IMS INC

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DRAFT

TAILINGS IMPOUNDMENT SITE SELECTION REPORT

JULY 30, 1991

Submitted to—

Montana Department of State Lands
Gallatin National Forest

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CONTENTS

SITE SELECTION REPORT

BACKGROUND

Crown Butte Mines, Inc. has proposed to develop a combination underground and open-pit gold, silver and copper mine—the New World Project—about three miles north of Cooke City in the Beartooth Mountains of southcentral Montana (Figure 1). As proposed, the project would include two open-pits and one underground mine, an ore-processing mill, a tailings pond and waste rock storage site, access roads, and a work camp. The agencies have selected a third party consulting firm, IMS Inc., to assist in the preparation of the EIS.

Crown Butte holds mineral rights on a combination of private and National Forest System lands. Development of these mining rights would be known as the New World Project. In November, 1990, Crown Butte submitted to the U.S. Forest Service (USFS) and the Montana Department of State Lands (DSL) an *Application for a Hard Rock Operating Permit & Proposed Plan of Operation* for the New World Project. The New World Project would consist of a 1,000 ton-per-day mine and mill complex. The project would mine gold/silver/copper reserves with an estimated annual production rate of 350,000 to 500,000 tons of ore over a 10 to 15 year period. The ore would be mined from an underground mine (Miller Creek deposit) and two open-pit mines (Como and McLaren deposits) and conveyed to a mill in the Fisher Creek drainage. Ore would be ground at the mill and the gold, silver and copper concentrated by conventional froth flotation and cyanide leach methods. Five and half million tons of tailings would be disposed in an 83-acre site in upper Fisher Creek. Prior to final reclamation, waste rock would be stored in Fisher Creek above the impoundment; all waste rock would be used in final reclamation.

Tailings Disposal and Waste Rock Storage Siting

Crown Butte retained Bechtel Corporation (Bechtel) to prepare preliminary designs for the mine waste disposal and storage facilities. Preliminary design reports for the facilities were prepared by Bechtel for inclusion in the permit application. The preferred tailings disposal and waste rock storage sites were both located in the upper drainage basin of Fisher Creek. Both facilities would required diversion of Fisher Creek.

Following a review of the application, the lead agencies provided Crown Butte with a number of Completeness Review questions concerning Crown Butte's mining and reclamation plans. Several of the questions focussed on the proposed facility siting and possible alternatives. The agencies were particularly concerned with the tailings impoundment siting. In response to these comments, Crown Butte submitted to the agencies an *Environmental Evaluation of Proposed Actions and Alternatives for the New World Project* (Alternatives Study) in April, 1991. A meeting with the DSL, the USFS, IMS, Crown

Butte and Bechtel was held in Helena, Montana in May 1991 to discuss the tailings impoundment siting and design.

During the meeting, Crown Butte agreed to prepare a more detailed site selection summary incorporating available data. Crown Butte and Bechtel compiled the site selection data and developed criteria for evaluating the data and ranking identified disposal sites. A second meeting was held at the project site July 9 and 10, 1991 by Crown Butte with the DSL, the USFS, IMS, Crown Butte, and Bechtel to discuss the site selection process and conduct a field reconnaissance of the sites. An attendance list accompanies this report. Participants in the July meeting are referred in this report as the Geotechnical Review Group.

Scope of Report

This report summarizes the site selection process initially completed by Crown Butte as presented in the application and Alternative Study and discusses the cooperative site selection process completed during the July meeting. The report is based on information and data provided by Crown Butte and its consultants and developed during the July meeting. This report has been prepared by IMS and D. P. Engineering, Inc. as part of the third party review of the proposed project for the agencies.

This report describes the site selection process for the tailings disposal facility and does not include the mill site or the waste rock disposal facility discussed in the application. Further, the site selection process was completed up to identification of alternative sites for field exploration. Crown Butte is planning field exploration and additional studies on each of the preferred alternative sites to determine the preferred site.

SITE SELECTION

The site selection process was developed to identify the most suitable site(s) for a proposed facility for a given project. It can be used to site facilities such as mill sites, waste disposal facilities, access routing, and other major components of a project. The format of the site selection process allows for the identification of the most suitable sites for operation and closure with respect to environmental impacts, engineering feasibility, and economic factors (including construction and operations). References describing site selection procedures and completed site selection studies are listed at the end of this report.

