In order to help mitigate the visual appearance of the reclaimed heap, portions of the uppermost lift(s) of ore would be varied in thickness and location to create a variable skyline. In addition, "micro-habitat" areas would be created by scouring small depressions with earth-moving equipment during final regrading.

Surface Reclamation - Existing Leach Pads

Several heap leach pads currently exist on the Zortman property. These include the 1979, 1980/'81, 1982, 1983, 1984, 1985/'86, and the 1989 pads. A portion of the material from the 1985/'86 pad (100,000 to 500,000 tons) would be excavated and used as pit backfill. Reclamation of the other pads would include reduction of slopes to no steeper than 2.5H:1V. Leach pad slopes would be reduced to 3H:1V in areas where this would not result in off-loaded pad materials being moved into natural or constructed drainages. Areas characterized as potentially acid-generating would be covered with Reclamation Cover B or C, depending on the degree of slope.

Liner Perforation

No changes are proposed for liner perforation for the 82, 83, 84, 85/86 and 89 leach pads. Perforation would not occur until water quality objectives have been met. Agencies would be consulted 90 days prior to liner perforation activities.

The Goslin Flats heap leach pad liner would be perforated after pad detoxification to eliminate moisture storage and any undesirable hydraulic conditions associated with the reclaimed facility. The liner would not be perforated until monitoring of the heap effluent indicates that water quality compliance has been met and risk of the formation of acid drainage is established to be minimal.

To perforate the liner, eight drain holes would be drilled through the pad's synthetic and clay liner systems at locations in the facility's collection basin to facilitate maximum moisture drainage. Each drain hole would be drilled to facilitate a eight inch opening into the underlying drainage system. The process solution wells placed and installed during pad construction phase would be used for the liner perforation openings into the collection basin. These process wells would have a twelve inch hole milled from the well casing caps to allow for drill steel and bit penetration from the well casing into and through the underlying liner surface. Each perforated drain hole would be backfilled with sized drain rock to an elevation of at least 5 feet above the liner surface to ensure continued drainage.

The following activities would be conducted at Goslin Flats prior to liner perforation:

1. Water which collects in the sumps of reclaimed leach pads would be sampled on an annual basis.

2. The rate of phreatic surface rise would be monitored by annual measurement of phreatic

surface elevations. Based on these measurements, the rate of infiltration into a reclaimed leach pad would be calculated.

3. After 10 years, if it is determined that water quality management objectives would be met for a given leach pad, the liner for that facility would be perforated.

4. If monitoring indicates that water quality management objectives would not be met, or if the rate of accumulation is such that dewatering of the leach pads becomes necessary before the 10-year monitoring period is reached, heap waters would be treated and/or discharged using the land application area.

2.8.2.5 Waste Rock Repositories Reclamation

Carter Gulch Waste Rock Repository

Reclamation of the Carter Gulch waste rock repository would be conducted concurrent with construction activities as a means of reducing the potential for acid rock drainage. As described in Section 2.8.1.5, construction of this repository would begin at the design toe. Initial construction would consist of an approximately 125 foot lift of waste to allow access to the area. Subsequent construction would be completed in 25 foot lifts with concurrent waste rock reclamation completed in sections every 100 feet of vertical height. Concurrent reclamation and utilization of 25 foot lift construction techniques would be used in an effort to minimize potential exposure to precipitation. In effect, use of the 25 foot lift construction techniques would provide additional areas of surface compaction due to haulage equipment traffic, in-turn yielding greater areas within the facility of low water permeability and porosity.

Waste repository slope lengths would be constructed at an angle of repose (1.5H:1V) along the original 125 foot lift and subsequent 25 foot lifts. The waste repository slopes would be regraded to an over 3H:1V from the 4800 ft elevation to the 5100 ft elevation. This would include a 25 ft bench every 100 vertical feet with an inter-bench slope of 2.75H:1V. The slopes below the 4800 ft elevation would remain at an overall 2H:1V slope. Topographical and watershed breaks would be provided by the installation of 25-foot wide constructed benches every 100 feet of vertical height or 200 feet of slope length, with exception of the first lift construction which would be placed at the 125 foot interval. Benches would be constructed with 1% gradients allowing precipitation to shed and be transported toward common rock drainages constructed along the peripheries of the facility. Benches would be sloped away from the waste rock storage area face to control precipitation collections from flowing over the bench and down subsequent waste repository faces.

In order to minimize precipitation infiltration into the repository facility, benches would be covered with Reclamation Cover B. Covered benches would be revegetated with native grasses, forbs and shrubs to control potential soil erosion and to develop wildlife habitat. Waste repository slopes would also be covered with Reclamation Cover B. Cover soiled slopes would be revegetated with native grasses, forbs and shrubs to enhance soil stability.

The top of the waste rock storage area, with a slope of <5%, would be covered using Reclamation Cover C. The facility top would also be revegetated with native grasses, forbs and shrubs.

Existing Waste Rock Dumps

Three waste rock dumps (Alder Gulch, OK and Ruby Gulch) are currently located within the project boundaries. The Alder dump and Ruby sulfide stockpile would be moved to the Goslin Flats leach pad and the OK dump would be reclaimed in its present location. Specific activities at each location are as follows:

- Alder Gulch Waste Rock Dump - ZMI would remove the entire Alder Gulch dump, approximately 3.4 million tons of waste material, before this area is covered by the new Carter Gulch waste rock repository. The material removed would be relocated to the Goslin Flats leach pad for further ore processing. The leach pad would have sufficient capacity for this reprocessed ore.

- OK Waste Rock Dump- ZMI would characterize the surface material from the reclaimed OK waste rock dump on a 100-foot grid. Based on the results of the sampling and waste characterization, additional reclamation (to include cover placement) may be conducted on this dump, which contains approximately 1.2 million tons of waste material. Reclamation cover type would depend on the amount of total sulfur concentrations in the characterization samples, as described in Section 2.8.2.2.

- Ruby Gulch Sulfide Stockpile - The "sulfide stockpile", consisting of approximately 40,000 tons of material located on the southern portion of the Ruby Gulch waste rock dump, would be relocated to the Goslin Flats leach pad for further ore processing. The slopes on the remaining material (approximately 2.5 million tons) in the Ruby waste dump would be reduced to 3H:1V, where topographic considerations allow. The surface of the waste rock dump would be tested and reclaimed, with the extent of reclamation and reclamation cover type dependant on sulfur concentrations, as described in Section 2.8.2.2.

2.8.2.6 Support Facilities Reclamation

Solution/Process Ponds Reclamation

Process and contingency ponds would be perforated, backfilled with compacted material and graded. Alluvial material excavated during the pond construction would be used for backfill, along with concrete materials from structure footings or pads. The graded pond areas would be cover soiled with an average soil cover of 8 to 12 inches and revegetated.

The carbon adsorption process for gold recovery generates little, if any, sludge. Sludges which might develop in processing ponds as the result of leach operations would be considered mine waste. The sludge would be sampled and a Toxicity Characteristics Leach Procedure (TCLP) performed to determine the mobility of any metals that may be present. If the TCLP analysis shows the sludge to be inert, it would be pumped to the leach pad for disposal prior to final cover of the heap. In the event mobile metals are present the sludge would be fixed with cement, the edge of the liner cut away from the anchor trench and folded over the cemented sludge prior to backfilling.

Process Plant Site Reclamation

Final reclamation would include the removal of all structures and equipment used in the mining and processing of ore through heap leach operations. Structures and equipment to be removed include:

- Existing processing plants, maintenance shop and support service structures
- Proposed crushing and processing facilities and equipment
- Proposed conveyer equipment
- Existing and proposed leach pad pumps and electrical structures
- Existing and proposed process spray and return lines
- Existing and proposed electrical power corridors (unless private, public, or regulatory agencies request continued use)
- Existing and proposed perimeter fencing of the property permit boundary
- Storage tanks and facilities
- Sediment control ponds and diversion ditches

All unoxidized bedrock exposed during construction activities and surfaces contaminated by spillage of non-oxide ore would be analyzed for total sulfur prior to reclamation activities. Materials shown to be potentially acid forming would be placed in the waste rock storage facility. Surfaces identified as potentially acid forming would be evaluated on a case-by-case basis and may be covered with Reclamation Cover A.

Reclamation of the process plant areas and service structures would include the dismantling and removal of all structures, concrete pads and footings. Concrete materials removed from the structures would be used for backfill materials for pond areas or disposed in an appropriate on-site waste disposal facility. All facilities would be dismantled and disposed as detailed below. The plant areas would be ripped by a track mounted dozer, leveled and graded to facilitate surface drainage. Final graded areas would be cover soiled with an average soil cover of 8 to 12 inches and revegetated to provide soil stability and re-establish vegetative communities.

It is estimated that 1,500 yd^3 of concrete would be removed and disposed. All steel structures would be salvaged or sold as scrap.

All solid waste generated during closure would be disposed in accordance with Montana laws and regulations of the DHES Waste Management Division. Inert waste (Class III, such as concrete, plastic, steel and wood) would be buried onsite in the Carter Gulch waste rock repository. Wastes not suitable for burial in a Class III facility, such as office waste and other Class II waste (household waste), would be transported to a landfill in the Lewistown area and disposed.

Soil Stockpile Reclamation

Cover soil stockpile locations would be ripped and revegetated after cover soil is redistributed.

Access and Haul Roads

Haul and access roadways would be graded to re-establish natural drainage patterns. Roadways would be ripped to alleviate surface compaction and provide additional fill material for the drainage and grading of the roadway surface. Roadway berms and loose, unconsolidated material above and below the roadway cut would be pulled or dozed into the roadway using a backhoe or dozer. The amount of backfilling would be restricted by equipment limitations (e.g. slopes that can be traversed by dozers and by the backhoe reach).

Haul roads would be sampled and analyzed every 100 feet to determine if acid forming materials are in contact with soil. Areas of the haul roads that have been constructed in acid-generating material would be covered with Reclamation Cover A. All final graded areas would be covered with a minimum of 8 inches of cover soil.

Cover soil would be sidecast and the fill toed next to the cover soil (Figure 2.8-16). When reclamation is accomplished, the fill material is replaced into the cut area and the cover soil is then spread over the fill. Cover soil thickness varies according to the cover soil available when the stripping was done for the roadway. However, it is anticipated that cover soil would be placed at an average thickness of 12-inches and minimum thickness of eight (8) inches. Cover soil would not be hauled into areas for reclamation purposes with the exception of haul roads in the pit area. Haul roads left in the pits after completion of mining would be used for reclamation access to the pit. Final graded, cover soiled areas would be revegetated.

As previously described, three roadway sections connecting the Zortman, Landusky, and Hays townsite would remain after final reclamation. Sections of these roadway surfaces would be associated with operations haulage roadways. Such sections remaining after post-operations would be reduced to a running width of 25 feet. Therefore, the outer 4 to 5 feet of running surface would be ripped, contoured, cover soiled, and revegetated.

The deviation from original topography from roadway reclamation varies significantly by site. Where haul roads, access roads and exploration roads are located in areas which require large cuts (10 feet or more) the roads generally would not be reclaimed to original contour. In contrast, roads located on gentle side hills or flats usually would be reclaimed to original contour.

The reclamation plan for access and haul roads includes:

1. Where possible (see explanation above) roadways would be graded to original contour.

2. Haul roads would be sampled and analyzed for total sulfur every 100-feet to determine if acid forming materials are in contact with soil;

3. Haul road segments identified as potentially acid forming (>0.5 percent total sulfur), would be covered using Reclamation Cover A.

Conveyor Corridor Reclamation

Reclamation of the conveyor corridor disturbances would include dismantling and removal of all structures, concrete pads, and footings. Concrete materials removed from the structures would be used for backfill materials or disposed in the Class III disposal facility. Surface construction disturbances associated with cut and fill operations to facilitate conveyor routing would be recontoured and blended with adjacent landforms. Surface disturbance areas would be cover soiled and revegetated with native grasses, forbs, shrubs, and trees.

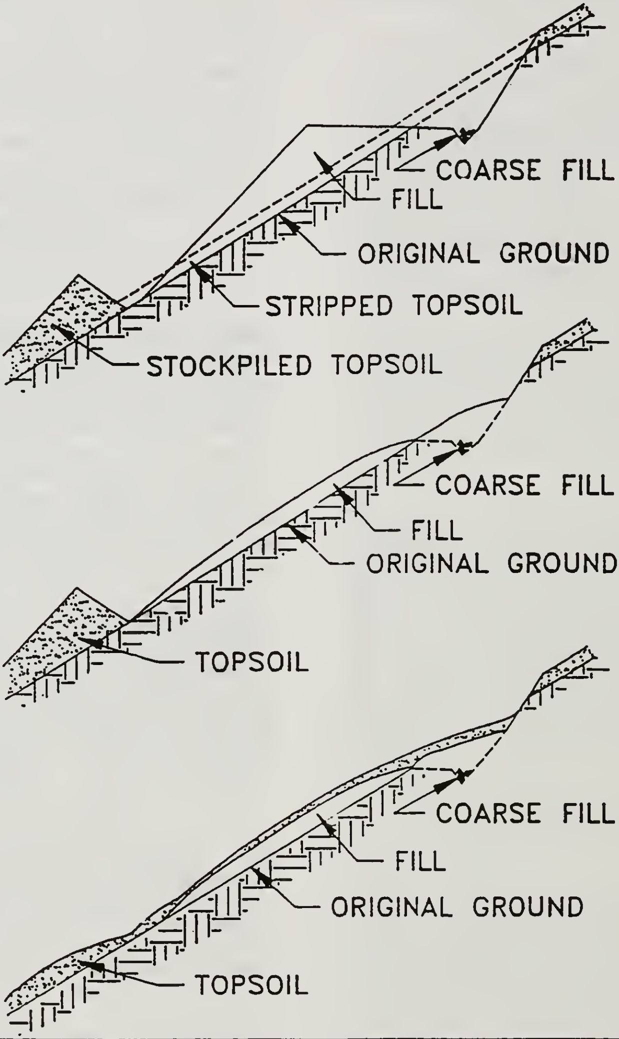
Limestone Quarry

The ultimate facilities development topography of the limestone quarry is proposed to consist of a 1H:1V quarry wall with 20 foot wide benches every 60 vertical feet on the northeast side of the quarry. The quarry floor would be graded at a maximum 5% slope to facilitate drainage and prevent ponding of water. Rock drains, rock lined swales, or other measures would be constructed as necessary to control erosion.

Cover soil would be placed to an approximate depth of 12 inches (8 inches minimum) on the pit floor and all quarry wall benches. With the exception of the benches, the quarry wall would not receive coversoil. The floor of the quarry would be scarified as necessary to reduce compaction and increase bond with the coversoil. Areas covered with soil would be revegetated.

Haulage access roadways connecting the quarry site with Zortman operations would be reduced to a running width of 25 feet along existing roadways. The outer 25 feet of running surface along the roadway would be ripped, contoured, cover soil with soil salvaged from the site and revegetated.

Reclamation of roadway disturbances would include reclaiming previously existing roads to a width of 25 feet



SOURCE: ZORTMAN MINING INC., 9/94

TYPICAL CONSTRUCTION SEQUENCE
FOR RECLAMATION OF
HAUL AND ACCESS ROADS

FIG. 2.8-1

and reclaiming new disturbances completely. Road reclamation would be similar to reclamation currently being done by ZMI on exploration drill roads. A Cat dozer would be used to push all the rock material into place, and then to spread the cover soil to approximate original contours. A track mounted backhoe may be used where applicable.

Vegetation is proposed to include nine tree and shrub types, and a grass seed mix of seven grasses that are native to the area. Steps in the revegetation process are described in Section 2.8.2.8.

Seaford Clay Pit

An additional 4.3 acres would be disturbed during the proposed expanded operations. Those areas in the clay pit already disturbed and reclaimed from previous operations would undergo additional reclamation; therefore, reclamation would be conducted on a total of 8.5 acres. A 3H:1V slope would be left after grading to allow runoff to proceed naturally downhill into the current drainage system. Cover soil would then be spread at an average of 18 inches, and a minimum cover of 12 inches, with vegetative seeding occurring during a seasonal period of higher precipitation. A seed blend of seven natural occurring area grass types would be used, as described in Section 2.8.2.8.

2.8.2.7 Reclamation/Post-Reclamation Water Handling and Treatment

Final MPDES requirements, discharge water quality standards, passive treatment and water management practices are being discussed between ZMI and the Water Quality Division of the DEQ (see the Water Quality Improvement Plan summary in Appendix A). Conditions of the MPDES permits would be adopted by ZMI for closure.

Reclamation goals include final reclamation cover and water management practices that would minimize mine-impacted waters as vegetation is reestablished.

Water Capture and Treatment

No changes are proposed for operational water capture and treatment upon cessation of mining and leaching activities. Water treatment would continue on an interim basis until final reclamation is established and water quality is acceptable. As water quality meets discharge standards and the appropriate agencies approve of release of the waters, capture ponds, sumps and pumpbacks would be dismantled and the sites reclaimed.

Mine Pit Runoff Control

Above pit diversions - No changes or improvements would be made to above pit diversions. The diversions would be designed to be maintenance free. However, highwalls would be visually inspected on a periodic basis and repairs made as necessary.

5000 foot diversion - The design of the 5000 foot diversion provides for collection and transport of surface water runoff, access and a maintenance free rubble collection area. The final bench slope would be graded from the base of the highwall toward the diversion channel. A berm or row of large, non-acid producing rocks would be placed adjacent to the channel to act as a final barrier to prevent highwall rubble from entering the channel, yet still allow runoff to enter the channel unimpeded. The diversion channel is designed to be a long-term, maintenance free structure. However, as part of the overall post-closure maintenance, visual monitoring would be periodically conducted on the entire length of the channel and maintenance conducted as necessary.

Pit floor diversion - A free draining surface would be constructed using waste rock backfill. A pit floor channel would be sized to carry runoff from a 6 inch, 24 hour storm event and would be cement lined or lined with geotextile, clay and rip-rap. Pit wall runoff would report to the pit floor channel. All material within the zone of fluctuating water table would be non-acid forming or amended with limestone to be non-acid forming and would be sampled and analyzed in accordance with the waste rock sampling and handling plan (see Section 2.8.1.5). The pit floor diversion would be routed into the Ruby Gulch capture and contingency ponds. Captured waters would be tested for quality. If water quality meets the MPDES discharge requirements, it would be released. If not, the water would be routed to the treatment plant. Maintenance of the diversion would include removal of sediment and repositioning of rip-rap as necessary.

Leach Pad Runoff Control

No changes to the operational diversions are proposed. Diversions would remain in place following reclamation. Maintenance would not be necessary as no disturbance would occur in the drainage areas above the diversions.

Waste Rock Repository Runoff Control

Topographical and watershed breaks would be provided by the installation of 25-foot wide constructed benches every 100 feet of vertical height, with the exception of the first lift construction which would be placed at a 125 foot interval. Benches would be constructed with 1% gradients allowing precipitation collections to be shed and transported towards common rock drainages constructed along the peripheries of the facility. Benches and peripheral drains would be sized for the 6 inch, 24 hour storm event. Benches would be sloped away from the waste rock repository face to control precipitation collections from flowing over the bench and down subsequent waste repository faces. Maintenance would include removal of sediment and repositioning of rip rap as necessary until vegetation was established. The benches would provide access for maintenance.

Land Application Disposal Area Runoff Control

ZMI has identified 456 acres for land application disposal of treated process solutions. This area was described in Section 2.8.1.7. There would be minor disturbance to the land application area to gain access to solution pipelines. Solution pipelines would be removed and all disturbed areas would be reseeded.

2.8.2.8 Reclamation Quality Control

ZMI or a mine contractor would place the clay cover. This process would be monitored by a qualified, independent third party engineering firm. The clay would be hauled from the Seaford clay pit and placed in compacted lifts (one 6-inch lift for Reclamation Cover A; two 6-inch lifts for Reclamation Cover B; and one 3-inch lift for Reclamation Cover C). The clay would be drill tested for thickness by ZMI personnel with third party guidance. Drill holes would be backfilled with commercial grade bentonite. Clay thickness would be considered acceptable if there is a minimum of a 6-inch depth for Reclamation Cover A, 12-inch depth for Reclamation Cover B, or 3-inch depth for Reclamation Cover C, with reclamation depth at 90% of the sampling locations no less than 4, 9, or 3 inches at any location for Reclamation Covers A, B, or C, respectively. If an area does not have the minimum thickness, additional clay would be brought in and compacted to obtain the required depth. Compaction testing would be done by the third party inspector with a nuclear density gauge. Specifications would be for the clay to meet 95% density (Standard Proctor test) at 90% of the test locations. A minimum density would be 90% compaction.

ZMI personnel would install the synthetic liner (15 - 20 mil PVC). Installation of the synthetic liner would also be monitored by a third party inspector. Seams would be air-lanced to ensure a good bond was achieved between field seamed PVC sheets. Areas having inadequate bonding, cuts or punctures would be repaired and tested until passed by the third party inspector. The entire area would be visually inspected and passed prior to cover with geotextile.

ZMI, or a mine contractor overseen by ZMI personnel, would install the capillary break. The capillary break thickness would be 3 feet over 90% of the area covered, with a minimum thickness of 2.5 feet at any location.

Monthly construction reports with testing results would be provided to the agencies.

2.8.2.9 Revegetation Procedures

Areas disturbed by mining-related operations would be revegetated to stabilize soil and slopes, reestablish communities ecologically comparable to pre-mine conditions, and restore watershed, wildlife, recreational and aesthetic values that meet post-operation land use objectives. The following sections describe ZMI's proposed revegetation program.

Species Selection

ZMI has developed permanent seed mixes to reestablish grassland and/or forest settings on each disturbed area. The plant species used in revegetation would depend on land use objectives, presence of the species on pre-mine disturbances, plant establishment potential, growth characteristics, stabilizing qualities, wildlife palatability and commercial availability. Interim seed mixes would be used on sites where soil stabilization is desirable prior to final reclamation.

Mountainous Areas - Table 2.8-7 shows the seed mixture selected for the mountainous areas disturbed by Zortman Mine operations. The seed rate used is based on broadcast rate of 150 to 170 Pure Live Seeds per square foot of coverage; the rate would be halved for drill seeding. Annual ryegrass would be seeded into mountainous sites at a rate of one pound per acre to provide rapid initial slope and soil stabilization. Tree and shrub species would be planted rather than seeded.

Goslin Flats Vegetative Species - Table 2.8-8 shows the seed mixture selected for the relatively flat areas disturbed by Zortman Mine operations. The seed rate used is based on broadcast rate of 150 to 170 Pure Live

TABLE 2.8-7

SEED MIX AND SEEDING RATE FOR MOUNTAINOUS AREA - ZORTMAN

Species	Common Name	Variety	Seed Rate Lbs/PLS	Seed Rate PLS/ft²
Grasses				
Agropyron cristatum	Crested wheatgrass	Ephraim	2.0	10
Agropyron riparium	Streambank wheatgrass	Sodar	8.0	29
Agropyron trachycaulum	Slender wheatgrass	Revenue	5.0	18
Bromus biebersteinii	Meadow brome	Regar	10.0	9
Festuc ovina	Sheep fescue	Covar	2.0	31
Lolium multiflorum	Annual ryegrass	---	1.0	5
Stipa viridula	Green needlegrass	Lodom	5.0	20
Forbs				
Lotus corniculatus	Birdsfoot trefoil	---	2.0	20
Linum lewisii	Lewis flax	Appar	2.0	14
Achillea millefolium	Common yarrow	---	0.1	6
Astragalus cicer	Cicer milkvetch	Lutana	1.0	4
Total Grasses & Forbs			**38.1**	**166**
Shrubs[1]			**Planting Rate**	
Juniperus communis	Common juniper			
Amelanchier alfnifolia	Serviceberry			
Prunus virginiana	Chokecherry			
Rosa woodsii	Wood's rose			
Symphoricarpos occidentalis	Snowberry			
Total Shrubs[1]			**400 stems per acre**	
Trees[2]			**Planting Rate**	
Pinus Ponderosa	Ponderosa Pine			
Pinus contorta	Lodgepole pine			
Pseudotsuga menziesii	Douglas-fir			
Total Trees[2]			**400 stems per acre**	

PLS = Pure Live Seed

[1] Planting rate for shrubs is a combination of any or all species listed, depending on site characteristics

[2] Planting rate for trees is a combination of any or all species listed, depending on site characteristics

TABLE 2.8-8

SEED MIX AND SEEDING RATE FOR GOSLIN FLAT - ZORTMAN

Species	Common Name	Variety	Seed Rate Lbs/PLS	Seed Rate PLS/ft^2
Grasses				
Agropyron dasystachyum	Thickspike wheatgrass	Critana	8.0	28
Agropyron spicatum	Bluebunch wheatgrass	Revenue	8.0	26
Agropyron trachycaulum	Slender wheatgrass	Revenue	2.0	7
Bouteloua gracillis	Blue grama	Lovington	1.0	19
Poa sandbergii	Sandberg bluegrass	---	1.0	21
Stipa comata	Needle-and-thread	---	3.0	8
Stipa viridula	Green needlegrass	Lodom	4.0	16
Forbs				
Achillea millefolium	Common yarrow	---	0.1	6
Linum lewisii	Lewis flax	Appar	2.0	14
Petalostemon purpureum	Purple prairie clover	---	1.0	7
Ratibida columnaris	Prairie coneflower	---	0.1	6
Total Grasses & Forbs			**30.2**	**158**
Shrubs[1]			**Planting Rate**	
Artemisia trident	Big sagebrush			
Artemisia cana	Silver sagebrush			
Rhus trilobata	Sumac			
Rosa arkansana	Prairie rose			
Total Shrubs[1]			**400 stems per acre**	

PLS = Pure Live Seed

[1] Planting rate for shrubs is a combination of any or all species listed, depending on site characteristics

Seeds per square foot of coverage; the rate would be halved for drill seeding. Tree and shrub species would be planted rather than seeded.

Seedbed Preparation

Seedbeds would be prepared immediately after the area to be revegetated has been graded, cover soil, and fertilized. On gentle slopes (flatter than 3H:1V) the seedbed would be disced and harrowed along the contour to break up large clods. On steeper slopes, areas too narrow to negotiate equipment, or on sites where organic debris has been respread, the soil surface would be left in a roughened condition. The resulting irregular seedbed would provide areas for plant germination and also reduce soil movement on steeper slopes. Seed and mulch would be applied to fresh road cuts and fills in areas subject to erosion as soon after construction as possible to prevent natural sloughing.

Seeding Methods

Seeding would be coordinated with other reclamation activities to occur as soon after seedbed preparation as possible. Fall seeding would be emphasized, while spring seeding would occur if areas are ready for revegetation and access is possible.

Broadcast, hydroseeding, and drill seeding methods would be used, although the majority of disturbances would be broadcast seeded. Broadcast seeding would occur on rocky areas, slopes steeper than 3H:1V, areas where organic debris has been respread, and small disturbances. Seed would be broadcast using manually operated cyclone-type bucket spreaders, mechanical seed blowers, or hydroseeders. When possible, broadcast seeded areas would be chained or harrowed to cover the seed. Where slope conditions allow, seeded areas would be dozer-tracked perpendicular to the slope. Seed would be covered by hand raking on smaller, less accessible sites.

Drill seeding would be done along contour wherever the reclamation surface is not level to achieve proper seed placement depth and promote good contact between seed and soil. Drill row spacing would range from 7 to 14 inches. Drill seeding would not be used in areas where reclaimed surface have rocky soil or where organic debris has been re-spread.

When hydroseeding is used the seed, fertilizer, and mulch would be sprayed in one application of about 250 lbs/acre. Where hydromulching is used, a second mulch application accompanied with a tackifier binding would be sprayed along the disturbance at manufacturer's recommended application rates.

Planting Methods

Trees and shrubs would be planted using two techniques: As clumped plantings on leach pad, waste rock storage area, and plant site crests and tops, and as continuous rows along sloped areas such as dike faces and the leach pad recontoured slopes. Trees and shrubs would not be planted on road cuts and cover soil stockpiles. Shrubs would be reestablished in the prairie grass community associated with the reclaimed tops and slopes of the Goslin Flats operations.

Tree species would be planted continuously across slopes such as dike faces, sloped areas of leach pads (except for the Goslin Flats leach pad), and waste repositories, and in clumps along level areas such as plant sites, and the tops of leach pads and waste repositories. Heap leach pads and waste repository tops would be planted in islands on level areas, with 10 to 30% of the area planted in forest species and the remainder planted in grasses for wildlife grazing. Distribution of the various tree species would depend on slope, reclamation surface, and moisture conditions.

ZMI would initially plant 400 trees per acre. Based on an anticipated survival rate of 65%, the final stocking rate after 15 years would be about 260 trees per acre. The appropriate planting time would be determined by site conditions such as soil moisture, soil temperature, air temperature, site accessibility, and previous reclamation planting experiences with trees and shrubs at Zortman Mine disturbances. Tree stock would be delivered to the site as close to the time of planting as possible, with no stock handled when the air temperature is below freezing and no planting when frost is still in the soil. Hand tools and power-driven augers or similar machines would be used to plant trees and shrubs. Mulching could be employed to conserve moisture and reduce competition.

If available, stock inoculated with mycorrhiza would be planted to enhance growth and prospects for plant survival. Partial shade from logging debris, snags, or other sources would be used to help establish seedlings. If tree seedling survival is less than 65% three years after planting, supplemental planting would be considered.

Cultural Treatments

ZMI would use surface ripping techniques, fertilization, and mulching to enhance revegetation success potential. Ripping would be conducted on soil stockpile sites, road surfaces, and other areas where compaction has occurred. Compacted soil on level areas would be tilled to break up the soil mass and improve water and air movement through the subsurface.

Fertilizer mixes and application rates would be based on soil tests; rates would be formulated to achieve soil macronutrient levels capable of promoting plant growth and productivity. Mulch would be spread evenly over seeded areas at rates dependent on seeding method and slope. Mulch would be anchored into the seedbed using a mulch crimper, disc, or tracked dozer. A tackifier would be applied on areas that are mulched in the fall and on areas which require prompt stabilization.

Noxious Weed Control

Noxious weeds would be controlled throughout the life of the operation by mechanical methods or chemical application by licensed personnel. Revegetated areas would be qualitatively evaluated on an annual basis to assess weed populations. A weed control plan has been developed by ZMI and reviewed by the Phillips County Weed Management program which outlines procedures for management of noxious weed infestation on mine property. ZMI would evaluate and control noxious weed populations on reclaimed areas until the reclamation bond is released on the reclaimed sites.

2.8.3 Landusky Mine: Company Proposed Expansion

ZMI proposes several changes to current operations at the Landusky Mine, including provisions for mining an additional 7.6 million tons of ore and 7 million tons of waste rock. Service facilities to support the reclamation operations would include developing a limestone quarry and expanded shale pit excavations. The location of the currently permitted mine area is shown on Figure 2.8-1. The disturbances associated with these projects are shown on Table 2.8-9, below.

TABLE 2.8-9
DISTURBANCES FOR THE COMPANY PROPOSED ACTION - LANDUSKY

Facility	Proposed Disturbance Increase[1]	Proposed Boundary Increase[1]
87/91 Leach Pad Extension	0	0
Gold Bug Waste Repository	0	0
LAD Support Area	14.0	0
Reclamation Access[2]	28.7	0
Drainage Construction	20.0	0
Quarry Areas and Access[2]	9.7	92.3
Total Disturbances	72.4	92.3

[1] All disturbances and increases in acres
[2] Access includes road disturbances

ZMI would continue to use open-pit mining and heap-leach mineral processing to extract gold and silver from ore. The quantity of ore to be mined under this application would constitute slightly less than one year of additional mining at the facility. No additional workers are anticipated to be hired under this expansion proposal.

2.8.3.1 Mine Pit Expansion

The CPA for the Landusky mine would involve lateral and vertical expansion of the existing Queen Rose/Suprise and August/Little Ben pits, and continued expansion of the South Gold Bug Pit. A plan view of the ultimate pit complex is shown on Figure 2.8-17. Typical cross sections of the expanded pit area are shown from two directions on Figures 2.8-18 and 2.8-19.

Mining Methods

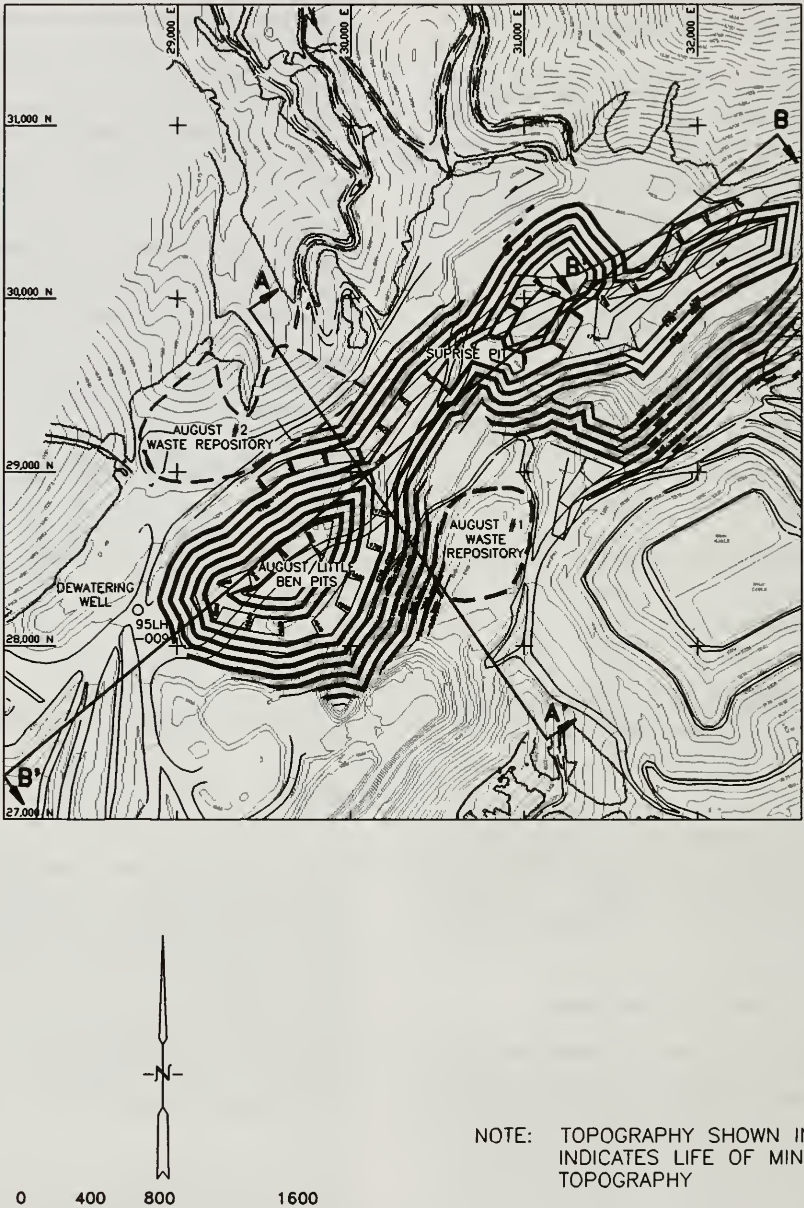
ZMI proposes to mine an additional 7.6 million tons of ore and 7 million tons of waste rock from the Landusky operation beyond that which is currently permitted. The material would come from the Queen Rose/Suprise, August/Little Ben, and South Gold Bug pits (see Figure 2.8-1). No new lateral disturbance is associated with the Queen Rose/Suprise and August/Little Ben pits since expansion would occur within the existing pit outlines. Ore proposed to be mined would be loaded on the existing 87/91 leach pad. End of mine life, based on current permitted leach pad capacity for the 87/91 leach pad, is estimated to be late 1995 to early 1996. Permitting of the proposed 7.6 million ore tons would extend the mine life by approximately one year. Table 2.8-10 provides a summary of currently permitted and disturbed acreages, proposed increases in disturbance area, and tons of ore and waste both mined and proposed to be mined.

TABLE 2.8-10
EXISTING AND PROPOSED DISTURBANCES - LANDUSKY

Description	Currently Permitted	Proposed Additional	Proposed Total
Permit Boundary (Acres)	1,287	92	1,379
Permitted Disturbance Area (Acres)	814	73	887
Total Ore (Tons)	116,674,000	7,600,000	124,274,000
Total Waste Rock (Tons)	90,000,000	7,000,000	97,000,000

Mining would be conducted by ZMI using company personnel and a fleet of 12 to 16 Caterpillar 777B haul trucks (or similar equipment), 10 to 12 diesel powered support vehicles (bulldozers, loaders, road graders and shovels), and 25 to 40 gasoline and propane powered service and utility vehicles. Contractors could provide additional services that might increase totals in each of the above equipment categories by as much as 50%. Mine operations are scheduled for 24 hours per day, seven days per week. Total ore and waste rock mined per day would be approximately 60 to 80 thousands tons.

The final pit floor elevation prior to backfill proposed for the Queen Rose/Suprise pit is 4,600 feet and the August/Little Ben pit final floor elevation is 4,400 feet. An adit entering the old underground Gold Bug workings is located at an elevation of 4,580 feet and the



NOTE: TOPOGRAPHY SHOWN IN BOLD INDICATES LIFE OF MINE TOPOGRAPHY

PLAN VIEW OF
PROPOSED LANDUSKY MINE
PIT DISTURBANCE

LANDDST1

August adit elevation is 4,604 feet. The expanded mining operation would require dewatering of the August pit. A dewatering well (95-LH-009) is proposed at the southwest perimeter of the pit. Dewatering rates could be several hundred gpm. Flow from the well would be piped by a 6" HDPE line to the 85/86 leach pad and added to the process circuit as makeup water, or treated (if necessary) and discharged into Montana Gulch.

Rock Characterization

The materials and their relative amounts to be mined during operations at the Landusky Mine are as follows. (See Section 3.1 for a description of the geology of the area, including simplified descriptions of rock types and typical mineral associations.)

- **Tertiary Porphyries** - ZMI has estimated that 81% of the rock mined would consist of Tertiary felsic porphyries and associated breccias. Of this amount, approximately 38% would be taken to leach pads for processing and the remaining 43% would be scheduled for waste handling.

- **Paleozoic Sediments** - Approximately 13% of the rock to be mined would be from Paleozoic sedimentary formations, with less than 9% of this material containing sufficient amounts of precious metals to be worth processing as ore. The bulk of the Paleozoic rock is unmineralized Emerson Formation, consisting of limestones, marls, and calcareous shales which would all be handled as waste rock. These lithologies show less alteration, less mineralization and have lower sulfur content than the igneous rocks.

- **Archaen Metamorphics** - About 3% of the rock to be mined would be composed of approximately equal amounts of schists, gneisses and amphibolites. Archean rocks have comprised a significant portion of the rocks mined at Landusky in recent time, but the proposed mining would result in removal of greater amounts of Tertiary and Paleozoic rocks, as illustrated below:

TABLE 2.8-11
ORE AND WASTE ROCK TYPES

Relative Age and Rock Type	Percent of Rock to be Mined[1]	Percent Ore	Percent Waste
Tertiary: Porphyries and Breccias	81%	38%	43%
Paleozoic: Sediments	13%	9%	4%
Archaen: Metamor-phics	3%	2%	1%
Unclassified	4%	3%	1%
Total	101%	52%	49%

[1] Total exceeds 100% due to rounding of percentages.

Materials Characterization

Mines wastes would continue to be characterized based on their total sulfur content. Section 2.5.3.1 provides information on the material characterization and classification strategy. No change from this strategy is proposed.

2.8.3.2 Crushing Operation

Mining of the deeper portions of the Queen Rose/Suprise, August/Little Ben, or expanded South Gold Bug pits would not require crushing or special handling for leaching purposes.

2.8.3.3 Ore Leaching Operation

A number of leach pads have been developed and used during the past 15 years of mining at Landusky. Table 2.5-8 provides a listing of those pads, showing their current and potential load capacities, and their current reclamation status. All pads but the combined 87/91 are fully loaded with ore. The following sections describe the expansion proposed for the 87/91 pad and the process by which metals would be extracted from the ore. The reader is referred to Section 2.5.3.3 for a discussion of the current status of leach pads at the Landusky Mine.

87/91 Pad Expansion and Operation

The 87/91 leach pad was developed by expanding the 87 leach pad to the east and the 91 leach pad to the west, for one combined unit. This leach pad has already been permitted. The 7.6 million tons of ore proposed to be mined under this expansion would be placed on the existing 87/91 leach pad. No new construction of either lined pad area or buttress is required or proposed; expansion of the pad would occur by increasing the vertical loading of ore on the pad. The final pad capacity on this facility would be increased from the current 101.9 million tons to 109.5 million tons, and the final elevation at completion would be 5450 feet, an increase in elevation of approximately 50 feet. There are no changes in lateral disturbance which are associated with the increase in loading of this pad to 19.5 million tons.

Solution Ponds

No additional solution ponds are proposed in connection with the proposed additional ore and waste rock mining.

Leak Detection System

No change is proposed to the leak detection system, as described in Section 2.5.3.3, Alternative 1. The existing underdrains and monitoring wells that are beneath and adjacent to the 87 and 91 leach pads would be used to monitor for process solution leakage.

Processing Plant Operation

No change is proposed in operation of the processing plant. The existing facilities would continue to be utilized to process gold bearing solutions from the leach pads. There would be no changes in reagent handling and storage.

2.8.3.4 Waste Rock

The program to characterize waste rock types, according to their potential to generate acid or neutralize acid drainage, was described in Section 2.5.3.4. This section describes how that characterization program would be used to sort and dispose each category of waste rock. The proposed waste rock repository expansion is also summarized.

Waste Rock Handling

No changes would be proposed to the waste rock handling methods described in Section 2.5.3.1, Alternative 1. Waste rock would continue to be segregated according to the criteria presented in the rock characterization section. Blue waste materials would be used in construction without restriction on the basis of geochemical properties. These materials would be stockpiled alongside the waste repository. Approximately 3%, or about 220,000 tons, of the waste generated during the expansion would be expected to classify as blue waste. Yellow waste materials would be positioned to ensure that their contact with air and water is limited. These materials would be placed around the margins of the waste repository, but within the volume to be protected by barriers. Yellow waste materials would also be used for constructions over which impermeable capping is planned. Approximately 13%, or about 855,000 tons, of the waste generated during the expansion is expected to be classified as yellow waste. Green waste materials would be placed in the cores of waste rock facilities which allow for isolation of the material. About 83%, approximately 5.8 million tons of waste rock, is expected to be considered green waste (Ryan 1994).

Repository Construction

Seven million additional tons of waste rock would be mined and scheduled for disposal in the Gold Bug and Queen Rose Waste Repositories. Approximately 3 million additional tons of waste would be placed in the Gold Bug repository and 4 million tons of waste would be placed in the Queen Rose repository. Waste rock from the expansion would increase the Gold Bug repository load to approximately 23 million tons. This amount of waste rock would fit within the repository's design capacity of 24 million tons. As in previous construction, the nominal slope of the repository would be built at 3H:1V, and drainage benches (15 - 30 feet wide) would be placed every 100 vertical feet. Reclamation at the Gold Bug would continue to occur concurrent with mining activities. Section 2.8.4.4 provides more information on the repository reclamation program.

2.8.3.5 Other Features and Facilities

Access and Haul Roads

A haul road would be constructed in the permitted disturbance area for accessing the South Gold Bug Pit area. Existing access and haul roads would be used and new roads may be constructed on existing disturbed areas within the pits. The 2,500 feet of haul road to the King Creek limestone quarry would be widened from 20 to 60 feet, resulting in an additional total disturbance of 5.7 acres.

Power and Water Supply
No changes are proposed in the current power and water supply systems for the Landusky Mine. Electrical power is obtained from the Landusky grid, which is supplied by the Big Flat Power Cooperative through an existing 23 kV line. Potable water is obtained from groundwater wells. Process water is obtained from precipitation and groundwater appropriation.

Sewage Treatment
No changes are proposed from the current septic waste treatment systems. See Section 2.5.3.5, Alternative 1, for additional information.

Chemical Use
No changes are proposed from the current inventory and use of potentially hazardous materials. See Section 2.5.3.7, Alternative 1, for additional information.

Waste Disposal
No changes are proposed from the current disposal methods for solid and/or hazardous wastes. See Section 2.5.3.7, Alternative 1, for additional information.

2.8.3.6 Water Handling and Treatment

Diversions and capture systems would be constructed to allow capture of mine-impacted waters and prevent deterioration of water quality in non-impacted drainages. Storm water would be segregated from mine-impacted water, and no impacted water would be released to surface water prior to treatment. Data would be collected in accordance with the monitoring plan to regularly monitor water quality.

