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ENVIRONMENTAL
QUALITY COUNCIL

August 19, 1992

Dear Reader:

The Draft Environmental Assessment (EA) prepared by the Department of State Lands (DSL) is enclosed for your review. The EA evaluates a closure plan for the W. R. Grace tailing impoundment in Rainy Creek near Libby, Montana. The closure plan presents an alternative flood routing plan for Rainy Creek, which is an amendment to the approved reclamation plan.

Public comment on this Draft EA will be received by DSL until 5:00 p.m. September 15, 1992. Comments should be made about the adequacy of the EA in addressing issues, new information not considered in the EA that may influence the analysis and clarification. Comments should be specific. The DSL will use public comments, answers to the comments, the EA, and the company's application to make a final decision on the project. The decision may be to deny the proposed action, approve the proposed action, or approve the proposed action with modifications.

A public meeting is scheduled for the First National Bank Community room on September 3, 1992, 7:00 p.m. Verbal and written comments will be accepted at the meeting or can be called in or mailed to:

Bob Winegar
Montana Dept. of State Lands
Capitol Station
Helena. MT 59620

Phone 444-2074.

Thank you for your time and consideration. Please call if you have any questions.

Sincerely,

Bob Winegar

Robert C. Winegar, Program Supervisor
Hard Rock Bureau
Reclamation Division

DRAFT ENVIRONMENTAL ASSESSMENT

for

W. R. Grace
Vermiculite Mine Closure Plan
near Libby, MT

OPERATING PERMIT 00010

PREPARED BY:

DEPARTMENT OF STATE LANDS
HARD ROCK BUREAU
HELENA, MONTANA

PURSUANT TO THE
MONTANA ENVIRONMENTAL POLICY ACT

August 19, 1992

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CHAPTER I - INTRODUCTION

A. Proposed Action

W. R. Grace & Company (W. R. Grace) closed its western vermiculite mining operation at Libby, in Lincoln County, MT in September 1990 (Figure 1). It has been dismantling its operational buildings and reclaiming the disturbed acreage since that time. The vermiculite mine has been operating since 1972 under Montana Department of State Lands (DSL) Operating Permit 00010 with a reclamation plan that was approved at that time. A total of 1200 acres of patented mining claims were permitted of which 865 were disturbed. No public lands on unpatented mining claims are involved in this project.

The proposed plan amends the approved reclamation plan by routing Rainy Creek and Fleetwood Creek over the impoundment surface rather than permanently diverting the streams around the impoundment disturbance area (Figure 2). The quantity of water to manage from a massive storm is calculated to be several thousand cubic feet per second. The investigation of designs for successfully handling such a large quantity of water has suggested that other alternatives, using the storage capacity of the tailings impoundment might provide a safer and more effective resolution of this problem. The reasons for this conclusion are discussed in the sections which follow. In addition, the mining company has supplied preliminary design specifications for the tailings impoundment, inlet channel, control structure, outlet channel, and emergency spillway (Figure 3). DSL must determine whether to approve, approve with modifications, or deny the proposed reclamation plan. W. R. Grace would like to complete all reclamation and closure requirements during 1992, and obtain bond release for the entire project area and facilities, including the tailings impoundment as soon as possible. DSL would approve, approve with modification, or deny W. R. Grace's proposed rerouting of Rainy Creek.

B. Purpose and Need for Action

The reclamation plan approved in 1972 was very conceptual and lacked specifics required under today's regulations and policy. This is especially true with regard to the tailings impoundment and stream channel diversions around the disturbed areas. Thus, W. R. Grace submitted a final revised reclamation closure plan for the tailings impoundment in April 1992 (Figure 3). In the closure plan, the mining company has done hydrologic evaluations and flood routing alternatives for the impoundment as well as detailed geotechnical evaluations including earthquake risk assessment (Vahdani, 1992; W. R. Grace, 1992). This plan is available, at the Department of State Lands Office in Libby and Helena, for public review and is summarized in Chapter 2.

Regulatory agencies including the Montana Department of State Lands (DSL); Department of Health & Environmental Sciences, Water Quality Bureau (WQB), Air Quality Bureau (AQB), and Solid and Hazardous Waste Bureau (SHWB); USDA Forest Service; Montana Department of Natural Resources and Conservation, Dam Safety Section (DSS); and the Lincoln County Board of County Commissioners as well as the general public have raised potential issues concerning the

environmental impacts of mine closure.

DSL must review the closure plan and preliminary design specifications and evaluate them for compliance with the Metal Mine Reclamation Act (Title 82, Chapter 4, Part 3 et seq. MCA). DSL must identify issues and develop possible mitigations and alternatives through the review process. In addition, the closure plan must be approved by the DSS since the dam has been classified as a "high hazard" structure (Foster, 1981). "High hazard" does not imply problems with the structure, but indicates a highway and the Kootenai River are downstream from the impoundment. This could result in loss of life if a catastrophic flood would occur. All decisions must be collectively considered under the Montana Environmental Policy Act (Title 75, Chapter 1, et seq. MCA.)

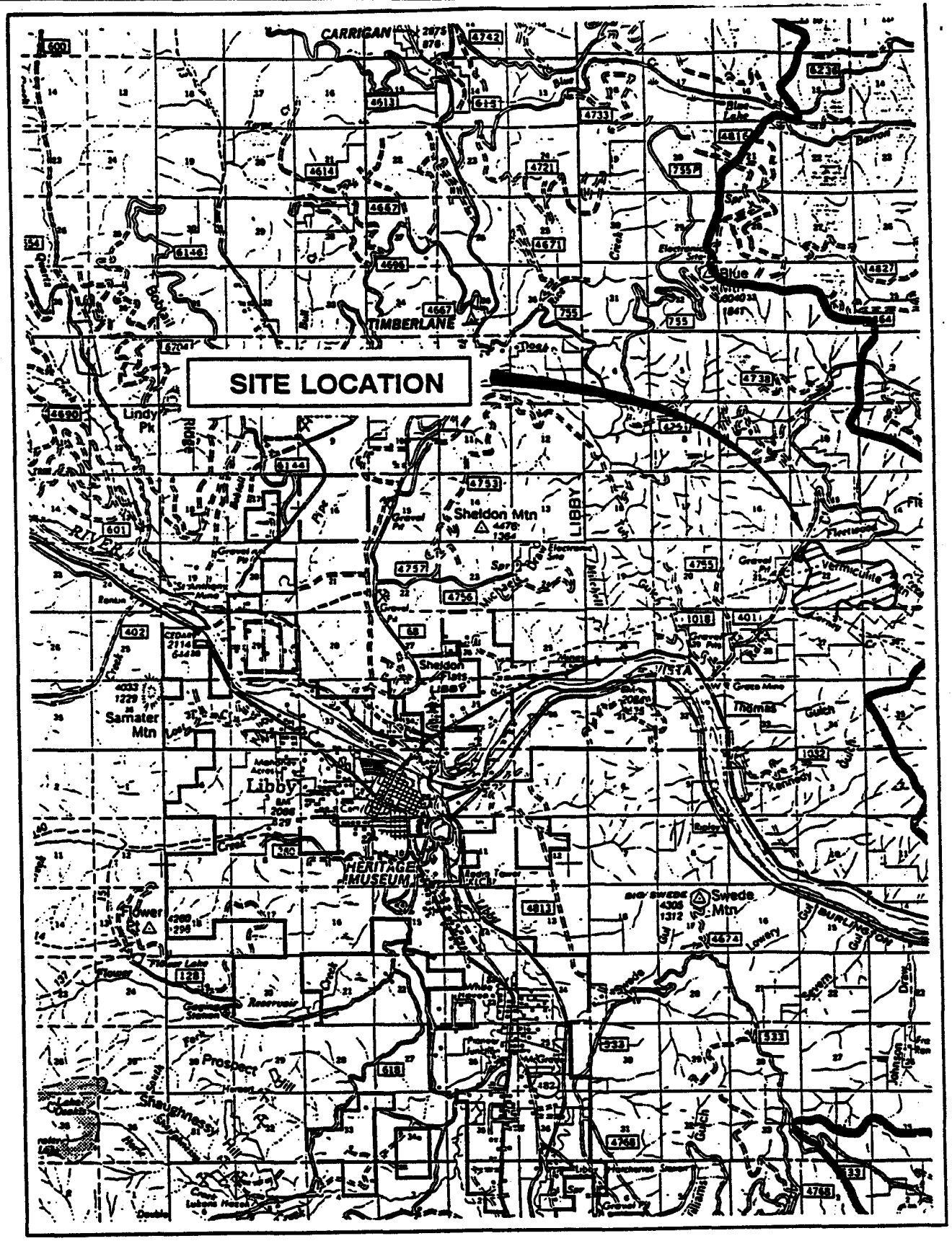

FIGURE 1. Location of W. R. Grace western vermiculite mine near libby, MT.

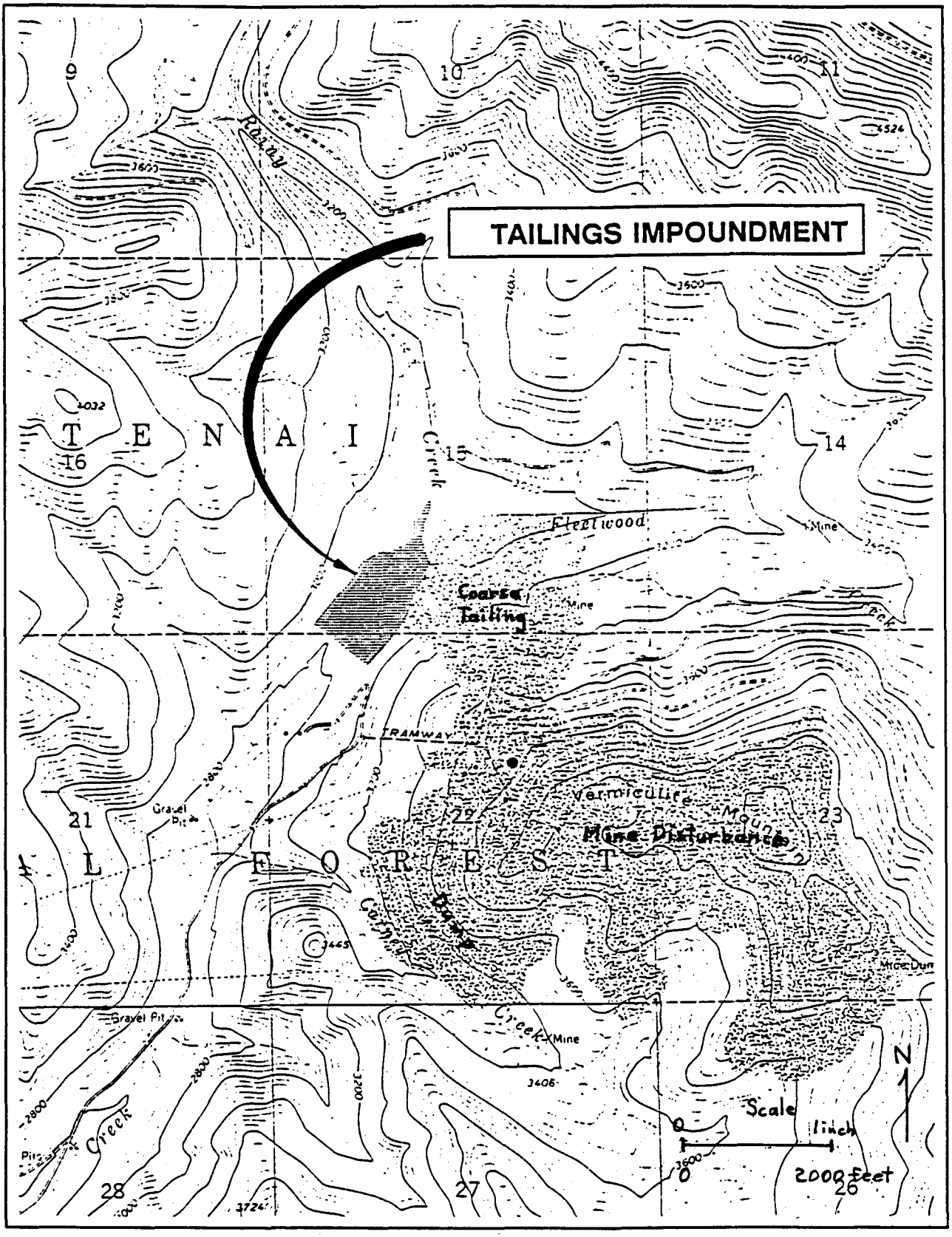

FIGURE 2. **W. R. Grace Vermiculite Tailings Impoundment. USGS Vermiculite Mountain, Mont Quadrangle, Lincoln Co.**

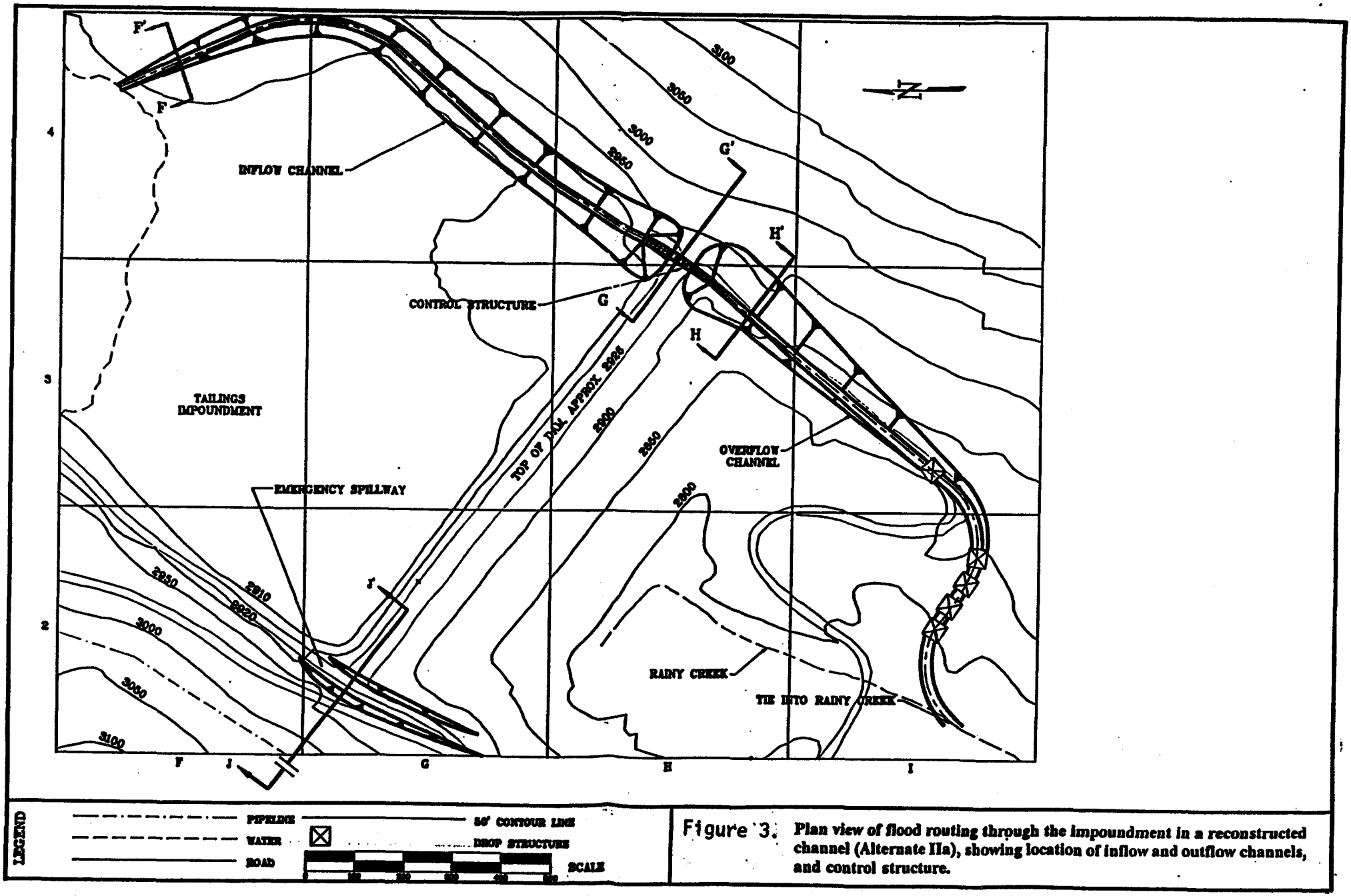

Figure 3. Plan view of flood routing through the impoundment in a reconstructed channel (Alternate IIa), showing location of inflow and outflow channels, and control structure.