The site selection process consists of the following steps—

- Regional screening to eliminate unsuitable areas and to locate potential sites;
- Elimination of sites with obvious fatal flaws;
- Qualitative rating of site evaluation criteria;
- Quantitative ranking of sites;
- Field exploration of top ranking sites;
- Evaluation of field data; and
- Site selection for final design.

The site selection process combined some of the above steps to accommodate the sensitive environmental setting of the proposed project. Also, unnecessary criteria were combined to eliminate detailed assessments since the site diversity did not require detailed comparisons to rank the sites. Regional screening was combined with site fatal flaw analyses since much of the area surrounding the project is either Yellowstone National Park or designated wilderness. Areas contiguous to the boundaries of these areas were not considered feasible for locating sites. Also, individual sites with less than 50 percent capacities were not considered in the ranking.

The qualitative evaluation and initial site screening were combined to rank sites and identify potential sites for a second, more detailed, screening and ranking. This initial ranking was done to eliminate undesirable sites which did not exhibit obvious fatal flaws.

Regional Screening and Fatal Flaw Analyses

Regional screening was performed within a ten mile radius of the site to exclude major areas from further consideration as potential tailings impoundment sites because of unfavorable characteristics. A wider area was excluded from consideration because of long tailings transport distances, large elevation differences from the mine, crossing of major streams, or passage through national park land or wilderness areas. Regional screening criteria used for this project included areas with excessively steep topography, areas with large drainage basins, areas with known adverse geologic conditions such as landslides, and areas in which existing land use was incompatible with tailings disposal.

Considerable discussion was held during the July meeting on the topography criterion. In its regional screening process, Crown Butte used 33% slopes (3[h]:1[v]) to differentiate acceptable sites from unacceptable sites. The Geotechnical Review Group acknowledged that with appropriate site modifications, a tailings impoundment could be sited on areas with slopes initially steeper than 3:1. Given the general site characteristics in the regional screening area, however, consideration of steeper slopes would not significantly increase the number of potential sites and would result in increased construction costs.

Incorporated with the regional screening was a fatal flaw analyses of areas and potential sites. For this study, a fatal flaw was defined as any factor sufficiently unfavorable or severe that, taken alone, would eliminate the area or site from further consideration. This step is similar to regional screening, but accounts for characteristics of specific areas and sites. Therefore, a particular region may be suitable but contain undesirable sites. Table 1 presents the criteria used for the regional screening and fatal flaw analyses. Figure 2 shows the area screened and the remaining areas considered for potential sites.

TABLE 1
REGIONAL SCREENING/FATAL FLAW CRITERIA

Topographic Features

- Areas that are generally too steep (e.g., side slopes or mountains too steep for safe, feasible construction and liner placement); and
- Areas in which access is difficult.

Land use/Ecologic

- National Park and designated wilderness;
- Recreational areas;
- Historic or archaeological sites;
- Human habitation; and
- Public road use.

Visual

- Unacceptable visual impact.

Construction and Operation

- Capacity too small with no adjacent site to develop to total capacity;
- Embankment height too great;
- Access to site difficult or costly; and
- Technical feasibility of site development.

Location of Potential Sites

Following the regional screening, the acceptable portions of the regional screening area were examined for potential tailings disposal sites. Twenty-eight impoundment sites were located within the regional screening area. Two sites were located at about 12 miles southeast of the mine. Several impoundments consisted of various embankment alignments within the same general area or drainage basin. These sites were combined, resulting in initial site screening of 13 sites.

Site Screening

The site screening was conducted in two phases in order to identify preferred sites for further evaluation. The initial site screening consisted of a qualitative evaluation of the sites followed by a semi-quantitative ranking of the sites. The second level of screening was a semi-quantitative ranking of preferred sites identified in the initial screening. The second level of screening was based on a site reconnaissance by the Geotechnical Review Group of most of the 13 sites.

Initial Site Screening. The qualitative evaluation of the sites was a subjective assessment by the Geotechnical Review Group of the characteristics and potential impacts of each site.

The qualitative evaluation criteria used in the assessment included visibility, land use, and potential environmental impacts. A list of criteria are presented in Table 2.