Water Capture and Treatment
The existing seepage capture systems, including Sullivan Park, Montana Gulch, Mill Gulch, and King Creek, would be sized to handle seepage generated by a 6.0 inch, 24 hour storm event. Seepage capture ponds and sumps would be inspected on a weekly basis for routine maintenance or repairs, if necessary.

ZMI proposes to treat Landusky capture water of unacceptable discharge quality at the Zortman water treatment plant until a new water treatment plant is constructed at the Landusky Mine. Landusky waters would be piped to Zortman via the existing pipeline, which would be rerouted due to expansion of the Zortman pit complex. The treatment process in use at the Zortman Mine can be summarized as lime precipitation. Low pH waters (i.e., those which are more acidic) are adjusted to a pH range of 6 - 9 and are clarified prior to discharge from the water treatment plant. The water treatment plant is designed to treat up to 2,000 gallons per minute of mine water, but the operating and discharge rate would depend on the quantity of mine water requiring treatment. See Section 2.5.3.6 for more detailed information on the water treatment plant operations, including a discussion on handling of the sludge produced from the plant and the interim water quality criteria to which the plant discharge water must adhere.

Changes proposed for water capture in Sullivan Park, Montana Gulch or King Creek, as well as the seepage capture pond and sump in Mill Gulch, are described in the Water Quality Improvement Plan (see Appendix A).

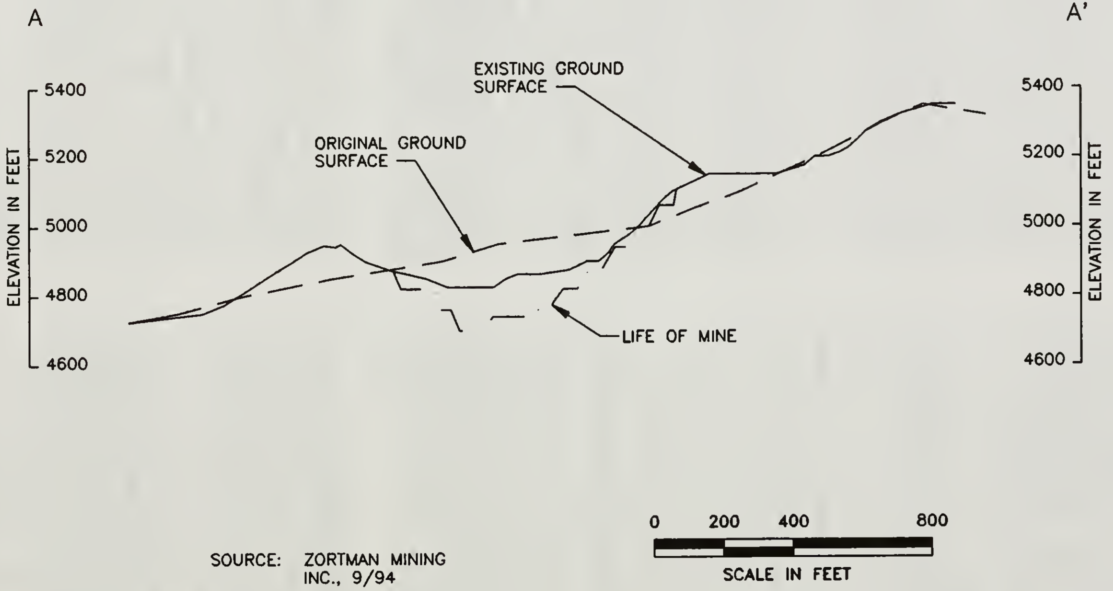
Changes to the seepage capture pond and sump in Mill Gulch are proposed (see Appendix A). In the event captured seepage water does not meet acceptable water quality criteria, it would be disposed of on the permitted land application disposal (LAD) area on Gold Bug Butte, used in the process circuit, or treated at the Zortman water treatment plant and discharged to Ruby Gulch until a new treatment plant is constructed at the Landusky Mine.

Surface Water Runoff Control
Surface water runoff diversions and controls would be sized for a 6-inch, 24-hour storm event with freeboard added as a safety measure. Diversion channels would be trapezoidal or V shaped, lined with geotextile to prevent piping and rip-rapped with durable, non-acid forming rock sized for drainage area requirements. Figure 2.5-6, in Alternative 1, illustrates location of lined and bedrock diversion ditches and outfalls.

All diversion ditches would have road access for maintenance purposes. Maintenance would consist of removal of sediment load and repositioning of rip-rap as required. Sediment would be disposed of in the waste rock repository.

Rip-rapped channels or existing scree slopes would be proposed for outfall structures. A rock blanket would be constructed at diversion discharge points in existing natural drainages. The rock blanket channel would consist of a geotextile lined diversion channel rip-rapped with 1.5 to 5.0 feet of durable, non-acid forming rock. Scree slope outfalls would be used where discharge points occur above the existing natural drainage.

Mine Pit
No changes are proposed for operational surface water runoff control. Dewatering of the August pit is described in Section 2.8.3.1.

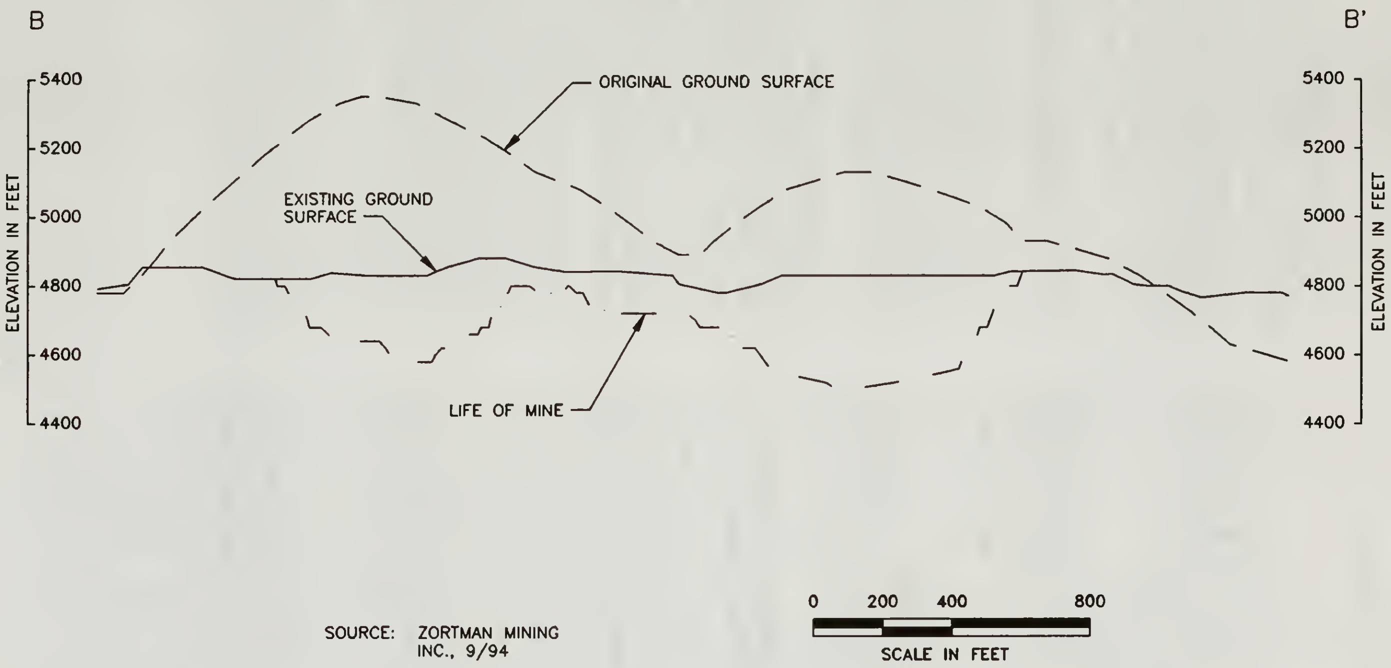


SOURCE: ZORTMAN MINING INC., 9/94

NOTE: SEE FIGURE 2.8-17 FOR CROSS-SECTION LOCATION

TYPICAL SECTION A-A'
LANDUSKY MINE

73ELA-A



SOURCE: ZORTMAN MINING INC., 9/94

NOTE: SEE FIGURE 2.8–17 FOR CROSS-SECTION LOCATION

TYPICAL SECTION B–B'
AT LANDUSKY MINE

FIG. 2.8–19

173ELB-B

Leach Pads
No changes are proposed for operational surface water runoff control. Storm water would be segregated from impacted water by implementing best management practices along the slope on the west side and with construction of new drains along the east side of the Sullivan Park leach pad buttress.

Waste Rock Repositories
No changes are proposed to the existing drainage control features for the Gold Bug and Mill Gulch waste repositories. No changes are proposed to the existing drainage control features for the Montana Gulch waste rock dump and the waste rock dumps at the head of King Creek.

Land Application Disposal
No emergency land application is anticipated during operations. In the unlikely event land application is required, it would be conducted as described in Section 2.5.3.6 for currently permitted operations.

2.8.4 Landusky Mine: Company Proposed Reclamation

Revised surface reclamation plans are proposed for all Landusky Mine facilities to provide for identification and implementation of improved reclamation techniques, with particular emphasis on enhanced reclamation covers to limit the potential for ARD generation. Although one focus of the reclamation plan would be to meet water quality management objectives with source controls and passive treatment measures, contingency plans are included for active water treatment.

Enhanced reclamation covers are required to prevent acidification of growth media placed during reclamation where acid forming materials are exposed. In addition, reclamation covers are proposed to limit infiltration, thereby minimizing the amount of seepage below facilities.

Final reclamation of the Landusky Mine is anticipated within 3 years of detoxification of the 87/91 leach pad. Reclamation timing of individual facilities is contingent upon operational factors, and scheduling variations within the overall timeframe could occur. Reclamation activities are submitted to the DEQ on an annual basis, reporting the previous year's reclamation and the activities anticipated for the following year. A reclamation schedule is shown on Table 2.8-12.

A number of operational systems have been installed or are proposed to ensure water quality protection. In addition to the enhanced reclamation covers proposed for some facilities, other water protection features include construction of operational drainages (versus post-operational drainages required under the current permit) which divert flows around leach pads, waste repositories and the pit complex, and capture systems which collect flows in two drainages. Contingency plans also exist for both active and passive water treatment.

2.8.4.1 Reclamation Materials

Reclamation materials would be required for construction and installation of reclamation caps, and for use in construction of drains and solution diversions. The primary materials to be used in reclamation covers would include non-acid forming waste rock and alluvial sediments, limestone, clays and cover soil. The following sections describe these materials.

Non-Acid Forming Material
Non-acid forming material would be used primarily as a capillary break, and to a lesser extent, as rip-rap and drain material. The non-acid forming waste rock ("blue" waste) would be mined and stockpiled adjacent to the Gold Bug waste repository for use in reclamation. The material would be required for reclamation of existing facilities (leach pads, waste rock dumps, etc.), as well as for reclamation of the proposed 87/91 leach pad expansion and pit complex.

King Creek Limestone Quarry
ZMI proposes to mine limestone from a quarry in the King Creek drainage. Material from this quarry would be used to construct drains or other facilities where a rock with high net neutralization potential is deemed desirable. This is a site where a quarry was previously permitted to provide materials for the King Creek public service project. Figure 2.5-2 shows the location of the proposed quarry site.

Limestone would be blasted, excavated and removed using ZMI equipment (Driltech C40KSH drills, Caterpillar 992 loader, Caterpillar D9N and D10N bulldozers and Caterpillar 777B haul trucks). The following materials would be disturbed:

TABLE 2.8-12

PROPOSED OPERATING AND RECLAMATION SCHEDULE FOR LANDUSKY

Facility	Operational Years (From Date of Approval)	Reclamation Years (From Date of Approval)[1]
Queen Rose, Suprise and August Pits	0 - 2.5	2 -3
South Gold Bug Pit	0	2
Gold Bug Waste Repository	0 - 2.5	0.5 - 3.5
Queen Rose Waste Repository	0 - 2.5	0.5 - 3.5
Mill Gulch Waste Repository	Not Used	In Progress
Montana Gulch Waste Dump	Not Used	1-4
August #1 and #2 Waste Dumps	0	3.5
Haul Roads	0 - 3.5	2.5 - 3.5
87/91 Leach Pad	0 - 5	5 - 8
85/86 Leach Pad	0	3
80-84 Leach Pad	0	2
83 Leach Pad	0	1
79 Leach Pad	0	1
Process Plants, Ponds and Storage Areas	0 - 7	8
Maintenance Shop, Warehouse, Offices, Parking and Storage Areas	0 - 7	4 - 8
Limestone Pits	0 - 7	8
Access Roads	0 - 8	0 - 8

[1] Subject to change based upon mine and operating plan.

MATERIAL	DEPTH	FATE
Cover soil	2 - 4 ft	Repositioned during revegetation
Weathered Limestone	4 - 15 ft	Repositioned during resloping
Competent Limestone	15 - 50 ft	Used in construction

The 2,500 feet of road from the haulage road into King Creek to the quarry site would be widened from 20 to 60 feet, with a disturbance of 5.7 acres resulting (assuming a 100 foot disturbance corridor). The disturbance in the immediate quarry area would be the quarry pit and areas of sidecast and stockpiled material. Cover soil and weathered material would be sorted and positioned onto areas adjacent to the quarry. The quarried material would be stockpiled at the quarry site prior to usage. The following disturbances are anticipated at the King Creek site:

Disturbance	Acreage
Limestone Pit	2.0
Storage for Salvaged Materials	1.0
Storage for Limestone	1.0
TOTAL	4.0

This disturbance would be sufficient for excavation, storage and movement of up to 50,000 tons of limestone. Total disturbance for the King Creek quarry would be 9.7 acres (4.0 acres for the quarry pit and 5.7 acres for haul road).

Williams Clay Pit

The Williams Pit would provide bentonitic clays for use in reclamation covers. Up to 650,000 yd^3, or 850,000 tons, of material would be excavated from the pit, which is located approximately 2 miles west of the town of Landusky (see Figure 2.5-2). The clay would be hauled by ZMI truck and loader fleet, or contracted out to a truck and loader fleet, from the pit over the county road leading to the Landusky Mine, through the town of Landusky and onto the mine site to the area of final placement.

Trucks carrying from 50 to 85 tons of clay would be grouped at the Williams pit and Landusky mine site and travel as a convoy under the direction of front and rear pilot vehicles. The round trip haul time would be approximately one hour, and one convoy would make the trip each hour. Depending on reclamation requirements and schedules, clay would be hauled 24 hours per day.

Cover Soil

Cover soil stockpiles are located on the Landusky mine site and would not require haul traffic on county roads. A maximum of 460,000 cy^3 of coversoil would be required for reclamation capping. Cover soil collection and transport would be accomplished using ZMI or contractor equipment.

2.8.4.2 Reclamation Testing and Covers

Reclamation testing of existing facilities and new disturbances would be as described for the Zortman Mine in Section 2.8.2.2. One of three reclamation covers designated as Reclamation Cover A, Reclamation Cover B, and Reclamation Cover C would be used on facilities. These covers are depicted on Figure 2.8-20 and described in Section 2.8.2.2.

2.8.4.3 Mine Pit Reclamation

Revised Pit Reclamation Procedures

ZMI began to backfill the Gold Bug pit with mine waste in February 1993. In addition to meeting the existing pit reclamation commitments in Alternative 1, all pit benches and pit floors would be sealed to limit surface water infiltration. Pits would be partially backfilled and the August adit used as drainage from the main Landusky mining complex (August/Little Ben and Queen Rose/Suprise pits) into Montana Gulch (see Figure 2.5-6. The following specific changes in the reclamation procedures are proposed:

1) Retreat reclamation and capping of benches

   During mining, bench areas identified as potentially acid forming would be capped with Reclamation Cover A (see Figure 2.8-21). Benches identified as non-acid forming would receive 8 inches of coversoil before revegetation.

2) Backfill pits to the August adit elevation

   At cessation of mining, the pit complex (Queen Rose/Suprise, August/Little Ben) would be backfilled to the 4600 feet level. An engineered drain would be constructed into the existing August adit and the pit complex floor graded to flow into the engineered drain. No reconditioning of the adit is proposed as it is free draining. Discharge of the adit is in Montana Gulch. Discharge would be collected in a capture pond.

The South Gold Bug pit would be backfilled to the 5040 feet level from the pit highwall, to the 5030 feet level at the pit daylight, using approximately 450,000 tons of waste rock. The pit floor backfill would be capped.

3) Capping and reclamation of the pit floor and backfill areas.

The pit floor complex would be capped with Reclamation Cover B (as shown on Figure 2.8-21).

4) Installation of final diversions.

Portions of the pit walls that are potentially acid forming and cannot be capped would have diversions installed above the highwalls, where access allows. These diversions would prevent storm water run-on.

2.8.4.4 Leach Pad Reclamation

The designation, volume, and current status of the eight leach pads in the Landusky mining area are shown on Table 2.5-8. Tasks associated with the reclamation of the heap leach facilities include heap detoxification, surface reclamation, and liner perforation.

Heap Detoxification

No modifications to the procedures for detoxification of the leached ore or heap decommissioning are proposed. Leached ore would be detoxified and reclaimed following the conclusion of processing. The detoxification process would take place in three steps: (1) an initial fresh water flush, (2) circulation of degraded pad effluents back through the system, and (3) a final circulation of cyanide free water to degrade and flush residual cyanide complexes from the heap. Section 2.8.2.4 provides an expanded discussion of the heap detoxification process.

Surface Reclamation (Proposed Cover Design)

Leach pad slopes would be reduced to 3H:1V areas where this would not result in off loaded pad materials being moved into natural or constructed drainages. The reslope of the 87/91 pad extension would be conducted as part of the 87 and 91 individual pad reclamation projects. Final slope reclamation would be accomplished by a mixture of slope reduction and constructive reslope, with some materials pushed off of containment or placed into the mine pits as backfill.

Leach pad slopes would be reduced in the northern portions of the drainages that flow onto the Fort Belknap Indian Reservation. Approximately 3,900,000 tons of spent ore would be partially off-loaded and placed on the southern, western, and eastern areas to reduce the slope from 2H:1V to 2.7H:1V. Spent ore would not be placed off containment until the material was neutralized. Reclamation Cover B or C would be placed on the regraded leach pad if testing confirmed the necessity for a cover.

A 100-foot-wide buffer around the 1987 and 1991 pads would be required for reclamation access roads. There would be 28.7 acres of disturbance associated with this roadway. Capping sequences (Reclamation Cover B or C) would be installed over detoxified and regraded leach pads.

Liner Perforation

No changes are proposed for liner perforation for the 80/82, 83, 84, and 85/86 leach pads. Perforation would not occur until water quality objectives have been met. The agencies would be consulted 90 days prior to liner perforation.

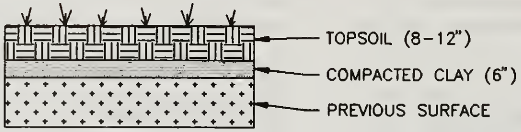
Further revisions to the reclamation plan for the 87/91 heap leach pad liner system perforation, include:

1) Water which collects in the sumps of reclaimed leach pads would be sampled on an annual basis.

2) The rate of phreatic surface rise would be monitored by annual measurement of phreatic surface elevations. Based on these measurements, the rate of infiltration into a reclaimed leach pad would be calculated.

3) After 10 years, if it is determined that water quality management objectives would be met for a given leach pad, the liner for that facility would be perforated.

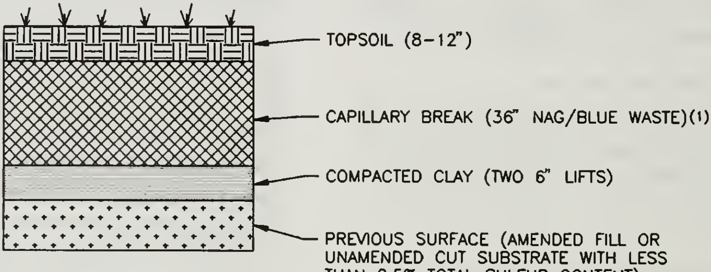
4) If monitoring indicates that water quality management objectives would not be met, or if the rate of accumulation is such that dewatering of the leach pads becomes necessary before the 10-year monitoring period is reached, heap waters would be treated and/or discharged using the land application area.



RECLAMATION COVER A

COVER FOR POTENTIALLY ACID GENERATING SECTIONS OF HAUL ROADS

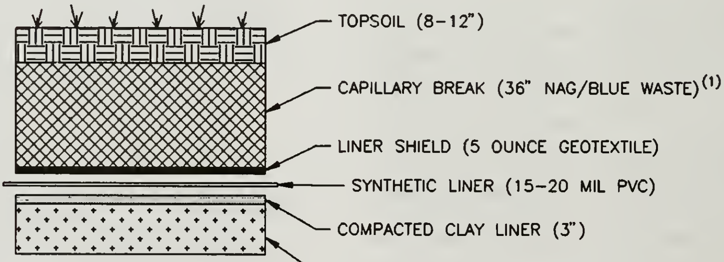
SCALE: 1"=4'



RECLAMATION COVER B

COVER FOR SLOPES 5 PERCENT OR MORE ON WASTE ROCK AND HEAP LEACH FACILITIES

SCALE: 1"=4'



RECLAMATION COVER C

COVER FOR SLOPES LESS THAN 5 PERCENT ON WASTE ROCK AND HEAP LEACH FACILITIES

SCALE: 1"=4'

NOTE:

1. NAG - NON ACID GENERATING
   BLUE WASTE - LESS THAN 0.2% TOTAL SULFUR.

SOURCE: ZORTMAN MINING INC., 9/94

ALTERNATIVE 4
RECLAMATION COVERS FOR LANDUSKY MINE WASTE ROCK AND HEAP LEACH FACILITIES AND SELECTED SECTIONS OF HAUL ROADS

173E0004

FIG. 2.8-20

Although final reclamation calls for puncture of leach pad liners, ZMI has agreed to provide 90 days notice prior to puncturing any of the liners, so that potential water resource impacts can be evaluated.

Land Application
Following completion of all land application operations, the land application area would be reclaimed. The pond liners would be removed and buried within the 1991 leach pads. All disturbances would be regraded to slopes no steeper than 3H:1V which would then be cover soiled and revegetated.

2.8.4.5 Waste Rock Facilities Reclamation

The designation and volume of waste rock material stored, and current reclamation status of the three waste rock facilities in the Landusky mining area are found in Table 2.5-10. Section 2.5.3.4 includes a narrative description for each of these facilities. Cover requirements for these facilities would be dependent on results of testing and the slope to be reclaimed. Section 2.8.4.2 provides more detail on each of these covers.

Montana Gulch Waste Rock Dump
This valley fill waste rock dump was constructed during the years 1979 to 1987. Waste materials were end dumped with no attempt to segregate materials within the dump by size or geochemical characteristics. No barrier layers were included in reclamation covers for this facility when reclamation was conducted during 1988 - 1990. This facility would be tested as described in Section 2.8.4.2 within three years of project approval and, if necessary, capped with appropriate reclamation barriers.

Mill Gulch Waste Rock Repository
The Mill Gulch waste repository currently contains 17 million tons of unclassified waste rock. This valley fill waste repository was constructed during 1987 - 1993, both by crest dumping and by lift addition. During 1990 - 1992 dump materials were amended with 2,600 tons of lime, which were placed on upper lifts of the dumps and ripped into the substrate. The existing interim cap, consisting of Reclamation Covers B and C, as described in Section 2.5.4.5, is proposed to be left as the final cap.

Gold Bug Waste Rock Repository
Repository reclamation is proposed to continue concurrent with mining operations in the same manner as described in Section 2.5.4.5, Alternative 1. To minimize infiltration, the repository slopes would be sealed with Reclamation Cover B. The repository top would be capped with Reclamation Cover C. These caps are proposed as final reclamation. Capping and revegetation would occur as portions of the repository are completed.

Queen Rose Waste Rock Repository
The Queen Rose waste rock repository is located within the previously mined northeast and north portions of the Queen Rose pit and entirely confined within the mined pit area. The repository contains approximately 3.2 million tons of waste rock from operations under existing permit. An additional 4 million tons of waste rock would be placed in the repository for a total capacity of 7.2 million tons.

The base of the northeast portion of the repository is at the 4,700 ft elevation and the top is at the 4,980 ft elevation. The base of the northern portion is at the 4,720 ft elevation and the top is at the 4,840 ft elevation. The repository would be constructed from the base up in the same manner as discussed in the Gold Bug waste repository section. Blocks of material which are scheduled as green waste would be segregated within the repository interior. The margins of the repository would be constructed with yellow waste. Final slopes would be graded at 3H:1V with a 30 ft wide intermediate bench on the northeast portion of the repository at the 4,920 ft elevation.

Reclamation of the repository would be concurrent with mining for portions of the repository that would not be used as backfill for the August/Little Ben pit. Approximately 3.1 million tons of material would be required to backfill the August/Little Ben area from the 4,400 ft elevation to the 4,600 ft elevation. The final repository slopes would be capped with Reclamation Cover B. The final repository tops (with less than 5% slopes) would be capped with Reclamation Cover C. As the pit floor was to be capped with Reclamation Cover B, no changes in quantities for reclamation materials would be required.

August #1 and #2 Waste Rock Dumps
The August #1 waste rock dump was constructed during 1984 and contains 700,000 tons of material. Waste materials were end dumped with no attempt to segregate materials by size, character, or placement within the dump. The waste material placed in the dump was taken in the early stages of mining and is oxidized. The August #1 waste rock dump has been recontoured at a 2H:1V slope. Final reclamation would consist of testing the surface to determine the need for reclamation capping. If it is not required, the dump surface would be covered with 8 to 12 inches of coversoil and revegetated with a mulch and tackifier base. If

geochemical characterization indicates a cover is required, Reclamation Cover B will be used.

The August #2 waste rock dump was constructed from 1980 to 1981 and contains 1,300,000 tons of material. Waste materials were end dumped with no attempt to segregate materials by size, character, or placement within the dump. The waste material placed in the dump was taken in the early stages of mining and is oxidized. The August #2 waste rock dump has been recontoured at slopes of 2H:1V to 2.25H:1V, coversoiled, and revegetated. The dump surface would be tested to determine the need for reclamation capping. If a cover is required, Reclamation Cover B would be used.

2.8.4.6 Support Facilities Reclamation

No changes are proposed to the procedures used in reclamation of the solution and process ponds, mill and processing plant sites, or the soil stockpile. See Section 2.5.4.6 for a discussion of the reclamation practices in use.

Access and Haul Road Reclamation

Haul Roads - Haul roads would be recontoured with waste rock to slopes no steeper than 2H:1V. The fill material would be sampled and analyzed for total sulfur every 100 feet to determine segments with potentially acid forming materials. Road fill identified as potentially acid forming (greater than 0.5% total sulfur) would be capped using Reclamation Cover A. Road fill identified as non-acid forming would be covered with 8 inches of coversoil and revegetated.

Access Roads - Access roads would have sidecast material pulled back into the road and recontoured to blend in with the existing topography, within the safe operating limits of the excavator or dozer. Available cover soil in the sidecast would be used as coversoil. No testing for potential acid generation is proposed.

Quarry/Borrow Pit Reclamation

The King Creek limestone quarry would be reclaimed after mining has ceased. The salvaged materials (weathered limestone and coversoil) would be repositioned on the pit floor at a slope of 3H:1V or shallower. The post reclamation scarp heights on the limestone pits would vary from 0 - 30 feet. The disturbed areas would be revegetated with grasses, forb, trees, and shrubs as required in Section 2.8.4.9.

An additional 6.7 acres at the Williams clay pit would be disturbed for the maximum proposed reclamation. Those areas in the clay pit already disturbed and reclaimed from previous operations, about 25.6 acres, would undergo additional reclamation; therefore, reclamation would be conducted on a total of 32.3 acres. A slope no steeper than 2.5H:1V would be left after grading to allow runoff to proceed naturally into the current drainage system to the southeast of the pit. Cover soil would then be spread at an average of 12 inches, and a minimum cover of 9 inches, with vegetative seeding occurring during a seasonal period of higher precipitation. A seed blend of seven natural occurring area grass types would be used, as described in Section 2.8.4.9.

2.8.4.7 Reclamation/Post-Reclamation Water Handling and Treatment

Final MPDES requirements, discharge water quality standards, passive treatment and water management practices are being discussed between ZMI and the Water Quality Division of the DEQ (see the Water Quality Improvement Plan summary in Appendix A). Conditions of the MPDES permits would be adopted by ZMI for closure.

Reclamation goals include final reclamation cover and water management practices that would minimize mine-impacted waters as vegetation is reestablished.

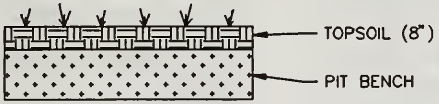
Water Capture and Treatment

No changes are proposed for operational water capture and treatment upon cessation of mining and leaching activities. Water treatment would continue on an interim basis until final reclamation is established and water quality is acceptable. As water quality meets discharge standards and the appropriate agencies approve of release of the waters, capture ponds, sumps and pumpbacks would be dismantled and the sites reclaimed.

Mine Pit Runoff Control

Above Pit Diversions - Where access allows, portions of the pit walls that are potentially acid forming and cannot be capped would have diversions installed above the highwalls. These diversions would prevent storm water from entering the pit. The diversions would be designed to be maintenance free. However, highwalls would be visually inspected on a periodic basis and repairs made as necessary.

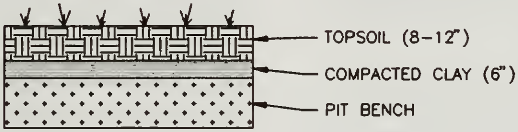
Pit Floor Diversion - At cessation of mining, the pit complex (Queen Rose/Suprise, August/Little Ben)



PIT BENCH COVER

NON-ACID GENERATING – LANDUSKY

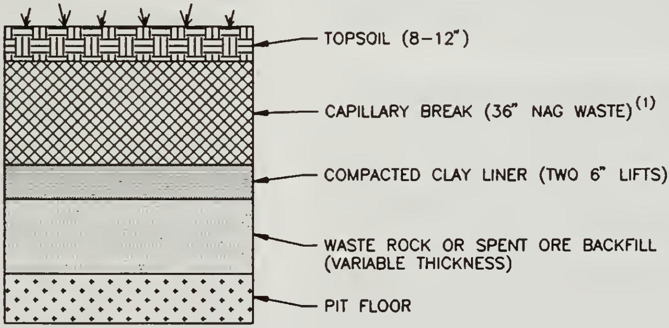
SCALE: 1"=4'



PIT BENCH COVER

ACID GENERATING – LANDUSKY
(RECLAMATION COVER A)

SCALE: 1"=4'



PIT FLOOR COVER

LANDUSKY
(RECLAMATION COVER B)

SCALE: 1"=4'

NOTE:

1. NAG – NON ACID GENERATING

SOURCE: ZORTMAN MINING INC., 9/94

ALTERNATIVE 4
RECLAMATION COVERS FOR
LANDUSKY MINE
PIT BENCHES AND FLOOR

FIG. 2.8–21

would be backfilled with approximately 939,000 tons of material, creating a final pit floor at approximately the 4600 feet elevation. An engineered drain would be constructed into the existing August Adit and the pit complex floor graded to flow into the engineered drain. The engineered drain and pit floor diversion would be sized for the 6-inch, 24-hour storm event. No reconditioning of the adit, other than establishing the engineered drain into the exposed adit in the pit highwall, is proposed as it is currently free draining. The adit portal is in Montana Gulch, buried beneath the Montana Gulch waste rock dump. Drainage from the August Adit would be captured in a pond near the tunnel mouth where it would be neutralized by lime addition or pumped back for treatment at the Zortman water treatment plant. The pond would be sized for a 6-inch, 24-hour storm event that includes runoff from the pit and underground workings.

Maintenance of the pit floor diversion would include removal of sediment and repositioning of rip-rap as necessary. Maintenance is not proposed after vegetation is established and sediment load eliminated. The engineered drain would be designed to be maintenance free.

Leach Pad Runoff Control

Diversions would be constructed around the leach pad and laterally across the buttresses, sized for runoff from the 6-inch, 24-hour storm event.

Waste Rock Repositories Runoff Control

No changes are proposed to the existing drainage control features for the Gold Bug and Mill Gulch waste repositories. No changes are proposed to the existing drainage control features for the Montana Gulch waste rock dump and the August waste rock dumps at the head of King Creek.

The top of the northeast portion of the Queen Rose repository would be sloped away from the face of the repository and routed to the northeast edge of the repository. A rip-rapped ditch 10 to 15 feet wide and 2 feet deep would be routed along the toe of the repository and drain to the August adit. A 30 ft wide intermediate bench would be placed at the 4,920 ft elevation and slope back into the repository at grades of 5 to 10%. The bench would be capped with clay or synthetic liner in a similar manner as the Gold Bug repository. The drainage from the intermediate bench would be graded to a drainage ditch located at the northeast edge of the repository. The top of the northern portion of the Queen Rose repository would be sloped away from the face of the repository and routed to the northeast edge of the repository. A rip-rapped ditch 10 to 15 feet wide and 2 feet deep would be routed along the toe of the repository and drain to the August adit. No intermediate benches would be constructed.

Land Application Disposal Area Runoff Control

Land application is not anticipated to be required for final heap draindown. Draindown solution would be pumped to Goslin Flats leach pad and incorporated as process water. Section 2.8.1.4 contains additional information on solution transport between the Landusky and Zortman mines and the use of this solution at the Goslin Flats leach pad.

2.8.4.8 Reclamation Quality Control

ZMI or a mine contractor would place the clay cap. Clay placement would be monitored by a qualified, independent third-party engineering firm. The clay would be hauled from the Williams clay pit and placed in two 6-inch compacted lifts. Each lift would be tested separately, approximately one test per acre. The clay would be drill tested for thickness by ZMI personnel with third party guidance. Drill holes would be backfilled with commercial grade bentonite. Clay thickness would be considered acceptable if there is a minimum 12-inch depth at 90% of the sampling locations and no less than 9 inches at any location. If an area does not have the minimum thickness, additional clay would be brought in and compacted to obtain the 12-inch depth. Compaction testing would be done by the third party inspector with a nuclear density gauge. Specifications would be for the clay to meet 95% density (Standard Proctor test) at 90% of the test locations. A minimum density would be 90% compaction.

ZMI personnel would install the synthetic liner (15 - 20 mil PVC). Installation of the synthetic liner would also be monitored by a third party inspector. Seams would be air-lanced to ensure a good bond was achieved between field seamed PVC sheets. Areas having inadequate bonding, cuts or punctures would be repaired and tested until passed by the third party inspector. The entire area would be visually inspected and passed prior to cover with geotextile. Monthly construction reports with testing results would be provided to the agencies.

ZMI, or a mine contractor overseen by ZMI personnel, would install the capillary break. The capillary break thickness would be 3 feet over 90% of the area covered, with a minimum thickness of 2.5 feet at any location.

2.8.4.9 Revegetation Procedures

In most respects, revegetation procedures for reclaimed areas at the Landusky Mine would be as described for the Zortman Mine (see Section 2.8.2.9). Areas disturbed by mining-related operations would be revegetated to stabilize soil and slopes, reestablish communities ecologically comparable to pre-mine conditions, and restore watershed, wildlife, recreational and aesthetic values that meet post-operation land use objectives. The only difference for Landusky revegetation from that described for the Zortman Mine is in seed mixtures and broadcast rates. The seed mixture selected for the Landusky Mine would be broadcast at approximately 180 Pure Live Seeds per ft^2. Table 2.8-13 presents the revegetation mixture and seeding/planting rates for the Landusky Mine.

2.8.5 Monitoring Programs and Research Studies

Section 2.5.5 provides a description of the monitoring programs and research studies ongoing at the Zortman and Landusky mines. The following sections describe only programs and studies which would be conducted in addition to the existing program, or proposed modifications to the existing programs.

2.8.5.1 Water Resources Operational Water Monitoring

The operational water monitoring program as currently defined would continue during expansion and reclamation of the Zortman and Landusky mines. Water resources monitoring, including sites already added to the program to collect data for the extension projects, would continue as described in Section 2.5.5.1. Changes to the monitoring frequency and chemical analytes could occur depending on the requirements of the final MPDES permit.

In the event that existing monitoring sites or wells must be decommissioned due to mining operations, regulatory agencies would be consulted and appropriate replacement sites would be selected.

Post Reclamation Water Monitoring

The purpose of post-reclamation water resource monitoring would be to verify the effectiveness of reclamation in maintaining the quality of water resources. This monitoring program would concentrate on those drainages downgradient of the heap leach pad facilities and waste rock facilities (e.g., Goslin Flats, Ruby Gulch, Alder Gulch).

Post-operation monitoring would use wells and stream stations which have been used during baseline and operational monitoring programs. This would ensure continuity of data and provide for comparison between pre-mining, mining and post-mining water resource systems. At present it is anticipated the final monitoring network would consist of the following monitoring sites (see Tables 2.5-13 through 2.5-17 and Exhibits 1 and 2 for a key to the locations of these sites):

Zortman Sites

- Surface Water — Z-1B, Z-5, Z-8, Z-15, Z-16, Z-16A, Z-18, Z-20, Z-21, Z-22, Z-27, Z-28, Z-31, Z-32, Z-42, and Z-44
- Groundwater — ZL-110, ZL-141/142/143, ZL-145, ZL-147,ZL-148, ZL-149, ZL-150, ZL-153, ZL-210,AG-200, AG-201, AG-202, AG-203, RG-110, and RG-111

Landusky Sites

- Surface Water — L-2, L-7, L-8, L-9, L-11, L-16, L-19, L-23, L-36, L-37, and L-39
- Groundwater — ZL-109, ZL-113, ZL-133, ZL-139, ZL-155, ZL-156, ZL-157, ZL-162, ZL-164, ZL-165, and TP-1

Monitoring sites may be revised based on the results of operational monitoring, which would identify sites most sensitive to environmental impacts. Diagnostic sampling parameters identified during operational monitoring would be used for post-operation water resource monitoring.

After reclamation and closure activities have commenced (immediately after cessation of mining activities), post-mining monitoring would go into effect. Post-mining monitoring would consist of four periods of monitoring as described below:

Period 1 — Immediately after completion of mining and leaching activities (including perforation of the heap leach pad liner), monthly monitoring would take place for one year in the leach pad, waste rock repository and

TABLE 2.8-13

SEED MIX AND SEEDING RATE FOR LANDUSKY REVEGETATION

Species	Common Name	Variety	Seed Rate Lbs/acre	Seed Rate PLS/ft^2
Grasses				
Agropyron dasystachyum	Thickspike wheatgrass	Critana	5.0	18
Agropyron spicatum	Bluebunch wheatgrass	Secar	5.0	16
Agropyron trachycaulum	Slender wheatgrass	Revenue	4.0	14
Agrostis alba	Redtop	---	0.20	22
Bromus marginatus	Mountain brome	Bromar	6.0	13
Festuc ovina	Sheep fescue	Covar	2.0	31
Lolium multiflorum	Annual ryegrass	---	2.0	10
Orizopsis humenoides	Indian ricegrass	Nezpar	5.0	16
Forbs				
Lotus corniculatus	Birdsfoot trefoil	---	2.0	20
Linum lewisii	Lewis flax	Appar	2.0	14
Achillea millefolium	Common yarrow	---	0.1	6
Total Grasses & Forbs			**33.3**	**180**
Shrubs[1]			**Planting Rate**	
Arctostaphylos	Kinnickinnick			
Juniperus communis	Common juniper			
Amelanchier alfnifolia	Serviceberry			
Prunus virginiana	Chokecherry			
Rosa woodsii	Wood's rose			
Symphoricarpos occidentalis	Snowberry			
Total Shrubs[1]			**400 stems per acre**	
Trees[2]			**Planting Rate**	
Pinus contorta	Lodgepole pine			
Pseudotsuga menziesii	Douglas-fir			
Total Trees[2]			**400 stems per acre**	

PLS = Pure Live Seed
[1] Planting rate for shrubs is a combination of any or all species listed, depending on site characteristics
[2] Planting rate for trees is a combination of any or all species listed, depending on site characteristics

pit areas. This would provide post-mining water quality data.

Period 2 If no water quality changes are detected in the first year of monthly monitoring, or if water quality improves, quarterly monitoring would be conducted for a period of one (1) year.

Period 3 If no water quality changes are detected, or if water quality improves during the first year of quarterly monitoring, semi-annual monitoring would be conducted for a period of three years. Semi-annual monitoring would be conducted during the spring (May-June) and fall (October-November).

Period 4 After year 5, monitoring would continue on an annual basis until the reclamation bond has been released, which would occur after neutralization of process solutions and reclamation have been successfully carried out and the water meets the requirements set forth in the MPDES permit.

A final design of the post-operation monitoring plan would be prepared near the end of the mining operation. Post-operation water resource monitoring would be continued until reclamation bond is released on the specific disturbance which the stream station or groundwater well is monitoring. Any changes proposed to the post-operation monitoring plan would be submitted to DEQ and the BLM for review and approval prior to implementation.

Heap Leach Pad

A monitoring program would be implemented for the spent ore pad to determine the quantity and quality of seepage through the materials; provide a basis for design of mitigation measures, if necessary; and to monitor any potential long-term changes.

Monitoring instrumentation would consist of neutron access tubes installed near the base of the facility, pressure-suction lysimeters placed a critical depths to monitor soil moisture quality below specific zones, and existing wells downgradient from the facility to monitor any potential impact to groundwater. Frequency of monitoring would be quarterly for the first year, semi-annually until apparent equilibrium conditions occur, and annually until bond release.

Carter Gulch Waste Rock Repository

A monitoring program would be implemented for the waste rock storage area to determine the quantity and quality of seepage through the materials; provide a basis for design of mitigation measures, if necessary; and to monitor any potential long-term changes.

Monitoring instrumentation would consist of neutron access tubes installed to the base of the facility, pressure-suction lysimeters placed at critical depths to monitor soil moisture quality below specific zones, and wells downgradient from the facility to monitor any potential impact to groundwater. Frequency of monitoring would be quarterly for the first year, semi-annually until apparent equilibrium conditions occur, and annually until bond release.

2.8.5.2 Reclamation Surface Performance Study (RSPS)

Section 2.5.5.2 describes the history and intent of the Reclamation Surface Performance Study (RSPS), including actions which have been initiated (primarily in Stage 1 (Help Model Evaluation) and Stage 2 (Preliminary Field Trials), and those planned to begin soon (primarily Stages 3 (Comprehensive Field Trial) and 4 (Operational Monitoring). The RSPS would be continued during the expansion projects.

2.8.5.3 Surface Reclamation Monitoring Revegetation

Revegetated areas would continue to be evaluated by field reconnaissance during the first season following seeding or planting to determine initial revegetation success. First year monitoring would include visual observation of overall germination and planting success. During the second season, monitoring would include quantitative and qualitative evaluations of canopy cover, species composition and tree planting success. Areas with poor germination and/or growth would be evaluated to determine causes of any unsuccessful revegetation. The agencies would be consulted and reclamation techniques would be modified to address any identified problems. Attempts to revegetate problem areas would be made until successful. Thereafter, monitoring would be conducted biannually until vegetation composition is stable.

Revegetation mixtures may be modified, with approval of MDSL and the BLM, to reflect plant material availability and other factors, including evaluation of initial revegetation success.

Soil
Vegetative characteristics such as vigor, color, growth rate, and post seedling emergence would be observed to monitor soil fertility. If plant nutritional deficiencies appear, micronutrient testing would be included in the sampling program and appropriate corrective measures would be taken.

Water Control Structures
All water control structures including diversions, exclusion berms, sediment traps and culverts would be periodically inspected and maintained to ensure that they are functioning properly.

Subsidence
Subsidence of reclaimed areas is not anticipated since ample time would be allowed prior to reclamation to allow any preferential settling or subsidence of the structure to occur. In addition, reclamation parameters associated with slope stability and regrading would reduce the possibility of slope subsidence on such areas as heap leach facilities and waste repositories. Monitoring for subsidence of reclaimed areas would be conducted during reclamation monitoring. Any subsidence noted during reclamation monitoring would be corrected and reseeded.

2.8.5.4 Air Quality Monitoring

Section 2.5.5.4 provides a description of the air quality monitoring program for the Zortman and Landusky mines. No changes to the existing program would be implemented for the Zortman and Landusky expansion projects.