C. Background

Vermiculite Mountain has been mined since the 1920s. Vermiculite Mountain has long been the subject of mineral exploration because of the unique geology of the area. However, vermiculite production has been the only economically viable operation there. Mining was done as early 1890 but the first large scale activity was begun by the Zonolite Company beginning in the mid 1920s. W. R. Grace acquired the Zonolite Company in 1963 and continued to operate as the Zonolite Division of W. R. Grace. The first beneficiation process used an air separation method to process ore into a high grade vermiculite product. This process tended to produce high dust levels which took on increased significance with the recognition that asbestiform fibers could lead to certain kinds of lung disease. The ore body has occurrences of tremolite which is classified as an asbestiform (asbestos-like) mineral. The process was converted to a wet process to reduce dust production during processing.

The W. R. Grace Mine came under the jurisdiction of DSL following the enactment of the Mental Mine Reclamation Act in 1971. In 1971 W. R. Grace undertook a major expansion to increase capacity and improve the beneficiation process. It was at this time that the tailings impoundment was built to provide for settlement of the fine tails produced by the new process and to recover water for reuse (Foster, 1981; Boettcher, 1963; and Lewis, 1971). The dam was designed and constructed in stages, with the 50 foot high (elevation 2830') starter dam constructed in 1971, immediately downstream of an older, existing dam. Additional construction phases in 1975, 1977, and 1980 have raised the top of dam elevation to 2925', for a total height of 135 feet measured from the downstream toe.

The vermiculite tailings impoundment is part of W. R. Grace's Construction Products Division vermiculite operations (Figure 2). The tailings impoundment encompasses approximately 70 acres within the drainage basin(s) of Rainy and Fleetwood Creeks. The site is located approximately seven miles east northeast of Libby, Montana, within the SW 1/4 of Section 15, and the NW 1/4 of Section 22, Township 31 North, Range 30 West, Lincoln County, Montana. The site is accessed by State Highway 37, and USFS Road No. 401, the Rainy Creek Road. The impoundment lies entirely within patented mine property owned by W. R. Grace and Company. Surrounding public land is managed by the USDA Forest Service, Libby Ranger District.

At the peak of operations, ore was processed at the rate of approximately 2,000,000 tons per year. Declining market conditions forced a gradual reduction in plant production from over 200,000 tons per year of product to less than 100,000 tons per year. In the fall of 1990, a decision was made to permanently close the facility because of the declining markets. Since 1990, the tailings impoundment has not received fine tails directly from the operations. However, small amounts of tailings from adjacent coarse tailings disposal areas continue to enter the reservoir through natural erosion processes, primarily surface runoff.

The tailings impoundment is located immediately below the confluence of Rainy Creek and Fleetwood Creek. After leaving the mine property, Rainy Creek flows toward the southwest and enters the Kootenai River about 2 1/2 miles downstream of the impoundment, and about 5 1/2

miles upstream of Libby. The Kootenai River is a tributary of the Columbia River. The catchment area above the impoundment is 9.4 square miles (sq. mi.), of which 5.9 sq. mi. is drained by Rainy Creek, and 3.5 sq. mi. is drained by Fleetwood Creek. The two flows enter the impoundment from the north and east, respectively.

Existing outlets from the impoundment consist of a decant tower and a chute spillway constructed of half-sections of 8 foot diameter corrugated metal pipe (CMP). Normal flows from Rainy Creek are currently diverted around the impoundment through a CMP pipe constructed of 48 and 52 inch diameter sections, re-entering the original channel approximately 800 feet downstream of the dam. All existing outlet and diversion structures will be removed as part of final closure.

D. Land Status

Ownership of the mine and impoundment area is W. R. Grace. The access road along Rainy Creek is owned by Lincoln County, U.S. Forest Service, and W. R. Grace. Only a small portion of the road is in the operating permit boundary.

E. Public Participation

Public participation is an important part of an environmental assessment. The Montana Environmental Policy Act (MEPA) (Title 75, Chapter 1, Section 101 et seq.) and its rules and regulations (ARM 26.2.601-663) directs DSL to disclose the effects of proposed mining related actions to the public and to officials making decisions concerning the proposal. The Public Participation Act (Title 2, Chapter 3, Section 103, MCA) and its regulations (ARM 26-81-701 et seq.) also apply. The degree of public participation required is judged by public response to the legal notice, past history of public involvement with the project, and by specific letters expressing interest in the project. Public notice of receipt of the application was published in the Libby newspaper on April 22 and 29 and May 6, 1992.

In addition, DSL sought public and other agency input to help identify environmental issues and concerns about W. R. Grace's proposed action through the process called scoping. The legal notice solicited comments on the proposed action. Several meetings and phone calls with other agencies in May 1992 were also held during the completeness review to identify potential issues involving the closure. An interdisciplinary team of DSL, DNRC, and DHES personnel was set up to prepare this EA. All discussions with agencies and the general public are documented in a DSL planning file about the proposed W. R. Grace closure plan. Issues and concerns raised by the public and the agencies are described below in Section G.

F. Agency Roles and Responsibilities

1. Montana Department of State Lands

The Department of State Lands (DSL) administers the Metal Mine Reclamation Act (MMRA) Title 82, Chapter 4, Part 3, MCA. The purpose of the act is to recognize and protect the

usefulness, productivity and scenic values of the lands and waters within the state and to reclaim the lands used for mining to comparable stability and utility for beneficial uses. The act and its rules and regulations (ARM 26.4.101 et seq.) set forth the steps to be taken in the administration of an operating permit and modification of its operating plan and reclamation plan over the life of the mining operation.

The Commissioner of DSL must decide whether to approve W. R. Grace's impoundment closure plan as proposed, approve the application subject to stipulations and/or with modifications, or deny the closure plan as proposed as required by MMRA.

DSL's rules and regulations (ARM 26.2.601 et seq.) implementing the Montana Environmental Policy Act (MEPA) Title 75, Chapter 1, MCA, require preparation of an environmental analysis of the impacts of the proposed changes and alternatives. The purpose of this EA is to:

a. Ensure that the agency uses the natural sciences and social sciences and the environmental design arts in planning and decision making.

b. Assist in the evaluation of reasonable alternatives and the development of conditions, stipulations or modifications to be made as part of a proposed action;

c. Determine the need to prepare an EIS through an initial evaluation and determination of the significance of impacts associated with a proposed action;

d. Ensure the fullest appropriate opportunity for public review and comment on proposed actions, including alternatives and planned mitigation, where the residual impacts do not warrant an Environmental Impact Statement (EIS);

e. Examine and document the effects of a proposed action on the quality of the human environment, and provide the basis for public review and comment.

2. Montana Department of Health and Environmental Sciences (MDHES)

a. Air Quality Bureau (AQB)

The Air Quality Bureau of MDHES administers the Clean Air Act of Montana, Title 75, Chapter 2, MCA. Any mining or milling project that emits more than 25 tons per year (tpy) of any pollutant must obtain an air quality permit.

The W. R. Grace operations had an Air Quality Permit specifically for the milling operation. The milling operation is now dismantled, so the permit no longer applies. General air quality provisions that applied to the mining activities while the operation was active, will apply to any current and future activities at the site, specifically, reasonable precautions must be taken to control fugitive dust emissions.

b. Solid and Hazardous Waste Bureau (SHWB)

To clarify agency roles and responsibilities, the AQB deals with the issue of public exposure of airborne pollutants, such as asbestos, resulting from mining operations. In contrast, the Montana Department of Labor and Industry, Safety Bureau, and the Federal Mine Safety and Health Administration (MSHA) regulate occupational exposure to airborne pollutants for mine employees. The issue of airborne asbestos exposure to the general public resulting from use of the access road to the Rainy Creek drainage has been raised in recent years. The MDHES Solid and Hazardous Waste Bureau (SHWB) has been asked to review the potential threat of asbestos to the general public along the access road. If a potential hazard is identified, the SHWB could use Montana's State: Comprehensive Environmental Compensation and Response Act (CECRA) (Title 75, Chapter 10, Section 701-724, MCA), to develop a cleanup plan to reduce the risk of asbestos exposure to the public.

c. Water Quality Bureau (WQB)

The MDHES Water Quality Bureau (WQB) is responsible for administration of several state statutes including the Public Water Supply Act (Title 75, Chapter 6 MCA), Sanitation and Subdivisions Act (Title 75, Chapter 4, MCA) and the Water Quality Act (Title 75, Chapter 5, MCA). The WQB also administers several sections of the Federal Clean Water Act pursuant to the Montana-Environmental Protection Agency (EPA) Agreement. The State of Montana, through the WQB, has been delegated authority for administration of the Nonpoint Source Pollution Program (319), National Pollution Discharge Elimination System (NPDES), and Water Quality Standards (CWA, section 307).

The Water Quality Act (WQA) provides a regulatory framework for protecting, maintaining and improving the quality of water for beneficial uses. Pursuant to the WQA, the WQB has developed water quality classifications and standards, and a permit system to control discharges into state waters. Mining operations must comply with Montana surface and groundwater regulations and standards.

The WQB, in conjunction with DSL and W. R. Grace has initiated a water quality monitoring plan to identify potential water quality impacts resulting from W. R. Grace's operations. As monitoring continues, the WQB will identify potential water quality problems, determine the need for discharge permits, and set water quality discharge standards that W. R. Grace must meet.

3. Montana Department of Natural Resources and Conservation (DNRC)

a. Dam Safety Section (DSS)

The DNRC, DSS of the Water Resources Division, has reviewed the W. R. Grace impoundment closure plan with DSL. Upon completion of dam closure construction, regulation of the impoundment structure will transfer from DSL to the DNRC. The DNRC will administer the dam in accordance with the Montana Dam Safety Act (Title 85, Chapter 15, Section 101-502, MCA).

Under State of Montana regulations for Dam Safety, Rule 36.14.206 (State of Montana, 1989):

(1) "...hazard determination shall be based on the consequences of dam failure--not the condition, probability, or risk of failure. A dam must be classified high-hazard if the impoundment capacity is 50 acre-feet or larger and it is determined that a loss of human life is likely to occur within the breach flooded area as a result of failure of the dam."

(3) ".. the effects of flood inundation... will continue downstream until the flood stage is equal to that of the 100 year floodplain.", and

(5) "Loss of life is assumed to occur if the following structures are present: . . . . other paved highways...".

Under Rule 36.14.502:

(1) "Spillways (principal and emergency) for high-hazard dams must safely pass the flood calculated from the inflow design flood. The minimum inflow design flood is expressed as a fraction of the probable maximum flood or as otherwise indicated in Table A" **(See Table 2.6 in Chapter 2),**

(2) " The minimum inflow design flood shall be the 100-year 24-hour flood",

(3) " .routing of the inflow design flood through the reservoir shall assume storage contents to be at the emergency crest elevation prior to routing",

(4) "...breach area... is designated as Category A if... major repair or alteration of the emergency spillway is to be performed where the downstream hazard contains more than 20 residences and the failure flood wave is less than 4 hours from the dam to the first residence",

(5) "...breach area.... is designated as Category B if the dam is an existing dam not meeting the criteria for a Category A dam".

The structure has been determined to have a classification of "high hazard." "High hazard" indicates that the impoundment is 50 acre-feet or larger, and in the event of a clear-weather breach of the dam, the ensuing flood wave would or could likely result in a loss of life.

The DNRC Dam Safety Section will require the owner of the dam to have an approved operation permit prior to the end of construction. An operating permit requires the development of three documents: an operation plan, maintenance plan, and an emergency action plan (EAP). The DSS will assist in the development of the owner's EAP by developing the downstream flood inundation maps. W. R. Grace has applied for a hazard classification determination, which may change the "high hazard" classification. The DSS will determine the renewal period of the

operation permit, however the permit will be valid for no more than five years.

The DNRC, Dam Safety Section does not require bonding to maintain an impoundment. The owner of the impoundment is liable for criminal penalties if the structure is not maintained in accordance with the DSS operating permit and it fails resulting in a loss of life.

G. Issues

This section of the EA summarizes issues raised during scoping. Issues are unresolved concerns. Some issues fall outside of the scope of analysis for this document and have been dismissed. Only issues related to specifics of the amendment to the impoundment closure plan and its possible effects will be analyzed in this EA.

1. Topography and Geology[1]

a. Impoundment

What is the stability of the impoundment in case of a major earthquake? What is the seismicity force that should be designed for in this area? The issue of impoundment stability is carried forward in the EA.

b. Carney Creek Waste Rock Dump Stability

In 1971, ore reserves and waste rock volumes indicated that enough volume of rock would be generated over the projected 100 year life of the mine to fill the entire Carney Creek drainage. Because of mine closure in 1990, the waste rock dump will not be completed.

The waste rock dump has inherent stability problems due to the structure of the ore and waste rock. The dump is currently standing at the angle of repose (1¼-1½ h:1v.). This is the permitted angle the waste rock dumps were to be reclaimed at in the original operating permit 00010 approved in 1972.

As a result of mass wasting, the waste rock dump toe has encroached on the Carney Creek stream channel. The slumping of waste rock has forced the creek to cut a new channel through the coarse waste rock that has rolled to the bottom of the drainage in the end dumping process used to form the waste rock dump. The mining company has begun initial attempts to revegetate the waste rock dump to enhance stability and to provide for drainage away from the dump.

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[1] Note: the issues of water quality and tailings dam stability were addressed in separate investigations by the company, titled "W. R. Grace Vermiculite Mine Closure Water Quality Monitoring Plan" (Hudson, 1991) and "Geotechnical Evaluation, W. R. Grace Dam, Rainy Creek, Montana" (Vahdani, 1992) respectively.

DSL has determined that any attempt to remove waste rock from the stream bottom and reestablish the original stream course would only accelerate the mass wasting process by unloading the toe of the developing slump. Therefore, W. R. Grace would continue the revegetation and drainage control processes and monitoring of the movement in the dump. W. R. Grace would also be required to maintain the sediment control pond below Carney Creek until DSL has adequate assurance that the mass wasting has been stabilized to a large degree. Bond would be held by DSL to maintain the sediment, erosion and drainage control systems until Carney Creek has stabilized and stops producing sediment because of mass wasting of the dump.

Erosion and drainage control is also being maintained on other waste rock dump complexes on the mine site. In case of continued erosion, slumping or other stability problems, DSL may revisit the reclamation plan at some future date under MMRA (82-4-337 MCA). The issue of dump reclamation will not be carried through this EA.

2. Hydrology

The tailings impoundment was constructed in 1972 and specifics about the closure plan were not detailed at that time. In 1992, W. R. Grace provided a plan that identified three flood routing alternatives. Major questions (issues) were raised by the public and the agencies in the scoping process.

What is the size of flood that the impoundment should be designed to pass that adequately assures public health and safety? What other features could be designed into the impoundment at closure that could increase the flood sizing?

What construction is necessary?

What is to be done to direct the flood through the impoundment area and to divert Rainy and Fleetwood Creek flows around or through the impoundment area?

How would long-term maintenance of the impoundment be addressed? Are long-term maintenance and replacement of impoundment structures bonded?

a. Water Quality

Water quality issues include the effects of sediment/asbestiform material in Rainy Creek below the impoundment, the effect of petroleum products in water and fish in Rainy Creek from the milling operation, and the need for a water quality discharge permit (MPDES) for the impoundment.

The determination of need for a water quality permit will be made by the DHES's Water Quality Bureau. This EA will evaluate the effects of the proposed reclamation plan on the water and fish in Rainy Creek.

Based on the results of the monitoring program, the WQB will identify water quality parameters of concern, establish discharge limits for various water quality parameters from the impoundment, and determine the need for a discharge permit. If problems are identified based on the monitoring, DSL will cooperate with the WQB to identify what measures need to be taken to resolve the issues.

Water quality impacts are addressed in the EA, especially those dealing with erosion and sedimentation.

Tailings were deposited in Rainy Creek below the impoundment before 1970 prior to the enactment of the metal Mine Reclamation Act. Commentors asked DSL to consider stream improvements below the impoundment as part of the closure plan. The area containing the historic tailing is outside the permit boundary and DSL has no authority to require W. R. Grace to implement any measures to prevent sediment transport from the historic tailings in Rainy Creek. However, DSL will evaluate which alternative impoundment diversion design would likely result in the least volume of downstream sediment.