2.8.5.5 Wildlife Monitoring

Section 2.5.5.5 provides a description of the wildlife monitoring program for the Zortman and Landusky mines. No changes to the existing program would be implemented for the Zortman and Landusky expansion projects. Expansion facilities would be included in the wildlife monitoring program.

2.8.6 Reasonably Foreseeable Future Actions

2.8.6.1 Mine Activities - Zortman

A proposal to mine the 2-million ton ore deposit in the Pony Gulch area is foreseeable (see Figure 2.8-1) because facilities to process the ore in Goslin Flats would be in place. Methods similar to those described in earlier sections would be used to mine this deposit; the ore would then be crushed and placed on the conveyor for transport to the Goslin Flats leach pad to be processed.

Proposals for vertical or lateral expansion of the Goslin Flats leach pad are foreseeable should substantial amounts of additional ore be identified through the exploration program.

Proposals for development of a new limestone source on the ridge above Zortman, or enlargement of the proposed Green Mountain limestone quarry, are foreseeable (see Figure 2.5-2). This material would be used to provide non-acid generating construction material for maintenance of drainage control structures. The quarrying of additional limestone resources could total as much as 1 million tons should there be a shortage of suitable waste rock for construction and reclamation purposes. Limestone may be used for capillary break material, rip-rap for drainages, under-drains, and/or as buttress material.

Proposals for construction of passive water treatment systems such as wetlands or anoxic limestone drains down gradient of the Zortman mine facilities are reasonably foreseeable as a means of mitigating effects from acid rock drainage. This would likely occur at the closure and post-closure phases of mine life.

2.8.6.2 Mine Activities - Landusky

Proposals for the mining and leaching of additional ore at the Landusky Mine are foreseeable. It is likely that ZMI would propose to mine an additional 12.2 million tons of ore and 8 million tons of waste rock at some future date, as some evidence exists that additional mineable ore is present at the Landusky Mine. This could be mined from the existing mine pits and the South Gold Bug pit area.

A leach pad to contain the 12.2 million tons of ore would probably be proposed either within an existing mine pit or at some other suitable location. It would be technically feasible to construct an in-pit leach pad in the Queen Rose/Suprise pit. Alternatively, spent ore from present leach pads could be off-loaded after detoxification, thereby providing additional room for new ore leaching. Spent ore off-loaded from the leach pads could be disposed in the mine pits as backfill.

Construction of a new leach pad would likely occur on existing disturbed ground and would involve mining of additional clay for leach pad liner. Crushing of some ore would be necessary to provide a protective layer over the pad liner.

Waste rock associated with foreseeable mining activity would be proposed for disposal in the existing Gold Bug waste rock repository or used as pit backfill in the South Gold Bug Pit. However, subsequent drilling could extend the bounds of the pit and may affect the viability of pit backfilling.

Additional limestone quarry operations (beyond the 50,000 tons which is proposed in Alternative 4) are foreseeable. This would be to obtain a source of non-acid generating material for construction-reclamation purposes should current projections for non-acid generating waste rock amounts be in error.

At the King Creek quarry this could involve mining of an additional 550,000 tons of limestone. A proposal to develop a new limestone quarry in Montana Gulch is also foreseeable. This quarry site would likely be located in the NW¼, SW¼, of Section 22, T25N, R24E (see Figure 2.5-2). This site is within the current Landusky Mine permit boundary. Another 550,000 tons of limestone may be proposed for mining from this new quarry. This would raise the final quarry disturbance to 10 acres for the King Creek quarry and 7 acres for the Montana Gulch quarry.

Due to ongoing discussions between ZMI and the DEQ Water Quality Division, the drainage control and capture systems may be proposed for revision to ensure attainment of new effluent limits. This could involve additional capture ponds, storage ponds for active water treatment facilities, storm water discharge settling ponds, and constructed wetlands.

A water treatment plant at the Landusky Mine would probable be necessary to comply with the Improvement Plan and to mitigate residual impacts, although the exact plant size and flow rate for a treatment plant have not been determined. However, such a plant could be similar in design and operation parameters to the existing Zortman water treatment plant, which has an operating flow of approximately 2,000 gpm. The plant would function to chemically neutralize the treated water and precipitate metals from the mine effluent. The water treatment plant would also have contingency capability to destroy cyanide using hydrogen peroxide or sodium hypochlorite. The storage capacity for the water treatment plant would include a 0.5 million gallon capture sump below the Landusky 85/86 leach pad and a 0.5 million gallon pond adjacent to the treatment plant.

Sludge from a water treatment plant at the Landusky Mine would probably be disposed by burial in an existing leach pad. A sludge disposal area would be proposed upon determination of the site location for the water treatment plant.

2.8.6.3 Exploration Activities

In 1991, ZMI submitted for agency consideration a long-term exploration program designed to assess areas of potential economic mineralization throughout that portion of the Little Rocky Mountains outside the Fort Belknap Reservation. ZMI withdrew the proposal in 1992 as a result of their decision to prioritize exploration efforts elsewhere. Since there has been no change in the basic geology and economic conditions that gave rise to the exploration proposal, it is included here as a reasonably foreseeable activity. While the details of this comprehensive exploration project would not be identical to the 1991 proposal, the overall concept would be as follows:

Under this alternative it is likely that exploration activities would be targeted on those areas adjacent to the conveyor route. This may result in identification of a minable deposit that could be accessed by the conveyor and leached at Goslin Flats. New exploration activities could occur over a 10-year period, and disturb approximately 128 acres. The greatest amount of activity (and disturbance) would likely be in the area between the existing Zortman and Landusky mines.

Geologic anomalies in some of the more remote areas in the Little Rocky Mountains would first be tested with small portable drill equipment, brought onsite by helicopter. This would determine if larger scale exploration was warranted. Up to ten sites would be tested with shallow (<100 foot) drill holes.

Overall, exploration could involve 200,000 linear feet of road construction, 5,000 linear feet of trenching, and 600 drill holes over a 10-year period (Table 2.8-14). New road construction would use bulldozers to build roads with bed-widths between 12 and 16 feet. Side-cast and road cuts would increase the average disturbed width to

TABLE 2.8-14
POTENTIAL EXPLORATION DISTURBANCE

Category	Currently Disturbed	Foreseeable Disturbance	Totals
Roads	47,940 ft 27.5 acres	200,000 ft 114.8 acres	247,940 ft 142.3 acres
Trenches	400 ft 0.3 acres	5,000 ft 3.1 acres	5,400 ft 3.4 acres
# Drill Sites:	137	500	637 sites
Off Road Drill Sites:	0	100	100 sites
Total Disturbances			
Linear Feet	48,340	205,000	253,340
Acres	27.8	127.6	155.4
No. of Sites	137	600	737

TABLE 2.8-15
MAXIMUM NEW CONSTRUCTION BY PROJECT YEAR[1]

Year	Roads (ft)	Trenches (ft)	In-Road Drillsites	Off-Road Drillsites
0[2]	47,940	400	137	0
1	35,000	1,000	150	40
2	35,000	1,000	150	40
3	35,000	1,000	150	40
4	35,000	500	150	40
5	25,000	500	100	25
6	25,000	500	100	25
7	25,000	500	100	15
8	25,000	500	50	15
9	10,000	500	50	10
10	0	0	0	0

1 Estimates shown represent maximum values for individual years. The total exploration disturbances shown in Table 2.9-14 would not be exceeded.

2 Year "0" represents existing conditions.

25 feet. Road grades would average less than 8% with approximately one-tenth of the roads being as steep as 8 to 25%.

The combined existing and foreseeable exploration activity could disturb 155 acres of land. The primary earthen material to be disturbed is topsoil, alluvium, and scree. Each of these materials would be removed during the construction phase of road building, trenching, and drilling, and stored on site for final reclamation.

Exploration trenches would be constructed using dozers to expose bedrock. Trench widths and depths would be approximately 15 feet, with individual trench lengths no greater than 250 feet.

Drilling would occur predominately within a constructed roadbed using track-mounted and buggy-mounted, reverse-circulation drilling equipment. These holes would be drilled to depths of approximately 300 feet. More than one hole may be drilled from a single drillsite. Off-road drilling would use skid-mounted, and large truck and track-mounted equipment, requiring approximately level drill pads 65 by 65 feet. These holes would be drilled to depths of approximately 600 feet. Drilling would use either air or water as a circulating medium depending on localized lithologic and hydrologic conditions. Standard drilling fluid additives would be used.

Down-hole geologic data would be collected by sampling, assaying, and describing drill cuttings. Approximately 5% (30) of the drill holes would be core sampled.

The maximum amount of new construction that would occur in any given year is shown in Table 2.8-15. At no point would yearly construction exceed 27 acres of disturbance.

2.8.6.4 Exploration Reclamation

Reclamation would be performed on a yearly basis concurrent with ongoing exploration and mineral evaluation. Unreclaimed land for any year would not exceed 71 acres, with this acreage decreasing substantially during the final four years of the project. A reclamation schedule is presented in Table 2.8-16.

Roads - Exploration roads would be recontoured using either rubber-tired backhoes, traxcavators and/or track-mounted dozers. Side-cast materials, deposited down slope of the roadway during construction, would be pulled back into the road cut. As the roadway slope is either backhoed or dozed into place, the final reclaimed surface would approximate the original contour.

Reclaimed roads associated with stream drainages crossed during construction would have culverts removed and the drainage recontoured to allow for continual surface flow. Additional soil stabilization techniques would be used in these areas to prevent erosion until vegetative cover is established. Such techniques include the placement of straw (free of noxious weeds) upstream of the surface crossing to reduce stream flow velocities or use of erosion control blankets such as excelsior, hemp mat or other geotextile materials to ensure adequate transfer of surface flows across the reclaimed area.

Trenches - Trenches constructed during exploration by track-mounted dozers would be backfilled, recontoured and revegetated during reclamation. Rubber-tired backhoes, rubber-tired loaders, traxcavators, and/or trackmounted dozers would be used to fill and recontour trench excavations with materials end-dozed or side-cast during the construction phase of exploration. Topsoil material stripped from the site and stockpiled during construction would be distributed along the recontoured surface prior to revegetation. Final reclamation surfaces would be revegetated to provide soil stability and reestablishment of vegetative communities.

Off-Road Drill Sites - Off-road drill sites constructed for deep hole (up to 600') exploration would be recontoured and revegetated to blend with adjacent undisturbed landforms. The above mentioned equipment would be used to recontour the disturbance prior to revegetation. Final recontoured sites would be revegetated to provide soil stability and reestablishment of vegetative communities.

Revegetation would be established on all disturbed areas except scree slopes. Seeding would be coordinated with other reclamation activities to occur as soon after recontouring and seedbed preparation as practical. Seeding would normally be conducted in fall (after Oct 15) or spring (prior to May 1) depending on weather conditions. All spring seedings would be conducted as early in the season as possible to maximize use of early precipitation. The majority of seeding would be manually broadcasted. Hydroseeding may be used in certain areas.

TABLE 2.8-16

FORESEEABLE EXPLORATION RECLAMATION SCHEDULE

Year	Roads (ft)	Trenches (ft)	Off-Road Drillsites	Acres/Year
1	12,940	400	0	7
2	15,000	500	10	10
3	25,000	500	10	16
4	25,000	500	10	16
5	35,000	500	10	21
6	35,000	500	10	21
7	30,000	500	10	19
8	30,000	500	10	19
9	25,000	1,000	15	16
10	15,000	500	15	10
Total	247,940 ft	5,400	100	155

Streams affected by exploration activity would be recontoured and revegetated. All exploration drill holes would be plugged completely from bottom to top where groundwater is encountered.

Drill hole closure and abandonment would be conducted in accordance with the Montana Hard Rock and Placer Exploration License Manual: Requirements, Policies, Procedures and General Information, Drill Hole Plugging Policy (June 21, 1993). In summary, all holes must be plugged at the surface, 5 to 10 feet with cement. Bentonite or a similar material from the bottom to within 5 to 10 feet of the surface.

All solid waste material (i.e. plastic, wood, metal, etc.) would be removed from the area on a continual basis and disposed of properly. Used hydrocarbon products would be transported from the area to be disposed of in accordance with pertinent regulations.

2.9 ALTERNATIVE 5: AGENCY MITIGATED EXPANSION AND RECLAMATION WITH GOSLIN FLATS LEACH PAD LOCATED IN UPPER ALDER GULCH RATHER THAN ON GOSLIN FLATS

Alternative 5 would allow expansion of both the Zortman and Landusky mines but impose agency-developed mitigations on the expansion and reclamation activities. The major modification to ZMI's expansion plans (see Alternative 4, Section 2.8) would be at the Zortman Mine, where the proposed the ore heap leach facility at Goslin Flats would instead be placed within Upper Alder Gulch. The agencies developed this alternative as a means of mitigating visual and noise impacts, and effects on wildlife associated with construction and operation of the leach pad and conveyor system to Goslin Flats. A significant modification of the Landusky reclamation requirements would be for ZMI to remove rock fill from the head of King Creek and backfill the pits to a minimum elevation required to create a surface which would freely drain into King Creek. Additional sources of backfill, such as the 85/86 leach pad and Montana Gulch waste rock dump, could also be required to reach the desired pit floor elevation. Other agency-developed mitigating measures are incorporated into this alternative, including those described in Alternative 3. Figure 2.9-1 shows the existing and proposed facilities at both mines associated with this alternative.

Many of the plans and facility designs for Alternative 5 are similar to or the same as those described in Alternative 4, and are hereby incorporated into this alternative. Therefore, the description of expansion and reclamation facilities is tiered to the discussion presented in Section 2.8. The focus of discussion for this alternative is on those areas which would be modified from the Company Proposed Action. The proposed mine expansions and facilities modifications are presented in Sections 2.9.1 (Zortman Mine) and 2.9.3 (Landusky Mine), followed by the proposed reclamation activities for each mine as described in Sections 2.9.2 and 2.9.4. Modifications to ZMI's proposed monitoring programs and research studies are described in Section 2.9.5. Section 2.9.6 contains an assessment of other activities which are reasonably foreseeable should Alternative 5 be implemented.

2.9.1 Zortman Mine: Agency Mitigated Expansion

The location and currently permitted area of the Zortman Mine and the proposed Mine expansion with relocation of the leach pad to Upper Alder Gulch, are shown on Figure 2.9-1. The total new disturbance for the Zortman expansion would be approximately 1,350 acres including buffer zones around disturbance and 405 acres previously disturbed under the existing permit.

Under this alternative ZMI would continue to use open-pit mining and heap-leach mineral processing to extract gold and silver from ore, as described in Section 2.8.1. The major modifications from the Proposed Action include:

- The 80-million ton capacity heap leaching facility would be constructed in Upper Alder Gulch as a valley fill leach pad, rather than at Goslin Flats.

- The ore crushing facility would be sited in the vicinity of the pit complex.

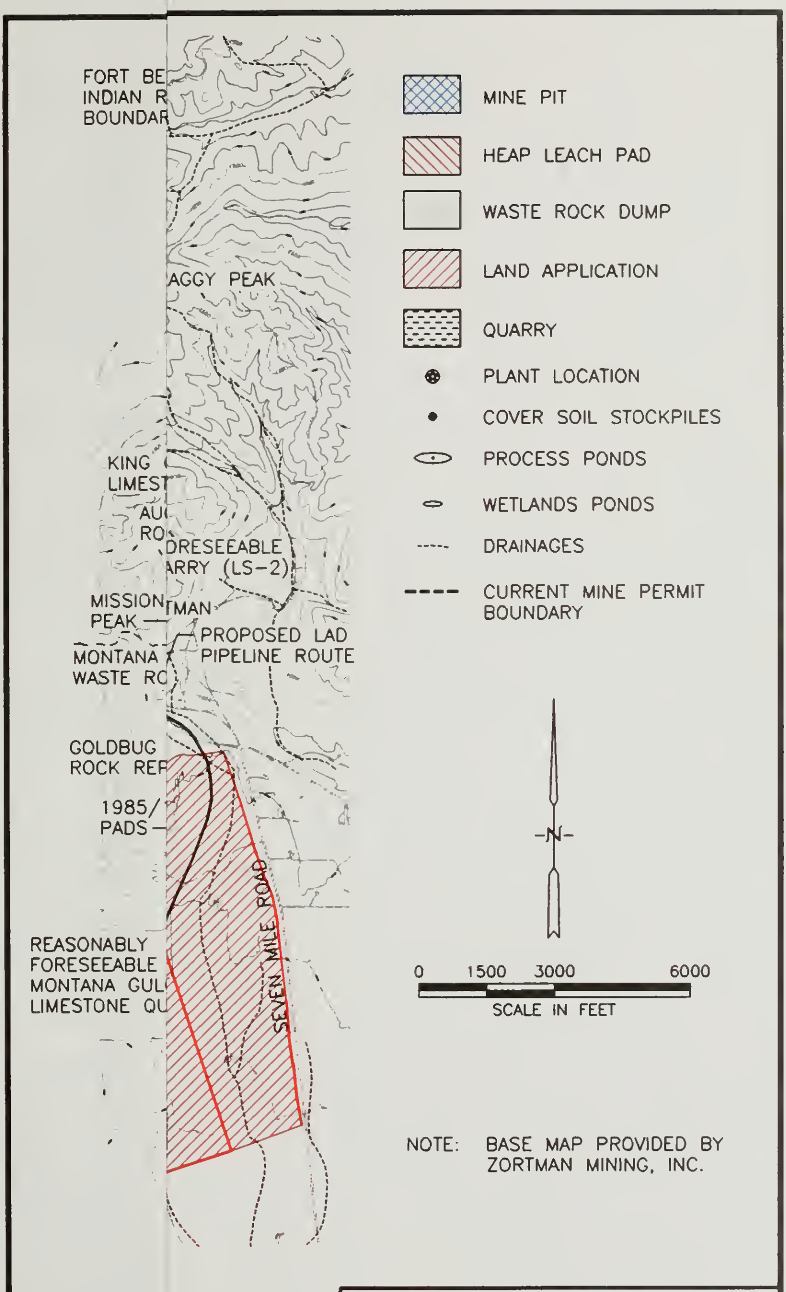
- Enlargement of the ore processing plant at the Zortman Mine to include a carbon adsorption circuit.

- Crushed ore would be transported to the heap leach pad by truck (rather than by conveyor system, as proposed in Alternative 4).

- All mine expansion and reclamation activities would be conducted in accordance with the Water Quality Improvement Plan (see Appendix A).

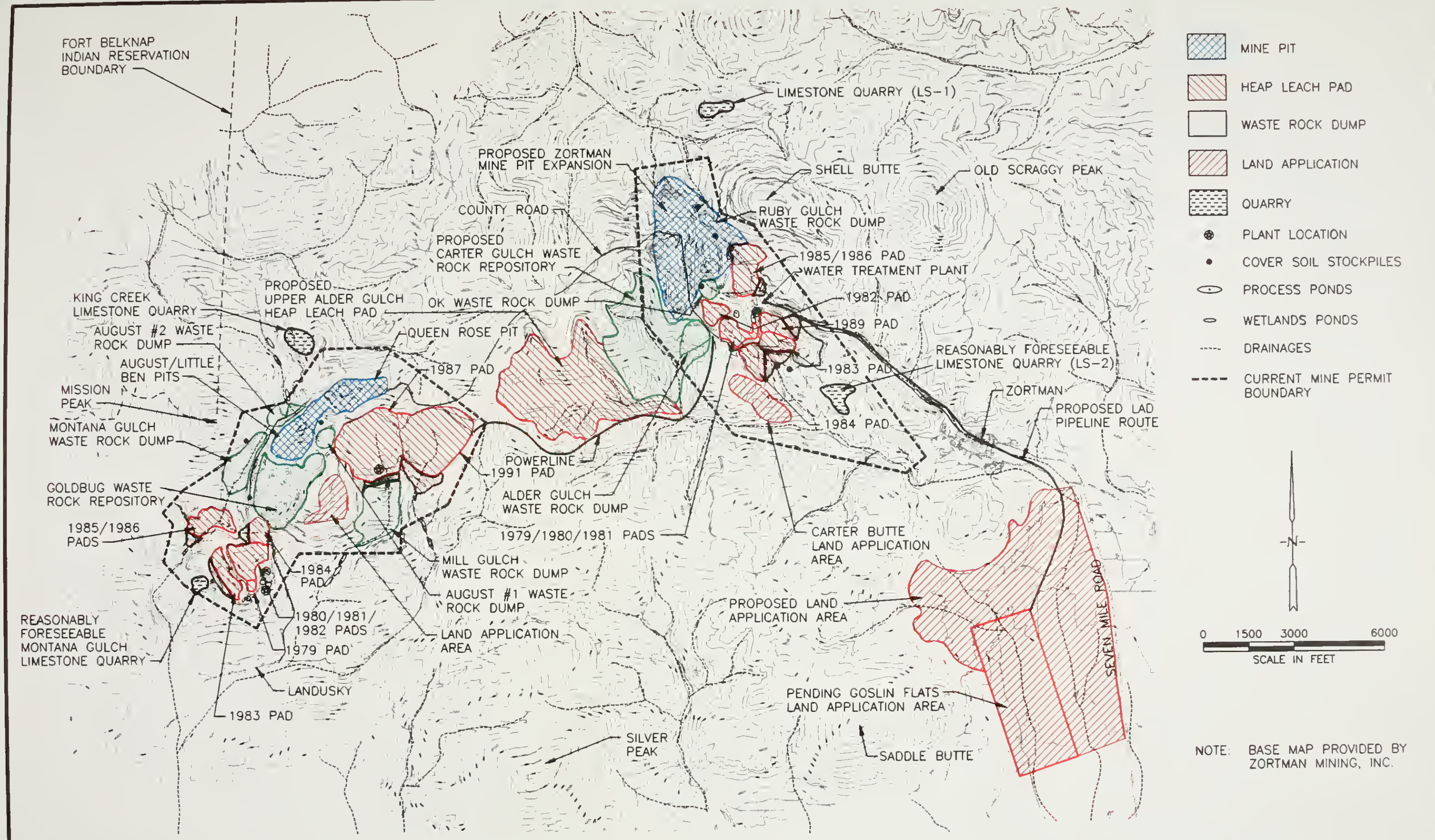
- All mine expansion and reclamation activities would be conducted in accordance with the signed Memorandum of Agreement developed under Section 106 of the National Historic Preservation Act (see Appendix E).

- Performance of an Environmental Audit on an annual basis would be carried out to assure that spill containment systems work properly, that leak detection systems are in proper working order, and that spill prevention and response planning can be realistically implemented through review of company



ALTERNATIVE 5
ZORTMAN-LANDUSKY
EXISTING AND PROPOSED
FACILITY LOCATIONS

FIG. 2.9-1



ALTERNATIVE 5: MAJOR NEW FACILITIES INCLUDE THE UPPER ALDER GULCH HEAP LEACH PAD, THE CARTER GULCH WASTE ROCK REPOSITORY, AND THE ZORTMAN MINE PIT EXPANSION

ALTERNATIVE 5
ZORTMAN-LANDUSKY
EXISTING AND PROPOSED
FACILITY LOCATIONS

ZLF-AL15

FIG. 2.9-1

training programs and inspection of emergency response equipment.

Ore production would be approximately 60,000 to 80,000 tons per day, with mining and leaching operations performed on a year-round basis. Mining and related operations would take place 7 days a week, 24 hours per day, 350 days per year. ZMI projects that the Company Proposed Action work force would be similar to current operations, with approximately 260-280 full-time employees, depending on seasonal requirements. The agencies' modifications to the mine expansion should not measurably change the rate of operations or the work force.

2.9.1.1 Mine Pit Expansion

Mine pit expansion would not change from that described in Section 2.8.1.1. The edges of the pit would be extended outward 600 or more feet from the current pit configuration. The pit would be deepened approximately 500 feet in some ore zones, to a lowest point of about 4,500 feet. A plan view of the pit complex was shown on Figure 2.8-3, with pit cross-sections displayed in Figures 2.8-4 and 2.8-5.

Mining Methods

Conventional open-pit mine methods (drill, blast, and transport) would be used. The mining description provided in Section 2.8.1.1 is applicable to this alternative unless otherwise noted in specific sections.

Rock Characterization

The materials and their relative amounts to be mined during expanded operations at the Zortman Mine were described in Section 2.8.1.1. The geochemical sampling and waste rock characterization program proposed by ZMI, and described in Section 2.8.1.1, would be implemented under this alternative. (The agencies have added mitigations restricting the use of certain waste rock types in reclamation, as described in Section 2.9.2).

Waste Rock Handling

Waste rock would be hauled by truck to the Carter Gulch waste rock repository. Placement of the waste rock within the repository would depend on the material's potential to create acid drainage. Waste rock would be segregated within the waste rock repository on the basis of total sulfur content, as shown in Table 2.8-4 of Alternative 4. However, waste rock could not be used in the construction of reclamation covers based solely on the sulfur content of the rock. Material used in construction purposes and as a capillary break must meet the geochemical and lithologic criteria described in Section 2.9.2.

2.9.1.2 Crushing Operation

Metallurgical testing at Zortman has shown that unoxidized ore must be crushed to facilitate gold recovery. Crushing reduces the size of individual ore fragments, thereby increasing the surface area upon which the heap leach chemicals will act to separate gold from the rock matrix. The basic process employed under this alternative for ore crushing would not change from that described in Section 2.8.1.2. However, the location for the crushing operations would be modified.

Because this alternative calls for placement of the ore heap leach facility in Upper Alder Gulch, an ore conveyance system would not be constructed along Alder Gulch and no ore processing facilities would be sited on Goslin Flats. Therefore, all ore crushing operations would take place in the vicinity of the pit complex, at a location selected by ZMI based on area requirements and ease of access. Ore would be hauled from the mine pit in trucks and placed in a truck dump hopper located at the crushing area near the pit. In the event the hopper is inoperable the ore would be placed in a stockpile adjacent to the primary crusher. Oxide ore would be crushed to less than 6 inches in diameter by a primary crusher, then dumped or trucked to a mixed ore (both oxidized and unoxidized ore) stockpile. Unoxidized ore would also be processed through the primary crusher, and then pass through additional crushing mechanisms in an enclosed facility.

Unoxidized ore would be placed in a coarse ore stockpile and fed into the secondary and tertiary crushing mechanisms. These crushers would be located in two buildings connected by conveyors. The secondary and tertiary crushers would operate continuously with a pass-through rate of approximately 1,000 tons/hour, although up to 2,000 tons/hour could be processed if necessary. The crushed, unoxidized ore coming out of the tertiary crusher would be fed into either the mixed ore stockpile or placed in a third stockpile containing only crushed, unoxidized ore. Three ore stockpiles would be developed and placed either near the pit complex or in closer proximity to the leach pad in Upper Alder Gulch. The contents of the three ore stockpiles were described in Section 2.8.1.2.

2.9.1.3 Conveyor System

Because no ore processing facilities would be located in Goslin Flats an ore conveyance system would not be

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training programs and inspection of emergency response equipment.

Ore production would be approximately 60,000 to 80,000 tons per day, with mining and leaching operations performed on a year-round basis. Mining and related operations would take place 7 days a week, 24 hours per day, 350 days per year. ZMI projects that the Company Proposed Action work force would be similar to current operations, with approximately 260-280 full-time employees, depending on seasonal requirements. The agencies' modifications to the mine expansion should not measurably change the rate of operations or the work force.

2.9.1.1 Mine Pit Expansion

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Mining Methods

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Rock Characterization

The materials and their relative amounts to be mined during expanded operations at the Zortman Mine were described in Section 2.8.1.1. The geochemical sampling and waste rock characterization program proposed by ZMI, and described in Section 2.8.1.1, would be implemented under this alternative. (The agencies have added mitigations restricting the use of certain waste rock types in reclamation, as described in Section 2.9.2).

Waste Rock Handling

Waste rock would be hauled by truck to the Carter Gulch waste rock repository. Placement of the waste rock within the repository would depend on the material's potential to create acid drainage. Waste rock would be segregated within the waste rock repository on the basis of total sulfur content, as shown in Table 2.8-4 of Alternative 4. However, waste rock could not be used in the construction of reclamation covers based solely on the sulfur content of the rock. Material used in construction purposes and as a capillary break must meet the geochemical and lithologic criteria described in Section 2.9.2.

2.9.1.2 Crushing Operation

Metallurgical testing at Zortman has shown that unoxidized ore must be crushed to facilitate gold recovery. Crushing reduces the size of individual ore fragments, thereby increasing the surface area upon which the heap leach chemicals will act to separate gold from the rock matrix. The basic process employed under this alternative for ore crushing would not change from that described in Section 2.8.1.2. However, the location for the crushing operations would be modified.

Because this alternative calls for placement of the ore heap leach facility in Upper Alder Gulch, an ore conveyance system would not be constructed along Alder Gulch and no ore processing facilities would be sited on Goslin Flats. Therefore, all ore crushing operations would take place in the vicinity of the pit complex, at a location selected by ZMI based on area requirements and ease of access. Ore would be hauled from the mine pit in trucks and placed in a truck dump hopper located at the crushing area near the pit. In the event the hopper is inoperable the ore would be placed in a stockpile adjacent to the primary crusher. Oxide ore would be crushed to less than 6 inches in diameter by a primary crusher, then dumped or trucked to a mixed ore (both oxidized and unoxidized ore) stockpile. Unoxidized ore would also be processed through the primary crusher, and then pass through additional crushing mechanisms in an enclosed facility.

Unoxidized ore would be placed in a coarse ore stockpile and fed into the secondary and tertiary crushing mechanisms. These crushers would be located in two buildings connected by conveyors. The secondary and tertiary crushers would operate continuously with a pass-through rate of approximately 1,000 tons/hour, although up to 2,000 tons/hour could be processed if necessary. The crushed, unoxidized ore coming out of the tertiary crusher would be fed into either the mixed ore stockpile or placed in a third stockpile containing only crushed, unoxidized ore. Three ore stockpiles would be developed and placed either near the pit complex or in closer proximity to the leach pad in Upper Alder Gulch. The contents of the three ore stockpiles were described in Section 2.8.1.2.

2.9.1.3 Conveyor System

Because no ore processing facilities would be located in Goslin Flats an ore conveyance system would not be constructed under this alternative. Ore would be transported from the crushing facilities to the leach pad by haul truck.

2.9.1.4 Upper Alder Gulch Heap Leach Pad

The heap leach pad and adjacent facilities, shown on Figure 2.9-2, would cover approximately 180 acres situated in the Alder Gulch drainage. Surface water diversion canals would direct natural flows around the leaching facility to Alder Gulch below the leach pad and appurtenant structures. An area of approximately 308 acres is enclosed by the proposed drainage canal. The leach pad would be approximately 4000 feet long by 3000 feet wide, and sized to contain 80 million tons of ore, the presently anticipated reserves. The heap leach pad liner design includes a composite liner system consisting of layers of compacted clay, a synthetic PVC (polyvinyl chloride) membrane, and a protective layer of crushed rock, tailing from historic ore milling, or rock crushed sufficiently to reduce sharp angles to minimize potential puncturing of the PVC. Ore would be stacked in 25 foot lifts to a maximum depth of approximately 550 feet.

The Alder Gulch heap leach pad is designed as a Valley Fill leach pad. The ore heap would be placed on the pad in lifts at a 3H:1V slope behind the starter dike. The 3H:1V constructed slope would also serve as the reclaimed slope. Benches would be constructed every 100 vertical feet for access to the ore heap from the valley sides. The proposed pad would incorporate in-heap impoundment of solution behind a starter dike to reduce pond costs and to aid cold weather operation. As shown on Figure 2.9-3, the leach pad design includes a composite liner and a 50 foot high starter dike with gate controlled outlet pipes to allow gravity flow of solution to the processing and contingency ponds. The starter dike would allow solution to be impounded behind the embankment and in the heap. A surge capacity of about 9 million gallons of solution would be available as in-heap impoundment. An operational head (hydrostatic pressure) of about 20 feet would be maintained on the liner at the starter dike during normal operations. The system could handle a maximum of 50 feet of head.

The perimeter of the pad and process area would be fenced with Page wire (similar to field fence, a 9 to 12 gauge woven wire). These fences would have 7½ feet high steel posts and 8 foot set posts 6 inches in diameter. All posts would be placed 15 feet apart and the Page wire reaches 6 feet high. The pad and process area perimeter would be fenced, as well as the ponds within the perimeter to ensure wildlife protection.

Leach Pad Construction

The following sections describe the construction and operation of the heap leach pad and how leaching solution is processed.

Foundation - All cover soil displaced during construction of the heap leach pad in Upper Alder Gulch would be picked up and stockpiled separately, one for topsoil, the other for subsoil. The subsurface would be regraded to create a stable foundation surface and to ensure effective leach solution drainage from the valley side slopes to the pregnant pond. Materials considered unsuitable for the pad foundation, such as wet, frozen or soft soil, would be excavated and stockpiled. Compacted fill would be required in some areas of the leach pad foundation to attain the desired grades. In addition, some areas of the valley may need to be graded or cut and filled to flatten slopes to an acceptable grade for liner installation. Pad construction would begin at the base of the starter dike, extend down the upstream slope of the starter dike, and continue up the valley as needed for ore placement. Compacted fill would be placed in loose lifts of 8 inches and compacted to at least 95% of the Standard Proctor laboratory dry density, a standard unit of measurement employed to maintain quality control as construction progresses. A layer of gravel or crushed, non-acid forming rock would be placed in the bottom of the valley below the leach pad liner, starter dike, and ponds to convey seepage away from the liner. The gravel layer would also be used as a leak detection system to detect leaks through the liner. Runoff between the proposed drainage diversion canal and intermediate limits of the liner would be directed into the gravel underdrain and leak detection system by an intermediate drainage control berm.

Liner - The pad liner system would consist of approximately 12 inches of compacted clay, mined from the Seaford clay pit, overlain by a textured, 30-mil PVC geomembrane. PVC would be used for the synthetic liner for several reasons. First, ZMI has used this material at other facilities at the Zortman and Landusky mines. PVC is more flexible and easier to install than some other synthetics, such as HDPE. Also, PVC often

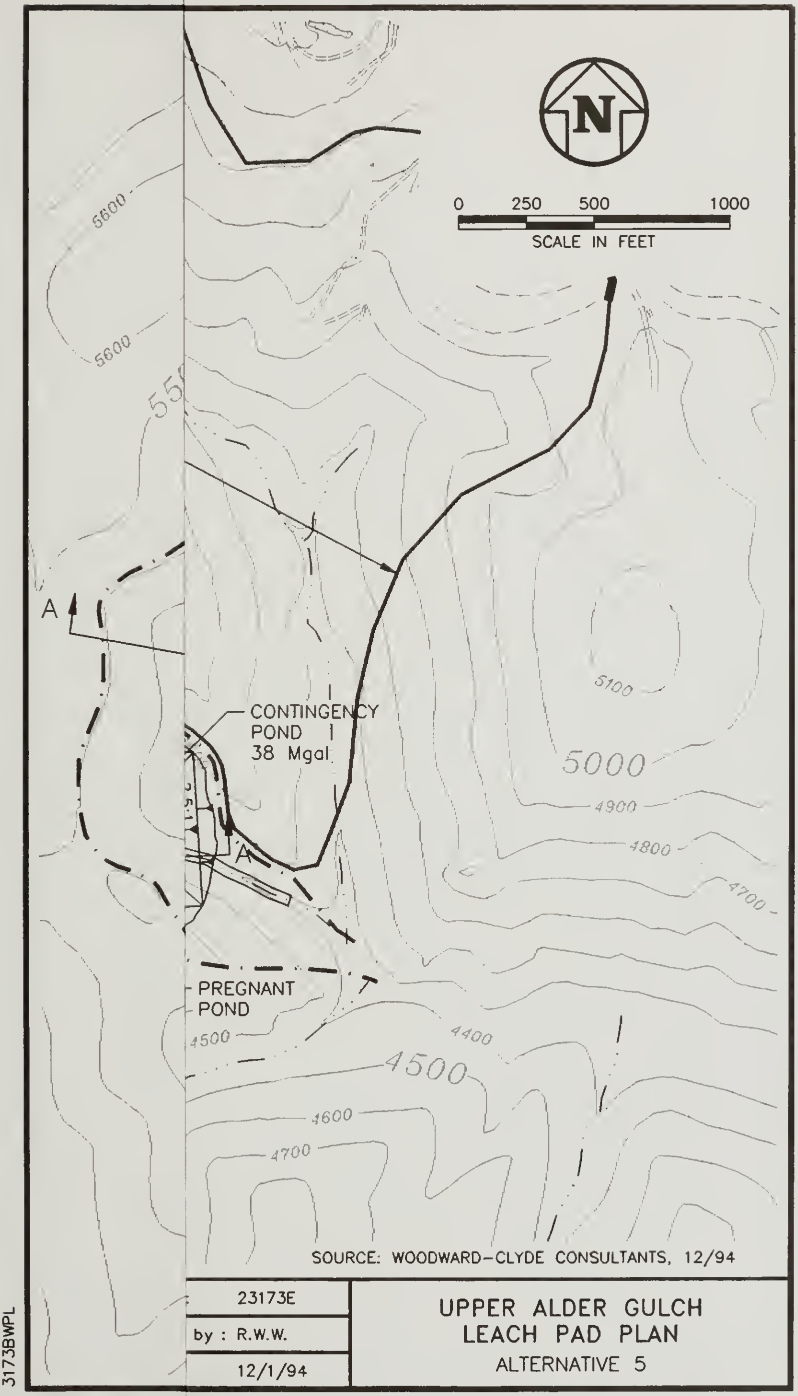

FIG. 2.9–2

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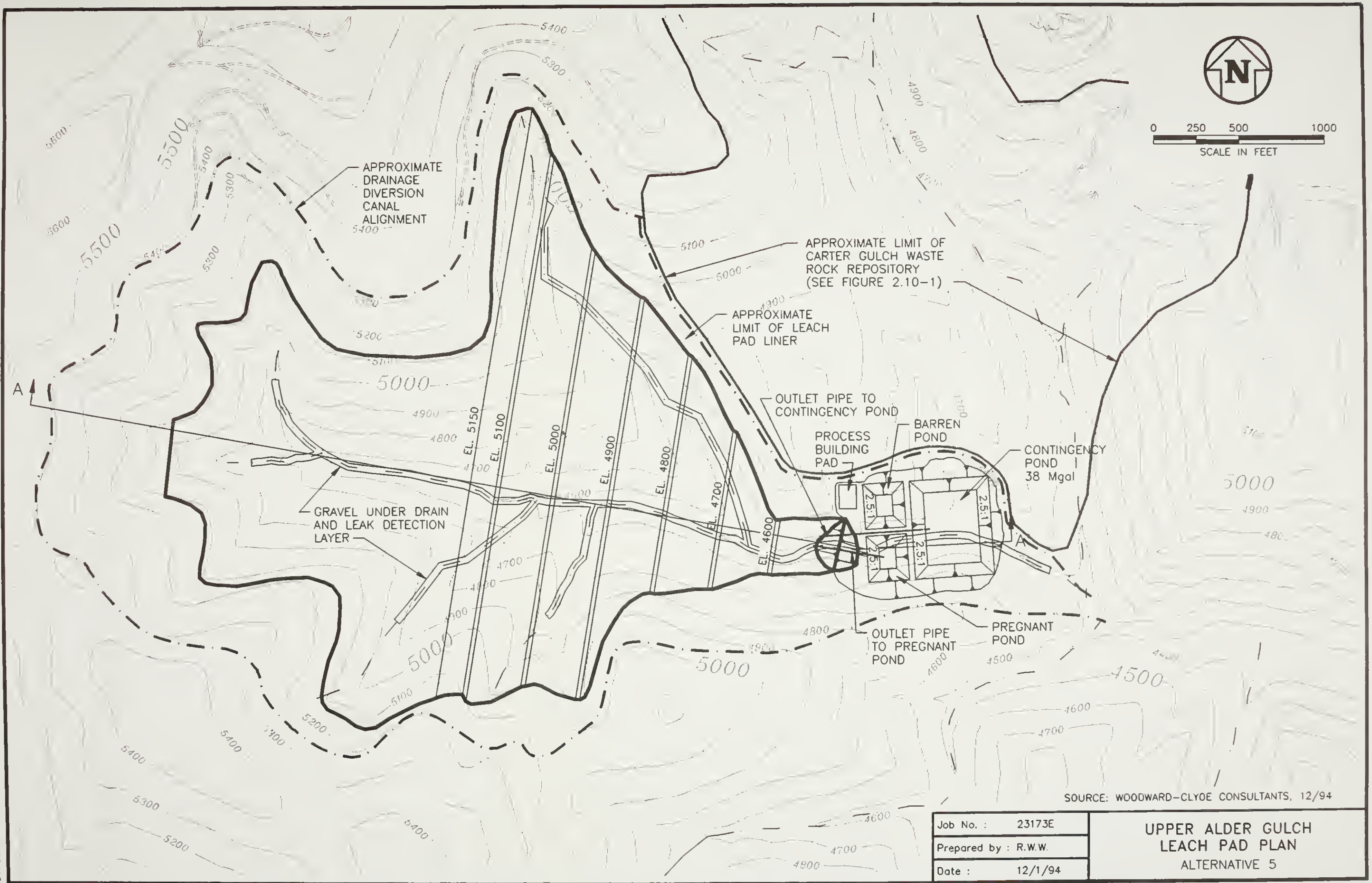

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FIG. 2.9-2

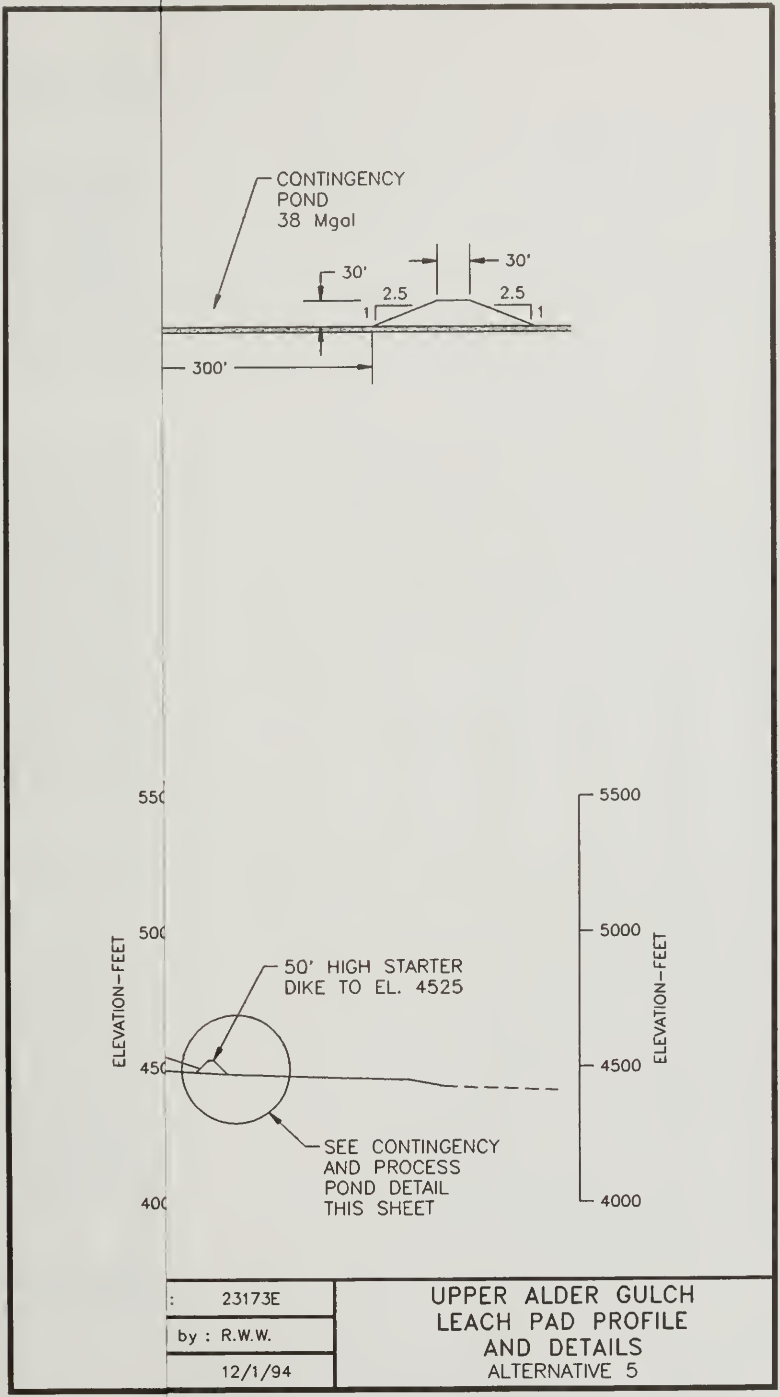

FIG. 2.9–3

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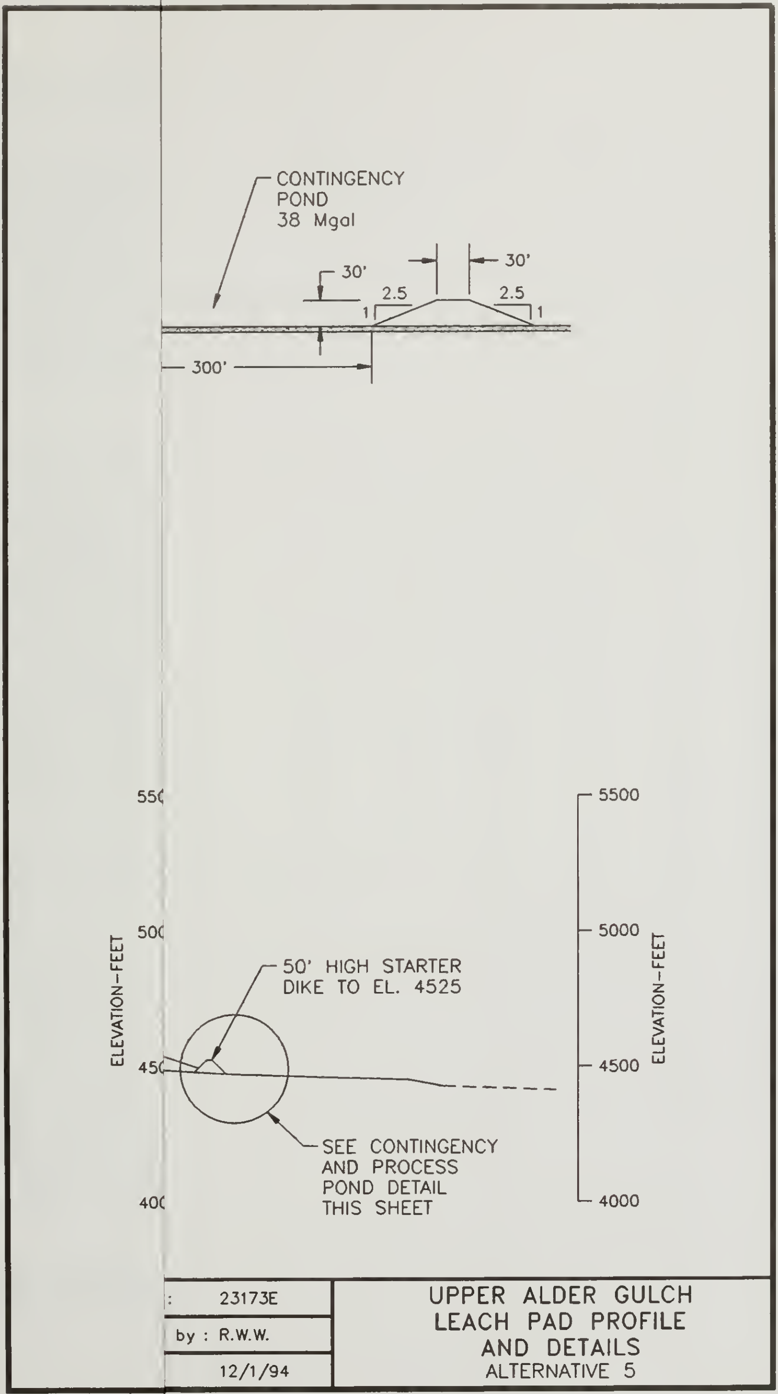

FIG. 2.9-3

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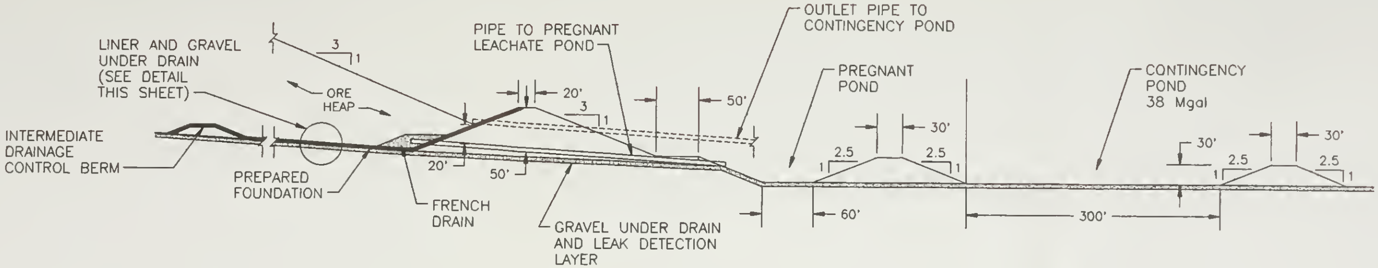

CONTINGENCY AND PROCESS POND DETAIL

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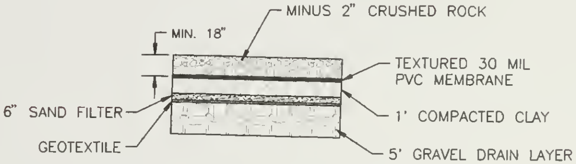

LINER AND UNDER DRAIN DETAIL

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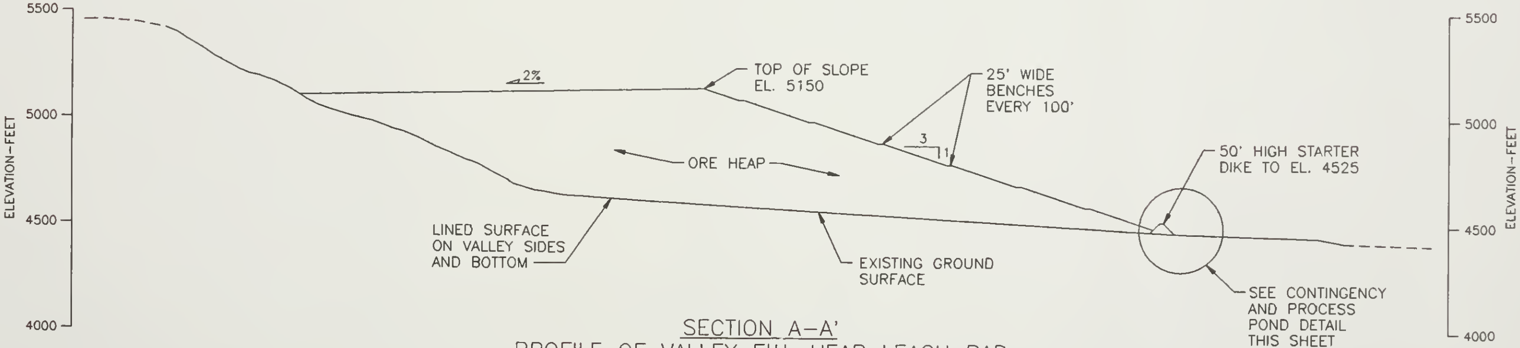

SECTION A–A'
PROFILE OF VALLEY FILL HEAP LEACH PAD

SCALE: 1" = 500'

SOURCE: WOODWARD CLYDE CONSULTANTS, 12/94

Job No. :	23173E
Prepared by :	R.W.W.
Date .	12/1/94

UPPER ALDER GULCH
LEACH PAD PROFILE
AND DETAILS
ALTERNATIVE 5

FIG. 2.9–3

requires fewer seams. This is important because seams are the most likely source of leaks. In addition, PVC is an accepted industry standard for this application.

Approximately 300,000 yd^3, or 500,000 tons, of clay would ultimately be required for liner construction. The clay would be placed in 6-inch loose lifts and compacted to at least 95% of the Standard Proctor laboratory dry density. A cross-section of the liner system is shown on Figure 2.9-3. Clay would be hauled approximately 7.5 miles from the Seaford pit to Upper Alder Gulch using ZMI trucks or a contractor fleet. Clay hauled to the leach pad would require transport through Zortman. Trucks would be grouped at the clay pit and travel as a convoy under the direction of front and rear pilot vehicles.

A geosynthetic fabric would be placed on the PVC liner for protection from tears and punctures during placement of the gravel layer. A minimum of 18 inches of 1-inch or smaller crushed rock would be placed on the geosynthetic fabric to protect it from potential punctures and tears during ore placement operations, and to provide an effective drainage horizon for solution transfer to the solution collection system. Alternatively, a graded protective layer could be used if well-rounded rock is not readily available. Six inches of rounded material or salvaged tailing could be placed on the geosynthetic fabric below 12 inches of crushed material. This upper layer could consist of select, competent ore or waste rock which has been crushed and screened to less than 3/4 inch size. No greater than 7% of the material would be silt or clay sized particles.

Ponds - The pregnant, barren, and contingency pond would be constructed by balanced cut and fill methods. Interior and exterior side slopes would be 2.5H:1V. An underdrain system would be installed to direct groundwater away from the ponds. Fill material would be placed and compacted in lifts and a 12-inch layer of compacted clay placed over the interior. A synthetic liner, consisting of 60 mil High Density Polyethylene (HDPE), would be placed over the clay. Even though HDPE has a higher cost than other synthetic materials, it would be used for synthetic liners in the ponds for a few reasons. First, it has been demonstrated as an accepted industry standard for this application. Second, HDPE is not susceptible to ultraviolet radiation, as is PVC, and will therefore not photodegrade. This is important because the pond liners would be subjected to UV exposure.

The pregnant and barren ponds would each hold approximately 6 million gallons of solution. The contingency pond would be sized to hold the calculated leach pad surcharge from a 24-hour, 100-year precipitation event plus the 36-hour draindown of the leach pad in the event power was lost during the storm event. Therefore, the contingency pond would hold approximately 38 million gallons in storage. All solution ponds would be enclosed with 6-foot wire fencing and covered with netting to keep birds from landing on the ponds.

Birdnetting would be done in conjunction with A&S Tribal Industries using 1 5/8 inch by 1 5/8 inch UV protected PVC. The bird net system consists of 1/8 inch grid support cable weaved through the netting and anchored by 4 inch steel casing set in the ground and cemented in place. The bird netting weave points would be placed on 16 foot centers. Pond netting to be installed would be received in 17 foot widths. The netting material would be overlapped 6 inches on each side and laced together with 1/8 inch weave cable.

Construction Quality Control - Construction of the heap leach pad would begin near the starter dike section of the leach pad (the "head") and proceed up the valley to the extent of the ultimate design. ZMI would retain a professional engineer or engineering company as an independent inspector to monitor leach pad construction. This inspector would be responsible for monitoring and reporting on all phases of construction to assure that design specifications are met, and that field modifications are justified and summarized. The inspector would perform or oversee material inspections and compaction tests, including tests on fill material and the soil liner, permeability tests on the soil liner, strength tests of the soil liner, and grain size analysis of solution drain material. The inspector would also prepare daily reports. An as-built report and drawings of the facility would be submitted to the agencies for review.

An independent third-party engineering firm would monitor and oversee installation of the synthetic liner, including deployment of the liner to the site. Liner panels would have a minimum overlap of 6 inches and be welded together with an adhesive-bodied solvent on a clean seaming surface. All field seams would be tested using a 30 psi air lance along the entire seam. Where air pockets or riffles are observed, they would be marked, repaired, and air lanced again to ensure proper bonding. The entire liner area would be inspected. Wrinkles, punctures, or defects that may be detected would be repaired and tested in order to ensure proper bonding. Additionally, seam analysis samples would be collected and sent to a certified laboratory for peel adhesion and bonded seam strength (shear) to confirm field testing and observation. An as-built report and

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An independent third-party engineering firm would monitor and oversee installation of the synthetic liner, including deployment of the liner to the site. Liner panels would have a minimum overlap of 6 inches and be welded together with an adhesive-bodied solvent on a clean seaming surface. All field seams would be tested using a 30 psi air lance along the entire seam. Where air pockets or riffles are observed, they would be marked, repaired, and air lanced again to ensure proper bonding. The entire liner area would be inspected. Wrinkles, punctures, or defects that may be detected would be repaired and tested in order to ensure proper bonding. Additionally, seam analysis samples would be collected and sent to a certified laboratory for peel adhesion and bonded seam strength (shear) to confirm field testing and observation. An as-built report and drawings of the facility would be submitted to the agencies for review.

Leach Pad Operation

Generally, facility operation at the Upper Alder Gulch site would include: the leaching of ore stacked on the pad; collection of pregnant solution at the bottom of the heap near the starter dike; transfer of the pregnant solution to ponds for storage prior to metal extraction; the metal extraction process itself; and the storage of barren solution in a pond for re-application to the ore heap.

Leach solution would be sprayed onto the heap at an average application rate of 0.005 gal/min/sq ft. A system of pipes and valves would allow the solution that is retrieved from the ore heap to be redistributed to the heap or sent to the process plant. Ore materials placed on the leach pad would vary from less than 1/2 inch to less than 6 inches in size. An oxide/non-oxide blend would be leached on the pad with lime added at a rate of approximately 4-8 lbs/ton of ore prior to loading. The mix of ore would typically be approximately 50% oxide/non-oxide, although there would be occasions where only oxide or only non-oxide ore would be loaded. Lime addition would increase pH values, enhance ore processing, and speed facility reclamation and closure. Equipment operation on the protective layer above the liner would be restricted to reduce the potential for liner damage.

Solution Management

The volume of solution required for ore processing would be maintained by adding makeup water during dry months, and by temporarily storing solution during periods of higher precipitation. Storm surge solution at the Upper Alder Gulch leach pad would be within the heap, in the pore space of the ore, and behind the starter dike or in surface ponds. The average external makeup water rate is expected to be 140 gallons per minute.

Pond Capacity - The barren and pregnant solution ponds would be sized to store approximately one day's maximum anticipated process plant requirements plus one million gallons contingency. Based on a maximum process flow rate of 3,500 gallons per minute, the barren and pregnant ponds would each be sized to retain about 6 million gallons.

The total in-heap storage capacity is approximately 9 million gallons impounded by the starter dike. The contingency ponds have been sized to store a total of approximately 38 million gallons of solution. In total, the system (barren, pregnant and contingency ponds and starter dike) would have a solution storage capacity of approximately 59 million gallons.

Heap Draindown - Heap draindown is the process through which the moisture content of the ore at the time heap leaching is conducted is reduced to an amount which the ore can retain after leaching stops. This reduction in moisture content adds free solution to the system, thereby increasing storage requirements and reducing storage capacity. A certain amount of operational draindown occurs through the heap leaching process, as active leaching advances from one portion of the ore heap to another, thereby isolating some ore from the active leach cycle.

It is possible that a heap leach facility's solution pumps could become inoperable, thereby removing some or all of the ore being leached from the active leach cycle. In such instances, excess solution drains from the ore. This circumstance is known as emergency draindown. Should an emergency draindown occur during the design storm event (100-year, 24-hour) excess solution would accumulate at a rate dependent on the leach pad area. The Upper Alder Gulch leach pad facilities would be designed to accommodate a 36-hour storm and pump shutdown duration.

Processing Plant Operation

A new ore processing plant with carbon adsorption circuit would be constructed near the base of the heap leach pad, with the contingency and process ponds. This would be more costly than modification of the existing processing plant at the mine site, but it is more efficient and safer for the processing facilities to be sited in one area. The ore processing would occur as described in Section 2.8.1.4.

Reagent Handling

Because the ore processing plant under this alternative would operate in the same manner as described in the Company Proposed Action, the use and handling of processing reagents would also be similar. Reagent handling is described in Section 2.8.1.4.

2.9.1.5 Carter Gulch Waste Rock Repository

Prior to construction of the new Carter Gulch waste rock repository, ZMI would remove all of the waste rock, approximately 3.4 million tons, from the existing Alder Gulch Waste Rock Dump. The existing material in Alder Gulch is seeping poor quality water from the toe of the dump, and removal of the material would reduce impacts to the drainage. This material would be relocated to the leach pad at Upper Alder Gulch for further processing as ore.

The proposed waste rock repository would be constructed in Carter Gulch, a fairly steep side drainage to Alder Gulch (see Figure 2.9-1). A portion of Alder Gulch has already been disturbed, although approximately 150 additional acres would be needed to store the waste rock. The waste rock repository would be designed to hold 78 million tons, although ZMI's proposed action would generate approximately 60 million tons. The construction for this facility would be as described in Section 2.8.1.5.

2.9.1.6 Other Features and Facilities

Office/Laboratory Facilities

This alternative would not change the locations or functions of ZMI's office and laboratory facilities. The main office building for ZMI is located in the town of Zortman. The production assay lab is located across the street from the main office in a separate building. The laboratory and office functions would continue as described in Section 2.5.1.5.

Access and Haul Roads

With a couple of exceptions, the road network described in Section 2.8.1.6 would be developed under this alternative as well. One exception would include construction of ore haul roads to the Upper Alder Gulch heap leach facility. As with other mine haul roads, this road would be constructed to allow a 70-foot running width from the inside edge to the inside toe of the safety berm. The other modification is that roads would not be constructed in Alder Gulch for access to a conveyor system, as ore would be transported to the heap leach pad by truck. All haul roads would be constructed on the daylight edge of the pit, which is the lowest area on the pit perimeter. Haul roads would be left on the remaining daylight edge after the pit is mined. Haul roads would not be needed into Goslin Flats.

Power and Water Supply

Power requirements for this alternative do differ from that proposed in Alternative 4 because no facilities would be constructed in Goslin Flats. Power requirements for the mine expansion and ore processing facilities would be supplied by connecting the Landusky Mine power line to the expansion operation. This would allow for any additional power needed at one operation to be allocated from the other.

Water supplies are likely to be similar as described for the Company Proposed Action in Section 2.8.1.6.3. Additional water could be required for road dust control since there would be a larger network of haul roads near the mine, and increased truck traffic to transport ore and bring in clay from the Seaford Pit.

Septic Treatment

No change from existing operations is anticipated for disposal of human waste, as described in Section 2.5.1.6.

Chemical Use

Chemicals used and required under this alternative would be essentially the same as described in Section 2.8.1.6 of the Company Proposed Action, except that ore processing chemicals (for example, sodium cyanide, lime, etc.) would be transported through the town of Zortman up to the processing facilities near the mine site. Increased amounts of diesel fuel above that required under the Company Proposed Action would be needed since ore would be hauled by truck to the heap leach pad, as opposed to ore transport on a conveyor system.

Waste Disposal

The types and amounts of solid waste generated under this alternative would be as described for the Company Proposed Action in Section 2.8.1.6. Methods of disposal would also remain the same.

2.9.1.7 Water Handling and Treatment

Water handling, capture, and treatment systems would be sized for seepage from the 100-year, 24-hour storm event and be similar to that described in the Company Proposed Action (Section 2.8.1.7). ZMI would be required to capture and treat seepage and degraded waters according to the Water Quality Improvement Plan (see Appendix A), and to meet the reclamation requirements described in Section 2.9.2. ZMI would have to meet the requirements of the compliance program and implement agency directed corrective measures when water quality threshold criteria (interim BAT Standards or final MPDES effluent limits) are exceeded. Unless otherwise indicated, water handling and treatment systems would be as described in Alternative 4, Section 2.8.1.7.

Water Capture and Treatment

No changes would be made to most seepage water capture and treatment systems from those described in the Company Proposed Action. The Carter Gulch capture system would be relocated further downstream to the toe of the Carter Gulch waste repository. The

Alder Spur capture system would be resized for the 100-year, 24-hour event. All captured seepage water would be pumped to the Zortman water treatment plant for treatment and released into Ruby Gulch.

Surface Water Runoff Control

With the exception for control of surface waters in the Upper Alder Gulch drainage, most surface water runoff control features described in Section 2.8.1.7 would apply to this alternative. All drainage and diversion ditches would have to be able to pass the peak flow from a 100-year storm event with 1 foot of freeboard. Prior to construction of the Upper Alder Gulch heap leach pad, ZMI would be required to submit for agency review and approval a site-specific drainage control plan.

The design features for control of surface water at the Upper Alder Gulch heap leach pad would include construction of a surface drainage diversion canal to intercept runoff above the final buildout level. The canal would be sized to convey the 100-year storm runoff in the drainage basin above the leach pad. The canal would channel runoff water around the leach pad, process areas, and pond and would empty into Alder Gulch below the disturbed area. Until final buildout of the lined area, precipitation that falls on the valley between the drainage diversion canal and intermediate edges of the liner would be channeled into the gravel underdrain by earth berms, to prevent water from seeping under the liner edge. The underdrain would also convey groundwater seepage.

Because a leach pad would not be developed in Goslin Flats, no surface water control systems would be required in this area.

Land Application Disposal (LAD) Area

LAD for neutralized process solutions would take place as described in Section 2.8.1.7 for the Company Proposed Action. However, a leach pad would not be developed in Goslin Flats, and land application would be limited to 285 acres ZMI has requested for land application disposal use. The pipeline carrying neutralized process solution would extend from the ore processing facilities down Ruby Gulch to the Goslin Flats.

2.9.2 Zortman Mine: Agency Mitigated Reclamation

The agencies have developed modifications to ZMI's proposed reclamation procedures which would: 1) reduce infiltration into areas with the potential to cause acidic drainage, 2) remove waste rock dumps and other sources currently causing degradation of surface water or groundwater, and 3) implement the Water Quality Improvement Plan to further mitigate effects of ARD should reclamation procedures fail to adequately protect water resources. Many of these reclamation modifications were described in detail in Section 2.7.2, for the Agency Mitigated Reclamation for Alternative 3. However, that alternative describes reclamation actions to be taken if ZMI's proposal for mine expansion is not approved. This alternative describes modified reclamation actions that would take place in conjunction with the mine expansion. The major reclamation modifications to be incorporated in this alternative include:

- Reclamation Cover C would be modified to include 6 inches of compacted clay (as opposed to 3 inches of compacted clay) between the bottom substrate and the PVC liner. The PVC liner thickness would be increased to 30 mil. For the purpose of discussion in this and future alternatives, this cover will be known as "Modified Reclamation Cover C."

- With the exception of the 89 leach pad dike, all facilities not used as pit backfill are assumed to be potentially acid generating and require re-reclamation using Reclamation Covers B or Modified C. Cover soil on the facilities would be removed, stockpiled, and reused. The 89 leach pad dike would be tested for sulfur content as described in Section 2.8.2.2, and re-reclaimed if sulfur exceeds 0.2% in more than 10% of the material tested.

- With the exception of leach pad dikes, existing facilities would be reclaimed to a 3H:1V slope, with constructed benches every 200 feet of slope length. In order to achieve the slope reductions while minimizing additional land disturbance, some material may have to be off-loaded from existing facilities and backfilled into the pit.

- In order to classify as "Non-Acid Generating" and be used without restriction in construction and reclamation, waste rock or other material:

  1) Cannot be composed of igneous breccia, felsic gneiss, monzonite, quartzite, or trachyte lithologies;

  2) Amphibolite, mafic gneiss, shale, dolomite or limestone must have a total sulfur content less than 0.8%, and a paste pH of 6.0 or greater;

  3) If syenite, must have a total sulfur content less than or equal to 0.2%, a paste pH of 6.5 or

greater, and a NNP greater than or equal to 0 with an NP:AP ratio greater than or equal to 1;

4) Must meet the criteria above as demonstrated by sampling and analyzing lithologies from every blasthole providing non-acid generating material.

- Material used for capillary break/drainage layers may be obtained from an area limestone source or non-acid generating waste rock.

- After detoxification, the 85/86 leach pad and dike would be removed to create a free draining surface and placed in the pit as backfill material prior to pit floor reclamation.

- The OK waste rock dump would be removed and used to backfill the pit complex. Cover soil would be re-salvaged and the waste rock footprint reclaimed.

- The tailing in Ruby Gulch above the town of Zortman would be removed from the drainage and placed in the pit complex or used as reclamation or construction material. The drainage would be restored as mitigation for existing disturbance to waters of the United States by other Zortman and Landusky mines facilities.

- The sulfide storage area would also be removed and placed on the Upper Alder Gulch leach pad for ore processing.

- The back-filled pits would be graded so that runoff drains freely, without impoundment in the pit, into the Ruby Gulch drainage.

- Reclamation viability, as described in Section 2.9.5 and other sections of this alternative, would be monitored by ZMI until the agencies have approved final closure and released the mine reclamation bond.

- The reclamation requirements of this EIS and the Water Quality Improvement Plan (see Appendix A) would be used as a basis for determining reclamation success and directing any further corrective measures.

- At the end of mine life, a comprehensive Environmental Site Assessment would be carried out that covers the entire Zortman mine permit area. This site assessment would include inspection of all locations where hazardous materials were stored and used and would identify evidence of spills or accidental releasees that may have contaminated soil and groundwater. This site assessment would include soil and groundwater sampling should evidence of contamination be identified.

Final reclamation of all facilities is anticipated to occur within 3 years after the Upper Alder Gulch leach pad has been detoxified and liner perforated. Reclamation of individual facilities is contingent upon a number of economic and operational factors, and scheduling variations within the overall timeframe could occur. Reclamation activities are submitted to the DEQ on an annual basis and reflect the most recent operating and reclamation schedule.

The following sections summarize the specific reclamation plans and actions proposed by ZMI for each of the major disturbance areas and provide a description of prescribed modifications to the reclamation procedures under this alternative.

2.9.2.1 Reclamation Materials

Reclamation materials would be required for construction and installation of reclamation caps and for use in construction of drains and diversions. The primary materials to be used in reclamation covers would include non-acid forming waste rock and limestone, clays and cover soil. These materials and their sources were described in Section 2.8.2.1. The following describes only modifications from the Company Proposed Action.

Non-Acid Forming Material

Non-acid forming materials would be used in reclamation covers on all disturbed areas. The reclamation covers used in this alternative require a capillary break of 36 inches, to be composed of a suitable non-acid generating waste rock or limestone.

Under this alternative the waste rock must meet the geochemical and lithologic criteria described in the beginning of Section 2.9.2 to be suitable for construction purposes and reclamation covers. It is likely that sufficient waste rock of suitable quality would be available from new mining for reclamation covers and construction, so that limestone would not be required as a capillary break material.

Limestone
If limestone is needed for construction purposes or in reclamation covers, it would be mined from LS-1, south of Green Mountain (see Figure 2.5-2). Mining and haul road development to this source would occur as described in Section 2.7.2.1.

Clay
As described in the Company Proposed Action (Alternative 4) clay would be used for leach pad liner construction as well as cover material on waste rock repositories, heap leach pads, haul roads, and pit benches and floors to restrict moisture infiltration. Clay required for the Upper Alder Gulch leach pad construction and reclamation would be mined from the Seaford clay pit. Section 2.7.2.1 describes the haul route from the Seaford pit to the Zortman Mine.

Cover Soil
Cover soil at the Zortman Mine is obtained from one of three stockpiles: the 82 leach pad site, the South Ruby Saddle stockpile, or the North Ruby Saddle stockpile. Approximate volumes of soil available at these stockpiles were shown on Table 2.5-5. These stockpiles would probably have insufficient supplies to adequately cover all disturbances to the extent required under this alternative. Approximately 410,000 yd^3 of cover soil would be required. Some cover soil may be salvaged during preparation of the Upper Alder Gulch leach pad, but surveys in this area indicate there is little suitable cover soil available. Another source of cover soil is the material salvaged during re-reclamation activities on facilities which have already been cover soiled and revegetated. Other materials used in reclamation include unconsolidated rock, scree and soil above and below roadway cuts, which are incorporated into the regrading of haul and access roads. It is possible that cover soil for Zortman Mine reclamation would have to be supplemented with cover soil from the Landusky mine stockpiles.

2.9.2.2 Reclamation Covers

Procedures used to cover disturbed areas would be as described in Alternative 3, Section 2.7.2.2. Under this alternative all disturbed areas not being used as pit backfill (with the exceptions noted such as haul roads and building-type facilities, and the 89 leach pad dike) are assumed to be acid generating and would be capped using either Reclamation Cover B or Modified Reclamation Cover C, depending on the slope of the disturbance. As described in Section 2.7.2.2, Reclamation Cover C would be modified by increasing the clay layer to a compacted minimum of 6 inches thick. The PVC liner thickness would be increased to 30 mil. A geofabric would be installed between the soil cover and the capillary break.

The other modification to reclamation covers is in the definition of "non-acid generating" material. The criteria for material to be suitable for use in capillary break were described at the beginning of Section 2.7.2. Certain rock types would be excluded from use and those not excluded must demonstrate a sufficiently high Paste pH, sufficiently low sulfur content, and appropriate neutralization potential. All waste rock considered for use as non-acid generating material must come from blastholes which have been characterized according to these criteria.

2.9.2.3 Mine Pit Reclamation

Mine pit reclamation would occur generally as described in Section 2.8.2.3, with some modification concerning the source of pit backfill materials. Approximately 9 million tons of spent ore and tailing from the 85/86 leach pad and dike, and Ruby Gulch drainage, would be placed in the pit complex as backfill in addition to the approximately 6 million tons of scheduled backfill proposed by ZMI. This material would be used to raise the pit floor to an elevation necessary to freely drain the pit and prevent surface water from ponding and infiltrating through the pit floor. If needed, additional backfill material could come from the Carter Gulch waste rock repository. The final pit construction would be as described in the Company Proposed Action. The final pit floor would be capped with Reclamation Cover B. The final cover would be revegetated with native grasses and forbs. Pit walls not covered by backfill would be cover soiled and revegetated where possible, to include tree planting to reduce visual impacts of highwalls.

2.9.2.4 Leach Pad Reclamation

Tasks associated with the reclamation of the heap leach facilities include heap detoxification, surface reclamation including slope reduction, reclamation cover placement, cover soiling and revegetation, and liner perforation. These steps have been described in detail previously. The following sections summarize the heap leach pad reclamation process from Section 2.8.2.4 with emphasis on modifications required by the agencies.

Existing Heap Leach Pads
Portions of the 85/86 heap leach pad and dike necessary to achieve a free draining surface would be removed and placed as backfill into the Zortman pit complex. The

footprints from this facility would be tested on 100 foot centers. Those areas with total sulfur content >0.5% sulfur would be capped with Reclamation Cover A and revegetated. Areas with lower sulfur contents would be scarified, covered with 8 inches of soil and revegetated.

Reclamation Cover B or Modified C would be placed on all other leach pad disturbances, including those such as the 79 and 80/81 pads which have been reclaimed under existing reclamation requirements. Leach pad slopes would be reduced to 3H:1V to further limit surface water infiltration, stabilize cover soil, and enhance the potential for successful revegetation. Leach pad dikes would be reduced to a slope sufficient to allow placement and retention of Reclamation Cover B.

<u>Heap Detoxification</u>

Heap detoxification for this alternative would be similar to that described in Section 2.5.2.4. In summary, the spent ore on the leach pad would be rinsed repeatedly with cyanide-free water to enhance degradation of cyanide compounds left in the heap. Heap detoxification is discontinued when the solutions returning from the heap maintain less than 0.22 mg/l cyanide (measured as <u>W</u>eak <u>A</u>cid <u>D</u>issociable or WAD cyanide) for a six month period which includes a spring, high-flow surface runoff event. Heap solutions remaining after detoxification would be pumped to a containment pond for neutralization and later land application disposal.

<u>Surface Reclamation - Upper Alder Gulch Leach Pad</u>

The reclamation criterion for pad slopes under this alternative is a maximum 3H:1V slope. Constructed benches must be placed every 200 feet of slope length. Slope reduction would be performed by track mounted bulldozers pushing ore heap material from the facility crest or top down over the lift slopes, using cut and fill material from each of the heap benches to obtain the desired slope. Leach pad crests, top and slopes would be capped with Reclamation Cover B (on slopes greater than 5%) or Modified C (on slopes 5% or less).

Heap retaining dikes would be reduced to a nominal slope of 2.5H:1V, or sufficient to allow placement and retention of Reclamation Cover B. The dike faces would be capped with Reclamation Cover B and revegetated to blend with existing undisturbed contact zones and reestablish vegetation communities. The reclaimed pad surfaces would be revegetated with native prairie grasses, forbs and shrubs to complete final reclamation. In order to help mitigate the visual appearance of the reclaimed heap, portions of the uppermost lift(s) of ore would be varied in thickness and location to create a variable skyline. In addition, "micro-habitat" areas would be created by scouring small depressions with earth-moving equipment during final regrading.

<u>Liner Perforation</u>

The heap leach pad liner system would be perforated after pad detoxification and surface reclamation to eliminate moisture storage and any undesirable hydraulic conditions associated with the reclaimed facility. The liner perforation requirements described in Section 2.7.2.4, including annual and monthly monitoring, would apply to this alternative. Drain holes would be drilled through the Upper Alder Gulch leach pad's synthetic and clay liner systems to facilitate drainage.

2.9.2.5 <u>Waste Rock Facilities Reclamation</u>

<u>Carter Gulch Waste Rock Repository</u>

The Carter Gulch waste rock repository would be reclaimed concurrent with construction activities as described in Section 2.8.2.5. Under this alternative the final slope of the repository would be 3H:1V, and constructed benches must be placed every 200 feet of slope length.

<u>Existing Waste Rock Dumps</u>

Three waste rock dumps (Alder Gulch, OK and Ruby Gulch) are currently located within the project boundaries. The Alder dump and Ruby sulfide stockpile would be moved to the leach pad. The OK dump would be removed entirely and used as backfill in the pit complex. The remainder of the Ruby Gulch dump (after sulfide stockpile removal) would be leached, if testing demonstrates economically recoverable amounts of metals are present, or backfilled in the pit complex. Cover soil from this dump would be salvaged. The footprint from all of these facilities would be tested for total sulfur content on 100-foot centers. Those areas with total sulfur content >0.5% sulfur would be capped with Reclamation Cover A and revegetated. Areas with lower sulfur contents would be scarified, covered with 8 inches of soil and revegetated.

2.9.2.6 <u>Support Facilities Reclamation</u>

Unless otherwise noted in the following sections, reclamation of support facilities would be as described in the Company Proposed Action, Section 2.8.2.6.

Solution/Process Ponds Reclamation

Reclamation of solution and process ponds would not differ from that described in the Company Proposed Action (Section 2.8.2.6).

Process Plant Site Reclamation

Final reclamation would include the removal of all structures and equipment used in the mining and processing of ore through heap leach operations. Reclamation of these facilities and footprints would not differ from that described in the Company Proposed Action, Section 2.8.2.6.

Soil Stockpile Reclamation

Cover soil stockpiles at the Zortman Mine may be depleted by the time surface reclamation activities are completed. The footprints from the soil stockpiles would be tested on 100 foot centers. Those areas with total sulfur content >0.5% sulfur would be covered with 6 inches of clay, followed by 8 inches of cover soil from other sources at the Zortman Mine or from the Landusky stockpiles, and revegetated. Areas with lower sulfur contents would be scarified, covered with 8 inches of soil and revegetated.

Access and Haul Roads

Reclamation requirements for access and haul roads would be as described in Section 2.8.2.6.

Limestone Quarry

Up to 13 acres would be disturbed at the LS-1 limestone quarry to provide about 1 million tons of limestone for construction and reclamation. The ultimate facilities development topography of the limestone quarry and reclamation procedures would be as described in Section 2.8.2.6.

Seaford Clay Pit

The Seaford clay pit has provided liner material for leach pad facilities at the Zortman Mine. Under this alternative the clay pit would also provide material for reclamation covers. Approximately 8.5 acres would be disturbed to supply about 1.1 million yd^3 of clay for Zortman Mine reclamation covers and the leach pad liner. Those areas in the clay pit already disturbed and reclaimed from previous operations would undergo additional disturbance and reclamation, as described in Section 2.8.2.6.

2.9.2.7 Reclamation/Post-Reclamation Water Handling and Treatment

Section 2.5.1.6 describes the various water and leachate capture systems, and the water treatment activities currently in effect at the Zortman Mine, including operation of a water treatment plan in accordance with the June, 1994 Administrative Order. This alternative incorporates the water handling and treatment procedures described in the Company Proposed Action (see Section 2.8.2.7). It also adopts the requirements described below.

Water Quality Improvement Plan

The Water Quality Improvement Plan (summarized in Appendix A) was described earlier, in Section 2.9.1.7. This program would continue through mine expansion operations and through reclamation and post-reclamation monitoring. Under this alternative ZMI would meet the requirements of the program and implement corrective measures when reclamation requirements are not met or water quality criteria are exceeded.

Section 2.9.5 contains additional surface reclamation and facilities monitoring requirements to determine overall compliance of Zortman Mine water handling and discharge programs.

Water Capture and Treatment

No changes are proposed for water capture and treatment upon cessation of mining and leaching activities from those implemented during mine operations (see Sections 2.8.1.7 and 2.9.1.7). Water treatment would continue until final reclamation is established and water maintains acceptable quality. As water quality meets discharge standards and the appropriate agencies approve of release of the waters, capture ponds, sumps and pumpbacks would be dismantled and reclaimed.

2.9.2.8 Reclamation Quality Control

The reclamation quality control procedures and requirements described in Alternative 3, Section 2.7.2.8, would apply to this alternative.

2.9.2.9 Revegetation Procedures

Revegetation procedures for this alternative would not be expected to differ significantly from those presented in Alternative 4, Section 2.8.2.9. However, no trees would be used in revegetation unless specifically needed to mitigate visual impacts. Only grasses, forbs and shrubs would be used to enhance wildlife habitat. Another change is that the agencies would not allow the use of crested wheatgrass in the reclamation seed mix. Areas disturbed at the Zortman Mine are and would be revegetated to stabilize soil and slopes, reestablish communities ecologically comparable to pre-mine conditions, and restore watershed, wildlife, recreational and aesthetic values that meet post-operation land use objectives. Vegetative cover must achieve 90% of that demonstrated in adjacent, natural communities of similar composition and location. Stock grazing would be restricted in revegetated areas until the vegetation canopy is 90% or greater of the reference area.

2.9.3 Landusky Mine: Agency Mitigated Expansion

ZMI has proposed several changes to current operations at the Landusky Mine, including provisions for mining an additional 7.6 million tons of ore and 7 million tons of waste rock. Service facilities to support these operations would include a limestone quarry and expanded shale pit excavations. The location of the currently permitted mine area is shown on Figure 2.9-1. This alternative would also allow ZMI to continue to use open-pit mining and heap-leach mineral processing to extract gold and silver from ore, with few modifications from the Company Proposed Action. The quantity of ore to be mined under this application would constitute slightly less than one year of additional mining at the Landusky Mine. No additional workers are anticipated to be hired.

The significant modification to the Company Proposed Action under this alternative concerns water control and treatment. All water handling, capture, and treatment systems would be sized for seepage from a 100-year, 24-hour storm event but ZMI would also be required to capture and treat seepage and degraded surface waters according to the Water Quality Improvement Plan. This modification is described in Section 2.9.3.7, and Appendix A contains a summary description. In addition, all mine expansion and reclamation activities would be conducted in accordance with the requirements established by the Memorandum of Agreement developed under Section 106 of the National Historic Preservation Act (see Appendix E).

- Performance of an Environmental Audit on an annual basis would be carried out to assure that spill containment systems work properly, that leak detection systems are in proper working order, and that spill prevention and response planning can be realistically implemented through review of company training programs and inspection of emergency response equipment.

Because this alternative includes many elements common with Alternative 4, mine operations are summarized with reference to more complete descriptions in Section 2.8.3. Additional detail is provided where a modification from the Company Proposed Action is included.

2.9.3.1 Mine Pit Expansion

The Company Proposed Action for the Landusky mine would involve lateral and vertical expansion of the existing Queen Rose/Suprise and August/Little Ben pits, and the South Gold Bug, which is an extension of the existing Gold Bug Pit. A plan view of the ultimate pit complex was shown on Figure 2.8-17, with typical cross sections of the pit expansions in Figures 2.8-18 and 2.8-19.

Mining Methods

The mining description provided in Section 2.8.3.1 is applicable to this alternative.

Rock Characterization

The materials and their relative amounts to be mined during expanded operations at the Landusky Mine were fully described in Section 2.8.3.1. The geochemical sampling and waste rock characterization program proposed by ZMI, and described in Section 2.8.1.1, would be implemented under this alternative. (The agencies have added mitigations restricting the use of certain waste rock types in reclamation, as described in Section 2.9.4).

2.9.3.2 Crushing Operation

Mining of the deeper portions of the Queen Rose/Suprise, August/Little Ben, or South Gold Bug pits would not require crushing or special handling for leaching purposes.

2.9.3.3 Ore Leaching Operation

As described in Section 2.8.3.3, the 7.6 million tons of ore from the expanded mining operations would be taken to the 87/91 leach pad for processing. This leach pad has already been permitted. No new construction of either lined pad area or buttress is required or proposed; expansion of the pad would occur by increasing the vertical loading of ore on the pad. The final pad capacity on this facility would be increased from the current 101.9 million tons to 109.5 million tons, and the final elevation at completion would be 5,450 feet, an increase in elevation of approximately 50 feet. There are no changes in lateral disturbance which are associated with the increase in loading of this pad to 19.5 million tons.

Solution Ponds

No additional solution ponds are proposed in connection with the proposed additional ore and waste rock mining.

Leak Detection System

No change is proposed to the leak detection system, as described in Section 2.5.3.3, Alternative 1. The existing underdrains and monitoring wells that are beneath and adjacent to the leach pads would be used to monitor for process solution leakage.

Processing Plant Operation

No change is proposed in operation of the processing plant. The existing facilities would continue to be utilized to process gold bearing solutions from the leach pads. There would be no changes in reagent handling and storage.

2.9.3.4 Waste Rock

The program to characterize waste rock types, according to their potential to generate acid or neutralize acid drainage, was described in Section 2.5.3.1.

Waste Rock Handling

Section 2.5.3.1 also describes how waste rock would be selectively handled and sorted according to their sulfur content and acid neutralization potential. No changes from that strategy are required in this alternative, except that waste rock could not be used in the construction of reclamation covers based solely on the sulfur content of the rock. Material used in construction purposes and as a capillary break must meet the geochemical and lithologic criteria described in Section 2.9.4.

Repository Construction

As described in the Company Proposed Action (Section 2.8.3.4), about 7 million additional tons of waste rock would be mined and scheduled for disposal in the Gold Bug waste repository or backfilled in the Queen Rose pit. The nominal slope of the repository would be built at 3H:1V, and drainage benches (15 - 30 feet wide) would be placed every 100 vertical feet. Reclamation at the Gold Bug would continue to occur concurrent with mining activities. Section 2.9.4.4 provides more information on the repository reclamation program.

2.9.3.5 Other Features and Facilities

No modifications to the Company Proposed Action are required under this alternative which would affect the Landusky Mine infrastructure and utilities. In fact, the Company Proposed Action would have little change to the currently permitted conditions as described in Section 2.5.3.5. A summary follows.

Access and Haul Roads

A haul road would be constructed in the permitted disturbance area for accessing the South Gold Bug Pit area. Any other access or haul roads would remain or be constructed on existing disturbed areas within the pits. The 2,500 feet of haul road to the King Creek limestone quarry would be widened from 20 to 60 feet, resulting in an additional total disturbance of 5.7 acres.

Power and Water Supply

No changes are proposed in the current power and water supply systems for the Landusky Mine. Electrical power is obtained from the Landusky grid, which is supplied by the Big Flat Power Cooperative through an existing 23 kV line. Potable water is obtained from groundwater wells. Process water is obtained from precipitation and groundwater appropriation.

Sewage Treatment

No changes are proposed from the current septic waste treatment systems. See Section 2.5.3.5, Alternative 1, for additional information.

Chemical Use

No changes are proposed from the current inventory and use of potentially hazardous materials. See Section 2.5.3.7 of the Company Proposed Action for additional information.

Waste Disposal
No changes are proposed from the current disposal methods for solid and/or hazardous wastes. See Section 2.5.3.7, Alternative 1, for additional information.

2.9.3.6 Water Handling and Treatment

As described in Section 2.8.3.6, diversions and capture systems would be constructed to allow capture of mine-impacted waters and prevent deterioration of water quality in non-impacted drainages. Drainage and diversion ditches must be able to pass the peak flow from a 100-year storm event with 1 foot of freeboard. Storm water would be segregated from mine-impacted water.

Water handling, capture, and treatment systems would be sized for 100-year, 24-hour storm events. Under this alternative ZMI would be required to capture and treat seepage and degraded state waters according to the Water Quality Improvement Plan (see Appendix A), and to meet the reclamation requirements described in 2.9.4. Under this alternative ZMI would have to meet the requirements of the program and implement agency directed corrective measures when water quality threshold criteria (interim BAT Standards or final MPDES effluent limits) are exceeded. Unless otherwise indicated, water handling and treatment systems would be as described in the Company Proposed Action, Section 2.8.3.6.