3. Air Quality

The W. R. Grace orebody contains asbestiform material (tremolite). The presence of an asbestiform mineral associated with the vermiculite ore body was identified as a significant health hazard a number of years ago primarily through occupational exposure. Former employees have contracted asbestos related diseases through occupational exposure at the mine site. The current air quality concern at this site relates primarily to wind erosion of tailings and other dust from disturbed or exposed areas as well as from road dust emissions.

a. Access Road Dust

Public exposure to airborne tremolite resulting from access road dust has been identified as a public health concern. The access road cuts through geologic materials that contain asbestiform material (tremolite). The most controversial issue raised by the public and the agencies since W. R. Grace announced closure of the mine has been the potential threat of asbestiform mineral exposure to the general public who may use the Rainy Creek road outside the permit area.

The Rainy Creek road is owned and authorized by Lincoln County, W. R. Grace and the US Forest Service. Only a small portion of the road is in the operating permit boundary. The state air quality rules stipulate that the person (entity) authorizing the use of the road must control emissions from the road.

Samples have been collected by the mining company and the agencies identifying varying levels of asbestiform materials on the road surface. At least in some places, the native surface materials, as indicated by samples taken out of the road cut surfaces, contain asbestos. Also, waste material from the mining operation was apparently used to "sand" the road surface in the wintertime.

b. Dust from the 850 Disturbed Acres in Permit Area.

DSL has reviewed the potential threat of asbestos exposure from fugitive dust emissions from the mine site. As discussed above in Agency Roles and Responsibilities, W. R. Grace is still subject to controlling fugitive dust emissions on all current and future activities at the mine site as required by the Air Quality Bureau (AQB). Dust control on the 850 acres disturbed is dependent on successful revegetation.

4. Revegetation

Old mine waste rock and tailings have naturally revegetated in areas where they have not been continually disturbed. The mine waste rock is inherently infertile, but supports vegetation. The area receives over 30 inches of precipitation per year.

W. R. Grace has been revegetating some of the mine pit benches since the mid-1980s. Almost all of the areas disturbed by mining have been seeded. Some areas have had trees planted. W. R. Grace will continue to revegetate until they secure bond release from DSL.

DSL will continue to monitor revegetation success. W. R. Grace will have to maintain erosion and sediment control systems in place until revegetation is adequate to control erosion. Noxious weed control efforts by W. R. Grace are ongoing.

Overall reclamation/revegetation success is not considered an important issue in this EA by DSL. Past revegetation efforts have been successful to date. The reclamation plan can be modified by DSL at any time when field investigation identifies a potential problem as per MMRA (82-4-337-MCA). Monitoring will continue as long as it is necessary. Therefore, reclamation/revegetation success has been dismissed as an issue in this EA.

5. Wildlife - Threatened and Endangered Species/Sensitive Species

Comments on the closure plan questioned the potential effect that a dam breach would have on sensitive fish species in the Kootenai River, namely bull trout and sturgeon.

The company has proposed an alternative that limits the potential for a dam breach and as a result limits the potential for downstream sediment/asbestiform mineral losses to the Kootenai River. The majority of asbestiform material deposited before 1972, downstream from the impoundment, is not subject to the Metal Mine Reclamation Act.

6. Bonding

Another issue, raised during this review was whether a permanent trust fund was needed for long-term compliance with reclamation, air, and water standards. No long term air, water or reclamation issues exist within the permit area given that jurisdiction over the impoundment transfers to the Dam Safety Bureau and the road dust recommendations would be coming after

further study.

DSL is holding a surety bond for $467,000 to guarantee reclamation success in case W. R. Grace does not complete its reclamation contract. DSL will hold that bond until W. R. Grace has completed all reclamation consistent with their approved reclamation plan. This includes successful revegetation of the 850 acres which are presently disturbed at the mine site, as well as any new disturbances which would result from the impoundment closure plans.

DSL will hold the bond to maintain sediment control ponds, for weed control, and to reshape washouts and other eroded areas if they occur. Some or all of the bond may be held indefinitely if problems arise. DSL will not release all the bond until monitoring shows compliance with water quality closure and the Dam Safety Section signs off on the construction of the flood control structures and the DSS operating permit is approved. DSL will advertise any proposed bond release in the Libby newspapers, providing the opportunity to comment on reclamation success. This issue is therefore not addressed further in this EA.

In summary, the issues to be carried forward in the EA are:

topography and geology (impoundment stability);

hydrology (flood routing and water quality);

air quality (asbestos hazard); and

wildlife (fisheries).

CHAPTER II - SUMMARY OF PROPOSED ACTION AND ALTERNATIVES[2]

This chapter summarizes the proposed impoundment closure alternatives submitted by W. R. Grace. Alternatives for routing Rainy Creek and Fleetwood Creek include full diversion (Alternative I - The No-Action Alternative) or partial diversion (Alternative III) of the streams around the tailing impoundment and routing the streams through the impoundment (Alternative II).

A. No Action - Alternative I: Full Diversion of Streams Around the Impoundment

Under the no action alternative the Department would deny W. R. Grace's proposed plan for impoundment closure. Therefore W. R. Grace would be required to implement the existing plan, which consists of diverting Rainy Creek around the impoundment.

B. Company's Proposed Action-Alternative II: Routing the Streams Through The Impoundment

W. R. Grace's impoundment is situated on Rainy Creek, immediately below the confluence with Fleetwood Creek, and impounds approximately 9.4 square miles of the Rainy Creek drainage area. W. R. Grace, after evaluating the best method to safely pass a design storm of 0.5 PMF magnitude in a stable manner, while assuring the long-term integrity of the dam, proposed to route the storm through the impoundment using controlled outflow structures.

By using the impoundment to temporarily store peak inflows, outflow volumes can be reduced to a fraction of the 0.5 PMF peak inflow volume.

A design flood of 0.5 Probable Maximum Flood (PMF) was selected as the design flood to be analyzed as described in Chapter 3, B. The 0.5 PMF was calculated at 5838 cubic feet/second (cfs). This flow is comparable to the flow of the Missouri River at the Canyon Ferry Dam for perspective.

Routing the floods through the impoundment using controlled outflow structures provided the safest and most cost-effective method of flood routing for the tailings impoundment while addressing the majority of the regulatory concerns.

1. Flow Channels

The general design approach of W. R. Grace's proposal entails routing all flood flows from both Rainy Creek and Fleetwood Creek into the tailings impoundment, controlling discharge with a control structure, and returning water to Rainy Creek (downstream of the tailings dam) by means of an outflow channel. No diversion structures would be employed. Flows in excess of 0.5 PMF

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[2]Chapters II, III and IV utilize modified text from "Final Report Engineering Analysis of Flood Routing Alternatives" Schafer and Associates, Unpublished Report, March, 1992.

would be handled with an armored emergency spillway. Routing flows through the impoundment provides the safest method of passing major flood events through the impoundment area, while maintaining the long-term integrity of the tailings dam.

Flood flows would enter the impoundment unrestricted and, depending on the discharge rate, would be passed directly through the impoundment and discharged, or temporarily stored in the existing reservoir until discharged. Discharges from the impoundment would be restricted to a design peak outflow by means of a concrete box culvert. Discharges from the control structure would enter a constructed outflow consisting of a rock-lined, trapezoidal channel connecting a series of concrete drop structures. Flows would be returned to Rainy Creek approximately 800 feet below the tailings dam. An inflow channel would be constructed in the tailings in order to connect the impoundment wetland with the control structure. This system would allow W. R. Grace to maintain a relatively constant water surface elevation (in the wetland) to aid in revegetation, and prevent saturation of the tailings dam.

Other work proposed during closure includes removal of the existing water control structures (Rainy Creek diversion, emergency spillway, and decant tower); providing a stabilized Fleetwood Creek channel through the coarse tailings dump; revegetation and other erosion control and surface stabilization measures; and, general reclamation efforts to improve natural aesthetics of the impoundment area.

Figure 3 shows a plan view of the tailings impoundment with the preferred flood routing alternate overlain. Following sections provide greater detail of the proposed closure plan for the vermiculite tailings impoundment.

2. Tailings Impoundment

The tailings impoundment would basically remain as it currently exists with a pond and associated fringe of emergent vegetation (wetland), "beach" area, dam, and inflow from Rainy and Fleetwood Creeks. The flood routing system would be constructed, the existing water control structures removed, and revegetation/reclamation work completed during closure.

Following closure, the pond would be retained as a natural wetland. The wetland would have a water surface elevation of 2904' and would encompass approximately 20 acres in the middle to upper portion of the impoundment. Water depths would range from 0 ft at the water's edge to a maximum of about 7 ft, with an average depth estimated at 2 to 4 feet. The water's edge would remain approximately 700 to 800 feet from the dam creating a "beach" area (between the water's edge and the upstream face of the dam) of slightly less than 20 acres. Revegetation would take place on the entire impoundment area. The estimated boundaries of the wetland, following closure, are represented on Figure 3.

Inflow from Rainy Creek would continue to enter the impoundment from the north. The Rainy Creek diversion structure, located approximately 1 mile upstream of the impoundment, and associated pipeline together with the present emergency spillway and decant tower/pipeline would

be removed. Fleetwood Creek would be restored to a stabilized channel located adjacent to the toe of the coarse tailings dump, and enter the impoundment from the east. Neither flow would be restricted or diverted.

A flood routing control system for the impoundment would be constructed on the lower (dam) end. Details are located in following sections.

3. Inlet Channel

An inlet or inflow channel, from the edge of the wetland to the control structure, would be constructed as part of the proposed flood routing system. In addition to flood routing, the inflow channel would provide passage for low flows through the impoundment to prevent the water surface elevation in the pond from rising, inundating the beach area, and eventually saturating the tailings dam. The inlet channel is shown on Figure 3. The inflow channel would connect the wetland with the control structure. The channel crest elevation (at the edge of the wetland) would be set at 2904' and the crest elevation of the control structure would be set at 2900', making a channel gradient of approximately 0.0038 ft/ft or 0.38%. Maximum calculated flow velocity in the inflow channel would be 5.5 feet per second.

The inflow channel would be a trapezoidal construction with 10 ft wide bottom, and a combination of 2:1 and 3:1 sideslopes. The bottom and sides of the channel (to 7 ft elevation) would be covered with a non-woven geo-textile, followed by a 6 inch bedding layer of "dirty" gravel, and overlain by a 12 inch (minimum) layer of well graded D50 = 411 cobbles with fines (dirty) and seeded. In addition to providing bedding for the cobble channel lining, the dirty gravel would improve revegetation success in the channel and substantially reduce the contribution of tremolite fibers from that portion of the channel. The dirty cobble lining should also improve reclamation success, further stabilizing the channel against storm events. The channel lining would be keyed into the sides of the channel.

The lined portion of the channel would be excavated at a 2:1 slope, with the upper portions excavated at a 3:1. The concept behind this design is that the upper, unlined portions of the slope would have less potential for erosion prior to vegetation becoming established with a flatter slope. Also, vegetation would have a better success rate, and would become established more quickly. Armoring the 2:1 slopes would prevent erosion and flood scour from occurring until vegetation becomes established. Should slope stability or other problems become evident during actual construction, the slopes would be flattened at that time.

4. Control Structure

A control structure would also be constructed through the tailings dam to control discharges from the reservoir, and into the outlet channel below the dam. The control structure would provide a method for safely reducing peak flows during major events while preserving the integrity of the dam and reducing the downstream impact. W. R. Grace has proposed a concrete box culvert to control outflow while preserving the surge capacity of the impoundment for major

storm events.

5. Outlet Channel

The outlet or outflow channel would be constructed as part of the flood routing system, and would carry discharges from the reservoir control structure and return them to the natural Rainy Creek channel downstream of the tailings dam. The outflow channel, constructed on the east abutment, would consist of a heavily armored channel in conjunction with a series of concrete grade control or drop structures. This type of construction would be both functional and aesthetically pleasing, and would quickly return the flows to Rainy Creek. Environmental disturbance would be kept to a minimum. Figure 3 shows the outflow channel in plan view.

The channel would begin at the outlet of the control structure (elevation 2897.6') and tie into the Rainy Creek channel at approximate elevation 2780', with a total length of about 1300 feet. Maximum gradient would be slightly over 0.04 ft/ft (4%), and would be adjusted to "fit" the existing terrain. Maximum drop height of the drop structures would be 12 feet.

A typical cross-section of the of the channel would be trapezoidal construction with a 10 foot wide bottom and 2:1 sideslopes, heavily armored with a minimum of 42 inches of rock rip-rap and underlain with a sand/gravel layer or a non-woven geotextile filter cloth. The rip-rap would be well graded with a minimum size of 3 inches and a maximum size of 36 inches. A 12-foot wide access road would be constructed on the inside berm.

The grade control structures proposed would be straight reinforced concrete drop structures similar to the SCS Type C structures, with a maximum drop height of 12 feet. The drop structures would be placed to utilize existing terrain, and depending on foundation conditions encountered during final design field investigations, some modifications may be required. Approximate drop structure locations are shown on Figure 3.

Construction of the outlet will require a moderate amount of excavation in the hillside adjacent to the east abutment of the tailings dam. With the close proximity of bedrock, portions of the channel will be in weathered or unweathered bedrock, requiring drilling and blasting. Some modification of the designed sideslopes of the outflow channel may be made should final design field investigations indicate the presence of durable bedrock. The intent of the project is to align the channel to maximize the use of the existing terrain and minimize environmental disturbance.

6. Emergency Spillway

An emergency relief spillway would be constructed on the west abutment of the tailings dam, and work in conjunction with the main flood routing system to assure safe passage of storm events exceeding 0.5 PMF. It would be sized to provide additional flood routing capacity within the constraints of maintaining construction within the abutment area of the dam, but without necessitating a relocation of the Forest Service portion of Rainy Creek road. The spillway would be designed to prevent overtopping of the tailings dam for storms with peak inflows of approximately

7700 cfs or 0.66 PMF (35 ft.). Construction of this emergency spillway is not required by regulation, but is proposed as a method of improving public safety. Figure 3 shows the general location of the spillway.

The emergency relief spillway would be constructed adjacent to the west abutment of the tailings dam, and would terminate 300+ feet downstream of the centerline of the dam. The design would prevent damage to the dam by delaying release of the overflows until past the toe of the tailings dam.

A typical cross-section of the of the emergency relief spillway would be trapezoidal construction with a 30 to 35 foot wide bottom and 2:1 sideslopes, armored with a minimum of 36 inches of well graded rock rip-rap.

7. Revegetation

Revegetation of the tailings impoundment area would provide for the re-establishment of plant species for slope stabilization, reduced erosion, utilization of excess water, aesthetic enhancement and self perpetuating vegetation for wildlife. The revegetation plan would include grasses, forbs, shrubs, and trees.

A specific grass mix would be used for reseeding, with each specie selected for a particular advantage that will include fixing nitrogen, production of organic matter, early emergence for soil cover and species with deep root penetration to stabilize the soil and recover water from a greater soil thickness. The tailings impoundment area would be hydroseeded at approximately 24 lbs PLS/acre and 2000 lbs/acre organic mulch where soil conditions permit. The mulch would aid in erosion control, soil aeration, seed germination, seedling establishment, and organic material enrichment. Broadcast seeding would be done on the soft tailings materials which provide poor bearing capacity for hydromulching equipment. An 18-46-0 (N-P-K) fertilizer would be applied concurrently to improve plant growth, color and vigor. All seeding would take place in the spring or early fall.

The lower, wetter portions of the tailings impoundment area are characteristic of riparian sites which naturally promote fast growing native species such as cottonwood, willow, aspen, birch, alder, chokecherry, dogwood, current, serviceberry and wild roses. These species would be planted to utilize excess water on the area surrounding the tailings pond and the beach area. Larger-sized trees are subject to wind-throw and are not recommended for this specific application.

Smaller trees and shrubs would be planted along the side slopes of the tailings dam and excavated channels. Certain provisions of the dam safety law prohibit trees on the face of dams. However, since the impoundment would normally not be holding water at capacity, the use of trees to stabilize the dam face, particularly at the lower elevations, would appear to offer more benefits both aesthetically and structurally than leaving the face of the dam entirely barren. Shrubs would quickly establish a denser cover to protect tree seedlings and new grass. Roots, especially those of woody vegetation, help stabilize banks by holding soil, reduce sediment flow and increases

hydraulic resistance flow.

The coarse tailings dump has already been reclaimed. Dozer basins were installed as catchments for runoff in order to reduce the potential for erosion. The entire coarse tailings area was seeded with a mixture of grasses and clovers. Several thousand trees and native plant species have been planted randomly along the face of the coarse tailings dump and in the dozer basins.