Water Capture and Treatment
The existing seepage capture systems would be sized to handle seepage generated by a 100-year, 24-hour storm event. Seepage capture ponds and sumps would be inspected on a weekly basis for routine maintenance or repairs, if necessary. Water captured from Landusky Mine facilities which is of unacceptable quality would be treated in a new water treatment plant at the Landusky Mine before discharge to surface waters.

Surface Water Runoff Control
Surface water runoff diversions and controls would be sized for a 100-year, 24-hour storm event with one foot of freeboard added as a safety measure. Diversion channels would be trapezoidal or V shaped, lined with geotextile to prevent piping and rip-rapped with durable, non-acid forming rock sized for drainage area requirements. All diversion ditches would have road access for maintenance purposes. Maintenance would consist of removal of sediment load and repositioning of rip-rap as required. Sediment would be disposed of in the waste rock repository. Other features would be as described in Section 2.8.3.6.

No changes from the existing operations (see Section 2.5.3.6) to control surface water runoff control would be implemented for the mine pit, leach pads, or waste rock facilities. (Post-reclamation water handling and discharge would differ significantly, however. See Section 2.9.4.7.)

Land Application Disposal
No emergency land application is anticipated during operations. In the event land application is required, it would be conducted as described in Section 2.5.3.6 for currently permitted operations.

2.9.4 Landusky Mine: Agency Mitigated Reclamation

Modifications to ZMI's proposed reclamation procedures are included in this alternative. These modifications would reduce infiltration into areas with the potential to cause acidic drainage, remove waste rock dumps and other sources currently causing degradation of surface water or groundwater, and establish a program to implement further corrective measures should reclamation procedures fail. Many of these reclamation modifications were described in detail in Section 2.7.4, for the Agency Mitigated Reclamation for Alternative 3. However, that alternative describes reclamation actions to be taken if ZMI's proposal for mine expansion is not approved. This alternative describes modified reclamation actions that would take place in conjunction with mine expansion. The major reclamation modifications to be incorporated in this alternative include:

- Reclamation Cover C would be modified to include 6 inches of compacted clay (as opposed to 3 inches of compacted clay) between the bottom substrate and the PVC liner. The PVC liner thickness would be increased to 30 mil. For the purpose of discussion in this and future alternatives, this cover is described as Modified Reclamation Cover C.

- The 91 leach pad dike would be re-reclaimed using Reclamation Covers B and/or Modified C, as appropriate. Other facilities not used as pit backfill would be tested for sulfur content. If greater than 10% of the material contains sulfur in concentrations exceeding 0.2%, the facility would be re-reclaimed using Reclamation Covers B and/or Modified C. Cover soil on the facilities would be removed, stockpiled, and reused.

- With the exception of leach pad dikes, the Gold Bug repository and the Mill Gulch waste rock dump, existing facilities would be reclaimed to a 3H:1V slope, with constructed benches every 200 feet of slope length. In order to achieve the slope reductions while minimizing additional land disturbance, some material may have to be off-loaded from existing facilities.

- In order to classify as "Non-Acid Generating" and be used without restriction in construction and reclamation, waste rock or other material:

  1) Cannot be composed of igneous breccia, felsic gneiss, monzonite, quartzite, or trachyte lithologies;

  2) Amphibolite, mafic gneiss, shale, dolomite or limestone must have a total sulfur content less than 0.8%, and a paste pH of 6.0 or greater;

  3) If syenite, must have a total sulfur content less than or equal to 0.2%, a paste pH of 6.5 or greater, <u>and</u> a NNP greater than or equal to 0 with an NP:AP ratio greater than or equal to 1;

  4) Must meet the criteria above as demonstrated by sampling and analyzing lithologies from every blasthole providing non-acid generating material.

- Material used for capillary breaks may be obtained from an area limestone source or non-acid generating waste rock.

- Rock fill would be removed and used as backfill to raise the pit floor to a minimum elevation of 4,850 feet (at the midpoint of the drainage) to create a surface which would freely drain into King Creek. Sources of pit backfill to reach the 4,850 foot level would include the Montana Gulch waste rock dump and the 85/86 heap leach pad.

- Portions of the 85/86 leach pad and dike would be removed in order to unblock the western tributary of Montana Gulch and create a free draining surface.

- Highwall runoff would be diverted from the mine pits into Montana Gulch and treated if necessary.

- Contingency water capture systems and settling ponds would be installed in upper King Creek to treat surface water runoff from the backfilled pit floors.

- The reclamation requirements of this EIS and the Water Quality Improvement Plan (see Appendix A) would be used as a basis for determining reclamation success and directing any further corrective measures.

- Reclamation viability, as described in Section 2.9.5, would be monitored by ZMI until the agencies have approved final closure and released the mine reclamation bond.

- At the end of mine life, a comprehensive Environmental Site Assessment would be carried out that covers the entire Landusky mine permit area. This site assessment would include inspection of all locations where hazardous materials were stored and used and would identify evidence of spills or accidental releases that may have contaminated soil and groundwater. This site assessment would include soil and groundwater sampling should evidence of contamination be identified.

Final reclamation of all facilities is anticipated to occur within 3 years after the 87/91 leach pad has been detoxified and the liner perforated. Reclamation of individual facilities is contingent upon a number of economic and operational factors, and scheduling variations within the overall timeframe could occur. Reclamation activities are submitted to the DEQ on an annual basis and reflect the most recent operating and reclamation schedule.

The following sections summarize the specific reclamation plans and actions proposed by ZMI for each of the major disturbance areas, and provide a description of prescribed modifications to the reclamation procedures under this alternative.

2.9.4.1 Reclamation Materials

Reclamation materials would be required for construction and installation of reclamation caps, and for use in construction of drains and diversions. The primary materials to be used in reclamation covers would include non-acid forming waste rock and limestone, clays and cover soil. These materials and their sources were described in Section 2.8.4.1. The following sections summarize uses for reclamation materials and modifications from the Company Proposed Action.

Non-Acid Forming Material
Non-acid forming material would be used primarily as a capillary break/drainage layer in reclamation covers, and to a lesser extent as rip-rap and drain material. The non-acid forming waste rock would be mined and stockpiled adjacent to the Gold Bug waste repository for use in reclamation. Non-acid forming waste rock is being used as an interim cap on the Mill Gulch waste rock dump and in the Gold Bug waste rock repository, and as a cap on the 91 heap leach pad dike. Waste rock used in these facilities comes from existing stockpiles and that generated by the ongoing mine operation. Significant additional quantities of non-acid generating material would be used in reclamation covers on all mine facilities. Some of this material could come from waste rock generated at the South Goldbug pit. Approximately 38 million tons of waste rock are now contained within dumps at the Landusky Mine, and it is possible some of this material is not acid generating and could be used in reclamation covers. However, it is only recently that ZMI has begun segregating waste material at the Landusky Mine based on acid generating potential, and it would likely be very inefficient to attempt to separate out suitable waste rock. In addition, the geochemical requirements for waste to be classified as suitable in capillary break are more stringent than the waste handling and segregation strategy ZMI has used.

Limestone/Dolomite
Dolomite and limestone from outcrops within the mine permit area have recently been used to provide a 3-foot buffering liner across the floor of the 4,640 bench in the Gold Bug waste rock repository. Limestone and dolomite from the mine pits could also be used as capillary break material in the reclamation covers if insufficient quantities of suitable non-acid forming waste rock are available. Sections 2.7.4.1 and 2.8.4.1 provide a description of the activities to be conducted to quarry limestone from the King Creek quarry.

Clay
Clay is used as a component layer of the caps which have been placed on the Mill Gulch waste rock dump and 91 leach pad dike. The expansive clay helps to reduce the possibility of moisture infiltration into the capped facilities. Two six-inch lifts of clay would be used in disturbed areas where Reclamation Cover B is installed, and one six-inch lift of clay would be used in areas capped by Modified Reclamation Cover C. A six inch layer of clay is also used in Reclamation Cover A, to be placed on some haul road disturbances and pit benches. Clay used in Landusky Mine reclamation comes from the Williams clay pit located approximately 2 miles west of the town of Landusky.

Cover Soil
Cover soil would be used on top of all mine disturbances, either as a final lift on the reclamation caps or as 8-inch layers directly overlying disturbed zones which are determined by testing not to have significant acid generating potential. Cover soil is obtained from one of four topsoil storage areas: the Mill Gulch stockpile, part of the Mill Gulch waste rock dump; the Little Ben soil stockpile; the Gold Bug soil stockpile; and the Montana Gulch soil stockpile. Approximate volumes of soil available at these stockpiles are shown on Table 2.5-11. Other, similar materials used for reclamation purposes would include unconsolidated rock, scree and soil above and below roadway cuts, which are incorporated into the regrading of haul and access roads.

2.9.4.2 Reclamation Covers

Procedures used to cover disturbed areas would be as described in Alternative 3, Section 2.7.4.2. Under this alternative all disturbed areas (with the exceptions noted such as haul roads and building-type facilities) are assumed to be acid generating and would be capped using either Reclamation Cover B or Modified Reclamation Cover C, depending on the slope of the disturbance. These reclamation covers are similar to the covers used during reclamation of the Mill Gulch waste rock dump.

The reclamation cover modifications to the Company Proposed Action are also included for this alternative. As described in Section 2.7.4.2, Modified Reclamation Cover C would be modified be increasing the clay layer to a compacted minimum of 6 inches thick. The PVC liner thickness would be increased to 30 mil. A geofabric would be installed between the cover soil and capillary break. In addition, the "non-acid generating" material used as capillary break must meet the geochemical and lithologic criteria described at the beginning of Section 2.9.4.

The interim covers already constructed on the Mill Gulch and Gold Bug waste rock facilities would remain as permanent reclamation caps, provided that the infiltration performance criteria are met. Additional soil could be added to these covers to achieve water infiltration criteria that the agencies stipulate.

2.9.4.3 Mine Pit Reclamation

The pit reclamation procedures described in the Company Proposed Action (Section 2.8.4.3) are generally those required under this alternative with modifications as follows. The final pit floor elevation prior to backfill proposed for the Queen Rose/Suprise pit is 4,600 feet and the August/Little Ben pit final floor elevation is 4,400 feet. The pits are to be backfilled to a minimum elevation of 4850 feet in order to create a surface which would freely drain into King Creek. This requirement also necessitates that the source of some of the pit backfill come from the rock fill located at the head of King Creek. Fill removal from the head of King Creek and partial backfilling of the mine pits would help to re-establish the pre-mining catchment area for King Creek. This action would also reduce the potential for surface water infiltrating the pit floors to contact sulfide-bearing zones and create acidic drainage. Pit floors and pit walls would be reclaimed as described in Alternative 3, Section 2.7.4.3.

2.9.4.4 Leach Pad Reclamation

The 87/91 heap leach pad liner system would be perforated after pad detoxification and surface reclamation to eliminate moisture storage and any undesirable hydraulic conditions associated with the reclaimed facility. The liner would not be perforated until monitoring of the heap effluent indicates that water quality compliance has been met and risk of the formation of acid drainage is established to be minimal.

The 85/86 leach pad would be breached to allow free drainage of the western tributary of Montana Gulch. The other liner perforation requirements described in Section 2.7.4.4 would apply to this alternative.

2.9.4.5 Waste Rock Facilities Reclamation

Part of the Montana Gulch waste rock dump could be used as pit backfill. The remaining footprint or unexcavated dump surface would be tested and reclaimed with Reclamation Cover A if sulfur concentrations exceed 0.5%. If the dump is not entirely removed that portion remaining would be reclaimed using Reclamation Covers B or Modified C. The interim cap placed on the Mill Gulch and Gold Bug waste rock facilities would remain as a permanent cover. Modified Reclamation Cover C would continue to be used on the Gold Bug waste rock repository. Reclaimed surfaces would be revegetated in accordance with Section 2.8.4.9, except where modified as described in Section 2.7.4.9.

2.9.4.6 Support Facilities Reclamation

Unless otherwise noted in the following sections, reclamation of support facilities would be as described for existing operations and the Company Proposed Action, Sections 2.5.4.6 and 2.8.4.6, or with modifications presented in Alternative 3, Section 2.7.4.6.

Solution/Process Pond Reclamation

Reclamation of solution and process ponds would not differ from that described for the existing operations, Section 2.5.4.6.

Soil Stockpile Reclamation

Soil stock piles would be reclaimed as described in Section 2.7.4.6.

Access and Haul Road Reclamation

Reclamation requirements for access and haul roads would be as described in Section 2.7.4.6.

Limestone Quarry Reclamation

Up to 3 acres would be disturbed at the King Creek limestone quarry to provide reclamation materials. The ultimate facilities development topography of the limestone quarry would be as described in Section 2.7.4.6.

Williams Clay Pit Reclamation

Additional mining at the Williams clay pit would take place to provide clays for all reclamation covers. Up to 9 acres would be disturbed under this alternative to supply reclamation materials. New and old disturbances at the clay pit would undergo reclamation as described in Section 2.7.4.6. All areas would be revegetated as described in Section 2.8.4.9, except where modified by Section 2.9.4.9.

Land Application Area

Following completion of all land application operations, the land application area would be reclaimed as described in Section 2.8.4.4.

2.9.4.7 Reclamation/Post-Reclamation Water Handling and Treatment

Final requirements for water discharge from the Landusky Mine including discharge standards, treatment methods, and water management practices are being developed. Where applicable, these actions and requirements of the Water Quality Improvement Plan supersede the reclamation requirements for water management described in previous regulatory actions for the Landusky Mine. This alternative incorporates the water handling and treatment procedures described in the Company Proposed Action (see Section 2.8.4.7), except where modified as described below.

Water Quality Improvement Plan

The Water Quality Improvement Plan (summarized in Appendix A) was described earlier, in Section 2.9.1.7. This program would continue through mine expansion operations and through reclamation and post-reclamation monitoring. Under this alternative ZMI would have to meet the requirements of the program and implement agency directed corrective measures when reclamation requirements are not met or water quality criteria are exceeded.

Section 2.9.5 contains additional surface reclamation and facilities monitoring requirements to determine overall compliance of Landusky Mine water handling and discharge programs.

Water Capture and Treatment

No changes are proposed for seepage water capture and treatment upon cessation of mining and leaching activities from those implemented during mine operations (see Section 2.5.4.7 and 2.9.3.6). Water treatment, at a new water treatment plant at the Landusky Mine, would continue until final reclamation is established and water quality is acceptable. As water quality meets discharge standards and the appropriate agencies approve of release of the waters, capture ponds, sumps and pumpbacks would be dismantled and reclaimed.

Mine Pit Runoff Control

Where access allows, portions of the pit walls that are potentially acid forming and cannot be capped would have diversions installed above the highwalls. These diversions would prevent storm water from entering the pit. Diverted highwall runoff would be directed to drain to Montana Gulch, as would any other runoff originating at areas not reclaimed and capped. The diversions would be designed to be maintenance free to the extent possible and pass the peak flow from a 100-year storm event with one foot of freeboard. Highwalls and diversion structures would be visually inspected on a periodic basis and repairs made as necessary.

As noted earlier, this Alternative requires ZMI to backfill the August/Little Ben pit to the 4850 foot level. The source of backfill would, in part, be the rock fill at the head of the King Creek. The fill removal and pit backfilling would approximately re-establish the pre-mining catchment area for King Creek by reconnecting surface runoff from the August/Little Ben and Queen Rose/Suprise pit areas with that drainage. Settling ponds would be constructed in upper King Creek between monitoring site L-5 and the existing sediment pond used to control erosion of historic mine tailing. The ponds would help prevent water discharged from the reclaimed pit areas from degrading water quality in King Creek. If additional water treatment is needed, a treatment plant would be constructed to chemically reduce concentrations of metals prior to discharge to King Creek.

Leach Pad Runon Control

Under this alternative diversions would be constructed around the leach pads and laterally across the buttresses, sized for the 100-year, 24-hour storm event. That portion of the 85/86 leach pad and dike blocking surface flow from the west tributary in Montana Gulch would be removed.

Waste Rock Repositories Runoff Control

No changes are proposed to the existing drainage control features for the Gold Bug and Mill Gulch waste repositories. The dumps at the head of King Creek and at Montana Gulch would probably be removed entirely for backfill under this alternative. Drainage from these areas would be directed into Montana Gulch.

2.9.4.8 Reclamation Quality Control

The reclamation quality control procedures and requirements described in Alternative 3, Section 2.7.2.8, would apply to this alternative.

2.9.4.9 Revegetation Procedures

Revegetation procedures would be essentially as described in Section 2.5.4.9. However, no trees would be used in revegetation except on a limited basis for visual impact mitigation. Only grasses, forbs and shrubs would be used to enhance wildlife habitat. Another change is that the agencies would not allow the use of Crested wheatgrass in the reclamation seed mix. Areas disturbed by mining-related operations would be revegetated to stabilize soil and slopes, reestablish communities ecologically comparable to pre-mine conditions, and restore watershed, wildlife, recreational and aesthetic values that meet post-operation land use objectives. Vegetative cover must achieve 90% of that demonstrated in adjacent, natural communities of similar composition and location to be considered acceptable. Stock grazing would be restricted in revegetated areas until the vegetation canopy is 90% or greater of the reference area.

2.9.5 Monitoring Programs and Research Studies

The monitoring programs and research studies outlined in Section 2.8.5 would apply to this alternative. Implementation of the Water Quality Improvement Plan, designed to identify degradation of water resources and trigger corrective action, should not substantively alter the basic water quality monitoring programs already required. The Plan would be expanded to cover new facilities developed under this alternative. A reclamation monitoring program would be instituted to provide ongoing evaluation of surface reclamation viability.

2.9.5.1 Water Resources

The monitoring program for groundwater and surface water would continue as described in Section 2.5.5.1. Some monitoring wells or surface water monitoring sites could be relocated as a result of actions taken to reduce slopes of heap leach facilities and waste rock dumps. All monitoring required by the water quality compliance program would be incorporated into this alternative.

In addition, ZMI would be required to establish a monitoring program for operation and maintenance of land application disposal areas. This program, to be submitted to the agencies for review and approval prior to land application of spent solutions, would include at a minimum the following elements:

- Analysis of barren solution samples prior to land application and during, to determine optimum hydrogen peroxide rates and metals loading to soil.

- Installation of suction lysimeters at varying depths with the land application area.

- Collection of pore water samples (from lysimeters) and chemical analysis to include at least cyanide, arsenic, cadmium, copper, selenium, zinc, and lead.

- Daily or more frequent monitoring of land application operations by mine personnel to check for runoff from the area, or new groundwater seeps.

- Immediate sampling of all new seeps or discharges, or solutions found discharging from the area, and analysis for metals and cyanide.

Should any discharges from the area be detected, in the form of solution runoff or new seeps, all land application procedures would be stopped. The agencies must be informed immediately of any such occurrence and approve corrective measures prior to re-start of land application.

2.9.5.2 Reclamation Surface Performance Study

Some expansion of the reclamation surface performance study would result from implementation of this alternative. ZMI would be required to monitor seepage from waste rock facilities on a frequency sufficient to develop long-term hydrographs for each site. The hydrographs would be used to assess and predict how and when seepage responds to high flow seasons or storm events. The hydrographs will also provide a tool for predicting opportunistic sampling events to evaluate changes in seepage quality.

2.9.5.3 Surface Reclamation Monitoring Programs

ZMI would implement a program to monitor long term viability of surface reclamation until such time as the agencies release the Mine Reclamation Bond. The program must evaluate the continued performance of such features as:

- Reclamation covers
- Revegetation success and permanence
- Erosion control measures

The reclaimed facilities would be monitored for excessive erosion including rilling and gullying. Excessive erosion would be that level which endangers the overall efficacy of the reclamation features and could hinder the achievement of reclamation goals or environmental compliance requirements. Soil loss could not exceed 2 tons per acre per year. ZMI would be required to notify the agencies of such concerns with the reclamation systems, and propose and implement approved corrective measures to alleviate concerns.

ZMI would be required to submit a surface reclamation monitoring plan to the agencies for review and approval.

2.9.5.4 Other Monitoring Programs

No changes are anticipated to the remainder of the monitoring programs from the descriptions provided in Section 2.8.5.

2.9.6 Reasonably Foreseeable Future Actions

2.9.6.1 Mine Activities - Zortman

Foreseeable mine activities for the Zortman Mine would be similar to those described under Alternative 4, as described in Section 2.8.6.1, but development of the estimated 2-million ton ore deposit in the Pony Gulch area is <u>not</u> foreseeable. Since there would not be a conveyor system passing near this deposit it is unlikely it would be proposed for mining in the immediate future.

2.9.6.2 Mine Activities - Landusky

Since Alternatives 4, 5 and 6 are almost identical with respect to proposed mining at the Landusky Mine, foreseeable activities under this alternative are the same as previously described for Alternative 4, as described in Section 2.8.6.1. These developments include additional ore extraction from the existing pits and South Gold Bug pit area, generation of a significant amount of waste rock as new ore is mined, construction and operation of a new leach pad in the Queen Rose pit or at an alternate site, and the construction and operation of new or expanded water treatment facilities would be foreseeable.

2.9.6.3 Exploration Activities

It is anticipated that exploration proposals would be the same as described for Alternative 4 in Section 2.8.6.2. The additional 200,000 linear feet of road and trench construction, with 600 drillsites, over a 10-year period could be proposed. The only difference would be that mineralized areas near the Upper Alder Gulch leach pad would probably be targeted for exploration in order to locate mineable deposits within economic haul distance of the leach pad site.

2.10 ALTERNATIVE 6: AGENCY MITIGATED EXPANSION AND RECLAMATION WITH WASTE ROCK REPOSITORY LOCATED ON RUBY FLATS RATHER THAN IN CARTER GULCH

Alternative 6 would allow expansion of both the Zortman and Landusky mines but impose agency-developed mitigations on the expansion and reclamation activities. The major modification to ZMI's expansion plans (see Alternative 4, Section 2.8) would be at the Zortman Mine where the proposed waste rock repository in Carter Gulch would instead be placed on the Ruby Flats, just east of the Goslin Flats leach pad. The agencies developed this alternative because a repository on Ruby Flats site would be easier to construct and maintain than would a facility in the steep Carter Gulch drainage. In addition, water quality degradation would be easier to prevent, contain, and correct on Ruby Flats than at the Carter Gulch drainage. The conveyor system would be used for waste rock movement as well as ore transport. A significant modification of the Landusky reclamation requirements would be for ZMI to remove the 85/86 heap leach pad in Montana Gulch and/or the Montana Gulch waste rock dump for use as backfill in the Landusky pit complex. This action would facilitate drainage from the pit areas and the Gold Bug adit. A drainage notch between the August Pit and Montana Gulch would be constructed to prevent runoff from the pits from flowing into the August tunnel. Other agency-developed mitigating measures are incorporated into this alternative, including many of those described in Alternative 3. Figure 2.10-1 shows the existing and proposed facilities for both mines under this alternative.

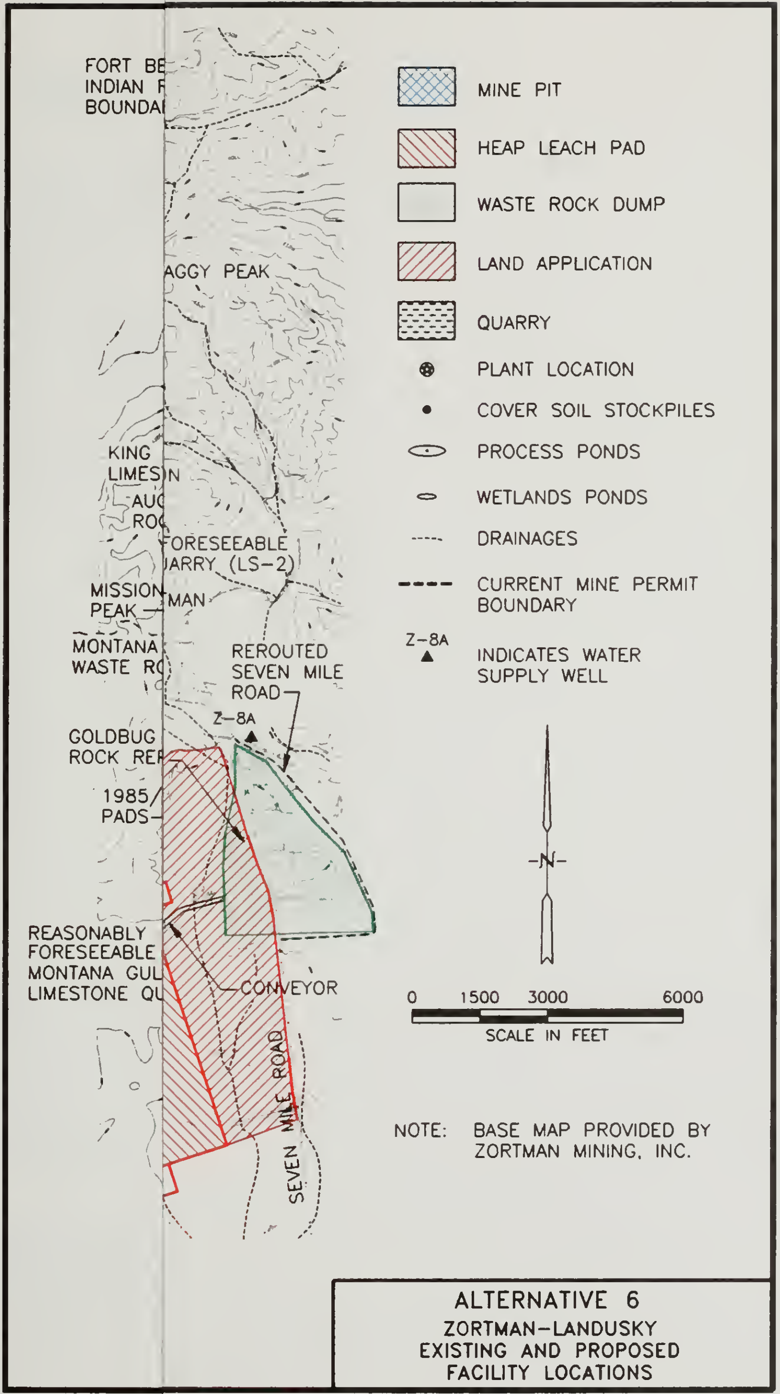
Many of the plans and facility designs for Alternative 6 are similar to or the same as those described in Alternative 4, and are hereby incorporated into this alternative. Therefore, the description of expansion and reclamation facilities is tiered to the discussions presented in Section 2.8. The focus of discussion for this alternative is on those areas which would be modified from the CPA. The proposed mine expansions and facilities modifications are presented in Sections 2.10.1 (Zortman Mine) and 2.10.3 (Landusky Mine), followed by the proposed reclamation activities for each mine as described in Sections 2.10.2 and 2.10.4. Modifications to ZMI's proposed monitoring programs and research studies are described in Section 2.10.5. Section 2.10.6 contains an assessment of other activities which are reasonably foreseeable should Alternative 6 be implemented.

2.10.1 Zortman Mine: Agency Mitigated Expansion

The location and currently permitted area of the Zortman Mine, and the Mine expansion with relocation of the waste rock repository to Ruby Flats, are shown on Figure 2.10-1. Total new disturbance for the Zortman expansion would be approximately 1,500 acres ultimate disturbance, including buffer zones around disturbance. Of that total, 401 acres were previously disturbed under existing permit.

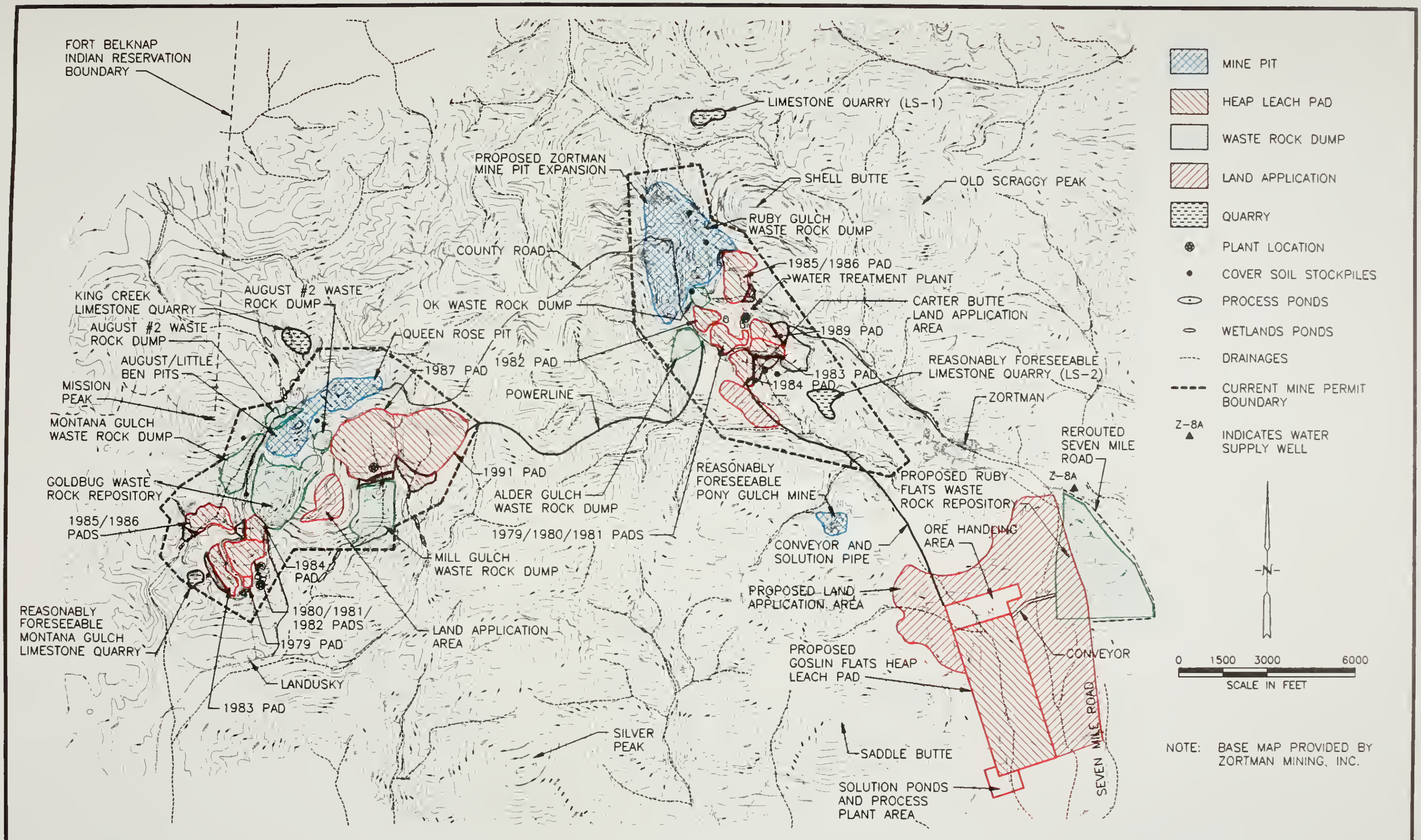
Under this alternative ZMI would continue to use open-pit mining and heap-leach mineral processing to extract gold and silver from ore, as described in Section 2.8.1. The major modifications from the Proposed Action include:

- The 60-million tons of waste rock would be placed in a repository constructed on the Ruby Flats, just east of the Goslin Flats heap leach pad.
- The waste rock repository would be lined on the bottom with a solution detection and collection system to reduce the potential for contamination of area water resources.
- Rerouting of the County-owned Seven Mile Road around the waste rock repository.
- All mine expansion and reclamation activities would be conducted in accordance with the Water Quality Improvement Plan (see Appendix A).
- All mine expansion and reclamation activities would be conducted in accordance with the signed Memorandum of Agreement developed under Section 106 of the National Historic Preservation Act (see Appendix E).
- Performance of an Environmental Audit on an annual basis would be carried out to assure that spill containment systems work properly, that leak detection systems are in proper working order, and that spill prevention and response planning can be



ALTERNATIVE 6
ZORTMAN-LANDUSKY
EXISTING AND PROPOSED
FACILITY LOCATIONS

FIG. 2.10-1



ZLF-ALT6

ALTERNATIVE 6: MAJOR NEW FACILITIES INCLUDE GOLSIN FLATS HEAP LEACH PAD, THE RUBY FLATS WASTE ROCK REPOSITORY, AND THE ZORTMAN MINE PIT EXPANSION

ALTERNATIVE 6
ZORTMAN-LANDUSKY
EXISTING AND PROPOSED
FACILITY LOCATIONS

FIG. 2.10-1

realistically implemented through review of company training programs and inspection of emergency response equipment.

- An alternate water source for bats (or other wildlife) would be constructed in Goslin Gulch between Azure Cave and the leach pad site to mitigate potential loss of wildlife drinking water on Goslin Flats.

Ore production would be approximately 60,000 to 80,000 tons per day, with mining and leaching operations performed on a year-round basis. Mining and related operations would take place 7 days a week, 24 hours per day, 350 days per year. ZMI projects that the Company Proposed Action work force would be similar to current operations, with approximately 260-280 full-time employees, depending on seasonal requirements. The agencies' modifications to the mine expansion should not measurably change the rate of operations or the work force.

2.10.1.1 Mine Pit Expansion

Mine pit expansion would not change from that described in Section 2.8.1.1. The outer edges of the pit would be extended outward 600 or more feet from the current pit configuration. The pit would be deepened approximately 500 feet in some ore zones, to a lowest point of about 4,500 feet. A plan view of the pit complex was shown on Figure 2.8-3, with pit cross-sections displayed in Figures 2.8-4 and 2.8-5.

Mining Methods

Conventional open-pit mine methods (drill, blast, and transport) would be used. The mining description provided in Section 2.8.1.1 is applicable to this alternative unless otherwise noted in specific sections.

Rock Characterization

The materials and their relative amounts to be mined during expanded operations at the Zortman Mine were described in Section 2.8.1.1. The geochemical sampling and waste rock characterization program proposed by ZMI, and described in Section 2.8.1.1, would be implemented under this alternative. (The agencies have added mitigations restricting the use of certain waste rock types in reclamation, as described in Section 2.10.2).

Waste Rock Handling

Waste rock would be hauled by truck to stockpiles near the head of the conveyor system and the 84 leach pad (see Figure 2.10-1). The waste rock would be crushed to accommodate transport on the conveyor system. Another primary crusher would probably be needed at the head of the conveyor system so that waste rock is not crushed in the primary ore crusher. Waste rock would be loaded onto the conveyor and shipped to a waste rock stockpile near the Goslin Flats leach pad to await further transport, or loaded directly into haul trucks for a mile-long haul to the Ruby Flats repository. Waste rock would not be segregated within the waste rock repository on the basis of total sulfur content, as is required for other alternatives. This waste rock repository would be lined in a manner similar to the Goslin Flats heap leach pad, with a solution containment and collection system. This added protection against leakage should obviate the need to selectively place waste rock within the repository.

Material used in construction and as a capillary break in reclamation covers must meet the geochemical and lithologic criteria described in Section 2.10.2.

2.10.1.2 Crushing Operation

The basic process employed under this alternative for ore crushing would not change from that described in Section 2.8.1.2. However, as noted in the previous discussion concerning waste rock handling, an additional primary crusher for waste rock size reduction could be required near the head of the conveyor system.

2.10.1.3 Conveyor System

The sizing of the overland conveyor system would not change for this alternative, even though the conveyor would also be used for waste rock transport. In an effort to reduce noise emanating from the conveyor system, and dust and fugitive emissions from the ore transport, the agencies would require the conveyor to be completely enclosed by a hood. The conveyor would be fenced, but the hood would also further reduce the potential for conveyor vandalism and prevent wildlife or humans from injury by conveyor operations. Other details concerning the conveyor design, construction, and operation are provided in Section 2.8.1.3.

2.10.1.4 Goslin Flats Heap Leach Pad

The ore heap leaching facility would not change significantly from that described in Alternative 4. Sections 2.8.1.4.1 through 2.8.1.4.5 describe the leach pad construction and operation, solution management operation of the processing plant, and handling of reagents. Figures 2.8-7 and 2.8-8 illustrate the heap

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realistically implemented through review of company training programs and inspection of emergency response equipment.

- An alternate water source for bats (or other wildlife) would be constructed in Goslin Gulch between Azure Cave and the leach pad site to mitigate potential loss of wildlife drinking water on Goslin Flats.

Ore production would be approximately 60,000 to 80,000 tons per day, with mining and leaching operations performed on a year-round basis. Mining and related operations would take place 7 days a week, 24 hours per day, 350 days per year. ZMI projects that the Company Proposed Action work force would be similar to current operations, with approximately 260-280 full-time employees, depending on seasonal requirements. The agencies' modifications to the mine expansion should not measurably change the rate of operations or the work force.

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Mine pit expansion would not change from that described in Section 2.8.1.1. The outer edges of the pit would be extended outward 600 or more feet from the current pit configuration. The pit would be deepened approximately 500 feet in some ore zones, to a lowest point of about 4,500 feet. A plan view of the pit complex was shown on Figure 2.8-3, with pit cross-sections displayed in Figures 2.8-4 and 2.8-5.

Mining Methods

Conventional open-pit mine methods (drill, blast, and transport) would be used. The mining description provided in Section 2.8.1.1 is applicable to this alternative unless otherwise noted in specific sections.

Rock Characterization

The materials and their relative amounts to be mined during expanded operations at the Zortman Mine were described in Section 2.8.1.1. The geochemical sampling and waste rock characterization program proposed by ZMI, and described in Section 2.8.1.1, would be implemented under this alternative. (The agencies have added mitigations restricting the use of certain waste rock types in reclamation, as described in Section 2.10.2).

Waste Rock Handling

Waste rock would be hauled by truck to stockpiles near the head of the conveyor system and the 84 leach pad (see Figure 2.10-1). The waste rock would be crushed to accommodate transport on the conveyor system. Another primary crusher would probably be needed at the head of the conveyor system so that waste rock is not crushed in the primary ore crusher. Waste rock would be loaded onto the conveyor and shipped to a waste rock stockpile near the Goslin Flats leach pad to await further transport, or loaded directly into haul trucks for a mile-long haul to the Ruby Flats repository. Waste rock would not be segregated within the waste rock repository on the basis of total sulfur content, as is required for other alternatives. This waste rock repository would be lined in a manner similar to the Goslin Flats heap leach pad, with a solution containment and collection system. This added protection against leakage should obviate the need to selectively place waste rock within the repository.

Material used in construction and as a capillary break in reclamation covers must meet the geochemical and lithologic criteria described in Section 2.10.2.

2.10.1.2 Crushing Operation

The basic process employed under this alternative for ore crushing would not change from that described in Section 2.8.1.2. However, as noted in the previous discussion concerning waste rock handling, an additional primary crusher for waste rock size reduction could be required near the head of the conveyor system.

2.10.1.3 Conveyor System

The sizing of the overland conveyor system would not change for this alternative, even though the conveyor would also be used for waste rock transport. In an effort to reduce noise emanating from the conveyor system, and dust and fugitive emissions from the ore transport, the agencies would require the conveyor to be completely enclosed by a hood. The conveyor would be fenced, but the hood would also further reduce the potential for conveyor vandalism and prevent wildlife or humans from injury by conveyor operations. Other details concerning the conveyor design, construction, and operation are provided in Section 2.8.1.3.

2.10.1.4 Goslin Flats Heap Leach Pad

The ore heap leaching facility would not change significantly from that described in Alternative 4. Sections 2.8.1.4.1 through 2.8.1.4.5 describe the leach pad construction and operation, solution management operation of the processing plant, and handling of reagents. Figures 2.8-7 and 2.8-8 illustrate the heap leach pad design from plan and cross-sectional views, respectively.

One modification to the design concerns the filter drains. A relatively shallow bedrock layer under the soil and subsoil in Goslin Flats is the Thermopolis Shale, which probably contains considerable pyrite and sulfur content. The agencies would not allow this material to be used without restriction in construction or reclamation purposes. Filter drains for the leach pad would have to be constructed using the native calcareous subsoil material or unmineralized limestones or carbonates from other sources.

2.10.1.5 Ruby Flats Waste Rock Repository

The agencies' modified waste rock repository would be constructed on the Ruby Flats, just northeast of the Goslin Flats heap leach pad (see Figure 2.10-1). The waste rock repository would be designed to hold 60 million tons. ZMI developed a conceptual design of this facility for the agencies. The repository would encompass approximately 203 acres, of which about 140 acres are privately owned at this time by the Square Butte Grazing Association. The facility would be three sided, and stand approximately 300 feet high when fully constructed.

Seven-Mile Road would have to be rerouted around the waste rock facility to the east to accommodate this site and design. In addition, the town of Zortman's community water supply well (Z-8a, as shown on Figure 2.10-1 and Exhibit 1) is located near the northwest corner of the Ruby Flats repository. For this reason, ZMI would have to provide a bottom liner and solution collection system as additional assurance that the water supply well does not become contaminated from the waste rock repository.

The footprint of the waste rock repository would be cleared of debris, stripped of cover soil, and graded to direct water or seepage to capture ponds at the toe (southwest corner) of the facility. The repository would be constructed from the bottom up, with haul roads developed on repository perimeters as the facility grows. Slopes of the repository would be no greater than 3H:1V. Waste rock would be deposited on a 1% grade and backsloped so that surface water can be diverted away. Temporary diversion channels, designed to handle peak flow from a 100-year event with at least one foot of remaining freeboard, would be constructed as necessary to further reduce the volume of water coming in contact with waste rock during construction.

Waste rock would not be segregated within the waste rock repository on the basis of total sulfur content, as is required for other alternatives. This waste rock repository would be lined in a manner similar to the Goslin Flats heap leach pad, with a solution containment and collection system. This added protection against leakage should obviate the need to selectively place waste rock within the repository and protects the Zortman water supply well from contamination. Solution collection from the repository would be either treated and discharged, or used in the leach pad process circuit.

2.10.1.6 Other Features and Facilities

Office/Laboratory Facilities

This alternative would not change the locations or functions of ZMI's office and laboratory facilities. The main office building for ZMI is located in the town of Zortman. The production assay lab is located across the street from the main office in a separate building. The laboratory and office functions would continue as described in Section 2.5.1.5.

Access and Haul Roads

The road network described in Section 2.8.1.6 would be developed under this alternative as well. An additional haul road would need to be developed to transport waste rock from the conveyor off-load area stockpiles to the repository on the Ruby Flats. As shown on Figure 2.10-1, Seven-Mile Road would be re-routed just south of the Ruby Flats waste rock repository. The new route would extend along the southern and eastern borders of the waste rock repository.

Power and Water Supply

Power requirements for this alternative differ somewhat from that proposed in Alternative 4. Power requirements for the mine expansion and ore processing facilities would be supplied by connecting the Landusky Mine power line to the expansion operation. This would allow for any additional power needed at one operation to be allocated from the other. However, transportation of the waste rock on the conveyor system would generate more power than that produced by the Company Proposed Action. This surplus power from the conveyor would be redirected back to the Zortman power grid.

Water supplies are likely to be as described for the Company Proposed Action in Section 2.8.1.6.

Septic Treatment
No change from existing operations is anticipated for disposal of human waste, as described in Section 2.5.1.6.

Chemical Use
Chemicals used and required under this Alternative would be essentially the same as described in Section 2.8.1.6 of the Company Proposed Action.

Waste Disposal
The types and amounts of solid waste generated under this alternative would be as described for the Company Proposed Action in Section 2.8.1.6. Methods of disposal would also remain the same.

2.10.1.7 Water Handling and Treatment

Water handling, capture, and treatment systems would be sized for 100-year, 24-hour storm events as described in the Company Proposed Action (Section 2.8.1.7), but under this alternative ZMI would be required to capture and treat seepage and degraded waters according to the Water Quality Improvement Plan (see Appendix A), and to meet the reclamation requirements described in 2.10.2. ZMI would have to meet the requirements of the compliance plan and implement agency directed corrective measures when water quality criteria (interim BAT Standards or final MPDES effluent limits) are exceeded. Additional requirements and elements of the water handling and treatment program for this alternative would be as described for Alternative 5, Section 2.9.1.7.

Water Capture and Treatment
No changes would be made to most seepage water capture and treatment systems from those described in the Company Proposed Action. No changes would be made to the existing Ruby Gulch capture systems. The Alder Spur capture system would be re-sized for the 100-year, 24-hour event. All captured seepage water would be pumped to the Zortman water treatment plant for treatment and released into Ruby Gulch.