The tailings impoundment is currently used by moose which forage for aquatic vegetation near its edges. The reestablishment of vegetation on other areas of the impoundment would encourage use by deer and elk which are also commonly seen in the area. The use of specific cultural treatments, proper seed selection and a diversity of woody plant material would aid in the re-establishment of vegetation which will have probable long-term soil stabilization and assist in the natural regeneration of a productive forest habitat.

8. Stabilization/Erosion Control

An important constituent of the flood routing system, and other (tailings impoundment) closure activities would be reduction of erosion and long-term stabilization. This is particularly important at this site as the tailings impoundment and coarse tailings dump have limited revegetation making them prone to erosion and other problems. W. R. Grace would exercise best management practices (BMP's) to reduce these concerns.

As described in the above sections, armoring of channels, revegetation, grade reduction (drop) structures, and other methods would be employed to reduce erosion in the flood routing systems. Cut slopes would be a maximum of 2:1 for long slopes, and 1.5:1 with spaced benches for road relocation and other lesser cuts. The emergency spillway would be constructed to release flows past the toe of the dam, and the groin of the dam would be reinforced as necessary.

Fleetwood Creek, now located in a sideslope constructed drainage channel, would be returned to a more natural channel adjacent to the toe of the coarse tailings dump. The channel would be stabilized with natural materials where possible including vegetation, log structures, and other methods to improve geomorphic stability.

The remaining impoundment wetland would improve surface water quality through natural filtration and settling.

9. Other Closure Activities

Other work that will be completed as part of the impoundment closure would be to remove the existing Rainy Creek diversion pipeline, remove and reclaim roads, regrade portions of the coarse tailings dump, and plant trees on the downstream face of the tailings dam (below the level of the tailings).

The final construction activity for the impoundment would be to demolish the decant tower

and plug its outflow piping with concrete.

10. Post-Closure Care

W. R. Grace is committed to proper management of the reclaimed mine property as long as it retains ownership of the property. Arrangements would be made for a full-time custodian to look after the property. Part of the custodian's responsibilities would include periodic inspection of stream routing structures to assure proper operation and structural integrity.

W. R. Grace would close access to the upper mine property. However, situated next to the Forest Service access road, the tailings pond area would be accessible to the public. These areas would be posted for no trespassing. The custodian would provide security for this area to prevent unauthorized access to the property which would assure that initial revegetation efforts are not disturbed by recreational use. The custodian would also be responsible for coordination with regulatory agencies for ongoing monitoring activities.

11. Water Quality Monitoring Program

A program of water quality monitoring was begun in the fall of 1991 by W. R. Grace to develop data regarding current water quality and to monitor the effects of closure activities on future water quality. This program is described in a document submitted to the Montana Department of State Lands, Water Quality Bureau (Hudson, 1991). The program calls for sampling and analysis of Rainy Creek, Fleetwood Creek, Carney Creek and discharges from the tailings impoundment. Monitoring will include heavy metals, although this should not be a problem for this particular mine, and asbestiform fibers. The monitoring will continue for a minimum of three years with provisions for additional monitoring depending on the results of the previous sampling.

12. Maintenance

The construction of channels for flood routing is not expected to be a solution without maintenance requirements. The recommended alternative is what we believe would offer the lowest maintenance requirements and least potential for catastrophic failures. The success of the closure in meeting these goals for the long-term depends on good maintenance practices. W. R. Grace is committed to this maintenance throughout its ownership of the property and would require that it be continued as a condition of any future sale of the property. The plans for maintenance with DNRC would be assigned to the new owner if a sale occurred.

Areas which would require periodic inspection, on at least an annual basis, would be the toe drain piping, box culvert outlet structure, and the constructed channels. Should the toe drains begin to fail and remedial action be indicated to prevent saturation and subsequent erosion of the dam foundations, W. R. Grace would implement appropriate corrective measures. A conceptual design for such remedial action has already been prepared by W. R. Grace. Other structures may also require maintenance or reconstruction from time to time to assure continued functionality according to intended design.

C. Alternative III: Partial Diversion of Flood Flows Around the Impoundment

A partial diversion of flood flows would entail diversion dam(s) and channels designed to intercept and divert flows up to and including a selected design flow, i.e. 10-year or 100-year events. Flows exceeding the design capacity of the diversion dams would be allowed to by-pass the diversion dam through a "blow-out" plug of uncompacted fill placed in an engineered spillway and be routed through the reservoir. The concept behind this alternative would be to provide a system that would combine the advantages of a full diversion system with the advantages of flood routing through the reservoir.

D. Flood Design Analyses

The following paragraphs describe various flood design considerations evaluated in the development of flood routing alternatives over the impoundment.

For the purpose of the conceptual study, W. R. Grace investigated two configurations for the box culvert control structure. These were twin 4 ft. by 6 ft. concrete box culverts (total open area 46.6 square feet), and a single 4 ft. by 8 ft. concrete box culvert (total open area 31.4 square feet). Both structures have an inflow elevation of 2900' and a 2 percent grade. Entrance construction will match adjacent contours.

Calculated peak outflow (26 feet elevation head) from the twin box culverts is 1080 cfs, and 744 cfs from the single box culvert. W. R. Grace then looked at the performance of these outlet structures under several flow conditions including the 100-year storm event and the 0.5 PMF event. Pertinent findings of this analysis are summarized in Table 2.1.

Table 2.1 Flood routing parameters for various routing alternatives.				
Design Flood	Peak Flow (cfs)	Control Structure	Peak Discharge[1]	Peak Water Elevation (ft)
100-Year	460	Twin 4' x 6'	228	2904.0'
0.5 PMF	5838	Twin 4' x 6'	983	2922.6'
0.5 PMF	5838	Single 4' x 8'	731	2925.1'
0.55 PMF	6320	Twin 4' x 6'	1078	2925.9'
0.66 PMF	7750	Twin 4' x 6'	2071[2]	2925.9'
0.66 PMF	7700	Single 5' x 9'	1869[3]	2925.9'

[1] Peak discharge from the proposed control structure.
[2] Includes outflow from a 50 foot wide emergency spillway.
[3] Includes outflow from a 35 foot wide emergency spillway.

1. 100-Year Event

Routing the 100-year, 24-hour event peak inflow of 460 cfs through the reservoir using a crest elevation (beginning of the inflow channel) of 2904' and the single 4' x 8' box culvert for outlet control, produced a peak discharge of 243 cfs and a maximum water surface elevation of 2905.4' at the outlet control structure. With this system,

virtually all of the impounded flows from a 100-year event would drain in less than 24 hours. This demonstrates that the surface water elevation of the impoundment would not rise significantly above the elevation of 2904' during a 100-year event if the twin box culverts are used to control outflow.

This is an important point. Should a 100-year event occur immediately before a 0.5 PMF event, the surface water elevation in the impoundment will remain at the proposed static water elevation of 2904'. Because of this, routing/storage will begin at elevation 2904' rather than the existing emergency crest elevation of 2920' as outlined by the Montana Dam Safety regulations (State of Montana, 1989).

2. Probable Maximum Flood

Various percentages of the PMF event, beginning with a minimum of 0.5 PMF, were calculated to be routed through the impoundment using representative outlet control scenarios, including with and without an emergency spillway.

Routing 0.5 PMF using the twin box culvert control (no emergency spillway) produced a peak discharge of 983 cfs, and a maximum water surface elevation of 2922', or slightly over 4 feet of freeboard remaining at the worst case. This routing was modeled using an initial water surface elevation of 2900', rather than the expected elevation of 2904'. Final water surface elevations are estimated to be about 0.6 feet higher than the model results, or approximately 2922.5'.

Routing 0.5 PMF using the single box culvert control (no emergency spillway) produced a peak discharge of 731 cfs at a maximum water surface elevation of 2925.1', or slightly less than 0.9 feet of freeboard. Again, a beginning elevation of 2900' was used, making the peak elevation slightly higher.

A calculated event with a peak flow of 6320 cfs (approximately 0.55 PMF) was routed through the reservoir using the twin box culverts, and no emergency spillway. This event would produce a peak outflow discharge of 1078 cfs, and a peak water surface elevation of 2926', or approximately 0.1 feet of freeboard.

A fourth model was completed to determine what peak flow the reservoir would safely handle with a 50 foot wide (2:1 sides) emergency spillway channel in conjunction with the twin box culverts. Setting the crest of the emergency spillway at elevation 2922' would allow an event of approximately 7750 cfs (0.66 PMF) through the impoundment without overtopping the dam. Maximum water elevation would be 2926'.

The proposed location of the emergency spillway imposes constraints on the amount of available space to construct the spillway without affecting the existing USFS portion of the Rainy Creek road. In order to avoid impacting the Rainy Creek road, the emergency spillway would be about 35 feet in width. A model was completed using a single box culvert and a 35 foot wide emergency spillway with a crest elevation of 2922'. This system will allow an event of approximately 7700 cfs (0.66 PMF) through the impoundment with a peak discharge (combined culvert and emergency spillway) of approximately 1860 cfs, and a maximum water elevation of 2926'.

The preferred control structure for this conceptual design is a single concrete box culvert with dimensions 4 ft by 8 ft, and an estimated total length of 120 feet (inlet to outlet). This structure would be less prone to blockage by debris and easier to maintain because of its large open area. The control structure would be placed in the east abutment of the tailings dam adjacent to the bedrock, and graded at 0.02 ft/ft, or 2%. Inlet (crest) elevation would be 2900' and outlet elevation approximately 2897.6'. The control structure would outflow directly into the outflow channel.

Peak inflows from large events would enter the reservoir and be temporarily stored until discharged through the control structure at a greatly reduced rate. With a peak inflow of 5838 cfs at 0.5 PMF, and a maximum control structure discharge of 744 cfs at 26 feet elevation head

(distance from free water surface to control structure crest elevation), outflows are reduced by greater than 85%. Stored water would take approximately two days to drain to the 2900 foot elevation.

Every precaution would be taken during final design and construction of the box culvert in the tailings dam to insure against failure and maintain the integrity of the dam. The box culvert will be bedded, backfilled, and compacted following strict specifications. Rip-rap in the apron approach to the inlet of the culvert would be upgraded to compensate for the acceleration of flow as it converges on the opening of the culvert. Provisions would be made for collection of debris before the culvert entry which could be substantial in a major flood. Constant on-site supervision would be provided by a Registered Professional Engineer.

With the reduction in peak discharge, the outflow channel would be considerably smaller and more stable, and flood impact to downstream areas would be greatly reduced as well.

E. Alternatives Dropped From Further Consideration

1. Variations on the Proposed Plan.

a. Common Diversion Dam (Alternate Ia)

Diversion of Rainy and Fleetwood Creeks around the impoundment is the currently approved method of flood routing following closure. Full diversion will entail intercepting and diverting both creeks around the impoundment, and ultimately returning them to Rainy Creek downstream of the dam.

Construction of a common diversion dam across the upper end of the existing impoundment would be required at a location where flows from Rainy Creek and Fleetwood Creek join. The flows would then be diverted around the tailings impoundment through an open channel or pipe constructed adjacent to the impoundment. Once past the dam, a concrete drop chute or other means of elevation reduction would return the diverted flows to Rainy Creek.

A common diversion dam, capable of diverting a 0.5 PMF event while retaining long-term structural integrity, would be very difficult to construct because of the tailings in the impoundment and east abutment. Tailings may not provide a competent foundation for the dam base or abutment, hence significant excavation of the tailings would be required. Conventional construction methods and equipment often fail when working in tailings, making the project costly and with questionable results. Therefore, this variation was dropped from further analysis.

b. Water Level at 2910' (Alternate IIb)

The fine tailings in the impoundment are saturated, unconsolidated, and have little bearing capacity making standard construction methods and equipment difficult to use. Due to the expected difficulties associated with constructing the inflow channel in the fine tailings, a variation

of this alternate was investigated. To reduce the problems of construction in the tailings materials, a low level dike of cohesive (low permeability) material would be constructed across the tailings impoundment, approximately 500 feet from the face of the tailings dam as recommended in the dam stability report (Vahdani, 1992). Located at this distance from the dam the potential impact of standing water on dam foundations is minimal. Top of dike elevation would be approximately 2912' with the water level in the impoundment maintained at 2910', which has been selected as the maximum practical elevation at which water can be maintained in the impoundment without an important loss of storage capacity or increasing the risks associated with saturated tailings dam foundations and sudden failure or breaching of the dike. By raising the water level in the impoundment, the length of inflow channel and subsequent tailings excavation would be reduced and this would reduce construction costs. This alternate provides water cover for much of the tailings and thereby reduces the potential for dust production and also reduces the areal extent of required revegetation.

There are some additional risks with this alternative, however. Should the dike leak, which it may very well do because of the difficulty in getting good compaction of the dike materials on top of tailings and the potential for seepage through the tailings material itself, a drainage channel would probably be needed below the dike. Also, in the event of a major runoff event, one slightly greater than a 100-year storm, the dike would be overtopped resulting in damage to it and to the drainage channel below the dike.

This construction alternative has been dropped from further consideration.

c. Separate Diversion Dams (Alternate 1b)

An alternate would be to construct a diversion dam at the extreme upper end of the impoundment, beyond the extent of the tailings. A separate diversion dam would be constructed for Fleetwood Creek upstream of the coarse tailings dump. Flows from Fleetwood Creek would be delivered to the Rainy Creek diversion by a constructed channel. Both flows would then enter a main diversion channel and be routed around the impoundment as above. Overtopping the dam could cause catastrophic failure of the dam. Dams in a series are not considered to be good engineering practice. Therefore, this alternate has been dismissed.

d. West Abutment Outlet (Alternate IId)

Locating the outflow control structure and channel on the west abutment, and the emergency spillway on the east abutment was investigated as an alternate for returning flows to Rainy Creek downstream of the tailings dam.

The primary advantage of this alternate would be to shorten the inflow channel through the tailings, reducing the extent of specialized construction to build the channel. Because the tailings are not as deep on this side of the impoundment, both the length of the channel excavation and the quantity of material to be removed would be reduced.

The primary disadvantage would be the steeper sideslopes making construction of the outflow channel more difficult, and with questionable long-term geotechnical stability. A concrete drop chute (at considerable cost) or significant excavation of the abutment area may be required. Placing the emergency spillway on the east abutment would require relatively more excavation, partially in undisturbed forest, to get the flow past the toe of the dam before releasing it, reducing visual aesthetics as well. A partial relocation of the Forest Service access road would be required. Due to these engineering and aesthetic draw-backs, and lack of discernable advantages, this construction alternative was eliminated.

e. Outlet Over Dam Face (Alternate IIe)

Constructing an outlet through the center of the dam and down the face was investigated as an alternate for returning flows to Rainy Creek. This alternate would consist of a straight inflow channel through the fine tailings connected to a reinforced concrete control structure and drop chute.

Placing an outlet in the dam face eliminates the need for excavation of either abutment, unless an emergency spillway is desired. The outlet control structure and drop chute would be built as one structure, and tied directly into the existing channel below the dam, eliminating the need for extensive downstream work. Overall, environmental disturbance would be negligible.

There would be an increased possibility of tailings dam saturation and seepage with this option. The zone of influence from the channel will affect a larger area than if it were located adjacent to an abutment. As with the other alternates, lining the channel would eliminate the problem. Long-term geotechnical stability of this system may be questionable, and construction would be moderately difficult on the steep slope.

Other disadvantages are reduced aesthetics, higher construction costs (reinforced concrete) and public safety (straight-walled drop chute and high velocities eliminate any chance of escape).

This construction alternative has been dropped from further consideration.

f. East Side Channel (Alternate Id)

An alternate to a full diversion channel would be construction of an open channel on the east side of the impoundment. The channel would be similar to the west side with a concrete drop chute/plunge pool. Flows would be diverted into the channel at the diversion dam, carried around the impoundment, and returned to Rainy Creek downstream of the tailings dam.

This alternate is <u>not</u> practical due to the proximity of the coarse tailings dump, and presence of shallow bedrock and steep slopes. The beginning section of the channel would be located entirely within the coarse tailings dump which is unconsolidated and geotechnically unstable. Significant design and engineering would be necessary to construct a channel in this material. Further, lining would be required to prevent rapid infiltration and increased foundation

instability. Excavation to natural material would be virtually impossible.

On the lower sections of the channel, the depth to bedrock is generally less than 10 feet (Lewis, 1971) and portions of the drainage sideslopes are very steep. These restrictions, coupled with the required channel size for 0.5 PMF, would require that the channel be constructed partially within the fine tailings. An alternative would be to construct the channel entirely in bedrock requiring extensive drilling and blasting. Either channel location has drawbacks.

Due to the overall drawbacks, this alternative was not considered further.

g. Pipeline (Alternate Ie)

A pipeline, or other closed conduit, was explored as an alternate for carrying full diversion flows around the tailings impoundment. As with the open channels, the entire flow from both Rainy and Fleetwood Creeks would be diverted into the pipeline which would carry this flow around the impoundment and return it to Rainy Creek downstream of the tailings dam. The pipeline would most likely be located on the west abutment, and would eliminate the need for a drop structure.

The primary advantage to a pipeline is the elimination of water loss through infiltration, and associated tailings dam saturation problems. Another advantage is the reduction in public accessibility, with the exception of the pipe entrance.

Disadvantages include size, geotechnical stability, maintenance, and cost. A pipeline greater than 20 ft (diameter) is required to carry 5838 cfs, the exact size depending on shape and material type. To properly install a pipe of this size requires extensive excavation, and specialized construction methods and equipment. Pre-stressed concrete pipe would be the best choice, but with considerable cost. Even with pre-stressed concrete, geotechnical stability may remain a problem, due primarily to the geology and topographic relief of the area.

A safety concern is the entrance into the pipeline, and the closed system preventing quick escape. Installation of a grate, or other barrier would prevent this, but would greatly increase maintenance and the possibility of plugging with subsequent system failure during major events.

Due to questionable stability and the probability of plugging and failure, this alternative was not evaluated in any greater detail.

CHAPTER III - AFFECTED ENVIRONMENT

A. Topography and Geology

The geology of the site is late Precambrian Belt Group consisting of finegrained clastic and carbonate rocks which have undergone various degrees of metamorphism, and are covered with glacial outwash and till (Boettcher, 1963). The tailings impoundment is located on an intrusive rock body called the Rainy Creek stock, of which Vermiculite Mountain and W. R. Grace's mining area is a part. Depths to bedrock range from less than 2 feet to about 25 feet on the valley walls, and from 20 to 45 feet on the valley floor. Portions of the bedrock are weathered and have low strength (Lewis, 1971).

The dam is located in Seismic Zone 2, with a potential for moderate earthquake damage. A study completed by Harding Lawson Associates (Vahdani, 1992) for W. R. Grace, indicates *"....the dam is expected to remain stable during and following the design earthquake"*, and ".....results of our stability analyses indicate that the dam is *stable during both static and dynamic loading* conditions".

Montana is one of the most seismically active states within the continental United States. Earthquakes may occur throughout Montana, but historical records indicate that three regions are most susceptible to seismic activity. These areas, in order of decreasing risk, are the West Yellowstone, Helena, and Polson areas. According to Montana Earthquakes, 1869 - 1979 (Montana Bureau of Mines and Geology (MBMG) Memoir #51 by Qamar and Stickney), magnitude 5 earthquakes are common in the Flathead Lake region, which is approximately 50 miles southeast of the W. R. Grace impoundment site. The region nearer the impoundment has been relatively inactive seismically. The MBMG report indicates that one magnitude 5 earthquake occurred approximately 10 miles southeast of the Rainy Creek impoundment during the 110 year period of record. The epicenter of this quake was apparently not located on a known fault, and may have been related to post-glacial isostatic rebound of the earth's crust, a common cause of randomly located, moderate intensity earthquakes in this region.

According to the MBMG report, most faults in the area show a notable lack of earthquake activity. According to a report on the stability of the proposed ASARCO Rock Creek tailing impoundment, geologic evidence indicates that only the Bull Lake (20 miles from the Rainy Creek impoundment site) and Rainy Creek faults have been active in the past several hundred thousand years (Dames and Moore 1992). Of these, only the Rainy Creek fault shows documented movement within the last 10,000 years. W. R. Grace has prepared a geotechnical stability report for the W.R. Grace impoundment (Vahdani, 1992). This report evaluates Maximum Credible Earthquake (MCE) potential for the impoundment site, and concludes that the strongest ground acceleration which could foreseeably be experienced at the site would be 0.30 g (30% of gravity). This would correspond to either a magnitude 7 quake occurring 13 kilometers (8 miles) from the site or a magnitude 5.5 quake occurring within 1 kilometer (0.62 mile) of the impoundment.

According to W. R. Grace, the impoundment will remain stable (the impounded saturated

tailing material will not liquefy) during such a quake (Vahdani, 1992). Liquefaction potential would be less if the tailings were drained than if they remain saturated.

An earthquake resulting in offset along the Rainy Creek fault would undoubtedly result in structural damage to the impoundment. Repair of the dam face and spillway or diversions would likely be necessary, regardless of the impoundment flood routing closure alternative selected. The issue of seismicity and its effects on the closure plan have been dismissed by DSL as DSS would maintain the oversight of the impoundment regardless of ownership in the future and can address repair and maintenance after an earthquake.

B. Hydrology

Rainy Creek below the W. R. Grace water supply intake to the Kootenai River is classified as C-1 according to state water quality standards. Water classified as C-1 is suitable for contact recreation, growth and propagation of salmonid fishes and other beneficial uses as listed in ARM 16.20.621. Most other surface waters in the Kootenai drainage are classified B-1. The primary difference between the C-1 and B-1 classification is that C-1 waters are not suitable for drinking water purposes.

As with other old mining permits, baseline water quality data is lacking for Rainy Creek. W. R. Grace initiated a water quality monitoring program in 1991 which was reviewed by the WQB and DSL. A preliminary review of the monitoring data indicates that numeric criteria established to protect these water uses are not exceeded. However, the concentration of arsenic, fluoride, iron, asbestiform fibers, and total petroleum hydrocarbons, (TPH) are elevated as a result of point and non-point sources of water pollution associated with the mine.

1. Hydrological Evaluation

a. Hydrological Parameters

In order to properly assess the requirements of the final closure design for the tailings impoundment it is necessary to evaluate the magnitude of streamflows for various levels of probability. W. R. Grace analyzed three storm events. A 10-year thunderstorm event was chosen to represent a condition which might be encountered on a regular basis and which might also be considered as a design parameter for some diversion alternates. A 100-year thunderstorm event was selected principally as the preferred basis for design of a partial diversion alternate, an event which would be exceeded only rarely, thereby, requiring use of emergency provisions on an infrequent time interval. A runoff equivalent to 0.5 of the probable maximum flood (PMF) event was also selected since the requirements for dam safety are based on the PMF. This value was selected in a meeting with the agencies in 1991 as the minimum design event to design for flood routing. There is also a recorded event in the area of a 0.5 PMF event. This event was a three-day general storm. W. R. Grace's analysis is based on a 6-hour thunderstorm event which produces a more intense runoff in a drainage of this size. The methodology for calculation of these design storms is described in the next section.

The Rainy Creek drainage basin is located on a southern exposure of the Purcell Mountains, and is primarily forest covered except for the area disturbed by the mining/milling operations and logging operations. The basin rises from an elevation of approximately 2900 at the surface of the tailings impoundment, to 6040 feet at the top of Blue Mountain. The longest length of channel is about 4.9 miles for Rainy Creek, and about 3.1 miles for Fleetwood Creek. Average channel slopes are 5 to 15 percent, with sideslopes ranging from 5 to 45 percent. Average stream gradients for Rainy and Fleetwood Creeks are 12.2% and 11.1% respectively.

Mean annual precipitation at Libby is 19.4 inches, with 37 percent of it occurring in the months of November through January, and 18 percent falling in the months of May and June. The month having the highest average precipitation is January with 2.42 inches.

Temperature in Libby ranges from an average of 22.4° Fahrenheit (F) in January to an average of 67° F in July. Average annual precipitation at the site is estimated at 30 inches per year (USDA, 1977), and the temperature would be expected to average 3 to 5 degrees cooler than at Libby. Climatological data was obtained from the Libby 1 NE Ranger station.

Soils in the area have been assigned a Hydrologic Soil Classification of "B" by the Soil Conservation Service (SCS). The drainage basin is estimated to have more than 75 percent ground cover of mature forest in good condition, with moderate slopes. Antecedent moisture is considered to be average. A "Curve Number" of 60 is estimated for both the Rainy Creek drainage basin and the Fleetwood Creek drainage basin. SCS Curve Numbers are used in the SCS hydrologic model to classify the drainage characteristics of different types of terrain. To assure a conservative runoff estimate, the curve number was selected slightly higher than normally recommended for forested lands to account for the impact from mining on areas of the Fleetwood Creek drainage and extensive clear cuts in Upper Rainy Creek. A summary of design conditions is shown in Table 3.1.

Table 3.1 Hydrologic parameters for Rainy Creek and Fleetwood Creek drainage areas impounded by the tailings dam.

WATERSHED NAME	AREA (Sq. Mi.)	SCS CURVE NUMBER	AVE SLOPE (%)	CHANNEL LENGTH (ft)	SOIL GROUP
Rainy Creek	5.9	60	12.2	25,870	B
Fleetwood Creek	3.5	60	11.1	16,370	B

b. Design Storms

Runoff from three design storms was used to evaluate flood routing through the tailings impoundment, specifically: 1) a 10-year frequency, 24-hour precipitation event; 2) a 100-year frequency, 24-hour precipitation event; and, 3) a 6-hour probable maximum flood (PMF) (USDA 1985; USDI 1989).

(1) 10-Year Event

A 10-year, 24-hour antecedent storm precipitation of 2.4 inches for Rainy Creek drainage basin was obtained from the National Oceanic and Atmospheric Administration (NOAA) Atlas (U.S. Dept. of Commerce, 1973). Using this precipitation value, a peak runoff for Rainy Creek (65 cfs) occurred 16.3 hours after the beginning of the storm. Peak runoff for Fleetwood Creek (45 cfs) occurred at 14.9 hours. Key parameters for this model are summarized in Table 3.2.

Table 3.2 Surface Water Runoff for a 10-year, 24 hour precipitation event using SCS-Type II rainfall distribution.

10-Year, 24-hour Storm Event				
Watershed Name	Precipitation (inches)	Runoff (inches)	Peak Flow (cfs)	Time of Peak (hours)
Rainy Creek	2.4	0.147	65	16.3
Fleetwood Creek	2.4	0.147	45	14.9
Combined Flows	2.4	0.147	107	15.5

The total runoff hydrograph for the entire watershed area impounded by the tailings dam was obtained by summing the two individual hydrographs, resulting in a peak flow of about 107 cfs occurring at 15.5 hours after the beginning of the event. The total runoff for the affected drainage area is 74 acre-ft, with 46 acre-ft from Rainy Creek, and 28 acre-ft from Fleetwood Creek.

(2) 100-Year Event

A 100-year, 24-hour antecedent storm precipitation of 3.4 inches was obtained from the NOAA Atlas (U.S. Dept. of Commerce, 1973). Using this precipitation value, a peak runoff for Rainy Creek (262 cfs) occurred 15.2 hours after the beginning of the storm. Peak runoff for Fleetwood Creek (204 cfs) occurred at 14.4 hours as summarized in Table 2.3.

Table 3.3 Surface Water Runoff for a 100-Year, 24-hour precipitation event using SCS-Type II rainfall distribution.

Watershed Name	Precipitation (inches)	Runoff (inches)	Peak Flow (cfs)	Time of Peak (hours)
Rainy Creek	3.4	0.489	262	15.2
Fleetwood Creek	3.4	0.489	204	14.4
Combined Flows	3.4	0.489	460	14.8

The total runoff hydrograph for the entire watershed area impounded by the tailings dam was obtained by summing the two individual hydrographs, resulting in a peak flow of 460 cfs occurring at 14.8 hours after the beginning of the event. The total runoff for the drainage area is 245 acre-ft, with 154 acre-ft from Rainy Creek, and 91 acre-ft from Fleetwood Creek.

(3) Probable Maximum Flood

The probable maximum flood (PMF) is the flood expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in a region. Three scenarios are most often considered when estimating the PMF, specifically 1) general seasonal storms (October through June), 2) rain on snow (including snowmelt) and, 3) summer convective thunderstorms. Based on the Hydrometeorological Report No. 43 (HMR 43), "Probable Maximum Precipitation, Northwest States" (U.S. Weather Bureau, 1966), intense local summer thunderstorms of short duration are most likely to produce a PMF event in this region of the United States (east of the Cascade divide and west of the Rocky Mountains).

Using the method outlined in HMR 43 for summer thunderstorms in small drainage basins (<550 square miles), a PMF event is estimated to produce 10.7 inches of precipitation in 6 hours.

Important runoff parameters for this event are summarized in Table 3.4. The peak runoff for a PMF event in the Rainy Creek drainage area was calculated to be 7330 cfs, occurring 5.5 hours after the beginning of the storm. Peak runoff for Fleetwood Creek was calculated at 5884 cfs occurring at 4.5 hours after the beginning of the storm.

Table 3.4 Surface Water Runoff for a 6-hr PMF event (10.7 in.) using a storm distribution hyetograph.

Watershed Name	Precipitation (inches)	Runoff (inches)	Peak Flow (cfs)	Time of Peak (hours)
Rainy Creek	10.7	9.2	7330	5.5
Fleetwood Creek	10.7	9.2	5884	4.5

Combined Flows	10.7	9.2	11676	5.0

The total PMF runoff hydrograph for the entire watershed area impounded by the tailings dam was obtained by summing the two individual hydrographs (Rainy and Fleetwood Creeks), resulting in a peak flow of 11,676 cfs occurring at 5.0 hours after the beginning of the storm event. The total runoff for the drainage area is 4612 acre-ft, with 2895 acre-ft from Rainy Creek, and 1717 acre-ft from Fleetwood Creek.

c. Tailings Impoundment Capacity

The elevation of the top of the vermiculite tailings dam is 2926', with an existing emergency spillway crest elevation of 2920'. The tailings surface elevations range from a low of 2895' just north of the decant tower, to a high of 2914' at the southeast corner of the impoundment. The average tailings elevation is estimated to be slightly over 2900'.

Using the conic volume method to determine the reservoir storage capacity, it is estimated that the reservoir will have a surface area of 68.7 acres and a storage volume of 871 acre-feet measured at the crest of the existing spillway. Approximately 431 acre-feet of storage is available between the existing emergency spillway crest and the dam crest, making the total storage capacity (top of dam) 1302 acre-feet. A tabulation of impoundment capacities as a function of elevation is given in Table 3.5.

Table 3.5 Storage capacity of the tailings impoundment/reservoir.

ELEVATION (ft.)	AREA (acres)	INCREMENTAL VOLUME (acres-ft)	CUMULATIVE VOLUME (acres-ft)
2895[1]	-	-	-
2900	10.4	26.0	26.0
2905	21.0	78.5	104.5
2910	48.7	174.3	271.8
2915	59.7	271.0	549.8
2920[2]	68.7	321.0	870.8
2926[3]	74.9	430.8	1301.6

[1] Lower limit of impoundment.
[2] Emergency spillway crest elevation.
[3] Top of dam elevation.

During the closure work on the impoundment, W. R. Grace propose to remove existing emergency spillway and to construct a new emergency spillway on the west side of the dam. The new emergency spillway would work in conjunction with a proposed primary outlet/control structure to route flows through the reservoir.

d. Dam Safety Requirements

The Rainy Creek Basin Zonolite Tailings Dam, MT-1470 has been rated as large in size and as having a high downstream hazard potential (Category 1), as determined by an inspection and report completed by Morrison-Maierle in 1981 (Foster, 1981). The inspection was conducted in accordance with U.S. Army Corp of Engineers Guidelines for Safety Inspection of Dams, and was completed for the State of Montana Department of Natural Resources and Conservation, under Public Law 92-367. The classification is based on a dam height of 135 feet, and storage capacity of 2120 acre-feet at the spillway crest.

The following conditions influenced W. R. Grace's selection of design criteria for the project:

- the height to the crest of the dam (from the tailings surface) is less than 50 feet;
- the capacity of the reservoir to the existing emergency spillway crest is less than 1000 acre-feet;
- there are no residences between the dam and the Kootenai River, however, a paved highway does exist;
- the impact to the Kootenai River of a dam breach is unknown, but is <u>not</u> expected to exceed the 100-year floodplain at the closest residence downstream;
- the work will be considered to be a major alteration to an existing dam.

Based on these conditions and the provisions in statutes cited in Chapter I, F., the tailings dam is considered to be high-hazard; thus, all other criteria for operations and maintenance of high-hazard dams are applicable. The breach area below the dam is unknown, thus it is assumed to meet the criteria for Category A, Table 3.6. Therefore, the required design flow, as shown in Table 2.6, is 0.30 PMF, or 3504 cfs.