Surface Water Runoff Control
All surface water runoff control features described in Section 2.8.1.7 would apply to this alternative. In addition, all drainage and diversion ditches would have to be able to pass the peak flow from a 100-year storm event with at least one foot of freeboard. Permanent diversions would be constructed around the Ruby Flats waste rock repository to minimize flow onto waste rock. Concurrent reclamation and temporary diversions would be used to limit infiltration of storm water.

Land Application Disposal (LAD) Area
Land application disposal for neutralized process solutions would take place as described in Section 2.8.1.7 for the Company Proposed Action. However, the Ruby Flats waste rock repository would be constructed on portions of the area proposed by ZMI for land application, thereby reducing the acreage available for solution disposal by approximately 40 acres.

2.10.2 Zortman Mine: Agency-Mitigated Reclamation

The agencies have developed modifications to ZMI's proposed reclamation procedures which would: 1) reduce infiltration into areas with the potential to cause acidic drainage, 2) remove waste rock dumps and other sources currently causing degradation of surface water or groundwater, and 3) implement the Water Quality Improvement Plan to further mitigate effects of ARD should reclamation procedures fail to adequately protect water resources. Many of these reclamation modifications were described in detail in Section 2.7.2, for the Agency Mitigated Reclamation for Alternative 3. However, that alternative describes reclamation actions to be taken if ZMI's proposal for mine expansion is not approved. This alternative describes modified reclamation actions that would take place in conjunction with the mine expansion. The major reclamation modifications to be incorporated in this alternative include:

- Reclamation Cover C would be modified to include 6 inches of compacted clay (as opposed to 3 inches of compacted clay) between the bottom substrate and the PVC liner. The PVC liner thickness would be increased to 30 mil. As described in Alternatives 3 and 5, this cover will be known as "Modified Reclamation Cover C."

- With the exception of the 89 leach pad dike, all facilities not used as pit backfill are assumed to be potentially acid generating and require re-reclamation using Reclamation Covers B or Modified C. Cover soil on the facilities would be removed, stockpiled, and reused. The 89 leach pad dike would be tested for sulfur content as described in Section 2.8.2.2, and re-reclaimed if sulfur exceeds 0.2% in more than 10% of the material tested.

- With the exception of leach pad dikes, existing facilities would be reclaimed to a 3H:1V slope, with constructed benches every 200 feet of slope length. In order to achieve the slope reductions while minimizing additional land disturbance, some material may have to be off-loaded from existing facilities and backfilled into the pit.

- In order to classify as "Non-Acid Generating" and be used without restriction in construction and reclamation, waste rock or other material:

  1) Cannot be composed of igneous breccia, felsic gneiss, monzonite, quartzite, or trachyte lithologies;

  2) Amphibolite, mafic gneiss, shale, dolomite or limestone must have a total sulfur content less than 0.8%, and a paste pH of 6. or greater;

  3) If syenite, must have a total sulfur content less than or equal to 0.2%, a paste pH of 6.5 or greater, <u>and</u> a NNP greater than or equal to 0 with an NP:AP ratio greater than or equal to 1;

  4) Must meet the criteria above as demonstrated by sampling and analyzing lithologies from every blasthole providing non-acid generating material.

- Material used for capillary break/drainage layers may be obtained from an area limestone source or non-acid generating waste rock.

- After detoxification, the 85/86 leach pad and dike would be removed to create a free draining surface and placed in the pit as backfill material prior to pit floor reclamation.

- The OK waste rock dump would be removed and used to backfill the pit complex. Cover soil would be re-salvaged and the waste rock footprint reclaimed.

- The tailings in Ruby Gulch above the town of Zortman would be removed from the drainage and placed in the pit complex or used as reclamation or construction material. The drainage would be restored as mitigation for existing disturbance to waters of the United States by other Zortman and Landusky mines facilities.

- The sulfide storage area would also be removed and placed on the Goslin Flats leach pad for ore processing.

- The back-filled pits would be graded so that runoff freely drains, without impoundment in the pit, into the Ruby Gulch drainage.

- Reclamation viability, as described in Section 2.10.5 and other sections of this alternative, would be monitored by ZMI until the agencies have approved final closure and released the mine reclamation bond.

- Reclaimed facilities would be recontoured to provide a topography that blends into the surrounding landscape. Straight edges would be rounded. Large, flat surface areas would be broken with changes in contour resembling natural drainage patterns.

- The reclamation requirements of this EIS and the Water Quality Improvement Plan (see Appendix A) would be used as a basis for determining reclamation success and directing any further corrective measures.

Final reclamation of all facilities is anticipated to occur within 3 years after the Goslin Flats leach pad has been detoxified and liner perforated. Reclamation of individual facilities is contingent upon a number of economic and operational factors, and scheduling variations within the overall timeframe could occur. Reclamation activities are submitted to the DEQ on an annual basis and reflect the most recent operating and reclamation schedule.

The following sections summarize the specific reclamation plans and actions proposed by ZMI for each of the major disturbance areas, and provide a description of prescribed modifications to the reclamation procedures under this alternative.

2.10.2.1 <u>Reclamation Materials</u>

Reclamation materials would be required for construction and installation of reclamation caps and for use in construction of drains and diversions. The primary materials to be used in reclamation covers would include non-acid forming waste rock and limestone, clays and cover soil. These materials and their sources were described in Section 2.8.2.1. The following describes only modifications from the Company Proposed Action.

Non-Acid Forming Material

The reclamation covers used in this alternative require a capillary break of 36 inches, to be composed of a suitable non-acid generating waste rock or limestone.

Under this alternative, the waste rock must meet the geochemical and lithologic criteria described in the beginning of Section 2.10.2 to be suitable for construction purposes and reclamation cover. It is likely that sufficient waste rock of suitable quality would be available from new mining for reclamation covers and construction, so that limestone would not be required as a capillary break material.

Limestone

Limestone would be used in construction and reclamation of the Goslin Flats leach pad. Limestone needed for construction purposes or in reclamation covers would be mined from LS-1 (see Figure 2.5-2). Mining and haul road development to this source would occur as described in Section 2.7.2.1.

Clay

As described in the Company Proposed Action (Alternative 4) clay would be used for leach pad liner construction as well as cover material on waste rock repositories, heap leach pads, haul roads, and pit benches and floors to restrict moisture infiltration. Clay required for construction and reclamation of facilities would be mined from the Seaford clay pit. Section 2.7.2.1 describes the haul route from the Seaford pit to the Zortman Mine.

Cover Soil

Cover soil at the Zortman Mine is currently obtained from one of three stockpiles listed, with soil volumes, on Table 2.5-5. These stockpiles would probably have insufficient supplies to adequately cover all disturbances to the extent required under this alternative. Approximately 550,000 yd^3 yards of cover soil would be required. Additional cover soil would be generated during construction of the Goslin Flats heap leach pad and Ruby Flats waste rock repository. The agencies believe construction of these two facilities would produce sufficient cover soil quantities for all Zortman Mine reclamation requirements. Another source of cover soil is the material salvaged during re-reclamation activities on facilities which have already been cover soiled and revegetated.

2.10.2.2 Reclamation Covers

Procedures used to cover disturbed areas would be as described in Alternative 3, Section 2.7.2.2. Under this alternative all disturbed areas not being used as pit backfill (with the exceptions noted such as haul roads and building-type facilities, and the 89 leach pad dike) are assumed to be acid generating and would be capped using either Reclamation Cover B or Modified Reclamation Cover C, depending on the slope of the disturbance. As described in Section 2.7.2.2, Reclamation Cover C would be modified by increasing the clay layer to a compacted minimum of 6 inches thick. The PVC liner thickness would be increased to 30 mil and a geofabric would be placed between the cover soil and the capillary break.

The other modification to reclamation covers is in the definition of "non-acid generating" material. The criteria for material to be suitable for use in capillary break were described at the beginning of Section 2.10.2. Certain rock types would be excluded from use and those not excluded must demonstrate a sufficiently high Paste pH, sufficiently low sulfur content, and appropriate neutralization potential. All waste rock considered for use as non-acid generating material must come from blastholes which have been characterized according to these criteria.

2.10.2.3 Mine Pit Reclamation

Mine pit reclamation would occur generally as described in Section 2.8.2.3, with some modification concerning the source of pit backfill materials. Approximately 9 million tons of spent ore and tailings from the 85/86 leach pad and dike, and Ruby Gulch drainage, would be placed in the pit complex as backfill in addition to the approximately 6 million tons of scheduled backfill proposed by ZMI. This material would be used to raise the pit floor to an elevation necessary to freely drain the pit and prevent surface water from ponding and infiltrating through the pit floor. Additional backfill material could come from the waste rock generated during expanded mine operations. The final pit construction would be as described in the Company Proposed Action. The final pit floor would be capped with Reclamation Cover B. The final cover would be revegetated with native grasses and forbs. Pit walls not covered by backfill would be cover soiled and revegetated where possible, to include tree planting to reduce visual impacts of highwalls.

2.10.2.4 Leach Pad Reclamation

Tasks associated with the reclamation of the heap leach facilities include heap detoxification, surface reclamation including slope reduction, reclamation cover placement, cover soiling and revegetation, and liner perforation. These steps have been described in detail previously. Heap leach pad reclamation would generally follow the procedures outlined in Section 2.8.2.4, with incorporation of the relevant modifications described in Alternative 5, Section 2.9.2.4.

Existing Heap Leach Pads

Reclamation of existing heap leach pads and dikes would be as described in Section 2.8.2.4, with the agencies modifications from Alternative 5, Section 2.9.2.4.

Heap Detoxification

The heap detoxification process for this alternative would be as described in Section 2.5.2.4, summarized in Section 2.9.2.4.

Surface Reclamation - Goslin Flats Leach Pad

The reclamation criterion for pad slopes under this alternative is a maximum 3H:1V slope, if topography allows, but no greater than 2.5H:1V. Constructed benches must be placed every 200 feet of slope length. Slope reduction would be performed by track mounted bulldozers pushing ore heap material from the facility crest or top down over the lift slopes, using cut and fill material from each of the heap benches to obtain the desired slope. Leach pad crests, top and slopes would be capped with Reclamation Cover B (on slopes greater than 5%) or Modified C (on slopes 5% or less).

Heap retaining dikes would be reduced to a nominal slope of 2.5H:1V, or sufficient to allow placement and retention of Reclamation Cover B. The dike faces would be capped with Reclamation Cover B and revegetated to blend with existing undisturbed contact zones and reestablish vegetation communities. The reclaimed pad surfaces would be revegetated with native prairie grasses, forbs and shrubs to complete final reclamation. In order to help mitigate the visual appearance of the reclaimed heap, portions of the uppermost lift(s) of ore would be varied in thickness and location to create a variable skyline. In addition, "micro-habitat" areas would be created by scouring small depressions with earth-moving equipment during final regrading.

Liner Perforation

The heap leach pad liner system would be perforated after pad detoxification and surface reclamation to eliminate moisture storage and any undesirable hydraulic conditions associated with the reclaimed facility. The liner would not be perforated until monitoring of the heap effluent indicates that water quality compliance has been met and risk of the formation of acid drainage is established to be minimal. The liner perforation requirements described in Section 2.7.2.4, including annual and monthly monitoring, would apply to this alternative. Drain holes would be drilled through the Goslin Flats leach pad's synthetic and clay liner systems to facilitate drainage.

2.10.2.5 Waste Rock Facilities Reclamation

Ruby Flats Waste Rock Repository

The Ruby Flats waste rock repository would be reclaimed concurrent with construction activities as described in Section 2.8.2.5. Two modifications from the Company Proposed Action are incorporated. First, because the waste rock repository would be lined to prevent seepage into underlying lithologies, it would have to be sloped at the foundation for solution drainage and collection. The second modification in this alternative from the Company Proposed Action is that the final slope of the repository would be 3H:1V, and constructed benches must be placed every 200 feet of slope length. This reduction in slope would increase the final disturbance footprint for this facility.

Existing Waste Rock Dumps

Existing waste rock dumps would be reclaimed as described in Section 2.9.2.5.

2.10.2.6 Support Facilities Reclamation

Unless otherwise noted in the following sections, reclamation of support facilities would be as described in the Company Proposed Action, Section 2.8.2.6.

Solution/Process Ponds Reclamation

Reclamation of solution and process ponds would not differ from that described in the Company Proposed Action, Section 2.8.2.6.

Process Plant Site Reclamation

Final reclamation would include the removal of all structures and equipment used in the mining and processing of ore through heap leach operations. Reclamation of these facilities and footprints would not differ from that described in the Company Proposed Action, Section 2.8.2.6.

Soil Stockpile Reclamation
Cover soil stockpiles at the Zortman Mine may be completely depleted by the time surface reclamation activities are completed. The footprints from the soil stockpiles would be tested on 100 foot centers. Those areas with total sulfur content >0.5% sulfur would be covered with 6 inches of clay, followed by 8 inches of cover soil from other sources at the Zortman Mine or from Landusky Mine stockpiles, and revegetated. Areas with lower sulfur contents would be scarified, covered with 8 inches of soil and revegetated.

Access and Haul Roads
Reclamation requirements for access and haul roads would be as described in Section 2.8.2.6.

Limestone Quarry
Up to 13 acres would be disturbed at the LS-1 limestone quarry to provide about 1 million tons of limestone for construction and reclamation. The ultimate facilities development topography of the limestone quarry and reclamation procedures would be as described in Section 2.8.2.6.

Seaford Clay Pit
The Seaford Clay Pit has provided liner material for leach pad facilities at the Zortman Mine. Under this alternative, the clay pit would also provide material for reclamation covers. About 11 acres would be disturbed to supply approximately 1 million yd^3 of clay for Zortman Mine reclamation covers and the leach pad liner. Those areas in the clay pit already disturbed and reclaimed from previous operations would undergo additional disturbance and reclamation, as described in Section 2.8.2.6.

2.10.2.7 Reclamation/Post-Reclamation Water Handling and Treatment

Section 2.5.1.6 describes the various water and leachate capture systems, and the water treatment activities currently in effect at the Zortman Mine, including operation of a water treatment plan in accordance with the June, 1994 Administrative Order. This alternative incorporates the water handling and treatment procedures described in the Company Proposed Action (see Section 2.8.2.7). It also adopts the requirements described below.

Water Quality Improvement Plan
The Water Quality Improvement Plan (attached as Appendix A) was described earlier, in Section 2.10.1.7. This program would continue through mine expansion operations and through reclamation and post-reclamation monitoring. Under this alternative ZMI would have to meet the requirements of the program and implement agency directed corrective measures when reclamation requirements are not met or water quality criteria are exceeded.

Section 2.10.5 contains additional surface reclamation and facilities monitoring requirements to determine overall compliance of Zortman Mine water handling and discharge programs.

Water Capture and Treatment
No changes are proposed for water capture and treatment upon cessation of mining and leaching activities from those implemented during mine operations (see Sections 2.8.1.7 and 2.10.1.7). Water treatment would continue until final reclamation is established and water maintains acceptable quality. As water quality meets discharge standards and the appropriate agencies approve of release of the waters, capture ponds, sumps and pumpbacks would be dismantled and reclaimed.

2.10.2.8 Reclamation Quality Control

The reclamation quality control procedures and requirements described in Alternative 3, Section 2.7.2.8, would apply to this alternative. Construction quality control of the waste rock repository would meet the same requirements as for the heap leach pad construction.

2.10.2.9 Revegetation Procedures

Revegetation procedures for this alternative would not be expected to differ significantly from those presented in Alternative 4, Section 2.8.2.9. However, no trees would be used in revegetation unless specifically needed to mitigate visual impacts. Only grasses, forbs, and shrubs would be used to enhance wildlife habitat. Another change is that the agencies would not allow the use of Crested wheatgrass in the reclamation seed mix. Areas disturbed at the Zortman Mine are and would be revegetated to stabilize soil and slopes, reestablish communities ecologically comparable to pre-mine conditions, and restore watershed, wildlife, recreational and aesthetic values that meet post-operation land use objectives. Vegetative cover must achieve 90% of that demonstrated in adjacent, natural communities of similar composition and location. Stock grazing would be restricted in revegetated areas until the vegetation canopy is 90% or greater of the reference area.

2.10.3 Landusky Mine: Agency Mitigated Expansion

ZMI has proposed several changes to current operations at the Landusky Mine, including provisions for mining an additional 7.6 million tons of ore and 7 million tons of waste rock. Service facilities to support these operations would include a limestone quarry and expanded shale pit excavations. The location of the currently permitted mine area and proposed facilities under this alternative for both mines is shown on Figure 2.10-1. This alternative would also allow ZMI to continue to use open-pit mining and heap-leach mineral processing to extract gold and silver from ore, with few modifications from the Company Proposed Action. The quantity of ore to be mined under this application would constitute slightly less than one year of additional mining at the facility. No additional workers are anticipated to be hired under this expansion proposal.

The significant modification to the Company Proposed Action required under this alternative concerns water control and treatment. All water handling, capture, and treatment systems would be sized for seepage from a 100-year, 24-hour storm event but ZMI would also be required to capture and treat seepage water and degraded surface waters according to the Water Quality Improvement Plan. This modification is described in Section 2.10.3.7, and Appendix A contains a summary description of the Improvement Plan. In addition, all mine expansion and reclamation activities would be conducted in accordance with the requirements established by the Memorandum of Agreement developed under Section 106 of the National Historic Preservation Act (see Appendix E).

Performance of an Environmental Audit on an annual basis would be carried out to assure that spill containment systems work properly, that leak detection systems are in proper working order, and that spill prevention and response planning can be realistically implemented through review of company training programs and inspection of emergency response equipment.

Because this alternative includes little variation from Alternative 4 mine operations are summarized with reference to more complete descriptions in Section 2.8.3. Additional detail is provided where a modification from the Company Proposed Action is included.

2.10.3.1 Mine Pit Expansion

The proposed expansion for the Landusky mine would involve lateral and vertical expansion of the existing Queen Rose/Suprise and August/Little Ben pits, and the South Gold Bug, which is an extension of the existing Gold Bug pit. A plan view of the ultimate pit complex was shown on Figure 2.8-17, with typical cross sections of the pit expansions in Figures 2.8-18 and 2.8-19.

Mining Methods

The mining description provided in Section 2.8.3.1 is applicable to this alternative.

Rock Characterization

The materials and their relative amounts to be mined during expanded operations at the Landusky Mine were fully described in Section 2.8.3.1. The geochemical sampling and waste rock characterization program proposed by ZMI, and described in Section 2.8.1.1, would be implemented under this alternative. (The agencies have added mitigations restricting the use of certain waste rock types in reclamation, as described in Section 2.10.4).

2.10.3.2 Crushing Operation

Mining of the deeper portions of the Queen Rose/Suprise, August/Little Ben, or South Gold Bug pits would not require crushing or special handling for leaching purposes.

2.10.3.3 Ore Leaching Operation

The 7.6 million tons of ore from the expanded mining operations would be taken to the 87/91 leach pad for processing. This leach pad has already been permitted. Other details of the heap leach operation would be as described in Section 2.8.3.3.

Solution Ponds

No additional solution ponds are proposed in connection with the proposed additional ore and waste rock mining.

Leak Detection System

No change is proposed to the leak detection system, as described in Section 2.5.3.3, Alternative 1. The existing underdrains and monitoring wells that are beneath and adjacent to the leach pads would be used to monitor for process solution leakage.

Processing Plant Operation
No change is proposed in operation of the processing plant. The existing facilities would continue to be utilized to process gold bearing solutions from the leach pads. There would be no changes in reagent handling and storage.

2.10.3.4 Waste Rock

The program to characterize waste rock types, according to their potential to generate acid or neutralize acid drainage, was described in Section 2.5.3.1. Section 2.8.3.4. describes how waste rock would be selectively handled and sorted according to their sulfur content and acid neutralization potential. The changes from that strategy as required in this alternative are summarized below.

Waste Rock Handling
Section 2.5.3.1 also describes how waste rock would be handled and designated for use in reclamation and construction based on geochemical characteristics. No changes from that strategy are required in this alternative, except that waste rock could not be used in the construction of reclamation covers based solely on the sulfur content of the rock. Material used in construction purposes and as a capillary break must meet the geochemical and lithologic criteria described in Section 2.10.4.

Repository Construction
As described in the Company Proposed Action (Section 2.8.3.4), about 7 million additional tons of waste rock would be mined and scheduled for disposal in the Gold Bug Waste Repository or backfilled in the Queen Rose pit. The nominal slope of the repository would be built at 3H:1V, and drainage benches (25 feet wide) would be placed every 50 vertical feet. Reclamation at the Gold Bug would continue to occur concurrent with mining activities. Section 2.10.4.4 provides more information on the repository reclamation program.

2.10.3.5 Other Features and Facilities

No modifications to the Company Proposed Action are required under this alternative which would affect the Landusky Mine infrastructure and utilities. In fact, the Company Proposed Action would have little change to the currently permitted conditions as described in Section 2.5.3.5. A summary follows.

Access and Haul Roads
A haul road would be constructed in the permitted disturbance area for accessing the South Gold Bug Pit area. Any other access or haul roads would remain or be constructed on existing disturbed areas within the pits. The 2,500 feet of haul road to the King Creek limestone quarry would be widened from 20 to 60 feet, resulting in an additional total disturbance of 5.7 acres.

Power and Water Supply
No changes are proposed in the current power and water supply systems for the Landusky Mine. Electrical power is obtained from the Landusky grid, which is supplied by the Big Flat Power Cooperative through an existing 23 kV line. Potable water is obtained from groundwater wells. Process water is obtained from precipitation and groundwater appropriation.

Sewage Treatment
No changes are proposed from the current septic waste treatment systems. See Section 2.5.3.5, Alternative 1, for additional information.

Chemical Use
No changes are proposed from the current inventory and use of potentially hazardous materials. See Section 2.5.3.5, Alternative 1, for additional information.

Waste Disposal
No changes are proposed from the current disposal methods for solid and/or hazardous wastes. See Section 2.5.3.5, Alternative 1, for additional information.

2.10.3.6 Water Handling and Treatment

As described in Section 2.8.3.6, diversions and capture systems would be constructed to allow capture of mine-impacted waters and prevent deterioration of water quality in non-impacted drainages. Mitigations and modifications incorporated into this alternative would be as described in Alternative 5, Section 2.9.3.6. ZMI would have to meet the requirements of the Water Quality Improvement Plan and implement agency directed corrective measures when water quality criteria are exceeded.

Water Capture and Treatment

The existing seepage capture systems would be sized to handle seepage generated by a 100-year, 24-hour storm event. Seepage capture ponds and sumps would be inspected on a weekly basis for routine maintenance or repairs, if necessary. Water captured from Landusky Mine facilities which is of unacceptable quality would be treated in a new water treatment plant at the Landusky Mine before discharge to surface waters.

Surface Water Runoff Control

Surface water runoff diversions and controls would be sized for a 100-year, 24-hour storm event with one foot of freeboard added as a safety measure. Diversion channels would be trapezoidal or V shaped, lined with geotextile to prevent piping and rip-rapped with durable, non-acid forming rock sized for drainage area requirements. All diversion ditches would have road access for maintenance purposes. Maintenance would consist of removal of sediment load and repositioning of rip-rap as required. Sediment would be disposed of in the waste rock repository. Other features would be as described in Section 2.8.3.6.

No changes from the existing operations (see Section 2.5.3.6) to control surface water runoff control would be implemented for the mine pit, leach pads, or waste rock facilities. (Post-reclamation water handling and discharge would differ significantly, however. See Section 2.10.4.7.)

Land Application Disposal

No emergency land application is anticipated during operations. In the event land application is required, it would be conducted as described in Section 2.5.3.6 for currently permitted operations.

2.10.4 Landusky Mine: Agency Mitigated Reclamation

Modifications to ZMI's proposed reclamation procedures which would reduce infiltration into areas with the potential to cause acidic drainage, remove waste rock dumps and other sources currently causing degradation of surface water or groundwater, and establish a program to implement further corrective measures should reclamation procedures fail. Many of these reclamation modifications were described in detail in Section 2.7.4, for the Agency Mitigated Reclamation for Alternative 3. However, that alternative describes reclamation actions to be taken if ZMI's proposal for mine expansion is not approved. This alternative describes modified reclamation actions that would take place in conjunction with mine expansion. The major reclamation modifications to be incorporated in this alternative include:

- Reclamation Cover C would be modified to include 6 inches of compacted clay (as opposed to 3 inches of compacted clay) between the bottom substrate and the PVC liner. The PVC thickness would be increased to 30 mil. For the purpose of discussion in this and future alternatives, this cover is described as Modified Reclamation Cover C.

- The 91 leach pad dike would be re-reclaimed using Reclamation Covers B and/or C, as appropriate. Other facilities not used as pit backfill would be tested for sulfur content. If greater than 10% of the material contains sulfur in concentrations exceeding 0.2%, the facility would be re-reclaimed using Reclamation Covers B and/or Modified C. Cover soil on the facilities would be removed, stockpiled, and reused.

- With the exception of leach pad dikes, the Gold Bug repository and the Mill Gulch waste rock dump, existing facilities would be reclaimed to a 3H:1V slope, with constructed benches every 200 feet of slope length. In order to achieve the slope reductions while minimizing additional land disturbance, some material may have to be off-loaded from existing facilities.

- In order to classify as "Non-Acid Generating" and be used without restriction in construction and reclamation, waste rock or other material:

  1) Cannot be composed of igneous breccia, felsic gneiss, monzonite, quartzite, or trachyte lithologies;

  2) Amphibolite, mafic gneiss, shale, dolomite, or limestone must have a total sulfur content less than 0.8%, and a paste pH of 6.0 or greater;

  3) If syenite, must have a total sulfur content less than or equal to 0.2%, a paste pH of 6.5 or greater, <u>and</u> a NNP greater than or equal to 0 with an NP:AP ratio greater than or equal to 1;

  4) Must meet the criteria above as demonstrated by sampling and analyzing lithologies from every blasthole providing non-acid generating material.

- Material used for capillary breaks may be obtained from an area limestone source or non-acid generating waste rock.

- Highwall runoff would be diverted from the mine pits into Montana Gulch and treated if necessary.

- Removal of the 85/86 leach pad from Montana Gulch and part of the Montana Gulch waste rock dump, and placement of this material in the pit as backfill.

- Backfill the pits to a minimum elevation of 4,900 ft (at the midpoint of the drainage ditch) to create a surface which will freely drain into Montana Gulch. Approximately 13 million tons of backfill would be required to reach this level.

- Prevent runoff from the Queen Rose/Suprise and August/Little Ben pit areas from flowing into the August tunnel by constructing a drainage notch between the August/Little Ben pit and Montana Gulch, and directing surface water to Montana Gulch immediately below the waste rock dump.

- Reclamation viability, as described in Section 2.10.5, would be monitored by ZMI until the agencies have approved final closure and released the mine reclamation bond.

- The reclamation requirements of this EIS and the Water Quality Improvement Plan (see Appendix A) would be used as a basis for determining reclamation success and directing any further corrective measures.

- At the end of mine life, a comprehensive Environmental Site Assessment would be carried out that covers the entire Zortman mine permit area. This site assessment would include inspection of all locations where hazardous materials were stored and used and would identify evidence of spills or accidental releases that may have contaminated soil and groundwater. This site assessment would include soil and groundwater sampling should evidence of contamination be identified.

- At the end of mine life, a comprehensive Environmental Site Assessment would be carried out that covers the entire Landusky mine permit area. This site assessment would include inspection of all locations where hazardous materials were stored and used and would identify evidence of spills or accidental releases that may have contaminated soil and groundwater. This site assessment would include soil and groundwater sampling should evidence of contamination be identified.

Final reclamation of all facilities is anticipated to occur within 3 years after the 87/91 leach pad has been detoxified and liner perforated. Reclamation of individual facilities is contingent upon a number of economic and operational factors, and scheduling variations within the overall timeframe could occur. Reclamation activities are submitted to the DEQ on an annual basis and reflect the most recent operating and reclamation schedule.

The following sections summarize the specific reclamation plans and actions proposed by ZMI for each of the major disturbance areas, and provide a description of prescribed modifications to the reclamation procedures under this alternative.

2.10.4.1 Reclamation Materials

Reclamation materials would be required for construction and installation of reclamation caps, and for use in construction of drains and solution diversions. The primary materials to be used in reclamation covers would include non-acid forming waste rock and limestone, clays and cover soil. These materials and their sources were described in Section 2.8.4.1. The following sections summarize the uses for the reclamation materials and modifications from the Company Proposed Action.

Non-Acid Forming Material

Section 2.9.4.1 summarized the uses and availability of non-acid forming materials at the Landusky Mine. Some of this material could come from waste rock generated at the South Gold Bug pit. Approximately 38 million tons of waste rock are now contained within dumps at the Landusky Mine, and it is possible some of this material is not acid generating and could be used in reclamation covers. However, it is only recently that ZMI has begun segregating waste material at the Landusky Mine based on acid generating potential, and it would likely be very inefficient to attempt to separate out suitable waste rock. In addition, the geochemical requirements for waste to be classified as suitable in capillary break are more stringent than the waste handling and segregation strategy ZMI has used.

Limestone/Dolomite

Dolomite and limestone from outcrops within the mine permit area have recently been used to provide a 3-foot buffering liner across the floor of the 4,640 bench in the Gold Bug waste rock repository. Limestone and dolomite from the mine pits could also be used as capillary break material in the reclamation covers. Section 2.8.4.1 provides a description of the activities to be conducted to quarry limestone from the King Creek quarry location.

Clay

Clay is used as a component layer of the caps which have been placed on the Mill Gulch waste rock dump and 91 leach pad dike. Two six-inch lifts of clay would be used in disturbed areas where Reclamation Cover B is installed, and one six-inch lift of clay would be used in areas capped by Modified Reclamation Cover C. A six-inch layer of clay is also used in Reclamation Cover A, to be placed on some haul road disturbances and pit benches. Clay used in Landusky Mine reclamation comes from the Williams Clay pit located approximately 2 miles west of the town of Landusky. Approximately 1.3 million yards of clay would be used in the reclamation covers.

Cover Soil

Cover soil is used on top of all mine disturbances, either as a final lift on the reclamation caps or as 8-inch layers directly overlying disturbed zones which are determined by testing not to have significant acid generating potential. Cover soil is obtained from one of the four cover soil storage areas listed on Table 2.5-11. Stockpile volumes are also shown on this table.

2.10.4.2 Reclamation Covers

Procedures used to cover disturbed areas would be as described in Section 2.7.4.2. Under this alternative all disturbed areas (with the exceptions noted) are assumed to be acid generating and would be capped using either Reclamation Cover B or Modified Reclamation Cover C, depending on the slope of the disturbance. These reclamation covers are similar to the covers used during reclamation of the Mill Gulch waste rock dump.

The reclamation cover modifications to the Company Proposed Action are also included for this alternative. As described in Section 2.7.4.2, Reclamation Cover C would be modified by increasing the clay layer to a minimum of 6 inches thick. The PVC liner thickness would be increased to 30 mil, and a geofabric would be installed between the cover soil and capillary break. In addition, the "non-acid generating" material used as capillary break must meet the geochemical and lithologic criteria described at the beginning of Section 2.10.4.

The interim covers already constructed on the Mill Gulch and Gold Bug waste rock facilities would remain as permanent reclamation caps., provided that the infiltration performance criteria are met. Additional soil could be added to these covers to achieve water infiltration criteria that the agencies stipulate.

2.10.4.3 Mine Pit Reclamation

The pit reclamation procedures described in the Company Proposed Action (Section 2.8.4.3) are generally those required under this alternative, but some modifications have been developed by the agencies, as follows. The pits are to be backfilled to a minimum elevation of 4,900 feet, measured at the midpoint of the drainage ditch, in order to create a surface which would freely drain into Montana Gulch. This action would also reduce the potential for surface water infiltrating the pit floors to contact sulfide-bearing zones and create acidic drainage.

A drainage cutout would be constructed across the bedrock divide between the August/Little Ben Pit and Montana Gulch, thereby preventing surface water from infiltrating to the August tunnel and redirecting flow to capture ponds by the Montana Gulch waste rock dump (see Section 2.10.4.7). Rock removed during construction of the drainage notch would be backfilled into the August/Little Ben pit. As backfill would proceed to the 4,900 foot level, a notch up to 100 feet deep would be required, with concurrent backfill in the August/Little Ben pit of about 300 feet thick. It is estimated 13 million tons of rock would be backfilled into the pit for this project. Any ore-grade material encountered during excavation of the notch could be transported to the 87/91 leach pad for processing. Approximately 5 million tons of spent ore from the 85/86 leach pad and up to 8 million tons of waste rock from the Montana Gulch dump would also be used as backfill in the pit.

Overall slope of the final pit walls would be required to be approximately 45 degrees (1H:1V) with 30-foot flat benches every 60 vertical feet. Pit floors are to be sloped and graded to facilitate free drainage, as described above. The final pit floor (i.e., the backfilled surface) would be covered with Reclamation Cover B to prevent surface water infiltration. This alternative also requires the placement of Reclamation Cover A on pit benches prior to revegetation (where revegetation is possible), which would include the use of trees to the extent possible to reduce visual impacts.

2.10.4.4 Leach Pad Reclamation

The 87/91 heap leach pad liner system would be perforated after pad detoxification and surface reclamation to eliminate moisture storage and any undesirable hydraulic conditions associated with the reclaimed facility. The liner would not be perforated until monitoring of the heap effluent indicates that water quality compliance has been met and risk of the formation of acid drainage is established to be minimal.

The 85/86 leach pad would be used as backfill in the pit. The other liner perforation requirements described in Section 2.7.4.4 would apply to this alternative.

2.10.4.5 Waste Rock Facilities Reclamation

Most of the Montana Gulch waste rock dump would be removed and used as backfill in the pit. The remaining footprint would be tested and reclaimed with Reclamation Cover A if sulfur concentrations exceed 0.5%. The interim cap placed on the Mill Gulch waste rock dump would remain as a permanent cover. Reclamation Cover C would continue to be used on the Gold Bug waste rock repository. Reclaimed surfaces would be revegetated in accordance with Section 2.8.4.9.

2.10.4.6 Support Facilities Reclamation

Unless otherwise noted in the following sections, reclamation of support facilities would be as described for existing operations and the Company Proposed Action, Sections 2.5.4.6 and 2.8.4.6, or with modifications presented in Alternative 3, Section 2.7.4.6

Solution/Process Pond Reclamation

Reclamation of solution and process ponds would not differ from that described for the existing operations, Section 2.5.4.6.

Soil Stockpile Reclamation

Reclamation requirements for soil stockpiles would be as described in Section 2.7.4.6. Based on the estimated amount available in stockpiles, sufficient cover soil exist at the Landusky Mine to be used in surface reclamation of all facilities.

Access and Haul Road Reclamation

Reclamation requirements for access and haul roads would be as described in Section 2.7.4.6.

Limestone Quarry Reclamation

Up to 3 acres would be disturbed at the King Creek limestone quarry to provide reclamation materials. The ultimate facilities development topography of the limestone quarry would be as described in Section 2.7.4.6.

Williams Clay Pit Reclamation

Additional mining at the Williams Clay Pit would take place to provide clays for all reclamation covers. About 9 acres would be disturbed under this alternative to supply materials for Landusky Mine reclamation covers. New and old disturbances at the clay pit would undergo reclamation as described in Section 2.7.4.6. All areas would be revegetated as described in Section 2.8.4.9, except where modified by Section 2.10.4.9.

Land Application Area

Following completion of all land application operations, the land application area would be reclaimed as described in Section 2.8.4.4.

2.10.4.7 Reclamation/Post-Reclamation Water Handling and Treatment

Final requirements for water discharge from the Landusky Mine, including discharge standards, treatment methods, and water management practices are being developed. Where applicable, these actions and requirements of the Water Quality Improvement Plan supersede the reclamation requirements for water management described in previous regulatory actions for the Landusky Mine. This alternative incorporates the water handling and treatment procedures described in the Company Proposed Action (see Section 2.8.4.7), except where modified as described below.

Water Quality Improvement Plan

The Water Quality Improvement Plan (summarized in Appendix A) was described earlier, in Section 2.10.1.7. This program would continue through mine expansion operations and through reclamation and post-reclamation monitoring. Under this alternative ZMI would have to meet the requirements of the program and implement agency directed corrective measures when reclamation requirements are not met or water quality criteria are exceeded.

Section 2.10.5 contains additional surface reclamation and facilities monitoring requirements to determine overall compliance of Landusky Mine water handling and discharge programs.

Water Capture and Treatment

No changes are proposed for seepage water capture and treatment upon cessation of mining and leaching activities from those implemented during mine operations (see Sections 2.5.4.7 and 2.10.3.6). Water treatment, at a new water treatment plant at the Landusky Mine, would continue until final reclamation is established and water quality is acceptable. As water quality meets discharge standards and the appropriate agencies approve of release of the waters, capture ponds, sumps and pumpbacks would be dismantled and reclaimed.

Mine Pit Runoff Control

Where access allows, portions of the pit walls that are potentially acid forming and cannot be capped would have diversions installed above the highwalls. These diversions would prevent storm water from entering the pit. Diverted highwall runoff would be directed to drain to Montana Gulch, as would any other runoff originating in areas not reclaimed and capped. The diversions would be designed to be maintenance free and pass the peak flow from a 100-year storm event with one foot of freeboard. Highwalls and diversion structures would be visually inspected on a periodic basis and repairs made as necessary.

As described earlier, a drainage cutout would be constructed across the bedrock divide between the August/Little Ben Pit and Montana Gulch, thereby preventing surface water from infiltrating to the August tunnel and redirecting flow to capture ponds below the Montana Gulch waste rock dump (see Section 2.10.4.2). The agencies believe this action could help reduce the potential for problems associated with acidic drainage emanating from beneath the Montana Gulch waste rock dump.

Upon exiting the cutout notch from the pit, runoff would be routed through a channel constructed along the existing haul road route around the Montana Gulch waste rock dump and discharged near the toe of the dump. This water would flow into settling and/or treatment ponds prior to discharging into Montana Gulch. Additional treatment would be conducted as needed to meet discharge criteria established in the Water Quality Improvement plan and/or the facility stormwater discharge permit. The ponds would be located below the waste rock dump and could also serve as treatment and/or settling ponds for the Gold Bug adit discharge. The channel would be sized to handle a 7-inch, 24-hour storm event within the pit drainage basin. The downstream slope of the waste rock dump would be re-graded to create a gentle gradient for discharge into the Gulch. The 85/86 leach pad would be removed and used as backfill in the pit. This action would simplify the surface water control and reduce long-term maintenance of diversions and under-drains.

Leach Pad Runon Control

Diversions would be constructed around the leach pad and laterally across the buttresses, sized for the 100-year, 24-hour storm event.

Waste Rock Repositories Runoff Control

No changes are proposed to the existing drainage control features for the Gold Bug and Mill Gulch waste repositories. The Montana Gulch waste rock dump would probably be entirely removed for backfill; drainage from this area would be directed into Montana Gulch. No changes are proposed to the existing drainage control features for waste rock dumps at the head of King Creek.

2.10.4.8 Reclamation Quality Control

The reclamation quality control procedures and requirements described in Alternative 3, Section 2.7.2.8, would apply to this alternative.

2.10.4.9 Revegetation Procedures

Revegetation procedures would be essentially as described in Section 2.5.4.9. However, no trees would be used in revegetation except on a limited basis for visual impact mitigation. Only grasses, forbs and shrubs would be used to enhance wildlife habitat. Another change is that the agencies would not allow the use of Crested wheatgrass in the reclamation seed mix. Areas disturbed by mining-related operations would be revegetated to stabilize soil and slopes, reestablish communities ecologically comparable to pre-mine conditions, and restore watershed, wildlife, recreational and aesthetic values that meet post-operation land use objectives. Vegetative cover must achieve 90% of that demonstrated in adjacent, natural communities of similar composition and location to be considered acceptable. Stock grazing would be restricted in revegetated areas until the vegetation canopy is 90% or greater of the reference area.

2.10.5 Monitoring Programs and Research Studies

The monitoring programs and research studies outlined in Section 2.8.5 would apply to this alternative, except where the agencies have identified specific additional monitoring programs or requirements. Implementation of a Water Quality Improvement Plan designed to identify degradation of water resources and trigger corrective action to mitigate environmental damage would be expected to expand the basic water quality monitoring program in place at the Zortman and Landusky Mines. A reclamation monitoring program would be instituted to provide ongoing evaluation of surface reclamation viability.

2.10.5.1 Water Resources

The monitoring program for groundwater and surface water would continue as described in Section 2.8.5.1. Some monitoring wells or surface water monitoring sites could be relocated as a result of actions taken to reduce slopes of heap leach facilities and waste rock dumps. All monitoring required by the Water Quality Improvement Plan would be incorporated into this alternative. In addition, ZMI would be required to establish a monitoring program for operation and maintenance of land application disposal areas. This program would be as described for Alternative 5 in Section 2.9.5.1.

2.10.5.2 Reclamation Surface Performance Study

Some expansion of the reclamation surface performance study would result from implementation of this alternative. ZMI would be required to monitor seepage from waste rock facilities on a frequency sufficient to develop long-term hydrographs for each site. The hydrographs would be used to assess and predict how and when seepage responds to high flow seasons or storm events. The hydrographs would also provide a tool for predicting opportunistic sampling events to evaluate changes in seepage quality.

2.10.5.3 Surface Reclamation Monitoring Programs

The agencies would require that ZMI implement a program to monitor long term viability of surface reclamation until such time as the agencies release the Mine Reclamation Bond. This program was described in Section 2.9.5.3.

2.10.5.4 Other Monitoring Programs

No changes are anticipated to the remainder of the monitoring programs from the descriptions provided in Section 2.8.5.

2.10.6 Reasonably Foreseeable Future Actions

2.10.6.1 Mine Activities - Zortman

Proposals for future mine activities would be the same as described under Alternative 4 (Section 2.8.6.1). The Pony Gulch ore deposit is likely to be proposed for mining in the future. Additional limestone resources are also likely to be proposed for mining. Passive water treatment measures would be proposed downgradient of mine facilities.

2.10.6.2 Mine Activities - Landusky

Since Alternatives 4, 5 and 6 are identical with respect to proposed mining at the Landusky Mine, foreseeable activities under this alternative are the same as previously described for Alternative 4 (Section 2.8.6.1). These developments include additional ore extraction from the existing pits and South Gold Bug pit area, generation of a significant amount of waste rock as new ore is mined, construction and operation of a new leach pad in the Queen Rose/Suprise pit or at an alternate site, and the construction and operation of new or expanded water treatment facilities would be foreseeable.

2.10.6.3 Exploration Activities

Proposals for future exploration activities would be the same as described under Alternative 4 (Section 2.8.6.2. The additional 200,000 linear feet of road and trench construction, with 600 drillsites, over a 10-year period could be proposed. Exploration could locate a minable deposit adjacent to the conveyor route.

2.11 ALTERNATIVE 7 (PREFERRED ALTERNATIVE): AGENCY MITIGATED EXPANSION AND RECLAMATION WITH WASTE ROCK REPOSITORY LOCATED ON EXISTING MINE FACILITIES RATHER THAN IN CARTER GULCH

Alternative 7 would allow expansion of both the Zortman and Landusky mines but impose agency-developed mitigations on the expansion and reclamation activities. The major modification to ZMI's expansion plans (see Alternative 4, Section 2.8) would be at the Zortman Mine, where the proposed waste rock repository would be constructed on top of existing facilities at the Mine. Based upon a preliminary design for a waste rock cap and pit contour at the Zortman Mine site (Golder Associates, Inc. 1995), the agencies developed this alternative as a way to reduce the amount of land disturbance associated with expanded mining activities, reduce the potential for impacts to water resources in drainages other than Ruby and Alder Spur, and enhance reclamation opportunities on existing facilities. This alternative could also reduce the amount of reclamation materials by concentrating disturbed areas and using water balance reclamation covers, as opposed to the barrier covers described in the first six alternatives. A significant modification of the Landusky reclamation requirements would be for ZMI to remove rock fill from the head of King Creek and backfill the pits to a minimum elevation required to create a surface which will freely drain into King Creek. Additional sources of backfill, such as the 85/86 leach pad and the Montana Gulch waste rock dump, may also be used to reach the desired Landusky Mine pit floor elevation. Other agency-developed mitigating measures designed to reduce or eliminate environmental impacts are incorporated into this alternative. Figure 2.11-1 shows the existing and proposed facilities at both mines associated with this alternative.