The flood routing volume proposed by W. R. Grace is 0.5 PMF, which converts to a design value of 5838 cfs (0.5 x 11,676 = 5838). This 0.5 PMF value meets the high-hazard design flow criteria and is used during the following flood routing analyses in Chapter IV.

Table 3.6 Emergency spillway inflow design flood(s) from Table A of the Montana Dam Safety regulations, Rule 36.14.502.		
CAPACITY TO THE EMERGENCY CREST / HEIGHT TO DAM CREST	BREACH AREA	
	CATEGORY A	CATEGORY B
Dams less than 100 acre-feet and less than 20 feet in height	2Q	Q
Dams less than 500 acre-feet and less than 35 feet in height	.2 PMF	.1 PMF
Dams less than 1000 acre-feet and less than 50 feet in height	.3 PMF	.15 PMF
Dams less than 12,500 acre-feet and less than 50 feet in height	.5 PMF	.5 PMF
Dams less than 50,000 acre-feet and less than 100 feet in height	.75 PMF	.75 PMF
Dams 50,000 acre-feet and or greater and 100 feet or greater in height	1.0 PMF	1.0 PMF

e. Proposed Design Flows

W. R. Grace proposes to use the flows summarized in Table 3.7 for flood routing through the vermiculite tailings impoundment. Boundary conditions and assumptions follow:

- A 2.4 inch, 24-hour design storm to simulate a 10-year return storm; and 3.4 inch, 24-hour design storm to simulate a 100-year return storm. Both storms are distributed as a SCS Type II convective thunderstorms;

- A 10.7 inch, 6 hour design storm to simulate a probable maximum flood (PMF) event, distributed as a convective thunderstorm according to U.S. Weather Bureau guidelines;

- Soils within the drainage classify as SCS type "B" soil group. The soils contain average in-situ antecedent moisture for the 10-year and 100-year return storms. Soils are considered to be near saturation, with 0.25 inch per hour infiltration for the PMF event;

- The drainage basins are dense forest in good condition, with more than 75 ground cover;

- Curve numbers of 60 are used for both Rainy Creek and Fleetwood Creek drainage

basins.

- The tailings dam is classified as a high-hazard dam according to Montana Dam Safety and U.S. Army Corp of Engineers regulations;

- The required inflow design is 0.30 PMF, based on less than 50 foot dam height (from surface of tailings), less than 1000 acre-feet storage at emergency spillway crest, and a Category A breach area (State of Montana, 1989);

- 0.5 PMF will be used for flood routing analyses and design;

Table 3.7 Design flood volumes proposed for flood routing alternatives analysis and conceptual design.

WATERSHED NAME	10-YEAR 24-HOUR (cfs)	100-YEAR 24-HOUR (cfs)	0.5 PMF 6-HOUR (cfs)
Rainy Creek	65	262	3665
Fleetwood Creek	45	203	2942
Combined Flows	107	460	5838

C. Air Quality

No baseline air quality data exist for the mine site, although air quality in the area is generally good. The issue of asbestiform material (tremolite) in the orebody and along the access road has caused W. R. Grace to initiate monitoring for asbestiform materials. Limited roadside air sampling from 1990 showed low levels of tremolite, generally less than 0.01 fibers per cubic centimeter, which is the EPA clearance level for school asbestos removal projects. There is no ambient air quality standard for asbestos and no baseline air quality information on asbestos levels before mining began. Thus the agencies cannot quantify a change, if any, from background levels. Monitoring is to continue in 1992.

D. Wildlife

No baseline wildlife monitoring data exist for wildlife in the mine area. The impacts of asbestos on sensitive fish species in the Kootenai River was raised in scoping. The agency has proceeded with evaluation of alternatives assuming that minimization of sediment and erosion in flood routing alternative section would minimize potential impacts to the fish in the Kootenai River.

CHAPTER IV - ENVIRONMENTAL CONSEQUENCES

A. All Alternatives

1. Air Quality

a. Access Road Dust

A relative proportion of tremolite would be expected in particulate emissions originating from the road surface at various sample points. The mining company conducted air monitoring in 1990 along the access road. The limited roadside air sampling has shown low levels of tremolite, generally less than 0.01 fibers per cubic centimeter, which is the EPA clearance level for school asbestos removal projects. There is no ambient air quality standard for asbestos and no baseline air quality information on asbestos levels before mining began. Thus the agencies cannot quantify a change, if any, from background levels.

W. R. Grace has initiated another summer of air quality monitoring in 1992. The Lincoln County Board of County Commissioners and the DHES, Solid and Hazardous Waste Bureau are conducting the monitoring for W. R. Grace. After the further investigations are done, if remedial action is determined to be necessary, it could include upgraded maintenance (chemical stabilization), cleanup, resurfacing, or ultimately closure of the road.

The proposed amended impoundment closure plan does not modify the Rainy Creek access road. Asbestos hazard with regard to the road is not fully evaluated in this EA because the studies on the road materials characteristics and air quality monitoring are still underway. DSL will wait until the results of the air quality monitoring are completed before making any recommendations about possible remedial measures along the portion of the access road that is in the permit boundary.

b. Dust From The 850 Disturbed Acres

W. R. Grace has hydroseeded and hydromulched almost all of the disturbed acres on the mine site as part of their reclamation activities. During the construction phase of impoundment closure, W. R. Grace would be required to control dust emissions until reclamation is completed. Past revegetation activities on mine pit benches, mine waste rock and mill tailings indicate dust emissions will not be a problem. Mine roads that will be left for access after mine closure will be closed to the public.

Assuming successful stabilization of the tailings and other exposed areas through reclamation and revegetation, wind erosion and resulting asbestiform emissions should be negligible. On-going success of reclamation will be evaluated by DSL.

DSL will continue to monitor dust emissions from the mine site along with the AQB. If a problem is identified during continuing mine disturbance reclamation, during impoundment closure

construction activities, or if the 1992 air quality monitoring along the Rainy Creek access road identifies a potential hazard exists, DSL will take appropriate measures at that time.

B. Overview of Alternatives

The project called for engineering analysis of available alternatives for routing floods through the area affected by the vermiculite tailings impoundment. Concerns that will be addressed by the analysis are topography and geology including safety of the structure-seismic events and tailing dam saturation, and water quality including contamination from asbestiform fibers and sedimentation.

Three basic options for flood routing have been considered: Alternative I - The No-Action Alternative - diverting all flows, including storms producing PMF events, around the impoundment and dam, Alternative II - Company Proposal - routing flows through the impoundment and discharging through an outlet channel constructed in or near the dam and Alternative III - a partial diversion of "normal" stream flows and routing of events exceeding diversion design flows into the impoundment. Flood routings were modeled using a computer program entitled "Hydrograph Develop Program," developed by the SCS in 1990.

Within each of the alternatives are several design variations called alternates which have been considered. Each main alternative will begin with a general summary followed by description of design concepts, and finally the environmental consequences.

1. Alternative I Full Diversion Around Impoundment - No Action Alternative

Alternate Ic: West Side Full Diversion Channel

Essential Design Features:

- Diversion dam(s) upstream of tailings dam to intercept streams discharge from diversion dams to a design maximum which is routed around the tailings

- Flood routing in large channels around dam

- Large drop chutes for return of stream flow to Rainy Creek below dam

a. Description of Design Concepts

(1) Westside Full Diversion (Alternate Ic)

Although full diversion was dismissed from further analysis because the stability of the diversion dam is at best questionable, the impacts of a west side full diversion channel have been

diversion dam is at best questionable, the impacts of a west side full diversion channel have been evaluated anyway. Should full diversion be selected, the best method for carrying the diverted flows around the tailings impoundment would be an open channel constructed on the west side of the impoundment. The channel would be constructed in natural material (off the tailings), and connected to a concrete drop chute/plunge pool below the tailings dam. Flows would be diverted into the constructed channel at the diversion dam, carried around the tailings dam and impoundment, and returned to Rainy Creek downstream of the dam.

A conceptual design was completed for a 0.5 PMF channel on the west side of the tailings using a beginning channel elevation of 2900', and a gradient of 0.005 ft/ft (0.5%). The structure would be a rock-lined, trapezoidal open channel with 20 ft wide (flat) bottom and 2:1 sideslopes. With a design flow of 0.5 PMF (5838 cfs) and applying Manning's Equation:

$$Q = A\ 1.486/n \times R^{2/3}\ S^{1/2}$$

in which:

Q = volume of flow, cfs
A = cross-sectional area of flow in ft^2
S = slope, ft/ft
R = hydraulic radius, ft
n = coefficient of roughness (0.04 for rock lined channels)

a peak flow depth of about 12 feet is calculated with a velocity of approximately 11 feet per second. With the beginning channel elevation of 2900' and 0.005 ft/ft gradient, the bottom elevation of the channel opposite the dam will be about 2888'. Recommended maximum cut slopes are 2:1, with spaced 10 ft safety benches where possible. The channel would be armored with a minimum of 24 inches of D50 = 18 inch-rock lining to handle the velocities associated with peak flows corresponding to the predicted peak water level.

b. Environmental Consequences of the Full Diversion Alternatives - No-Action Alternative

(1) Topography and Geology

Safety and long-term integrity of any system are directly related, and should be the primary considerations when selecting a flood routing system. The full diversion alternate <u>increases</u> the potential for failure, and <u>decreases</u> the safety of the system. The drop chute and plunge pool, constructed of reinforced concrete, would be difficult to build on the steep slopes occurring in the permit area. Stability of the structure in a massive flood condition would be problematic. Cavitation, the stresses and pressure of running water, is very high in flood condition.

The channels carrying the diverted flows would be very large, and inherently less stable than smaller channels, particularly when constructed into the side of a hill as they would be in this

case. From a hydrologic and geotechnical standpoint, any channel, natural or constructed, located above the low point in a drainage is generally not considered to provide good long-term service, particularly when considering flows of this magnitude (.5PMF or 5838 cfs).

For the west side channels, construction of the drop chute will be costly, and plugging during high flows a primary concern.

The drop chute below the tailings dam would be a large, concrete structure to handle the volume and velocity of the peak flows. Construction on the steep terrain of the west abutment area will be very expensive, and long-term geotechnical stability may be difficult to obtain. Other safety considerations include public accessibility to the large, fast moving flows in the channels and drop chute.

The diversion dams are designed to only collect water prior to routing around the impoundment and would have little useful storage capacity. Should the diversion channels become plugged, or the system fail for some other reason, the flood flows would quickly breach the diversion dams and enter the impoundment. The breach could be rapid, in turn causing a large surge of water to strike the tailing dam. If the tailings dam did not fail from impact, the impoundment would begin to fill and could cut a new channel from the tailings impoundment into the diversion channel, or in an improbable event, could block the diversion channel with debris so badly that overtopping of the impoundment might occur. Either event would bring the potential for extensive uncontrolled erosion of the tailings material. Overtopping the dam could cause catastrophic failure of the dam unless additional precautions are taken.

Full diversion of a 0.5 PMF event (5838 cfs) requires a complex system of very large diversion dams, channels, and drop chute to route the entire peak flow of a storm of this magnitude around the impoundment, and return it to Rainy Creek downstream of the tailings dam. This alternate ignores the potential for flood control in the unused storage capacity of the impoundment. By allowing the reservoir to surge and temporarily store the peak flood flows, outflow peaks can be reduced to roughly 15 percent of the peak inflow (5838 cfs) and still contain a 0.5 PMF event.

Environmental disturbance would be substantial for a full diversion flood routing system, primarily from the massive excavations required to construct the diversion channels and drop chute. Channel lining with an impermeable material is recommended to prevent the complete loss of the smaller summer flows, and reduce potential for dam saturation. In order to construct an engineered channel that would have a reasonable longevity and acceptable maintenance, a large portion of either abutment would be removed, which creates an additional problem, namely, where to spoil the waste.

Relocation of the Forest Service access road at several locations would be necessary.

A drilling program in the tailing and in the dam foundation materials was done as part of a study to assess the stability of the dam and impounded tailings during static and seismic loading

conditions (Vahdani, 1992). The study concludes that the dam is currently safe under seismic load, even with the water at the face of the dam, and will not fail. The study encountered two types of tailings materials which appear to be interbedded and sloping away from the dam face. Elastic silts comprise about 60 percent of the tailing while loose, poorly graded sands and silty sands comprise about 40 percent. The elastic silts are not expected to liquify in a seismic event; however the sands could liquify if they remain saturated. If a section of the dam were to be removed the tailing could be expected to fail, but would maintain a 4:1 angle of repose. The potential for material run-off in the event of a failure would be very limited (Vahdani 1992).

The drilling also indicated that the tailing consolidated with depth and gained significant strength. If the tailing is left without standing surface water, up to 5 feet of surface subsidence is projected in areas of deeper tailing as excess pore water pressure is relieved. The major threat to dam stability would be the eventual failure of the toe drain piping. It would then be possible for the phreatic surface to raise in the dam and possibly begin seeping from the dam face. Should this occur, there would be the likelihood of erosion of the toe and eventual weakening of the dam. Installation of additional piezometers would be required to provide better monitoring and a conceptual design for a permanent drain structure would be retrofitted as required is proposed. Based on the probable hydraulic conductivity of the tailings material, it may be possible to lower the phreatic surface in the dam permanently by maintaining the pond surface approximately 500 feet upstream from the crest of the dam.

W. R. Grace committed to lining the channel regardless of which alternative closure plan is selected. Infiltration could be eliminated by lining the channel with an impervious liner material, possibly HDPE or clay. Depending on the life of the selected material, infiltration would be greatly reduced or eliminated, at least through the life of the liner. W. R. Grace committed to lining the channel regardless of which alternative closure plan is selected.

(2) Hydrology

While water contamination, particularly from tremolite fibers <u>may</u> be reduced by diversion, it would not be eliminated. Constructing a diversion dam to collect both flows simultaneously would include disturbance of a section of the tailings impoundment. In addition, Fleetwood Creek will be flowing through the coarse tailings.

Asbestiform fiber contamination from the tailing impoundment and coarse tailing dump could be reduced by Alternate Ib. This alternate would prevent streamflows from contacting the tailing, however, fibers would naturally continue to enter Fleetwood Creek from the intrusive rock from which Fleetwood Creek originates. Further, Carney Creek, which enters Rainy Creek downstream of the impoundment, would continue to contribute tremolite fibers to Rainy Creek, regardless of the routing alternative selected.

Downstream flooding and erosion are more likely under any Alternative I scenario than under either Alternative II or III. Flood surges are mitigated in Alternative II.

Reduction of downstream sedimentation associated with the tailings would be expected with a full diversion. The surface of the impoundment is currently devoid of vegetation and subject to potential erosion from major storm events despite its relatively low angle of repose because of the small particle size of the fine tailings. Over the next 3 to 5 years, it is anticipated that vegetation will become firmly established on the both the fine and coarse tailings and the potential for erosion will be greatly decreased. Sediment contribution from the tailings should become small.

Disadvantages associated with diversion include the loss of settling and natural filtration associated with some of the other options which provide a wetland in the upper portion of the tailings impoundment. While the impact of sedimentation from tailings materials may be lessened, there is a great potential for increased sedimentation from other sources associated with the massive excavations which would be required for the channels, drop chute, and other diversion structures.

In summary, all variations of Alternative I greatly reduce safety, increase the possibility of system failure, increase environmental disturbance, and increase construction and maintenance costs over other alternatives. Concerns over geotechnical stability, asbestiform fibers, and tailings dam saturation are not eliminated.

(3) Wildlife

Potential sediment contribution from historic tailings in Rainy Creek downstream of the impoundment is higher with a full diversion alternative, therefore increasing potential impacts to sensitive fish species in the Kootenai River.

Advantages (Table 4.1) and disadvantages (Table 4.2) of the full diversion alternates are summarized below in Section C.

2. Alternative II - Channel Construction Through the Impoundment: The Company's Proposed Plan

Options:

- Alternate IIa: Water Level at 2904'
- Alternate IIc: East Abutment Outlet

Essential Design Features:

- Streams enter impoundment and collect in a pond at the upper end with water level kept away from dam for improved stability
- Unused tailings impoundment capacity used for storm surge up to 0.5 PMF

- Lined channel (for erosion control) delivers water to outlet structure at the dam

- Box culvert outlet control structure reduces stream discharge from impoundment during major storm events

- Optional emergency spillway for storms in excess of 0.5 PMF

- Armored channel/drop structures return stream flow to Rainy Creek below the dam

Initial studies of this concept were approached from the standpoint that a 0.5 PMF event could be safely routed through the impoundment and discharged through the dam into a channel or drop structure constructed to withstand such a massive flood event. Large, armored channels similar to those required for a full diversion were the result. These concepts suffered from many of the same stability problems that were cited for the full diversion alternatives. A study of the flood surges and the damping effect caused by the unfilled volume of the tailings impoundment suggested that the most useful feature of this concept is the potential for storing much of the runoff from events comparable to a PMF and releasing it downstream at a much reduced and more manageable volume. The alternative flood routing investigation centered on designs which would take advantage of this as it provided the safest method of passing a flood event equal to or exceeding a 0.5 PMF event, while adequately addressing the majority of the engineering, environmental and geotechnical concerns.

A general concept employed in these alternates is to hold water away from the dam during all but very large runoff events. This principal of design results from the work of W. R. Grace on geotechnical stability of the dam (Vahdani, 1992). The study showed that although the dam would not fail with water at the face even during an earthquake, additional stability and a reduced risk of foundation saturation could be obtained by keeping water back some distance, thereby lowering the phreatic surface at the dam. W. R. Grace considered two concepts for providing this increased level of stability and several options for passing water through the dam face.

a. Description of Conceptual Designs

(1) Water Level at 2904' (Alternate IIa)

This alternate would allow inflows from Rainy and Fleetwood Creeks to enter the impoundment unimpeded. Once in the reservoir, the flows would be temporarily stored, or passed directly through the impoundment with a constructed channel, depending on the volume received. This alternate provides for a water elevation in the impoundment of 2904' which is the <u>minimum</u> practical elevation that can currently be obtained through control at the decant tower. Tailings materials have accumulated to this level at the decant tower.

Discharge from the impoundment would be controlled at the tailings dam by a control

structure, preferably a single concrete box culvert. The control structure would limit outflows to a maximum design flow (about 15 percent of 0.5 PMF). At this design rate the impoundment can receive a 0.5 PMF event without overtopping the dam.

An extensive study of outlet control structures was made before selecting the box culvert design. The control structure must necessarily have a small cross-sectional area if it is to reduce the volume of discharge and fully utilize the impoundment storage capacity. More natural control structures such as open channels were considered but these could only be utilized by sacrificing a large portion of the impoundment's potential storage capacity. Pipelines were also considered as an inexpensive alternative but these presented safety hazards and were judged to be more subject to failure in long-term service.

Outflows from the control structure would be returned to Rainy Creek by an engineered channel armored with a rock rip-rap lining, integrating a series of reinforced concrete drop structures. The channel would be considerably smaller than a full diversion channel, and would be designed to incorporate natural terrain where possible to promote aesthetics and decrease environmental disturbance. Figure 3 shows a plan view of this routing alternate.

An emergency spillway, designed to safely pass flows exceeding the 0.5 PMF without overtopping or causing damage to the dam, could be constructed with this system. The spillway would be located opposite the control structure and outflow channel to prevent interference during use. A conceptual plan of a spillway located at the west abutment is shown on the plan. The spillway would be constructed such that flows are carried past the toe of the dam before released in order to prevent damage to the dam.

(2) East Abutment Outlet (Alternate IIc)

Placing the control structure and outflow channel on the east abutment, and the emergency overflow channel on the west abutment, as shown in Figure 3, is judged to be the best overall alternate for routing floods through the vermiculite tailings impoundment while maintaining structural integrity. Placing the outflow on the east abutment provides the most aesthetically pleasing alternate for returning the flows to Rainy Creek, with the least environmental disturbance of considered alternatives.

The east abutment area can easily be modified to construct the outflow channel without drastically disturbing the area. The outflow channel would be armored with a rock rip-rap lining and integrate a series of drop structures placed to take maximum advantage of the terrain. A natural drainage would be incorporated into the final design to increase aesthetics, and decrease excavation and construction costs.

The emergency spillway, if provided, would be constructed in natural material adjacent to the tailings dam on the west abutment to the extent that it did not interfere with the existing Forest Service road. The area is presently disturbed from mining activities. To protect the toe of the dam, the spillway will carry the flows past the toe before release. The excavated material

would be placed in the groin of the dam for additional protection.

The primary disadvantage of this alternate is the longer inflow channel in the tailings, resulting in higher construction costs to excavate and construct the channel. Some drilling and blasting may be required to construct portions of the outflow channel as well.

b. Environmental Consequences of the Channel Through the Impoundment Alternative.

(1) Topography and Geology

Routing floods through the tailings impoundment provides the best method to safely pass storm events of 0.5 PMF or larger while assuring the integrity of the dam. This concept would take advantage of the temporary storage capacity of the impoundment to reduce outflows while providing safe, effective flood routing.

The existing tailings dam is geotechnically very stable, having been designed to withstand earthquakes of a recommended 5.5 magnitude with no loss of integrity. Temporarily storing peak flows provides a way of assuring minimum risk to the dam. Elimination of upstream diversion dams associated with the other main alternatives reduces risks associated with diversion dam failure.

Because of the storage capacity in the reservoir, and the emergency spillway, risk from debris/plugging would be minimal for this alternative. In addition, several low maintenance structures would be installed to prevent debris from entering the control structure. During peak events, the entrance into the control structure would be submerged to prevent debris from entering into the control structure.

Reduced peak outflows would result in a considerably smaller outflow channel, making escape from the channel easier, hence better for public safety. In addition, the reduced outflows would result in less flood damage to downstream structures, such as the highway.

Topographical disturbance would be minimized with this alternate, especially when compared with full diversion. Much less excavation is necessary.

Saturation of the tailings dam in the immediate vicinity of the inflow channel, and resulting embankment stability should the toe-drains become inoperable, is a primary concern. Because of the low permeability of the fine tailings relative to the dam material, major water loss through infiltration would not be expected to be as severe of a problem as with the diversion channels. Further, the rate of water movement through the fine tailings would be much slower than the dam, as demonstrated by the piezometers installed in the dam face. Water entering the dam from the tailings or channel would be expected to drain relatively quickly, hence reducing the possibility of saturation and subsequent seepage.

As discussed earlier, diverting flows to the side of the impoundment will not eliminate the

possibility of tailings dam saturation. The only sure method of eliminating the risk, from any alternate, is with an impermeable channel or pipeline. Should tailings dam saturation become a problem, construction of an engineered toe drain would be completed by W. R. Grace.

(2) Hydrology

With this alternate, tremolite fibers from the coarse tailings dump, and fine tailings impoundment will continue to impact surface water. However, during normal flow conditions the low gradient of the reconstructed channel and the placement of protective cover in the reconstructed channel would greatly reduce the risk of tremolite entrainment. Also, it is anticipated that entrainment would continually decrease as vegetation becomes established and stabilizes the dump, impoundment, and other disturbed areas. Preliminary data from water monitoring programs indicate that water quality degradation from other mineral constituents would be minimal at this site.

Tremolite fibers would not be eliminated from Rainy Creek, regardless of the alternative selected. Fibers from the headwaters of Fleetwood Creek, from Carney Creek, and in the Rainy Creek streambed downstream of the impoundment, would continue to contribute to fiber counts in Rainy Creek.

Increased sedimentation from the tailings impoundment is expected for a short period of time (estimated at 2 to 5 years) following closure. After that, vegetation will become established and provide slope stabilization, reduced erosion, utilization of excess water, and wildlife forage. Sedimentation associated with channel excavations and other construction activities may also occur for a short time period, but will be negligible compared with a full diversion alternate.

Routing the surface water flows through the impoundment would take advantage of the remaining wetland to improve water quality through natural filtration and settlement.

In summary, routing floods through the existing tailings impoundment with a controlled outflow system provides the best method to safely control flood events meeting or exceeding the required 0.5 PMF design. This general concept provides a feasible method to safely route floods while minimizing environmental disturbance and maintenance, and improving aesthetics.

(3) Wildlife

Using the impoundment to control flood surges reduces the potential sedimentation from historic tailings deposited in Rainy Creek below the impoundment. Therefore, this alternative reduces the potential impact to sensitive fish species in the Kootenai River

Advantages (Table 4.3) and disadvantages (Table 4.4) of Alternative II - routing the flood flows in a reconstructed channel through the tailings impoundment follow in Section E:

3. Alternative III - Partial Diversion of Flood Flows Around Impoundment

Options:

- Alternate IIIa: 100-Year Storm Diversion

- Alternate IIIb: 10-Year Storm Diversion

Essential Design Features:

- Diversion dam(s) upstream of tailings dam intercepts Rainy and Fleetwood Creeks

- Outlet control structure reduces stream discharge from diversion dams to a design maximum which is routed around the tailings

- Drop chutes similar to Alternate I but smaller return diverted stream flow to Rainy Creek below tailings dam

- Runoff in excess of design maximum overflows to the tailings impoundment

- Secondary outlet and discharge channel similar to that of Alternate IIa

a. Description of Conceptual Designs

(1) 100-Year Flood Diversion (Alternate IIIa)

A partial diversion system would require one or more dams similar to the full diversion dams, but designed to allow higher flows to by-pass them during larger events. The smaller design flows would be diverted around the impoundment in an open channel or pipeline, returning to Rainy Creek below the tailings dam. The larger flows would be routed through the reservoir, which would include a constructed inflow channel and outflow channel, control structure, and emergency spillway. This alternative would virtually "double" the costs for the project, by requiring both flood routing systems to be constructed.

Designing and constructing a structurally competent diversion dam capable of diverting smaller flows while by-passing larger flows would be difficult to accomplish. As stated earlier, the tailings do not provide adequate foundation for structures, making long-term structural integrity and durability questionable. A single by-pass flood event would likely cause irreparable damage to the diversion structure due to scouring of the foundation layer. Constructing separate dams for Fleetwood and Rainy Creeks above the tailings would be again an option. Regardless of the diversion dam site selection, continual maintenance would be required.

Due to the adverse conditions associated with the east side (coarse tailings, bedrock, etc.), the partial diversion channel would be constructed on the west side of the impoundment. Assuming a 10 ft. flat-bottomed channel, 2:1 maximum cut slopes, and 0.005 ft/ft gradient produces a channel section with a bottom-of-channel elevation of approximately 2888' at the tailing dam. As with a full diversion channel, massive cuts would be required to construct a channel that would provide long-term service. Complete relocation of the Forest Service access road would again be required.

During a 0.5 PMF event, the water level in the impoundment would rise to at least 2922', making the water level in the partial diversion channel 34 feet in depth. Obviously, this volume of flow would be impossible to control without a structure, further increasing the cost of this system while providing limited added benefit. Lining the channel would also be recommended to prevent infiltration, geotechnical instability, and possible tailings dam saturation.

An option would be to install a pipeline to carry the partial flows around the impoundment, making the system similar to the existing Rainy Creek diversion pipeline. Continual maintenance could be expected based on W. R. Grace's experience with the current pipeline, and plugging would be a problem. A pipeline system of any kind is not recommended.

A partial diversion system would require separate outflow channels for the diversion channel, and the "backup" impoundment routing system. An outflow channel for the impoundment would be constructed and the partial diversion would require a drop chute or some other method of returning outflows to the elevation of Rainy Creek downstream of the tailings dam.

(2) 10-Year Flood Diversion (Alternative IIIb)

The partial diversion of stream flows exceeding a 10-year storm event would be virtually identical to the 100-year event. The restrictions of construction equipment dictate that the diversion channel would assume basically the same dimensions. The only important design variation would be in the outlet control structure from the diversion dam(s). This outlet structure would be more restrictive in order to limit flow. The smaller outlet would be a potential source of problems in that it would be more likely to plug with debris and would likely require more frequent cleanout.

One perceived advantage of this alternate would be the periodic wetting of the tailings which might be beneficial for maintenance of vegetation and reduction of potential dust production. However, this wetting would be incomplete at best and its benefits would be questionable on such an infrequent and unpredictable basis.

b. Environmental Consequences of Partial Diversion Alternatives

(1) Topography and Geology

From a safety standpoint, partial diversion would not improve safety over the "no diversion"

alternate, however, it is better than a full diversion system. The reasons are covered in previous sections. Plugging or failure of smaller partial diversion dams would be less critical.

The environmental disturbance would be more extensive than under any other option. Massive excavations would be required for the diversion channel and drop chute. All excavation required for the outflow channel associated with routing through the impoundment would remain as well.

The possibility of saturating a portion of the tailings dam due to continuous flow through the impoundment would be eliminated, however, saturation from the diversion channel remains a possibility once the channel lining decays.

(2) Hydrology

Asbestiform fiber contamination of surface water from the tailings impoundment would be reduced by diverting the "day-to-day" smaller flows around the impoundment, but would not be eliminated.

Downstream impact would be reduced when compared to full diversion, but would be greater than the alternates routing floods through the impoundment.

Short-term sedimentation from the tailing impoundment would be reduced with this alternative, but may increase from the major excavations associated with the diversion channel. The advantage of using the impoundment wetland for improving surface water quality through natural filtration and settling would be eliminated.

In summary, using a partial diversion system in conjunction with an impoundment routing system does not increase safety over the impoundment routing system. This alternate would greatly increase cost. Maintenance and environmental disturbance increase, and geotechnical stability, construction feasibility, tailings dam saturation, and sedimentation remain as issues.

(3) Wildlife

Partial diversion of stream flows increase the potentila threat of sediment transport of historic tailings in Rainy Creek below the impoundment to the Kootenai River. This alternative increased potential impacts to sensitive fish species in the Kootenai River.

Advantages (Table 4.5) and disadvantages (Table 4.6) of the partial diversion alternate are summarized below in Section C.

C. Comparison of Alternatives

1. Alternative I - No Action Alternative - Advantages and Disadvantages of the Full Diversion Alternative

Table 4.1 Advantages associated with a full diversion flood routing system - The No-Action Alternative

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ALTERNATE I - NO-ACTION ALTERNATIVE FULL DIVERSION - ADVANTAGES

All Alternates:

Possible reduction in downstream tremolite fiber concentration in surface water;

Probable reduction in short-term sedimentation from the tailings impoundment.

Intercepts water from both Rainy Creek and Fleetwood Creek before contact with any portion of the tailings impoundment area.

Table 4.2 Disadvantages associated with full diversion flood routing system - the no-action alternative

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ALTERNATE I - NO-ACTION ALTERNATIVE FULL DIVERSION - DISADVANTAGES

All Alternates:

Does not use the reservoir capacity to temporarily store peak flows resulting in higher peak flows downstream in Rainy Creek;

Will not eliminate tremolite fiber contamination of downstream surface water during flood events;

Construction of diversion dams in tailings is very difficult, and the long-term stability of such dams is questionable;

Major environmental disturbance to construct channels to carry diverted flows around the tailings impoundment.

Massive cut slopes would be required;

Diversion dam(s), channels, and other structures will be required to handle 0.5 PMF flows, making them large and very costly;

Dam safety is inferior. Dams in series are more prone to catastrophic failure;

No backup flood routing system;

The diversion channels will not eliminate the possibility of tailings dam saturation and resultant stability concerns, unless impermeable lining is installed;

Does not take advantage of the wetland within the tailings facility for settling and natural surface water filtration;

Increased maintenance;

Tailings will be dry, thereby increasing the possibility of blowing dust and raising air quality risks;

Limited opportunity for wetland habitat construction.

Greater environmental disturbance resulting from construction.

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2. Alternative II - Advantages and Disadvantages of the Channel Through the Impoundment Alternative

Table 4.3 Advantages associated with routing floods through the tailings impoundment - Alternative II

ALTERNATIVE II ROUTING THROUGH IMPOUNDMENT - ADVANTAGES

All Alternatives:

- Provides a higher level of public safety than other alternatives while retaining a relatively simple design;
- Provides a safe, cost effective method to handle storm flows while maintaining long-term integrity of the dam;
- Geotechnically the most stable alternative;
- Plugging/debris problems less critical or likely;
- The system would be capable of handling floods larger than 0.5 PMF with the addition of a relatively simple emergency spillway;

- Outflow channel relatively small, making construction feasible and cost effective;

- Limited environmental disturbance;

- More natural/aesthetic outflow channel;

- Remaining wetland provides improves surface water quality through natural filtration and settling;

- Water loss to infiltration expected to be minimal;

- Less overall maintenance;

- Reduced potential for airborne particulate;

- Reduced outflows will reduce downstream impact from flooding and flushing of historic tailings to the Kootenai River.

Water Level at 2904' (Alternate IIa):

- Maintains water away from the dam face as much as possible for maximum safety.

East abutment outflow (Alternate IIc):

- Less overall environmental disturbance than west side outflow channel;

- Existing terrain can be easily modified for outflow channel thereby reducing environmental disturbance;

- Emergency spillway on west abutment can be constructed with a minimum of excavation and disturbance;

- Highest public safety of all alternates.