Many of the plans and facility designs for Alternative 7 are similar to or the same as those described in Alternative 4, and are hereby incorporated into this alternative. Therefore, the description of expansion and reclamation facilities is tiered to the discussion presented in Section 2.8. The focus of discussion for this alternative is on those areas which would be modified from the Company Proposed Action. The proposed mine expansions and facilities modifications are presented in Sections 2.11.1 (Zortman Mine) and 2.11.3 (Landusky Mine), followed by the proposed reclamation activities for each mine as described in Sections 2.11.2 and 2.11.4. Modifications to ZMI's proposed monitoring programs and research studies are described in Section 2.11.5. Section 2.11.6 contains an assessment of other activities which are reasonably foreseeable should Alternative 7 be implemented.

2.11.1 Zortman Mine: Agency Mitigated Expansion

The location and currently permitted area of the Zortman Mine and the proposed Mine expansion with development of the waste rock repository on existing facilities are shown on Figure 2.11-1. The total new disturbance for the Zortman expansion would be approximately 1,170 acres ultimate disturbance, including buffer zones around disturbance and 405 acres previously disturbed under existing permit.

Under this alternative ZMI would continue to use open-pit mining and heap-leach mineral processing to extract gold and silver from ore, as described in Section 2.8.1. The major operational modifications from the Proposed Action include:

- The waste rock repository would be constructed mostly on existing facilities around the Zortman pit complex, rather than in Carter Gulch.

- All mine expansion and reclamation activities would be conducted in accordance with the Water Quality Improvement Plan (see Appendix A).

- All mine expansion and reclamation activities would be conducted in accordance with the signed Memorandum of Agreement developed under Section 106 of the National Historic Preservation Act (see Appendix E).

- Performance of an Environmental Audit on an annual basis would be carried out to assure that spill containment systems work properly, that leak detection systems are in proper working order, and that spill prevention and response planning can be

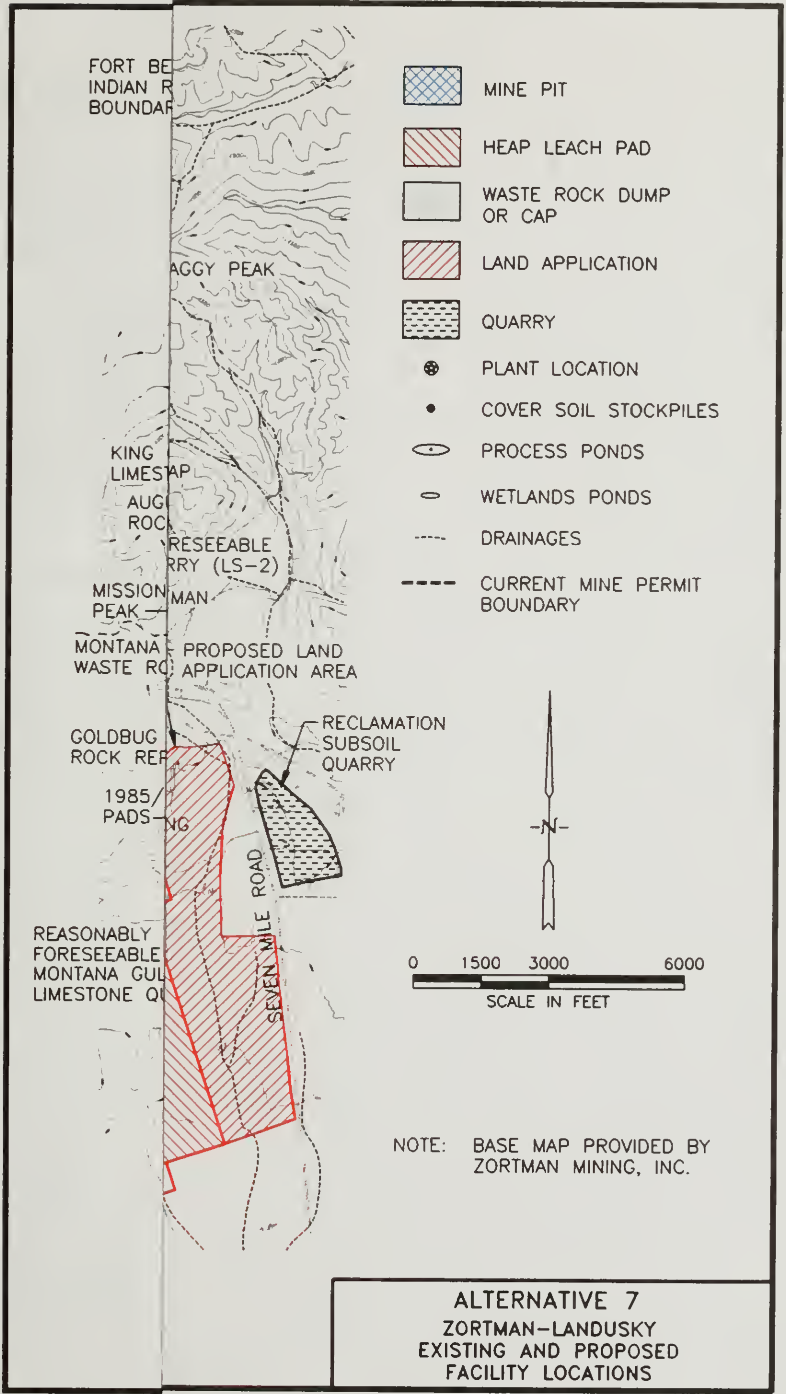

FIG. 2.11-1

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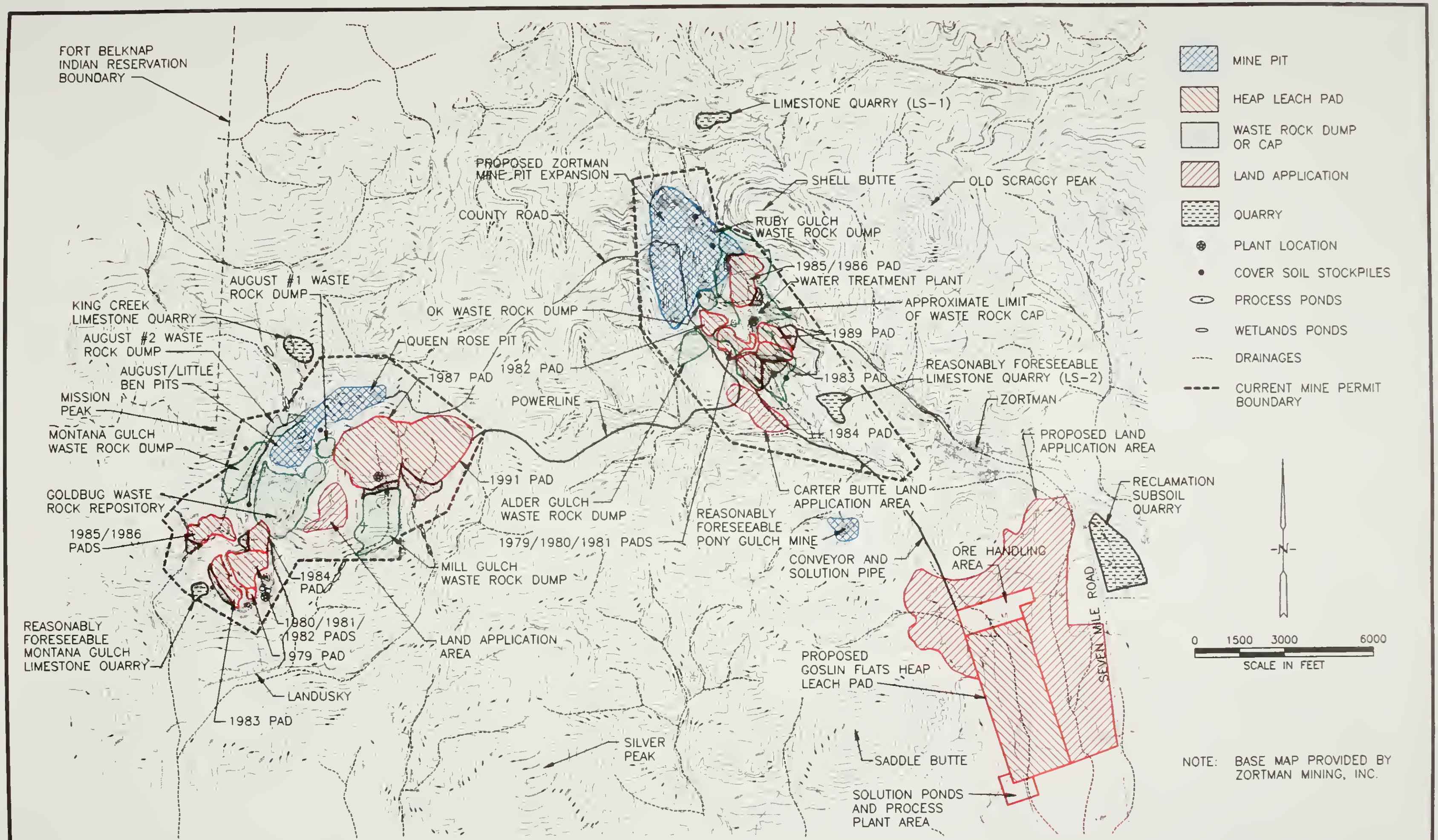

ALTERNATIVE 7: MAJOR NEW FACILITIES INCLUDE THE GOSLIN FLATS HEAP LEACH PAD, THE WASTE ROCK CAP, AND THE ZORTMAN MINE PIT EXPANSION

ALTERNATIVE 7
ZORTMAN-LANDUSKY
EXISTING AND PROPOSED
FACILITY LOCATIONS

ZLF-ALT7

FIG. 2.11-1

realistically implemented through review of company training programs and inspection of emergency response equipment.

- An alternate water source for bats (or other wildlife) would be constructed in Goslin Flats between Azure Cave and the leach pad site to mitigate potential loss of wildlife drinking water on Goslin Flats.

Ore production would be approximately 60,000 to 80,000 tons per day, with mining and leaching operations performed on a year-round basis. Mining and related operations would take place 7 days a week, 24 hours per day, 350 days per year. ZMI projects that the Company Proposed Action work force would be similar to current operations, with approximately 260-280 full-time employees, depending on seasonal requirements. The agencies' modifications to the mine expansion should not substantively change the rate of operations or the work force.

2.11.1.1 Mine Pit Expansion

Mine pit expansion would not change from that described in Section 2.8.1.1. The edges of the pit would be extended outward 600 or more feet from the current pit configuration. The pit would be deepened approximately 500 feet in some ore zones, to a lowest point of about 4,500 feet. A plan view of the pit complex was shown on Figure 2.8-3, with pit cross-sections displayed in Figures 2.8-4 and 2.8-5.

The sequencing of ore extraction from the pits would change, however. Pit mining would be staged to allow approximately equal portions of oxide and non-oxide ores to be placed on the Goslin Flats leach pad. Non-oxide waste rock would be placed immediately in completed pits, while oxide waste rock could be used in reclamation covers or stockpiled for reclamation use.

The mine pit footprint would encompass a portion of the 85/86 leach pad area. As described in Section 2.11.2, this leach pad and dike would be removed after detoxification is complete and placed in the mine pits as backfill or releached on the Goslin Flats leach pad.

Mining Methods

The mining description provided in Section 2.8.1.1 is generally applicable to this alternative.

Rock Characterization

The materials and their relative amounts to be mined during expanded operations at the Zortman Mine were described in Section 2.8.1.1. The geochemical sampling and waste rock characterization program proposed by ZMI, and described in Section 2.8.1.1, would be implemented under this alternative. (The agencies have added mitigations restricting the use of certain waste rock types in reclamation, as described in Section 2.11.2).

Waste Rock Handling

Waste rock would generally be handled according to its potential to create acid. Waste rock known to be acid generating would be placed in the center of the finished mine pits as backfill. As described in Section 2.11.2.3, the mine pit complex would have a bottom layer of non-acid generating, acid-buffering material, and be capped to reduce infiltration and contact with the waste rock. Non-acid forming waste rock would be stockpiled for use in reclamation or used immediately as cover and encapsulation material on existing facilities needing reclamation, such as leach pads.

Waste rock would be segregated on the basis of total sulfur content, as shown in Table 2.8-4 of Alternative 4. However, waste rock or other material used in construction and as a capillary break in reclamation covers must meet the geochemical and lithologic criteria described in Section 2.11.2.

2.11.1.2 Crushing Operation

The basic process employed under this alternative for ore crushing would not change from that described in Section 2.8.1.2.

2.11.1.3 Conveyor System

The design and sizing of the overland conveyor system would not change for this alternative. Details concerning the conveyor design, construction, and operation are provided in Section 2.8.1.3.

2.11.1.4 Goslin Flats Heap Leach Pad

The heap leaching facility would not change significantly from that described in Alternative 4. Section 2.8.1.4 describes the leach pad construction and operation, solution management, operation of the processing plant, and handling of reagents. Figures 2.8-7 and 2.8-8 illustrate the heap leach pad design from plan and cross-sectional views, respectively.

In addition, agency modifications to leach pad construction described in Alternative 6, Section 2.10.1.4

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realistically implemented through review of company training programs and inspection of emergency response equipment.

- An alternate water source for bats (or other wildlife) would be constructed in Goslin Flats between Azure Cave and the leach pad site to mitigate potential loss of wildlife drinking water on Goslin Flats.

Ore production would be approximately 60,000 to 80,000 tons per day, with mining and leaching operations performed on a year-round basis. Mining and related operations would take place 7 days a week, 24 hours per day, 350 days per year. ZMI projects that the Company Proposed Action work force would be similar to current operations, with approximately 260-280 full-time employees, depending on seasonal requirements. The agencies' modifications to the mine expansion should not substantively change the rate of operations or the work force.

2.11.1.1 Mine Pit Expansion

Mine pit expansion would not change from that described in Section 2.8.1.1. The edges of the pit would be extended outward 600 or more feet from the current pit configuration. The pit would be deepened approximately 500 feet in some ore zones, to a lowest point of about 4,500 feet. A plan view of the pit complex was shown on Figure 2.8-3, with pit cross-sections displayed in Figures 2.8-4 and 2.8-5.

The sequencing of ore extraction from the pits would change, however. Pit mining would be staged to allow approximately equal portions of oxide and non-oxide ores to be placed on the Goslin Flats leach pad. Non-oxide waste rock would be placed immediately in completed pits, while oxide waste rock could be used in reclamation covers or stockpiled for reclamation use.

The mine pit footprint would encompass a portion of the 85/86 leach pad area. As described in Section 2.11.2, this leach pad and dike would be removed after detoxification is complete and placed in the mine pits as backfill or releached on the Goslin Flats leach pad.

Mining Methods

The mining description provided in Section 2.8.1.1 is generally applicable to this alternative.

Rock Characterization

The materials and their relative amounts to be mined during expanded operations at the Zortman Mine were described in Section 2.8.1.1. The geochemical sampling and waste rock characterization program proposed by ZMI, and described in Section 2.8.1.1, would be implemented under this alternative. (The agencies have added mitigations restricting the use of certain waste rock types in reclamation, as described in Section 2.11.2).

Waste Rock Handling

Waste rock would generally be handled according to its potential to create acid. Waste rock known to be acid generating would be placed in the center of the finished mine pits as backfill. As described in Section 2.11.2.3, the mine pit complex would have a bottom layer of non-acid generating, acid-buffering material, and be capped to reduce infiltration and contact with the waste rock. Non-acid forming waste rock would be stockpiled for use in reclamation or used immediately as cover and encapsulation material on existing facilities needing reclamation, such as leach pads.

Waste rock would be segregated on the basis of total sulfur content, as shown in Table 2.8-4 of Alternative 4. However, waste rock or other material used in construction and as a capillary break in reclamation covers must meet the geochemical and lithologic criteria described in Section 2.11.2.

2.11.1.2 Crushing Operation

The basic process employed under this alternative for ore crushing would not change from that described in Section 2.8.1.2.

2.11.1.3 Conveyor System

The design and sizing of the overland conveyor system would not change for this alternative. Details concerning the conveyor design, construction, and operation are provided in Section 2.8.1.3.

2.11.1.4 Goslin Flats Heap Leach Pad

The heap leaching facility would not change significantly from that described in Alternative 4. Section 2.8.1.4 describes the leach pad construction and operation, solution management, operation of the processing plant, and handling of reagents. Figures 2.8-7 and 2.8-8 illustrate the heap leach pad design from plan and cross-sectional views, respectively.

In addition, agency modifications to leach pad construction described in Alternative 6, Section 2.10.1.4

would apply. In summary, these modifications preclude the unrestricted use of Thermopolis Shale in construction or reclamation activities, and require that filter drains would have to be constructed using native calcareous subsoil or unmineralized carbonates. The agencies' quality control procedures for leach pad construction, also described in Section 2.10.1.4, are incorporated into this alternative as well.

Another mitigation is incorporated into this alternative. It is believed that bats resident to Azure Cave use the stock ponds located at Goslin Flats. These ponds would be displaced by construction of the Goslin Flats leach pad. Because of the loss of use of these ponds, and to keep bats from attempting to use the process solution ponds, ZMI would be required to construct a new freshwater pond closer to the cave in upper Goslin Flats.

2.11.1.5 Waste Rock Repository and Facility Cap

The waste rock repository would be constructed on top of existing facilities at the Zortman Mine site. Use of this area and the pit complex for waste rock storage would serve two principle purposes. First, disturbance for waste rock storage would largely be limited to areas and facilities already disturbed by mining activities. Second, the waste rock repository would serve a dual role as a cap on top of existing facilities which require re-reclamation or better cover from surface water infiltration.

Approximately 250 acres would be necessary for pit recontouring and construction of the waste rock cap. The waste rock cap would be designed to contain a maximum of 60 million tons of waste rock, the amount anticipated to be generated during expanded mining activities. However, about 20 million tons of this waste rock would be backfilled into the pit complex.

Prior to construction of the new waste rock repository, ZMI would remove all of the waste rock, approximately 3.4 million tons, from the existing Alder Gulch waste rock dump. The existing material in Alder Gulch is seeping poor quality water from the toe of the dump, and removal of the material would reduce impacts to the drainage. This material would be relocated to the leach pad at Goslin Flats for processing as ore.

Repository Construction

A preliminary configuration for the waste rock repository and cap is shown on Figure 2.11-2. The waste rock cap would be placed in 25-foot lifts and constructed with a 3H:1V overall slope, with 15-foot wide benches every 50 vertical feet. Benches would be backsloped and drain toward common surface water diversion ditches built along the edges of the facility.

The toe of the waste rock repository would extend from the Alder Spur drainage elevation, about 4,420 feet above mean sea level, to a maximum elevation of 5,220 feet east of the mine pit. The toe of the waste rock repository in the Ruby Gulch drainage would be located at an approximate elevation of 4,500 feet above mean sea level.

The waste rock repository would be constructed over existing facilities at the Zortman Mine which may not have been designed to hold large quantities of additional overburden (the waste rock cap thickness would extend up to 370 feet in the area of the backfilled Ross Pit). To minimize settlement, the waste cap would be placed in lifts ranging in thickness from 5 to 25 feet. In areas where differential settlement may occur, such as between existing heaps, waste rock would be placed in 5 foot lifts.

2.11.1.6 Other Features and Facilities

Office/Laboratory Facilities

This alternative would not change the locations or functions of ZMI's office and laboratory facilities. The laboratory and office functions would continue as described in Section 2.5.1.5.

Access and Haul Roads

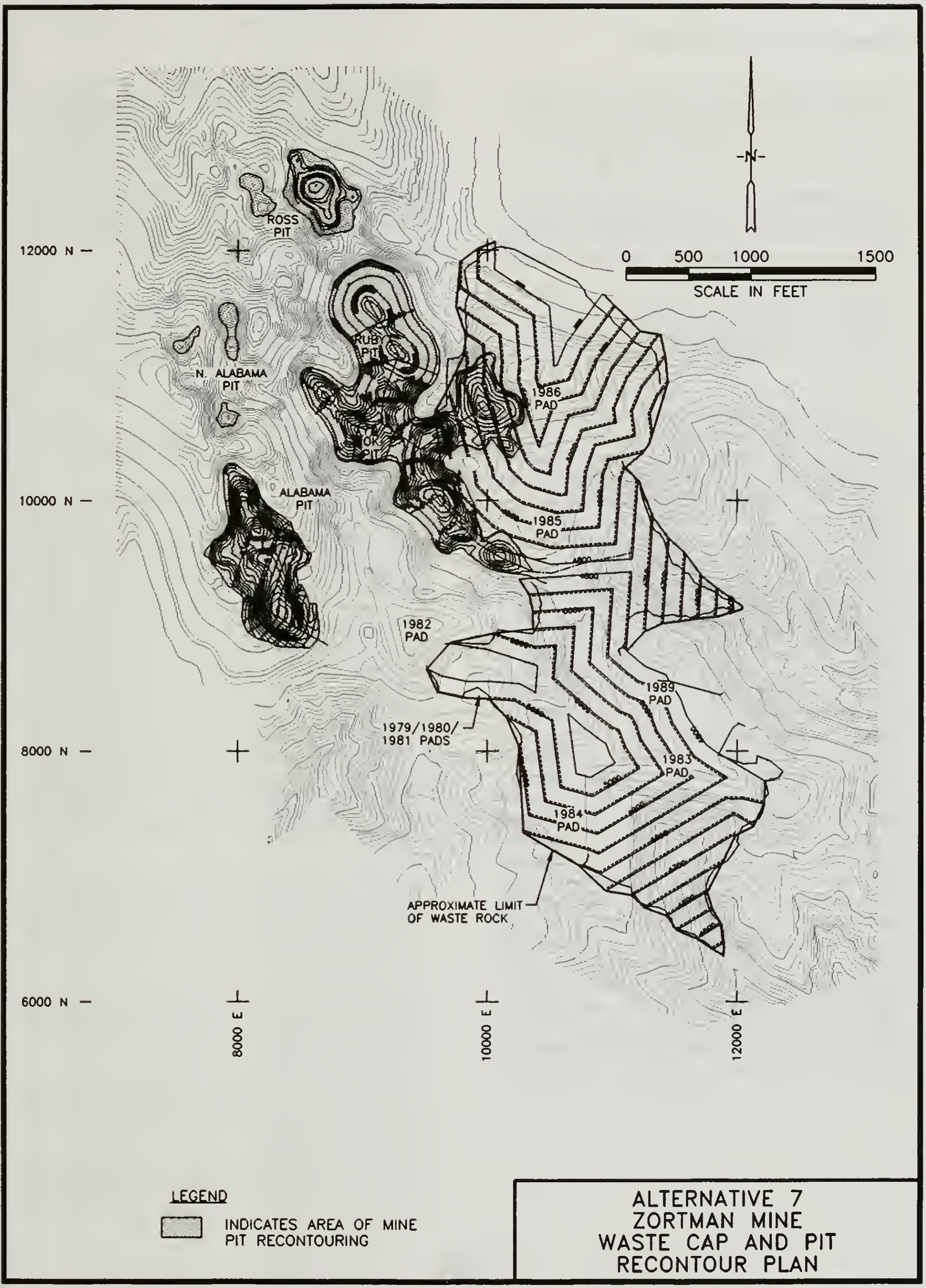
The road network described in Section 2.8.1.6 would be developed under this alternative as well. All haul roads would be constructed on the daylight edge of the pit, which is the lowest area on the pit perimeter, and on the margins of the waste rock cap within the repository on disturbed ground. Haul roads would be left on the margin of the waste rock cap after installation of the final reclamation cover, to facilitate reclamation and closure monitoring.

Power and Water Supply

Power requirements and water supplies for this alternative do not differ from that proposed in Alternative 4, as described in Section 2.8.1.6.

Septic Treatment

No change from existing operations is anticipated for disposal of human waste, as described in Section 2.5.1.6.



ALTERNATIVE 7
ZORTMAN MINE
WASTE CAP AND PIT
RECONTOUR PLAN

FIG. 2.11–2

Chemical Use

Chemicals used for ore processing and other mine activities under this alternative would be essentially the same as described in Alternative 4, Section 2.8.1.6.

Waste Disposal

The types and amounts of solid waste generated under this alternative would be as described for the Company Proposed Action in Section 2.8.1.6. Methods of disposal would also remain the same.

2.11.1.7 Water Handling and Treatment

Water handling, capture, and treatment systems would be sized for 100-year, 24-hour storm events as described in the Company Proposed Action (Section 2.8.1.7), but under this alternative ZMI would be required to capture and treat seepage and degraded waters according to the Water Quality Improvement Plan (see Appendix A), and to meet the reclamation requirements described in 2.9.2. ZMI would have to meet the requirements of the compliance plan and implement agency directed corrective measures when water quality criteria (interim BAT Standards or final MPDES effluent limits) are exceeded. Additional requirements and elements of the water handling and treatment program for this alternative would be as developed for Alternative 5, Section 2.9.1.7, or as described in the following sections.

Water Capture and Treatment

As with other agency-mitigated alternatives, all seepage water capture systems would be resized to handle flow from the 100-year, 24-hour event. New or upgraded capture ponds, groundwater cutoff walls or interception trenches, or interceptor wells would be necessary downstream of the new mine facilities in Alder Spur, Ruby Gulch, and Goslin Flats. These facilities would have to be designed in accordance with requirements set forth in the Water Quality Improvement Plan. The water treatment plant would have to be relocated because the new waste rock repository would encompass the area presently occupied by the plant. This facility would be relocated to Ruby Gulch, adjacent to the capture ponds. All captured seepage water would be pumped to the water treatment plant for treatment and released into Ruby Gulch.

Surface Water Runoff Control

With the exception of the surface water diversion and runoff systems constructed around the mine pits and waste rock repository, all surface water control features described in Section 2.8.1.7 and modified in Section 2.9.1.7 would apply to this alternative. Prior to construction of the waste rock repository and recontouring of the mine pits, ZMI would be required to submit for agency review and approval a site-specific drainage control plan.

Land Application Disposal (LAD) Area

LAD for neutralized process solutions would take place as described in Section 2.8.1.7 for the Company Proposed Action.

2.11.2 Zortman Mine: Agency Mitigated Reclamation

The agencies have developed modifications to ZMI's proposed reclamation procedures which would: 1) reduce infiltration into areas with the potential to cause acidic drainage, 2) remove waste rock dumps and other sources currently causing degradation of surface water or groundwater, and 3) implement the Water Quality Improvement Plan to further mitigate effects of ARD should reclamation procedures fail to adequately protect water resources. Many of these reclamation modifications were described in detail in Section 2.7.2, for the Agency Mitigated Reclamation for Alternative 3. However, that alternative describes reclamation actions to be taken if ZMI's proposal for mine expansion is not approved. This alternative describes modified reclamation actions that would take place in conjunction with the mine expansion. The major reclamation modifications to be incorporated in this alternative include:

- Water-balance reclamation covers would be used on the new waste rock repository, the new Goslin Flats leach pad, the 82 leach pad, and any other existing reclaimed or unreclaimed facilities.

- The performance criterion for the reclamation covers would be to limit infiltration to not more than 5% of precipitation.

- To the extent possible, cover soil on existing facilities to be re-reclaimed would be removed, stockpiled, and reused.

- With the exception of leach pad dikes, existing facilities would be reclaimed to a 3H:1V slope, with constructed benches for erosion control every 50 vertical feet. In order to achieve the slope reductions while minimizing additional land disturbance, some material may have to be off-loaded from existing facilities.

- In order to classify as "Non-Acid Generating" and be used without restriction in construction and reclamation, waste rock or other material:

  1) Cannot be composed of igneous breccia, felsic gneiss, monzonite, quartzite, or trachyte lithologies;

  2) Amphibolite, mafic gneiss, shale, dolomite or limestone must have a total sulfur content less than 0.8%, and a paste pH of 6. or greater;

  3) If syenite, must have a total sulfur content less than or equal to 0.2%, a paste pH of 6.5 or greater, <u>and</u> a NNP greater than or equal to 0 with an NP:AP ratio greater than or equal to 1;

  4) Must meet the criteria above as demonstrated by sampling and analyzing lithologies from every blasthole providing non-acid generating material.

- Material used for capillary breaks may be obtained from an area limestone source or non-acid generating waste rock.

- After detoxification, portions of the 85/86 leach pad and dike would be removed to allow surface runoff to freely drain to Ruby Gulch. This material would be placed in the Goslin Flats leach pad or used as pit backfill. The footprint would become part of the new waste rock repository.

- The OK waste rock dump would be removed and used to backfill the pit complex. Cover soil would be re-salvaged and the waste rock footprint reclaimed.

- The tailing in Ruby Gulch above the town of Zortman would be removed from the drainage and placed in the pit complex or used as reclamation or construction material. The drainage would be restored as mitigation for existing disturbance to waters of the United States by other Zortman and Landusky mines facilities.

- The sulfide storage area would also be removed and placed on the Goslin Flats leach pad for ore processing.

- The back-filled pits would be graded so that runoff drains freely, without impoundment in the pit, into the Ruby Gulch drainage.

- A borrow pit would be developed on Ruby Flats, if needed, to provide subsoil for use in construction and reclamation activities, and to stockpile reclamation materials removed from Goslin Flats during leach pad construction.

- Reclamation viability, as described in Section 2.11.5 and other sections of this alternative, would be monitored by ZMI until the agencies have approved final closure and released the mine reclamation bond.

- The reclamation requirements of this EIS and the Water Quality Improvement Plan requirements (see Appendix A) would be used as a basis for determining reclamation success and directing any further corrective measures.

- At the end of mine life, a comprehensive Environmental Site Assessment would be carried out that covers the entire Zortman mine permit area. This site assessment would include inspection of all locations where hazardous materials were stored and used and would identify evidence of spills or accidental releases that may have contaminated soil and groundwater. This site assessment would include soil and groundwater sampling should evidence of contamination be identified.

Reclamation of all facilities is anticipated to occur within 3 years after the Goslin Flats heap leach pad has been detoxified and liner perforated. Reclamation of individual facilities is contingent upon a number of economic and operational factors, and scheduling variations within the overall timeframe could occur. Reclamation activities are submitted to the DEQ on an annual basis and reflect the most recent operating and reclamation schedule.

The following sections summarize the specific reclamation plans and actions proposed by ZMI for each of the major disturbance areas and provide a description of prescribed modifications to the reclamation procedures under this alternative.

2.11.2.1 Reclamation Materials

Reclamation materials would be required for construction and installation of reclamation caps and for use in construction of drains and diversions. The primary materials to be used in reclamation covers would include non-acid forming waste rock, limestone, and cover soil. These materials and their sources were described in Section 2.8.2.1. In addition, the water balance covers required under this alternative incorporate the use of geosynthetic clay liner (known as "GCL") on all reclamation slopes less than or equal to 25% (a 4H:1V slope). The following summarizes the use of reclamation materials and emphasizes modifications from the Company Proposed Action.

Non-Acid Forming Material

The reclamation covers used in this alternative require a capillary break of at least 24 inches, to be composed of a suitable non-acid generating waste rock or limestone.

Under this alternative the waste rock must meet the geochemical and lithologic criteria described in the beginning of Section 2.11.2 to be suitable for construction purposes and reclamation covers. It is likely that sufficient waste rock of suitable quality would be available from new mining for reclamation covers and construction, so that limestone would not be required as a capillary break material.

Limestone

If there is insufficient non-acid generating waste rock available for reclamation covers, limestone would provide a suitable supplemental material. Limestone would be mined from LS-1, south of Green Mountain (see Figure 2.5-2). Mining and haul road development to this source would occur as described in Section 2.7.2.1.

Cover Soil

Cover soil at the Zortman Mine is obtained from one of four stockpiles shown on Table 2.5-5. These stockpiles would probably have insufficient supplies to adequately cover all disturbances to the extent required under this alternative.

Additional cover soil would be generated during construction of the Goslin Flats heap leach pad, but these sources still may provide insufficient quantities for the required reclamation work. If so, a new subsoil borrow pit would be developed at the Ruby Flats. Ruby Flats would also serve as a stockpile storage area for materials salvaged during construction of the Goslin Flats leach pad.

Another source of cover soil is the material salvaged during re-reclamation activities on facilities which have already been cover soiled and revegetated.

Geosynthetic Clay Liner (GCL)

A GCL is essentially a combination of a thin bentonite clay layer sandwiched between two woven, synthetic layers called geotextiles. The bentonite provides a seal between the geotextiles. When the bentonite is exposed to moisture it swells, providing added protection against leaks or cracks. Most slopes in the Alternative 7 configuration would probably be greater than 25%; hence, the need for GCL would be limited.

Clay

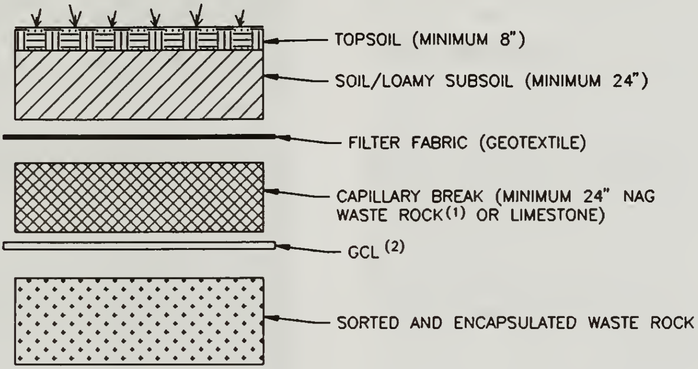
As described in the Company Proposed Action (Alternative 4) clay would be used for leach pad liner construction. However, clay would not be used in the water balance reclamation covers.

2.11.2.2 Reclamation Covers

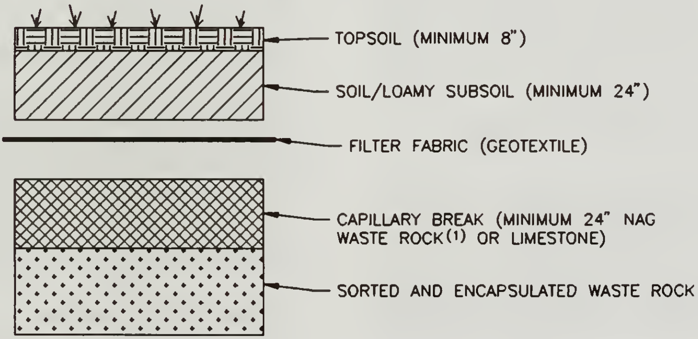
Procedures used to cover disturbed areas would be significantly different from those presented in earlier alternatives. This alternative would require the use of water balance reclamation covers to be installed on all disturbances (with the exceptions noted such as haul roads and building-type facilities). Water balance reclamation covers differ significantly from water barrier reclamation covers (such as Reclamation Covers A, B, or C). Water barrier covers limit the downward migration of water into the waste zone by using low permeability materials such as compacted clay, geotextiles, or synthetics like PVC. Water balance covers are designed to limit the amount of moisture reaching the waste zone by maximizing evapotranspiration. Any residual water in the capillary break would drain laterally to collection sumps.

As shown on Figure 2.11-3, one of two reclamation covers would be installed, depending on the slope of the facility to be covered. On the tops of reclaimed facilities and pit benches, where slopes would be less than 25%, a GCL would be placed on top of the waste material. The GCL would be covered by at least 24 inches of capillary break using non-acid generating waste rock or limestone.

Slopes steeper than 25 percent would not need a GCL because steeper slopes have a higher level of runoff and less surface water infiltration. A filter fabric would be



RECLAMATION COVER FOR SLOPES ≤ 25 PERCENT
SCALE 1"=4'



RECLAMATION COVER FOR SLOPES > 25 PERCENT
SCALE 1"=4'

NOTES:

1. NAG – NON ACID GENERATING MATERIAL WITH TOTAL SULFUR CONTENT <2% AND PASTE PH ≥7.
2. GCL – GEOSYNTHETIC CLAY LINER.

ALTERNATIVE 7
WATER BALANCE RECLAMATION COVERS
FOR ZORTMAN–LANDUSKY MINES

173E0023

FIG. 2.11–3

placed on top of the capillary break to limit downward migration of fine grained particles which could clog the capillary break drainage capacity. At least 2 feet of soil to loamy subsoil would be placed on top of the filter fabric, followed by a minimum of 8 inches of cover soil. The cover would then be revegetated.

The other modification to reclamation covers is in the definition of "non-acid generating" material. The criteria for material to be suitable for use in capillary break were described at the beginning of Section 2.11.2. Certain rock types would be excluded from use and those not excluded must demonstrate a sufficiently high Paste pH, sufficiently low sulfur content, and appropriate neutralization potential. All waste rock considered for use as non-acid generating material must come from blastholes which have been characterized according to these criteria.

Haul roads would not be capped by the reclamation covers described above. The haul roads would be tested, on 100 foot centers, to determine the potential for the subsurface to generate acid conditions. This determination would be based only on sulfur concentrations. Haul road concentrations with sulfur in excess of 0.5 percent would be covered with 3.5 feet of non-acid generating material overlain by 12 inches of cover soil. Haul road disturbances with lower sulfur concentrations would be covered only with 8 inches of cover soil.

2.11.2.3 Mine Pit Reclamation

Mine pit reclamation would occur generally as described in Section 2.8.2.3, with some modification concerning the source of pit backfill materials and sequencing of the reclamation. Pits within the complex which were mined out would be backfilled first, using waste rock from the active pits. Twenty-five foot thick lifts of waste rock would be placed and compacted using haul equipment.

Additional waste material from other sources would be used to supplement the level of backfill. Approximately 9 million tons of spent ore and tailing from the 85/86 leach pad and dike, and Ruby Gulch drainage, would be placed in the pit complex as backfill. This material in conjunction with that generated by mining activities should raise the pit floor to an elevation necessary to freely drain the pit and prevent surface water from ponding and infiltrating through the pit floor. In addition, the pit floor should be graded at greater than 25% to facilitate free drainage and minimize the area requiring a GCL in the reclamation cover.

Overall slope of the pit walls would be approximately 45 degrees (1H:1V) with 30-foot wide (flat) safety benches positioned every 60 vertical feet. Retreat reclamation would be used for pit benches. Instead of Reclamation Cover A, the cover on these areas would include 3.5 feet of non-acid generating material overlain by 12 inches of cover soil. Pit walls would be tested for acid generating potential by use of total sulfur analysis. In accordance with the Montana Metal Mine Reclamation Act, pit walls which have the potential to generate acid must be covered with at least two feet of non-acid generating material.

ZMI would be required to conduct a study, after mine closure and pit reclamation, of the potential for use of pit highwalls as peregrine falcon hack sites. This study would be coordinated with BLM, DEQ, and the appropriate state and federal fish and wildlife agencies.

Surface water diversions would be installed to preclude runoff from contacting those portions of the pit walls that are potentially acid forming and which are too steep to be capped. The final pit floor would be capped using the water balance covers described above. The final cover would be revegetated with native grasses and forbs.

2.11.2.4 Leach Pad Reclamation

Tasks associated with the reclamation of the heap leach facilities include heap detoxification, surface reclamation including slope reduction, reclamation cover placement, cover soiling and revegetation, and liner perforation. These steps have been described in detail previously. The following sections summarize the heap leach pad reclamation process from Section 2.8.2.4, including modifications required under this alternative.

Existing Heap Leach Pads

Portions of the 85/86 heap leach pad and dike necessary to achieve a free draining surface would be removed and placed as backfill into the Zortman pit complex. Portions of this area would be incorporated into the expanded pit; the remainder would be capped with waste rock generated during mining activities. As described earlier, the waste rock would in turn be capped using the water balance reclamation cover.

The appropriate water balance cover would be placed on top of those remaining leach pad disturbances which would not be capped by the waste rock repository. Generally, the leach pad areas not scheduled for cover by the waste rock repository include the 82 pad, and portions of the 79/80/81, and 84 pads (see Figure

2.11-2). Leach pad slopes would be reduced to 3H:1V, with benches every 50 vertical feet, to further limit surface water infiltration, stabilize cover soil, and enhance the potential for successful revegetation. Leach pad dikes would be reduced to a slope sufficient to allow placement and retention of the water balance reclamation cover.

Heap Detoxification

The heap detoxification process for this alternative would be as described in Section 2.5.2.4. In summary, the spent ore on the leach pad would be rinsed repeatedly with cyanide-free water to enhance degradation of cyanide compounds left in the heap. Heap detoxification is discontinued when the solutions returning from the heap maintain less than 0.22 mg/l cyanide (measured as Weak Acid Dissociable or WAD cyanide) for a six month period which includes a spring, high-flow surface runoff event. Heap solutions remaining after detoxification would be pumped to a containment pond for neutralization and later land application disposal.

Surface Reclamation - Goslin Flats Leach Pad

The reclamation criterion for pad slopes under this alternative is 3H:1V, if topography allows, but no steeper than 2.5H:1V. Constructed benches must be placed every 50 vertical feet. Slope reduction would be performed by track mounted bulldozers pushing ore heap material from the facility crest or top down over the lift slopes, using cut and fill material from each of the heap benches to obtain the desired slope. Leach pad crests, top and slopes would be capped with the appropriate water balance reclamation cover.

Other reclamation for heap retaining dikes and revegetation of leach pad surface would be as described in Section 2.10.2.4.

Liner Perforation

The heap leach pad perforation requirements would generally be as described in Section 2.7.2.4. However, the agencies also modify the liner perforation procedures by requiring that perforation be reversible in case leach pad drainage deteriorates to an unacceptable level after detoxification has been certified. Liner perforation techniques would be subject to approval by the agencies, but could include the use of horizontal drains or wells which could be sealed to stop drainage.

2.11.2.5 Waste Rock Facilities Reclamation

Waste Rock Repository and Cover

The waste rock repository constructed at the mine site would be reclaimed concurrent with mine pit backfilling and as waste is placed over the existing leach pads. Waste material and reclamation material would be staged at the mine site to be available as reclamation proceeds. The final slope of the repository would be 3H:1V, and constructed benches must be placed every 50 vertical feet.

Existing Waste Rock Dumps

Three waste rock dumps (Alder Gulch, OK and Ruby Gulch) are currently located within the project boundaries. The Alder dump and Ruby sulfide stockpile would be moved to the Goslin Flats leach pad. The remainder of the Ruby Gulch dump (after stockpile removal) would be leached, if testing demonstrates economically recoverable amounts of metals are present, or backfilled into the pit. The OK dump would be removed entirely as the expanded pit incorporates its location, and used as backfill in the pit complex. Cover soil from this dump would be salvaged. Where these facilities are not covered by the new waste rock repository, their footprints would be tested for total sulfur content on 100-foot centers. Those areas with total sulfur content >0.5% sulfur would be covered with 3.5 feet of non-acid generating material and 12 inches of soil. Areas with lower sulfur contents would be scarified, covered with 8 inches of soil and revegetated.

2.11.2.6 Support Facilities Reclamation

Unless otherwise noted in the following sections, reclamation of support facilities would be as described in the Company Proposed Action,Section 2.8.2.6.

Solution/Process Ponds Reclamation

Reclamation of solution and process ponds would not differ from that described in the Company Proposed Action, Section 2.8.2.6.

Process Plant Site Reclamation

Final reclamation would include the removal of all structures and equipment used in the mining and processing of ore through heap leach operations. Structures and equipment to be removed were described in Section 2.8.2.6. All footprints from these facilities and areas contaminated by spillage of non-oxide ore would be tested on 100-foot centers for total sulfur prior to reclamation activities. Surfaces found to contain >0.5% sulfur would be covered with 3.5 feet of non-acid generating material and 12 inches of cover soil, and revegetated. Other areas would be capped with 8 inches of cover soil and revegetated.

Soil Stockpile Reclamation

Cover soil stockpiles at the Zortman Mine may be completely depleted by the time surface reclamation activities are completed. The footprints from the soil stockpiles would be tested on 100 foot centers. Those areas with total sulfur content >0.5% sulfur would be covered with 3.5 feet of non-acid generating material and 12 inches of soil, and revegetated. Areas with lower sulfur contents would be scarified, covered with 8 inches of soil and revegetated.

Access and Haul Roads

Reclamation requirements for access and haul roads would generally be as described in Section 2.8.2.6. Where total recontouring is not possible, haul roads would be reclaimed by pulling at least four feet of sidecast material over the roadbed.

Limestone Quarry

Up to 13 acres would be disturbed at the LS-1 limestone quarry to provide liner and underdrain material for the Goslin Flats leach pad. The ultimate facilities development topography of the limestone quarry and reclamation procedures would be as described in Section 2.8.2.6.

Seaford Clay Pit

The Seaford clay pit has provided liner material for leach pad facilities at the Zortman Mine. Under this alternative the clay pit would again provide material for leach pad construction. About 4.3 acres would be disturbed to supply clay for the leach pad construction. Those areas in the clay pit already disturbed and reclaimed from previous operations would undergo additional disturbance and reclamation, as described in Section 2.8.2.6.