Table 4.4 Disadvantages associated with routing floods through the tailings impoundment - Alternative II

ALTERNATIVE II ROUTING THROUGH IMPOUNDMENT - DISADVANTAGES

All Alternates:

- Inflow channel difficult to construct in fine tailings, requiring specialized construction methods and equipment and increased costs;

- Does not address tremolite fiber issue actively;

- Possible saturation of a portion of the tailings dam;

- Probable increased short-term sedimentation;

- Slight risk of control structure becoming plugged.

Water Level at 2904' (Alternate IIa):

- Potentially difficult construction of a long channel through soft mucky tailings.

East abutment outlet (Alternate IIc):

- Excavation of bedrock may be necessary to construct outflow channel;

- Longer inflow channel required, unless variation is selected.

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3. Alternative III - Advantages and Disadvantages of the Partial Diversion Alternative

Table 4.5 Advantages associated with partial diversion flood routing systems - Alternative III

ALTERNATIVE III PARTIAL DIVERSION - DISADVANTAGES

All Alternates:

- Would provide a higher level of public safety than a full diversion;

- Geotechnically more stable than full diversion;

- Plugging of channel from flood debris less critical than full diversion;

- Possible reduction in downstream tremolite fiber concentration in surface water;

- Possible reduction in short-term sedimentation from the tailings impoundment.

100-Year Flood Design Basis (Alternate IIIa):

- Diversion dam outlet structures would be less prone to plugging than those for a 1 0-year flood.

10-Year Flood Design Basis Alternate IIIb):

- Periodic wetting of tailings may enhance growth of vegetation and provide for some degree of dust control;

- Marginally lower costs for channel lining materials.

Table 4.6 Disadvantages associated with partial diversion flood routing systems - Alternative III

ALTERNATE III PARTIAL DIVERSION - ADVANTAGES

All Alternates:

- Adds no safety benefit to impoundment routing (no diversion) alternative;

- Partial diversion dams difficult to construct in fine tailings, requiring specialized construction methods and equipment and increased costs;

- Long-term stability and integrity of partial diversion dams questionable;

- Increases overall cost of the project significantly due to combination of systems;

- Increased maintenance, particularly with partial diversion dams;

- Saturation of tailings dam remains a possibility without diversion channel lining;

- Possible increased short-term sedimentation from excavation;

- Does not take advantage of impoundment wetland;

- Plugging of smaller partial diversion channels;

- Largest environmental disturbance of all alternatives.

100-Year Flood Design Basis (Alternate IIIa):

- Tailings will not receive a thorough wetting on any reasonably short time frame.

10-Year Flood Design Basis (Alternate IIIb):

- More prone to plugging than a system designed for larger flows.

CHAPTER V - CUMULATIVE EFFECTS

This chapter analyses the cumulative effects of activities in the Rainy Creek drainage. Cumulative effects are the impacts of related past and present activities and other future activities that are currently planned in the Rainy Creek area added to the impacts of each alternative.

A. Major Activities Planned, Proposed, or Projected

1. Mining Activities

a. Mining and Exploration

No mineral exploration or mining is active or proposed in the Rainy Creek drainage. Any future sale of the W. R. Grace property or evaluations of the mineral potential of Vermiculite Mountain that would require ground disturbance would require additional environmental reviews and an analysis of the cumulative effects on Rainy Creek flood routing systems in place.

Reclamation of past mining and exploration activities conducted by W. R. Grace is ongoing. DSL is requiring the maintenance of sediment control ponds, erosion control systems, rehabilitation of washed out areas, weed control and dust control within the permit boundary as mine waste rock dumps and mine pit benches begin to revegetate.

The flood routing alternative selected would affect reclamation of the coarse fraction tailings dump adjacent to the impoundment and the impoundment surface and embankment. Flood routing structures required under the various alternatives would disturb varying amounts of new and previously disturbed land in the Rainy Creek and Fleetwood Creek drainage.

Flood routing the streams over the impoundment minimizes the amount of additional acreage that would have to be disturbed to ensure adequate safety. Full diversion and partial diversion of the streams around the impoundment create more disturbance. Flood routing the streams over the impoundment produces the environmentally most acceptable alternative and reduces the total cumulative impacts to the watershed as well as the Kootenai River downstream of the impoundment.

Reclamation activities of pre-1971 tailings deposited in Rainy Creek below the W. R. Grace impoundment are naturally revegetating and are not proposed to be redisturbed or reclaimed except in the immediate vicinity of the flood routing structures below the impoundment. These new disturbances would be covered by the current operating permit bond and would be reclaimed according to the existing reclamation plan for the mine site.

The flood routing alternatives affect cumulative effects of tailing transport downstream of the impoundment. Less historic tailing transport is expected with a flood routing alternative that takes the streams over the existing impoundment. Sediment carried into the impoundment, settles out before discharging downstream. In addition, reduced volumes and flow rates of water leaving

the control structures would decrease potential erosion of historic tailings in lower Rainy Creek. Flood routing streams through the impoundment reduces cumulative impacts of sediment and tailings transport to the Kootenai River.

2. Logging and Recreation (Access)

Based on evaluations of the risk of asbestos exposure to the public from the dust along Rainy Creek road, additional dust abatement procedures may be necessary. Monitoring of the risk of asbestos exposure is ongoing along the road. DSL would wait until the monitoring is completed before deciding on what measures are necessary, if any, along the stretch of Rainy Creek in the permit boundary to reduce cumulative impacts of airborne asbestos exposure to the public. Typical dust abatement measures might include hardening of the surface, resurfacing, use of chemical dust control agents, paving, speed controls, watering, and closure of the road.

Closure of the mine in 1990 has already reduced the level of dust produced along Rainy Creek road. The Air Quality Bureau and Solid and Hazardous Waste Bureau would decide on appropriate dust control measures needed depending on the potential risk identified in 1992 monitoring. DSL would implement dust control measures during any construction and reclamation activities associated with the flood routing alternatives.

The Rainy Creek road in the permit boundary would have to be relocated as part of the diversion Alternatives I and III. This relocation of the road would give DSL, the Forest Service, and Lincoln County an opportunity to build that portion of the new road with non-asbestiform materials. In addition, the old road can be reclaimed and revegetated to reduce the cumulative airborne asbestos potential in the area of the proposed road relocation at least.

The company's proposed plan would not require relocation of the Rainy Creek road. Reduction of cumulative effects of airborne asbestos from the Rainy Creek road would be dependent on the dust abatement measures.

The Libby Ranger District of the Kootenai National Forest completed an EA in 1992 on management activities in the Rainy Creek drainage. These activities are part of the Kootenai River Wildlife Habitat Enhancement Project. Total disturbance proposed by the timber management activities in the EA included 371 acres of public land and 82 acres of private lands and 2.1 miles of new roads.

Air quality is the obvious issue for development in the area. Ongoing studies on the Rainy Creek road and geology (existence of other areas containing abestiform fibers) would determine if these developments would increase exposure.

Increased sediment production from vegetation removal would have minimal cumulative effects on the full or partial diversion alternatives, Alternative I and III. Sediment would simply be washed to the Kootenai River in a flood event along the Rainy Creek drainage.

Increased sediment loads from vegetation removal would increase the rate at which the impoundment would fill with sediment in Alternative II, which calls for routing the streams across the impoundment. As long as the inlet channel elevation at 2904' elevation would be maintained, the reduction in flood storage capacity from sediment accumulation is minimized. The Dam Safety Section will be maintaining the impoundment under an operating permit with the landowner in the future.

No additional cumulative effects have been identified in the Rainy Creek drainage.

B. Summary of Cumulative Effects

No exploration and mining are proposed in the drainage basin. Thus no cumulative effects could be identified.

Routing the streams across the impoundment reduces the potential for sediment from historic mining operations in the area to be washed into the Kootenai River. No cleanup of historic tailings in Rainy Creek is proposed at this time. Therefore no cumulative effects with alternatives I, II, or III would occur.

Although some timber management activities are proposed in the drainage basin, they would have a minimal or unmeasurable effect on flood flows proposed to be controlled under Alternatives I, II and III.

CHAPTER VI - CONCLUSIONS AND RECOMMENDATIONS

A. Flood Routing

DSL has evaluated the effects of three alternative flood routing plans for W. R. Grace's tailing impoundment in Rainy Creek:

Alternative I: The no-action alternative, full diversion of the streams around the impoundment;

Alternative II: The company's proposed action, routing the streams through the impoundment; and

Alternative III: Partial diversion of the streams around the impoundment.

At present Rainy Creek is diverted around the impoundment through a temporary structure. However, a long term solution to stream routing is necessary upon closure. All proposed structures are designed for 0.5 Probable Maximum Flood (PMF) event. This standard exceeds that required by DNRC.

The present approved reclamation plan, which is the no-action alternative, Alternative I diverts the 0.5 PMF event around the impoundment. This alternative would necessitate sizeable diversion dam(s) and large excavations for the diversion channel and ancillary support services through very steep terrain, thereby causing large amounts of environmental disturbance. Alternative III, partial diversion, was also evaluated. Both designs would introduce additional engineered structures in the Rainy Creek drainage which would require continual monitoring and maintenance. The full, unchecked discharge of a 0.5 Probable Maximum Flood (PMF) event could have a detrimental effect on lower Rainy Creek where erosion rates in old mine tailings deposited before 1970 could be excessive.

Alternative II, the routing of Rainy Creek through the tailings impoundment is the preferred alternative and would take advantage of the impoundment's storage capacity. As a result, a more controlled discharge of flood waters could be realized through the lower Rainy Creek drainage. Additionally, this design would require less construction, less disturbance, and ultimately less long-term maintenance and rehabilitation.

Stability analyses conducted on the tailings embankment determined that the dam had an adequate safety factor when examined for both static and seismic loadings. The dynamic analysis was performed using the Maximum Credible Earthquake (MCE) and with a water level located at the upstream face of the dam, a condition encountered during a 0.5 PMF event. The proposed routing design under normal operating conditions would have the impounded water located approximately 750' behind the dam. Overtopping of the embankment would occur during a storm event in excess of the 0.7 PMF.

Stability analysis also showed that a catastrophic failure of the dam and tailings would not occur even if the embankment were overtopped. There would be erosion of the downstream face and increased sedimentation due to this erosion, and perhaps a dam breach. Yet even with a dam breach, the strength of the impounded tailings preclude liquefaction, and therefore the discharge of tailings down Rainy Creek would be limited.

Suspended sediment from upstream would settle out and form a delta as water velocities drop upon entering the designed wetland system upstream of the dam. This would result in less sediment deposition in the lower Rainy Creek drainage and ultimately in the Kootenai River. The stream gradients are >10% in Rainy Creek and Fleetwood Creek. The surface of the impoundment is less than 1%. This depositional environment would help to insulate asbestiform materials currently exposed on the impoundment surface. Erosion of the tailings is limited as long as the emergency spillway, control box, and dam do not fail.

The principle behind flood routing systems is to have a controlled discharge of surface runoff. A controlled discharge reduces water velocities, and thus erosion of surface soils. By using the storage capacity of the existing tailings facility, and regulating the discharge of the impounded waters by employing a control structure, the rate at which surface runoff is introduced into lower Rainy Creek is effectively controlled. This rate limiting design reduces the potential for surface erosion. Thus Alternative II is the agencies preferred alternative.

Based on findings of the engineering analysis of the various flood routing alternatives, Alternative II routing the flood through the tailings impoundment using a designed structure to control discharges to an east abutment outflow channel (Alternate IIc) appears to be the best, most feasible, and safest method for flood routing Rainy Creek through the vermiculite tailings impoundment area and is therefore the preferred alternative. This alternative would provide sufficient storage capacity within the impoundment to receive a 0.5 PMF event <u>without</u> utilizing an emergency spillway. The emergency spillway would still be provided for the event of an even larger storm.

Alternative II does constitute an amendment to the permit which required diversion of water around mine wastes at closure. This could be a matter of concern from the standpoint of water quality issues. This mine is not a base metal mine and does not produce acid mine drainage typically containing high levels of metals. One important area of concern is tremolite fiber in Rainy Creek. However, Rainy Creek is not utilized directly as a drinking water source. Other alternatives will not totally eliminate this concern since Fleetwood Creek and Carney Creek originate in areas where natural outcropping of tremolite occurs or which have been subject to disturbance by mining activity.

In order to reduce these concerns, disturbed areas would be stabilized to reduce erosion through the establishment of vegetative cover. Similar measures are proposed for the tailings impoundment to reduce the level of suspended particulate in surface waters discharged through the dam. Included in these measures would be revegetation of tailing beach areas and installation of channel linings to stabilize the channel and prevent direct contact with underlying tailings material.

A program to establish current water quality levels is underway and will continue on a regular basis as reclamation proceeds. Overall release of asbestiform fibers from the tailings under Alternative II should be minimal due to these design measures.

Another area of concern for reclamation is allowing surface waters to be routed through mine waste facilities. Had this facility presented an important risk to water quality, recommendations would have been entirely different. As it is, the resolution of the safety and long-term stability aspects of the existing situation take precedence over the water quality issues, which are not as life threatening or environmentally damaging. In summary, site-specific considerations make channel re-establishment a sound decision where at other facilities diversion may be more technically sound.

DSL has concluded that the direct impacts and cumulative impacts of the company's proposed action minimize the environmental impacts associated with the existing approved flood routing design. The company's proposed action does not produce significant effects to the area resources. As a result, an Environmental Impact Statement is not needed.

CHAPTER VII - CONSULTATION AND COORDINATION

This EA was prepared by the Hard Rock Bureau (HRB) of the Montana Department of State Lands.

The Montana Department of Health and Environmental Sciences, Air Quality Bureau (AQB), Water Quality Bureau (WQB) and the Solid and Hazardous Waste Bureau (SHWB); the Montana Department of Natural Resources and Conservation, Dam Safety Section of the Water Resources Division; and the Montana Bureau of Mines and Geology were consulted in preparation of this document.

In addition the Northern Region office of the US Forest Service, Kootenai National Forest (KNF) Supervisor's office as well as the KNF Libby Ranger District, and the Army Corps of Engineer's were consulted through the review process on evaluating the flood routing alternatives.

Individuals involved in preparation were:

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GLOSSARY

AQB	Air Quality Bureau
ARCO	Atlantic Richfield Company
ARM	Administrative Rules of Montana
ASARCO	American Smelting and Refining Company
asbestiform	Of or having the physical characteristics of asbestos.
cfs	cubic feet per second
DHES	Montana Department of Health and Environmental Sciences
DNRC	Montana Department of Natural Resources and Conservation
DSL	Montana Department of State Lands
DSS	DNRC, Dam Safety Section of the Water Resources Division
dynamic analysis	In earthquake studies, it evaluates the response of the dam when there is ground motion.
EA	Environmental Assessment
EAP	Emergency Action Plan
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FS	US Forest Service
g	Gravity (see ground acceleration), a force equal to the gravitational force of the earth.
grain of the dam	Downstream valley area of dam.
ground acceleration	A measure of the force initiated by a seismic event. It is expressed in terms of a percent of gravity (g). Too much ground acceleration can shear or deform material in a dam.

HRB	Hard Rock Bureau
KNF	Kootenai National Forest
mass wasting	The movement of soil and rock by gravity down a slope.
MBMG	Montana Bureau of Mines and Geology
MCA	Montana Codes Annotated
MCE	Maximum Credible Earthquake
MEPA	Montana Environmental Policy Act
MMRA	Montana Metal Mine Reclamation Act
MSHA	Mine Safety and Health Administration
phreatic surface	The free water level in a tailings impoundment or dam.
PMF	Probable maximum flood
PMP	Probable maximum precipitation
point source	In water pollution, a point source is any discernable, confined conduit where a water sample can be collected such as from a culvert, pipe, or stream. In contrast, a non-point source is hard to quantify such as erosion.
scoping	The process of identifying issues in an environmental analysis.
SECRA	State Comprehensive Compensation and Response Act
seismicity	The study of earthquake potential in an area.
SHWB	Solid and Hazardous Waste Bureau
slumping	The movement of soil or rock down a slope by gravity.
static analysis	An evaluation of the stability of the dam when the ground is not in motion.
surety bond	A financial guarantee similar to an insurance policy that will pay for reclamation not completed by a mining company up to the value of the policy.

toe drains	Drains constructed at the base of a dam to increase internal water drainage.
tph	total petroleum hydrocarbons
tpy	tons per year
USDA	United States Department of Agriculture
USDI	United States Department of Interior
WQB	Water Quality Bureau

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