2.11.2.7 Reclamation/Post-Reclamation Water Handling and Treatment

Final requirements for water discharge from the Zortman Mine, including discharge standards, treatment methods, and water management practices are being developed. Section 2.5.1.6 described the various water and leachate capture systems, and the water treatment activities currently in effect at the Zortman Mine, including operation of a water treatment plan in accordance with the June, 1994 Administrative Order. This alternative incorporates the water handling and treatment procedures described in the Company Proposed Action (see Section 2.8.2.7). It also adopts the requirements described below.

Water Quality Improvement Plan

The Water Quality Improvement Plan (summarized in Appendix A) was described earlier, in Section 2.11.1.7. This program would continue through mine expansion operations and through reclamation and post-reclamation monitoring. Under this alternative ZMI would have to meet the requirements of the program and implement agency directed corrective measures when reclamation requirements are not met or water quality criteria are exceeded.

Section 2.11.5 contains additional surface reclamation and facilities monitoring requirements to determine overall compliance of Zortman Mine water handling and discharge programs.

Water Capture and Treatment

No changes are proposed for water capture and treatment upon cessation of mining and leaching activities from those implemented during mine operations (see Sections 2.8.1.7 and 2.11.1.7). Runoff from reclaimed mine pits, leach pads, haul roads, and process facilities would be controlled, conveyed and discharged into the Carter Gulch, Alder Spur, and Ruby Gulch drainages. ZMI would provide a site water drainage plan for agency approval prior to implementation of this alternative. Water treatment would continue until final reclamation is established and acceptable water quality is maintained. As noted earlier, the Zortman Mine water treatment plant would be relocated to Ruby Gulch. As water quality meets discharge standards and the appropriate agencies approve uncontrolled release of untreated waters, capture ponds, sumps and pumpbacks would be dismantled and reclaimed.

Adit Sealing

The expanded mining activities would remove the majority of historic underground openings and mine workings. Two haul adits connect these workings to the ground surface, one daylighting north of the Ross pit in the Lodgepole Creek drainage and one located to the southeast of the OK pit under the 85 pad in Ruby Gulch. To minimize oxygen flow and discharge of transfer water collected in the workings the adits would be sealed using concrete bulkheads where exposed in the pits.

2.11.2.8 Reclamation Quality Control

The reclamation quality control procedures and requirements described in Alternative 3, Section 2.7.2.8, would apply, where appropriate, to this alternative. However, less quality control would be required for this alternative since clay and a PVC liner would not be a component of the water balance reclamation covers.

2.11.2.9 Revegetation Procedures

Revegetation procedures for this alternative would not be expected to differ significantly from those presented in Alternative 4, Section 2.8.2.9. However, no trees would be used in revegetation unless specifically needed to mitigate visual impacts. Only grasses, forbs and shrubs would be used to enhance wildlife habitat. Another change is that the agencies would not allow the use of Crested wheatgrass in the reclamation seed mix. Areas disturbed at the Zortman Mine are and would be revegetated to stabilize soil and slopes, reestablish communities ecologically comparable to pre-mine conditions, and restore watershed, wildlife, recreational and aesthetic values that meet post-operation land use objectives. Vegetative cover must achieve 90% of that demonstrated in adjacent, natural communities of similar composition and location. Stock grazing would be restricted in revegetated areas until the vegetation canopy is 90% or greater of the reference area.

2.11.3 Landusky Mine: Agency Mitigated Expansion

ZMI has proposed several changes to current operations at the Landusky Mine, including provisions for mining an additional 7.6 million tons of ore and 7 million tons of waste rock. Service facilities to support these operations would include a limestone quarry and expanded shale pit excavations. The location of the currently permitted mine area and proposed facilities under this alternative for both mines is shown on Figure 2.11-1. This alternative would also allow ZMI to continue to use open-pit mining and heap-leach mineral processing to extract gold and silver from ore, with few modifications from the Company Proposed Action. The quantity of ore to be mined under this application would constitute slightly less than one year of additional mining at the facility. No additional workers are anticipated to be hired under this expansion proposal.

The only significant modification to the Company Proposed Action required under this alternative concerns water control and treatment. All water handling, capture, and treatment systems would be sized for seepage from a 100-year, 24-hour storm event (as described in the Company Proposed Action) and ZMI would also be required to capture and treat seepage water (using extraction wells or other applicable technology) and degraded surface waters according to the Water Quality Improvement Plan. This modification is described in Section 2.11.3.7, and Appendix A contains a summary description of the compliance program. In addition, all mine expansion and reclamation activities would be conducted in accordance with the requirements established by the Memorandum of Agreement developed under Section 106 of the National Historic Preservation Act (see Appendix E).

Performance of an Environmental Audit on an annual basis would be carried out to assure that spill containment systems work properly, that leak detection systems are in proper working order, and that spill prevention and response planning can be realistically implemented through review of company training programs and inspection of emergency response equipment.

Because this alternative includes little variation for Landusky Mine operations from Alternative 4, most mine operations are summarized with reference to more complete descriptions in Section 2.8.3. Additional detail is provided where a modification from the Company Proposed Action is included.

2.11.3.1 Mine Pit Expansion

The proposed expansion for the Landusky mine would involve lateral and vertical expansion of the Queen Rose/Suprise and August/Little Ben pits, and the South Gold Bug pit, which is an extension of the existing Gold Bug Pit. A plan view of the ultimate pit complex was shown on Figure 2.8-17, with typical cross sections of the pit expansions in Figures 2.8-18 and 2.8-19.

Mining Methods

The mining description provided in Section 2.8.3.1 is applicable to this alternative.

Rock Characterization

The materials and their relative amounts to be mined during expanded operations at the Landusky Mine were fully described in Section 2.8.3.1. The geochemical sampling and waste rock characterization program proposed by ZMI, and described in Section 2.8.1.1, would be implemented under this alternative. (The agencies have added mitigations restricting the use of certain waste rock types in reclamation, as described in Section 2.11.4.).

2.11.3.2 Crushing Operation

Mining of the deeper portions of the Queen Rose/Suprise, August/Little Ben, or South Gold Bug pits would not require crushing or special handling for leaching purposes.

2.11.3.3 Ore Leaching Operation

As described in Section 2.8.3.3, the 7.6 million tons of ore from the expanded mining operations would be taken to the 87/91 leach pad for processing. This leach pad has already been permitted.

Solution Ponds

No additional solution ponds are proposed in connection with the proposed additional ore and waste rock mining.

Leak Detection System

No change is proposed to the leak detection system, as described in Section 2.5.3.3, Alternative 1. The existing underdrains and monitoring wells that are beneath and adjacent to the leach pads would be used to monitor for process solution leakage.

Processing Plant Operation

No change is proposed in operation of the processing plant. The existing facilities would continue to be utilized to process gold bearing solutions from the leach pads. There would be no changes in reagent handling and storage.

2.11.3.4 Waste Rock

The program to characterize waste rock types, according to their potential to generate acid or neutralize acid drainage, was described in Section 2.5.3.1. Section 2.8.3.4. describes how waste rock would be selectively handled and sorted according to their sulfur content and acid neutralization potential. The changes from that strategy as required in this alternative are summarized below.

Waste Rock Handling

Section 2.5.3.1 also describes how waste rock would be handled and designated for use in reclamation and construction based on geochemical characteristics. No changes from that strategy are required in this alternative, except that waste rock could not be used in the construction of reclamation covers based solely on the sulfur content of the rock. Material used in construction purposes and as a capillary break must meet the geochemical and lithologic criteria described in Section 2.11.4.

Repository Construction

As described in the Company Proposed Action (Section 2.8.3.4), about 7 million additional tons of waste rock would be mined and scheduled for disposal in the Gold Bug waste repository or backfilled in the Queen Rose pit. The nominal slope of the repository would be built at 3H:1V, and drainage benches (25 feet wide) would be placed every 50 vertical feet. Reclamation at the Gold Bug would continue to occur concurrent with mining activities. Section 2.11.4.4 provides more information on the repository reclamation program.

2.11.3.5 Other Features and Facilities

No modifications to the Company Proposed Action are required under this alternative which would affect the Landusky Mine infrastructure and utilities. In fact, the Company Proposed Action would have little change to the currently permitted conditions as described in Section 2.5.3.5. A summary follows.

Access and Haul Roads

A haul road would be constructed in the permitted disturbance area for accessing the South Gold Bug Pit area. Any other access or haul roads would remain or be constructed on existing disturbed areas within the pits. The 2,500 feet of haul road to the King Creek limestone quarry would be widened from 20 to 60 feet, resulting in an additional total disturbance of 5.7 acres.

Power and Water Supply

No changes are proposed in the current power and water supply systems for the Landusky Mine. Electrical power is obtained from the Landusky grid, which is supplied by the Big Flat Power Cooperative through an existing 23 kV line. Potable water is obtained from groundwater wells. Process water is obtained from precipitation and groundwater appropriation.

Sewage Treatment

No changes are proposed from the current septic waste treatment systems. See Section 2.5.3.5, Alternative 1, for additional information.

Chemical Use
No changes are proposed from the current inventory and use of potentially hazardous materials. See Section 2.5.3.5, Alternative 1, for additional information.

Waste Disposal
No changes are proposed from the current disposal methods for solid and/or hazardous wastes. See Section 2.5.3.5, Alternative 1, for additional information.

2.11.3.6 Water Handling and Treatment

As described in Section 2.8.3.6, diversions and capture systems would be constructed to allow capture of mine-impacted waters and prevent deterioration of water quality in non-impacted drainages. Mitigations and modifications incorporated into this alternative would be as described in Alternative 5, Section 2.9.3.6 ZMI would have to meet the requirements of the Water Quality Improvement Plan (see Appendix A), and implement agency directed corrective measures when water quality criteria are exceeded.

Water Capture and Treatment
The existing seepage capture systems would be sized to handle seepage generated by a 100-year, 24-hour storm event. Seepage capture ponds and sumps would be inspected on a weekly basis for routine maintenance or repairs, if necessary. Water captured from Landusky Mine facilities which is of unacceptable quality would be treated at a new water treatment plant constructed at the Landusky Mine.

Surface Water Runoff Control
Surface water runoff diversions and controls would be sized for a 100-year, 24-hour storm event with one foot of freeboard added as a safety measure. Diversion channels would be trapezoidal or V shaped, lined with geotextile to prevent piping and rip-rapped with durable, non-acid forming rock sized for drainage area requirements. All diversion ditches would have road access for maintenance purposes. Maintenance would consist of removal of sediment load and repositioning of rip-rap as required. Sediment would be disposed of in the waste rock repository. Other features would be as described in Section 2.8.3.6.

No changes from the existing operations (see Section 2.5.3.6) to control surface water runoff control would be implemented for the mine pit, leach pads, or waste rock facilities. (Post-reclamation water handling and discharge would differ significantly, however. See Section 2.11.4.7.)

Land Application Disposal
No emergency land application is anticipated during operations. In the event land application is required, it would be conducted as described in Section 2.5.3.6 for currently permitted operations.

2.11.4 Landusky Mine: Agency Mitigated Reclamation

The agencies have developed modifications to ZMI's proposed reclamation procedures which would reduce infiltration into areas with the potential to cause acidic drainage, remove waste rock dumps and other sources currently causing degradation of surface water or groundwater, and establish a program to implement further corrective measures should reclamation procedures fail to adequately protect resources. Many of these reclamation modifications were described in detail in Section 2.7.4, for the Agency Mitigated Reclamation for Alternative 3. However, that alternative describes reclamation actions to be taken if ZMI's proposal for mine expansion is not approved. This alternative describes modified reclamation actions that would take place in conjunction with mine expansion. The major reclamation modifications to be incorporated in this alternative include:

- Water-balance reclamation covers would be used on the expanded Gold Bug waste rock repository and other existing reclaimed or unreclaimed facilities.

- The performance criterion for the reclamation covers would be to limit infiltration to not more than 5% of precipitation.

- To the extent possible, cover soil on facilities to be removed or re-reclaimed would be removed, stockpiled, and reused.

- The 91 leach pad dike would be re-reclaimed using the water balance cover. Other facilities not used as pit backfill would be tested for acid generating potential and re-reclaimed using a water balance cover.

- With the exception of leach pad dikes, the Gold Bug repository, and the Mill Gulch waste rock dump, existing facilities would be reclaimed to a 3H:1V slope, with constructed benches every 50 vertical feet. In order to achieve the slope reductions while minimizing additional land disturbance, some material may have to be off-loaded from existing facilities.

- In order to classify as "Non-Acid Generating" and be used without restriction in construction and reclamation, waste rock or other material:

  1) Cannot be composed of igneous breccia, felsic gneiss, monzonite, quartzite, or trachyte lithologies;

  2) Amphibolite, mafic gneiss, shale, dolomite, or limestone must have a total sulfur content less than 0.8%, and a paste pH of 6.0 or greater;

  3) If syenite, must have a total sulfur content less than or equal to 0.2%, a paste pH of 6.5 or greater, and a NNP greater than or equal to 0 with an NP:AP ratio greater than or equal to 1;

  4) Must meet the criteria above as demonstrated by sampling and analyzing lithologies from every blasthole providing non-acid generating material.

- Material used for capillary breaks may be obtained from an area limestone source or non-acid generating waste rock.

- Rock fill would be used as backfill to raise the pit floor to a minimum elevation of 4,850 feet (at the midpoint of the drainage) to create a surface which would freely drain into King Creek. Sources of pit backfill to reach the 4,850 foot level would include the Montana Gulch waste rock dump and the 85/86 heap leach pad.

- Portions of the 85/86 leach pad and dike would be removed in order to unblock the western tributary of Montana Gulch and create a free draining surface.

- Backfill the pits to a minimum elevation of 4,850 ft (at the midpoint of the drainage ditch) to create a surface which would freely drain into King Creek. Approximately 13 million tons of backfill would be required to reach this level.

- Highwall runoff would be diverted from the mine pits into Montana Gulch and treated if necessary.

- Contingency water capture systems and settling ponds would be installed in upper King Creek to treat surface water runoff from the backfilled pit floors.

- Reclamation viability, as described in Section 2.11.5, would be monitored by ZMI until the agencies have approved final closure and released the mine reclamation bond.

- Reclaimed facilities would be recontoured to provide a topography that blends into the surrounding landscape. Straight edges would be rounded. Large, flat surface areas would be broken with changes in contour resembling natural drainage patterns.

- The reclamation requirements of this EIS and the Water Quality Improvement Plan (see Appendix A) would be used as a basis for determining reclamation success and directing any further corrective measures.

- At the end of mine life, a comprehensive Environmental Site Assessment would be carried out that covers the entire Landusky mine permit area. This site assessment would include inspection of all locations where hazardous materials were stored and used and would identify evidence of spills or accidental releases that may have contaminated soil and groundwater. This site assessment would include soil and groundwater sampling should evidence of contamination be identified.

Final reclamation of all facilities is anticipated to occur within 3 years after the 87/91 leach pad has been detoxified and liner perforated. Reclamation of individual facilities is contingent upon a number of economic and operational factors, and scheduling variations within the overall timeframe could occur. Reclamation activities are submitted to the DEQ on an annual basis and reflect the most recent operating and reclamation schedule.

The following sections summarize specific reclamation plans and actions proposed by ZMI for each of the major disturbance areas, and provide a description of prescribed modifications to the reclamation procedures under this alternative.

2.11.4.1 Reclamation Materials

Reclamation materials would be required for construction and installation of reclamation caps, and for use in construction of drains and solution diversions. The primary materials to be used in reclamation covers would include non-acid forming waste rock and limestone, cover soil, and geosynthetic clay liner. These materials and their sources were described in Section

2.8.4.1 or, for the Geosynthetic Clay Liner, Section 2.11.2.1. The following sections summarize the uses for the reclamation materials and modifications from the Company Proposed Action.

Non-Acid Forming Material
Non-acid forming material would be used primarily as a capillary break, and to a lesser extent as rip-rap and drain material. The non-acid forming waste rock would be mined and stockpiled adjacent to the Gold Bug waste repository for use in reclamation. Non-acid forming waste rock is being used as an interim cap on the Mill Gulch waste rock dump and in the Gold Bug waste rock repository, and as a cap on the 91 heap leach pad dike. Waste rock used in these facilities comes from existing stockpiles and that generated by the ongoing mine operation. Significant additional quantities of non-acid generating material would be used in reclamation covers on all disturbed areas. Some of this material could come from waste rock generated at the South Gold Bug pit. Approximately 38 million tons of waste rock are now contained within dumps at the Landusky Mine. Some of this material is not acid generating and could be used in reclamation covers.

Limestone/Dolomite
Limestone and dolomite have been used in small amounts at the Landusky Mine. Because of their high carbonate content both of these rock types are useful to neutralize acidic conditions. Dolomite and limestone from outcrops within the mine permit area have recently been used to provide a 3-foot buffering liner across the floor of the 4,640 bench in the Gold Bug waste rock repository. Limestone and dolomite from the mine pits could also be used as capillary break material in the reclamation covers. Sections 2.7.4.1 and 2.8.4.1 provides a description of the activities to be conducted to quarry limestone from the King Creek quarry location.

Cover Soil
Cover soil is used on top of all mine disturbances, either as a final lift on the reclamation caps or as 8-inch layers directly overlying disturbed zones which are determined by testing not to have significant acid generating potential. Cover soil is obtained from one of four cover soil storage areas shown on Table 2.5-5. Approximate volumes of soil available at these stockpiles were shown on Table 2.5-11.

Geosynthetic Clay Liner
The use of GCL in water balance covers, and its application to reclamation in this alternative, was described for the Zortman Mine in Section 2.11.2.1. The agencies would also require use of the water balance covers for Landusky Mine reclamation, and GCL would be a necessary component for reclamation covers on all slopes less than or equal to 25%.

Clay
Clay has been used as a component layer of the caps which have been placed on the Mill Gulch waste rock dump and Gold Bug waste rock repository. However, the water balance covers used in this alternative do not require clay, and its use in reclamation would be limited to small amounts for water collection ponds and diversion trenches.

2.11.4.2 Reclamation Covers

Procedures used to cover disturbed areas would differ significantly from the Company Proposed Action described in Section 2.8.4.2. Under this alternative all disturbed areas, with the exception of the Mill Gulch and Gold Bug waste rock facilities, and facilities scheduled for backfill, would be tested according to the procedures outlined in Section 2.8.2.2. Those areas requiring re-reclamation would be covered using a water balance reclamation cover, as described in Section 2.11.2.2.

In addition, the "non-acid generating" material used as capillary break must meet the geochemical and lithologic criteria described at the beginning of Section 2.11.4.

The interim covers already constructed on the Mill Gulch and Gold Bug waste rock facilities would remain as permanent reclamation caps, provided that the infiltration performance criteria are met. Additional soil could be added to these covers to achieve the 5% or less water infiltration criteria.

2.11.4.3 Mine Pit Reclamation

The pit reclamation procedures described in the Company Proposed Action (Section 2.8.4.3) are generally those required under this alternative, but some modifications have been developed by the agencies, as follows. The pits are to be backfilled to a minimum elevation of 4,850 feet, measured at the midpoint of the drainage ditch, in order to create a surface which will freely drain into King Creek. This action would also reduce the potential for surface water infiltrating the pit floors to contact sulfide-bearing zones and create acidic drainage. This mitigation was fully described in Section 2.9.4.3.

To comply with the Montana Metal Mine Reclamation Act, highwalls which are determined to be potentially acid generating would have to be covered with at least two feet of non-acid generating material and revegetated.

Overall slope of the final pit walls would be approximately 45 degrees (1H:1V) with 30-foot flat benches every 60 vertical feet. Pit floors are to be sloped and graded to facilitate free drainage, as described above. The final pit floor (i.e., the backfilled surface) would be covered with the appropriate water balance cover to reduce surface water infiltration. This alternative also requires that pit benches be covered with 3.5 feet of non-acid generating material overlain by 8 inches of cover soil. Revegetation of pit benches (where revegetation is possible) would include the use of trees to the extent possible to reduce visual impacts.

2.11.4.4 Leach Pad Reclamation

The 87/91 heap leach pad liner system would be perforated after pad detoxification and surface reclamation to eliminate moisture storage and any undesirable hydraulic conditions associated with the reclaimed facility. The liner would not be perforated until monitoring of the heap effluent indicates that water quality compliance has been met and risk of the formation of acid drainage is established to be minimal.

The 85/86 leach pad would be breached to allow free drainage of the western tributary of Montana Gulch. The other liner perforation requirements described in Section 2.7.4.4 would apply to this alternative, except that liner perforation would be required to be reversible, using horizontal drains or other agency-approved technology.

2.11.4.5 Waste Rock Facilities Reclamation

Part of the Montana Gulch waste rock dump could be removed and used as backfill in the pit. The remaining footprint or unexcavated dump surface would be tested and re-reclaimed as needed with the water balance cover. The interim cap placed on the Mill Gulch waste rock dump would remain as a permanent cover. A water balance cover would be used on the Gold Bug waste rock repository. Reclaimed surfaces would be revegetated in accordance with Section 2.8.4.9 unless otherwise stipulated in this alternative.

2.11.4.6 Support Facilities Reclamation

Unless otherwise noted in the following sections, reclamation of support facilities would be as described for existing operations and the Company Proposed Action, Sections 2.5.4.6 and 2.8.4.6, or with modifications presented in Alternative 3, Section 2.7.4.6

Solution/Process Pond Reclamation

Reclamation of solution and process ponds would not differ from that described for the existing operations (Section 2.5.4.6).

Soil Stockpile Reclamation

Based on the estimated amount available in stockpiles, sufficient cover soil exist at the Landusky Mine to be used in surface reclamation of all facilities. Cover soil would either be placed directly on graded areas prior to revegetation, or spread on top of the water balance cover or non-acid generating material where potentially acid generating material is to be capped. The footprints from the soil stockpiles would be tested and re-reclaimed with the appropriate water balance cover if needed. Areas with lower sulfur contents would be scarified, covered with 12 inches of soil and revegetated.

Access and Haul Road Reclamation

Reclamation requirements for access and haul roads would be similar to that described in Section 2.7.4.6. However, where total recontouring is not possible haul roads would be reclaimed by pulling at least four feet of sidecast material over the roadbed.

Limestone Quarry Reclamation

Up to 3 acres would be disturbed at the King Creek limestone quarry to provide reclamation materials. The ultimate facilities development topography of the limestone quarry would be as described in Section 2.7.4.6.

Williams Clay Pit Reclamation

New and old disturbances at the clay pit would undergo reclamation as described in Section 2.7.4.6. All areas would be revegetated as described in Section 2.8.4.9, except where modified by Section 2.11.4.9.

Land Application Area

Following completion of all land application operations, the land application area would be reclaimed as described in Section 2.8.4.4.

2.11.4.7 Reclamation/Post-Reclamation Water Handling and Treatment

Final requirements for water discharge from the Landusky Mine, including discharge standards, treatment methods, and water management practices are being developed. Where applicable, these actions and requirements of the Water Quality Improvement Plan supersede the reclamation requirements for water management described in previous regulatory actions for the Landusky Mine. This alternative incorporates the water handling and treatment procedures described in the Company Proposed Action (see Section 2.8.4.7), except where modified as described below.

Water Quality Improvement Plan

The Water Quality Improvement Plan (summarized in Appendix A) was described earlier, in Section 2.11.1.7. This program would continue through mine expansion operations and through reclamation and post-reclamation monitoring. Under this alternative ZMI would have to meet the requirements of the program and implement agency directed corrective measures when reclamation requirements are not met or water quality criteria are exceeded.

Section 2.11.5 contains additional surface reclamation and facilities monitoring requirements to determine overall compliance of Landusky Mine water handling and discharge programs.

Water Capture and Treatment

No changes are proposed for seepage water capture and treatment upon cessation of mining and leaching activities from those implemented during mine operations (see Sections 2.5.4.7 and 2.11.3.6). Water treatment, at a new water treatment plant at the Landusky Mine, would continue until final reclamation is established and water quality is acceptable. As water quality meets discharge standards and the appropriate agencies approve of release of the waters, capture ponds, sumps and pumpbacks would be dismantled and reclaimed.

Mine Pit Runoff Control

Where access allows, portions of the pit walls that are potentially acid forming and cannot be capped would have diversions installed above the highwalls. These diversions would prevent storm water from entering the pit. Diverted highwall runoff would be directed to drain to Montana Gulch, as would any other runoff originating in areas not reclaimed and capped. The diversions would be designed to pass the peak flow from a 100-year storm event with one foot of freeboard. Highwalls and diversion structures would be visually inspected on a periodic basis and repairs made as necessary.

As noted earlier, this alternative requires ZMI to backfill the August/Little Ben pit to the 4850 foot level. The source of backfill would, in part, be the rock fill at the head of the King Creek. The fill removal and pit backfilling would approximately re-establish the pre-mining catchment area for King Creek and restore historic flow by reconnecting surface runoff from the August/Little Ben and Queen Rose/Suprise pit areas with that drainage. Settling ponds would be constructed in upper King Creek between monitoring site L-5 and the existing sediment pond used to control erosion of historic mine tailing. The ponds would help prevent water discharged from the reclaimed pit areas from degrading water quality in King Creek. Additional treatment would be conducted as needed to meet discharge criteria established by the Water Quality Improvement Plan and/or the facility stormwater discharge permit.

Leach Pad Runon Control

Diversions would be constructed around the leach pad and laterally across the buttresses, sized for the 100-year, 24-hour storm event. The 85/86 leach pad would be removed from the west tributary and used as backfill in the pit. This action would simplify the surface water control and reduce long-term maintenance of diversions and under-drains.

Waste Rock Repositories Runoff Control

No changes are proposed to the existing drainage control features for the Gold Bug and Mill Gulch waste repositories. The Montana Gulch waste rock dump would probably be partly removed for backfill; drainage from this area would be directed into Montana Gulch.

2.11.4.8 Reclamation Quality Control

The reclamation quality control procedures and requirements described in Alternative 3, Section 2.7.4.8, would apply, where appropriate, to this alternative. However, less quality control would be required for this alternative since clay and a PVC liner would not be a component of the water balance reclamation covers.

2.11.4.9 Revegetation Procedures

Revegetation procedures would be essentially as described in Section 2.5.4.9. However, no trees would be used in revegetation except on a limited basis for visual impact mitigation. Only grasses, forbs and shrubs would be used to enhance wildlife habitat. Another change is that the agencies would not allow the use of Crested wheatgrass in the reclamation seed mix. Areas disturbed by mining-related operations would be revegetated to stabilize soil and slopes, reestablish communities ecologically comparable to pre-mine conditions, and restore watershed, wildlife, recreational and aesthetic values that meet post-operation land use objectives. Vegetative cover must achieve 90% of that demonstrated in adjacent, natural communities of similar composition and location to be considered acceptable. Stock grazing would be restricted in revegetated areas until the vegetation canopy is 90% or greater of the reference area.

2.11.5 Monitoring Programs and Research Studies

The monitoring programs and research studies outlined in Section 2.8.5 would also apply to this alternative. The implementation of a water quality compliance plan designed to identify degradation of water resources and trigger corrective action to mitigate environmental damage would be expanded to cover new mine facilities. A reclamation monitoring program would be instituted to provide ongoing evaluation of surface reclamation viability.

2.11.5.1 Water Resources

The monitoring program for groundwater and surface water would continue as described in Section 2.8.5.1. Some monitoring wells or surface water monitoring sites could be relocated as a result of actions taken to reduce slopes of heap leach facilities and waste rock dumps. The monitoring requirements for land application disposal areas outlined in Section 2.9.5.1 would also apply. All monitoring required by the water quality compliance program are incorporated into this alternative.

2.11.5.2 Reclamation Surface Performance Study

The reclamation surface performance study modifications described in Section 2.9.5.2 would apply to this alternative.

2.11.5.3 Surface Reclamation Monitoring Programs

The agencies would require that ZMI implement a program to monitor long term viability of surface reclamation until such times as the agencies release the Mine Reclamation Bond. This program was described in Section 2.9.5.3.

2.11.5.4 Other Monitoring Programs

No changes are anticipated to the remainder of the monitoring programs from the descriptions provided in Section 2.8.5.

2.11.6 Reasonably Foreseeable Future Actions

2.11.6.1 Mine Activities - Zortman

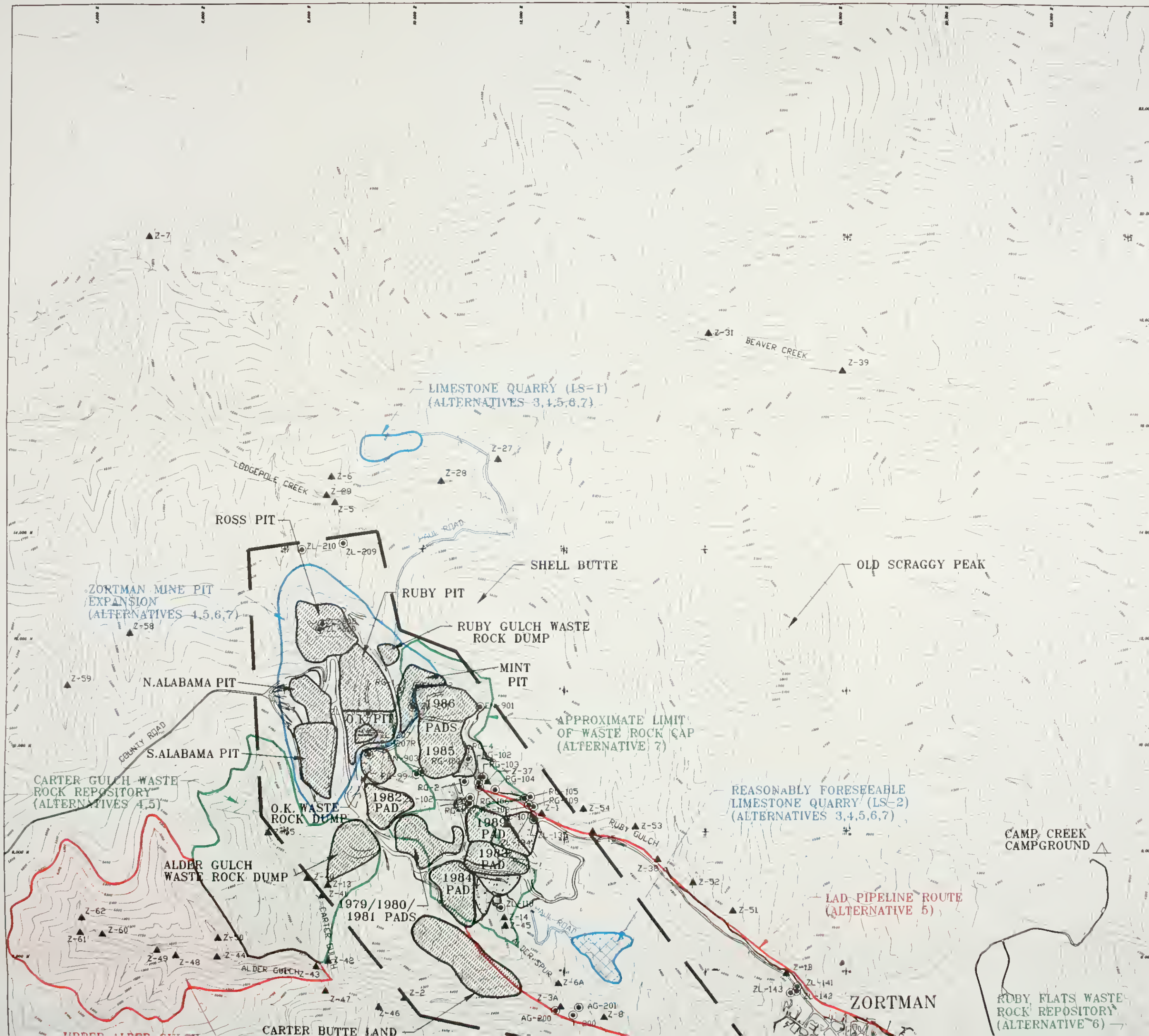
Foreseeable mine activities for the Zortman Mine would be very similar to those described under Alternative 4, as described in Section 2.8.6.1.

2.11.6.2 Mine Activities - Landusky

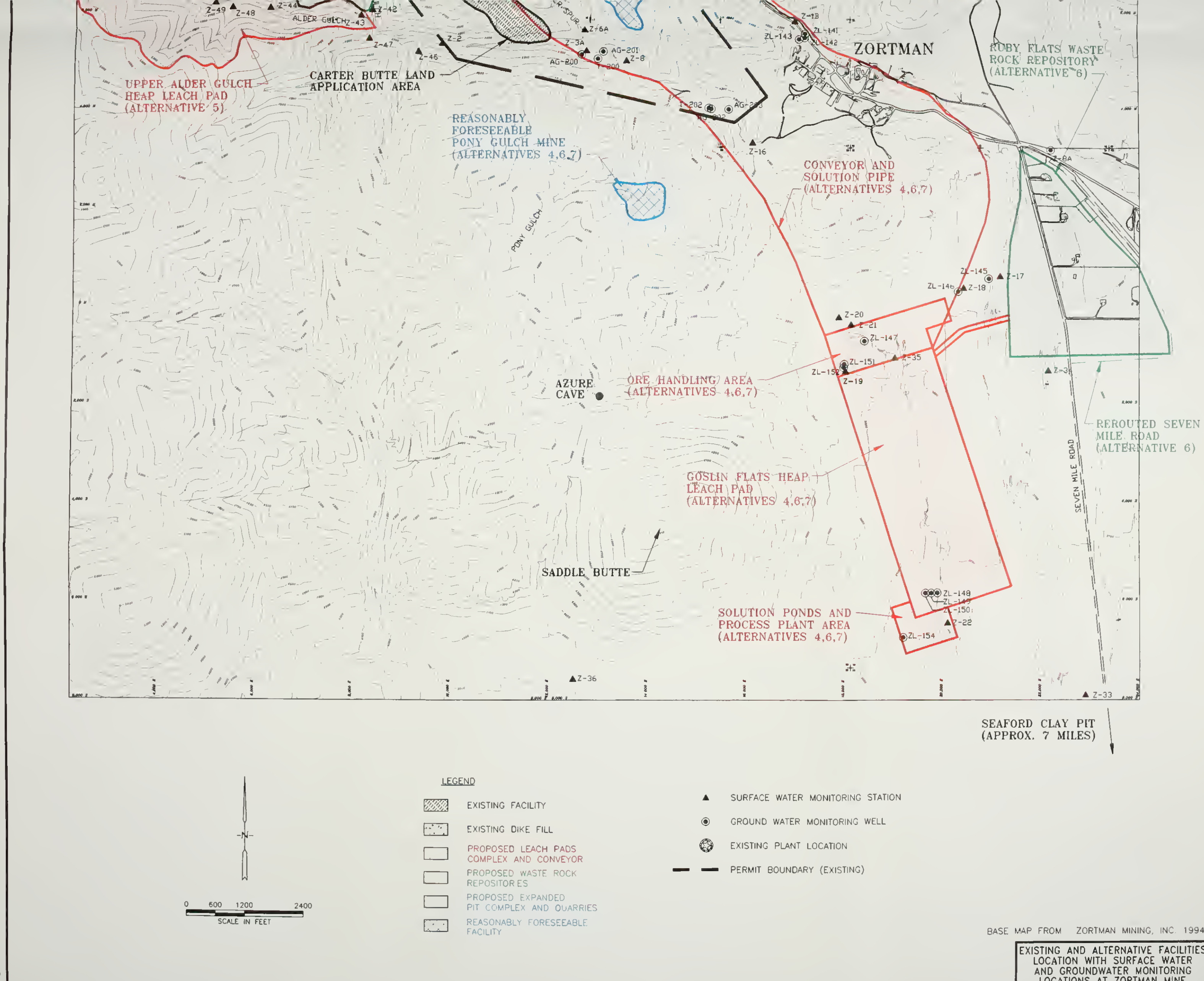
Since Alternatives 4, 5 and 6 are almost identical with respect to proposed mining at the Landusky Mine, foreseeable activities under this alternative are the same as previously described for Alternative 4, as described in Section 2.8.6.1. These developments include additional ore extraction from the existing pits and South Gold Bug pit area, generation of a significant amount of waste rock as new ore is mined, construction and operation of a new leach pad in the Queen Rose pit or at an alternate site, and the construction and operation of new or expanded water treatment facilities would be foreseeable.

2.11.6.3 Exploration Activities

It is anticipated that exploration proposals would be the same as described for Alternative 4 in Section 2.8.6.2. The additional 200,000 linear feet of road and trench construction, with 600 drillsites, over a 10-year period could be proposed.



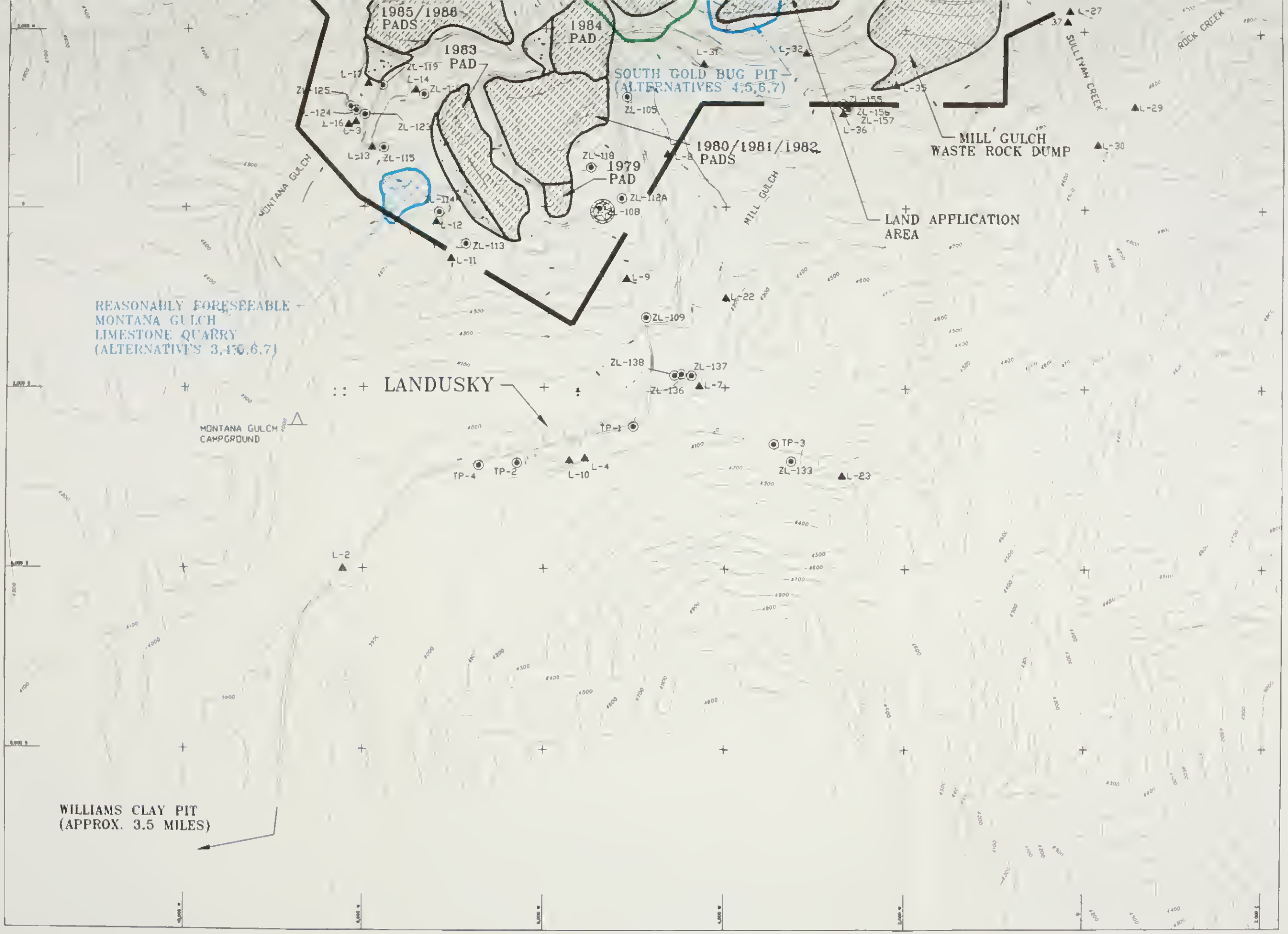
Z-7
Z-31
BEAVER CREEK
Z-39
LIMESTONE QUARRY (LS-1)
(ALTERNATIVES 3,4,5,6,7)
Z-27
LODGEPOLE CREEK
Z-6
Z-28
Z-29
Z-5
ROSS PIT
ZL-210
ZL-209
HAUL ROAD
SHELL BUTTE
OLD SCRAGGY PEAK
ZORTMAN MINE PIT
EXPANSION
(ALTERNATIVES 4,5,6,7)
RUBY PIT
Z-58
RUBY GULCH WASTE
ROCK DUMP
Z-59
MINT
PIT
N.ALABAMA PIT
1986
PADS
O.K. PIT
APPROXIMATE LIMIT
OF WASTE ROCK CAP
(ALTERNATIVE 7)
COUNTY ROAD
S.ALABAMA PIT
1985
CARTER GULCH WASTE
ROCK REPOSITORY
(ALTERNATIVES 4,5)
1982
PAD
REASONABLY FORESEEABLE
LIMESTONE QUARRY (LS-2)
(ALTERNATIVES 3,4,5,6,7)
Z-54
O.K. WASTE
ROCK DUMP
RUBY GULCH
Z-53
1989
PAD
CAMP CREEK
CAMPGROUND
1983
PAD
ALDER GULCH
WASTE ROCK DUMP
1984
PAD
Z-38
Z-52
Z-13
1979/1980/
1981 PADS
LAD PIPELINE ROUTE
(ALTERNATIVE 5)
Z-51
Z-62
Z-14
Z-45
HAUL ROAD
Z-61
Z-60
Z-49
Z-48
Z-44
Z-42
ALDER GULCH
Z-43
ALDER SPUR
Z-6A
ZL-141
ZL-143
ZL-142
ZORTMAN
Z-47
Z-2
Z-46
Z-3A
AG-201
Z-8
AG-200
RUBY FLATS WASTE
ROCK REPOSITORY
(ALTERNATIVE 6)
CARTER BUTTE LAND



EXISTING AND ALTERNATIVE FACILITIES LOCATION WITH SURFACE WATER AND GROUNDWATER MONITORING LOCATIONS AT ZORTMAN MINE

EXHIBIT 1


Fort Belknap Indian Reservation Boundary
SOUTH BIGHORN CREEK
KING CREEK
SWIFT GULCH
KING CREEK LIMESTONE QUARRY (ALTERNATIVES 3,4,5,6,7)
LANDUSKY MINE PIT EXPANSION AND BACKFILL AREAS (ALTERNATIVES 4,5,6,7)
AREA OF ADDITIONAL ORE (ALTERNATIVES 4,5,6,7)
QUEEN ROSE PIT
AUGUST #2 WASTE ROCK DUMP
AUGUST #1 WASTE ROCK DUMP
MISSION PEAK
AUGUST LITTLE BEN PITS
MONTANA GULCH WASTE ROCK DUMP
GOLDBUG WASTE ROCK DUMP
GOLDBUG PIT BACKFILL (ALTERNATIVES 4,5,6,7)
1991 PAD
1987 PAD
1985/1986 PADS
1984 PAD
1983 PAD
SOUTH GOLD BUG PIT
ROCK CREEK
L-21
L-19
L-6
L-39
L-20
ZL-139
L-5
L-38
L-27
L-37
L-31
L-32
ZL-119
L-14
ZL-132
ZL-131
EN-908
EN-904
EN-906



LEGEND

- EXISTING FACILITY
- EXISTING DIKE FILL
- PROPOSED LEACH PADS COMPLEX
- PROPOSED WASTE ROCK REPOSITORIES
- PROPOSED EXPANDED PIT COMPLEX AND QUARRIES
- REASONABLY FORESEEABLE FACILITY
- ▲ SURFACE WATER MONITORING STATION
- ⊙ GROUND WATER MONITORING WELL
- EXISTING PLANT LOCATION
- PERMIT BOUNDARY (EXISTING)

-N-

0 400 800 1600
SCALE IN FEET

BASE MAP FROM ZORTMAN MINING, INC. 1994

EXISTING AND ALTERNATIVE FACILITIES LOCATION WITH SURFACE WATER AND GROUNDWATER MONITORING LOCATIONS AT LANDUSKY MINE

EXHIBIT 2

LAND-FAC