To determine a preferred order or ranking of sites, a semi-quantitative ranking was then performed by assigning a numerical value of one to three to each site for each criterion. The numerical values were summed to provide an overall semi-quantitative ranking. The ranking is presented in Table 3. Based on this ranking, five sites were chosen for further screening.

Site Selection. A second level of site ranking was complete to determine preferred sites for field evaluation. Four of the five sites identified in the initial screening were observed in the field. Following the site visits, a ranking of sites was done using criteria presented in Table 4. The ranking is presented in Table 5.

TABLE 2
QUALITATIVE AND INITIAL RANKING CRITERIA

Geologic Hazards

- Avalanche potential;
- Rock slides; and
- Active faulting.

Operability

- Access throughout winter months; and
- Pumping versus gravity feed of tailings.

Waters of the U.S.

- Site located in stream classified as waters of the U.S.; and
- Site adjacent to waters of the U.S.

Proximity to Mine Site

- Distance from site to mine and length of tailings line;
- Distance to national park or wilderness area; and
- Distance to town or private residence.

Drainage Basin Water Quality

- Existing water quality in site location;
- Existing water quality downstream of site; and
- Development downstream of site.

Table 3. Initial site ranking.

Criterion	Site												
	SB-1	SB-2	SB-3	SB-4	FC-1	FC-2	FC-3	FC-6	FC-11	Miller Creek	Lulu Pass	Daisy Pass	DP-4
Geologic hazard	3	2	2	3	2	2	3	3	1	2	3	2	1
Operability	3	2	2	3	3	3	2	2	1	1	1	1	1
Waters of the U.S.	3	3	3	3	1	2	1	3	3	1	3	1	1
Proximity	2	1	1	2	3	3	1	2	2	1	2	2	1
Drainage basin	2	1	1	2	3	3	1	2	3	1	1	3	1
Total	13	9	9	13	12	13	8	12	10	6	10	9	5
Ranking	1	4	4	1	2	1	5	2	3	6	3	4	7

TABLE 4
SITE SELECTION RANKING CRITERIA

Runoff Control

- Facility located outside flood plain;
- Diversion of flood flows feasible;
- Flood protection post-closure; and
- Maintenance on flood diversion facilities.

Wetlands

- Potential for wetlands.

Hydrogeology

- Depth to ground water;
- Ground water discharge area; and
- Ground water impact on facility.

Tailings Transport

- Distance to site;
- Topographic relief along pipeline route;
- Spill containment potential; and
- Spill impact potential.

Recreation Area

- Designated recreation;
- Undesignated public use area; and
- Minimize/mitigate disturbance of areas.

Disturbance

- Area of disturbance for containment;
- Access to site; and
- Area of disturbance for construction materials.

Visibility

- Site visibility from parks, wilderness, and public access areas.

Reclamation

- Technical feasibility; and
- Long-term maintenance.

Geologic Hazards

- Avalanche potential;
- Rock slides;
- Slope/foundation instability; and
- Bedrock conditions.

Table 5. Site selection ranking.

Criterion	Site SB-1	SB-4	FC-1	FC-2	FC-6
Runoff Control	2	3	1	1	2
Wetlands	3	2	2	2	2
Hydrogeology	2	3	3	3	3
Tailings Transport	2	2	3	3	1
Recreation	3	3	3	3	1
Disturbance	1	2	3	1	2
Visual	1	2	3	2	1
Reclamation	3	3	1	1	2
Geologic Hazards	3	3	2	1	3
Total	20	23	21	17	17
Ranking	3	1	2	4	5

Three of the five sites ranked close together and were selected as the preferred sites for additional studies. FC-1 is a typical valley impoundment and is located in upper Fisher Creek. It is Crown Butte's preferred alternative. SB-1 is a sidehill impoundment and is located south of Henderson Mountain. The third site (SB-4) is east of SB-1 and is located in the head of a small drainage area. The impoundment configuration will be similar to a valley impoundment.

Conclusions and Recommendations

Three sites have been identified for further study as tailings disposal impoundments. The sites are diverse in layout and location. This shows, therefore, the site selection process did not bias parameters such as site location, and/or impoundment construction methods in determining the preferred sites.

The following recommendations are presented for the completion of the site selection study—

- Conduct field and environmental work to characterize the sites in more detail;
- Conduct a detailed qualitative and semi-quantitative analyses on the three sites once the field data is available; and
- Select a preferred site and proceed with final design studies.

REFERENCES

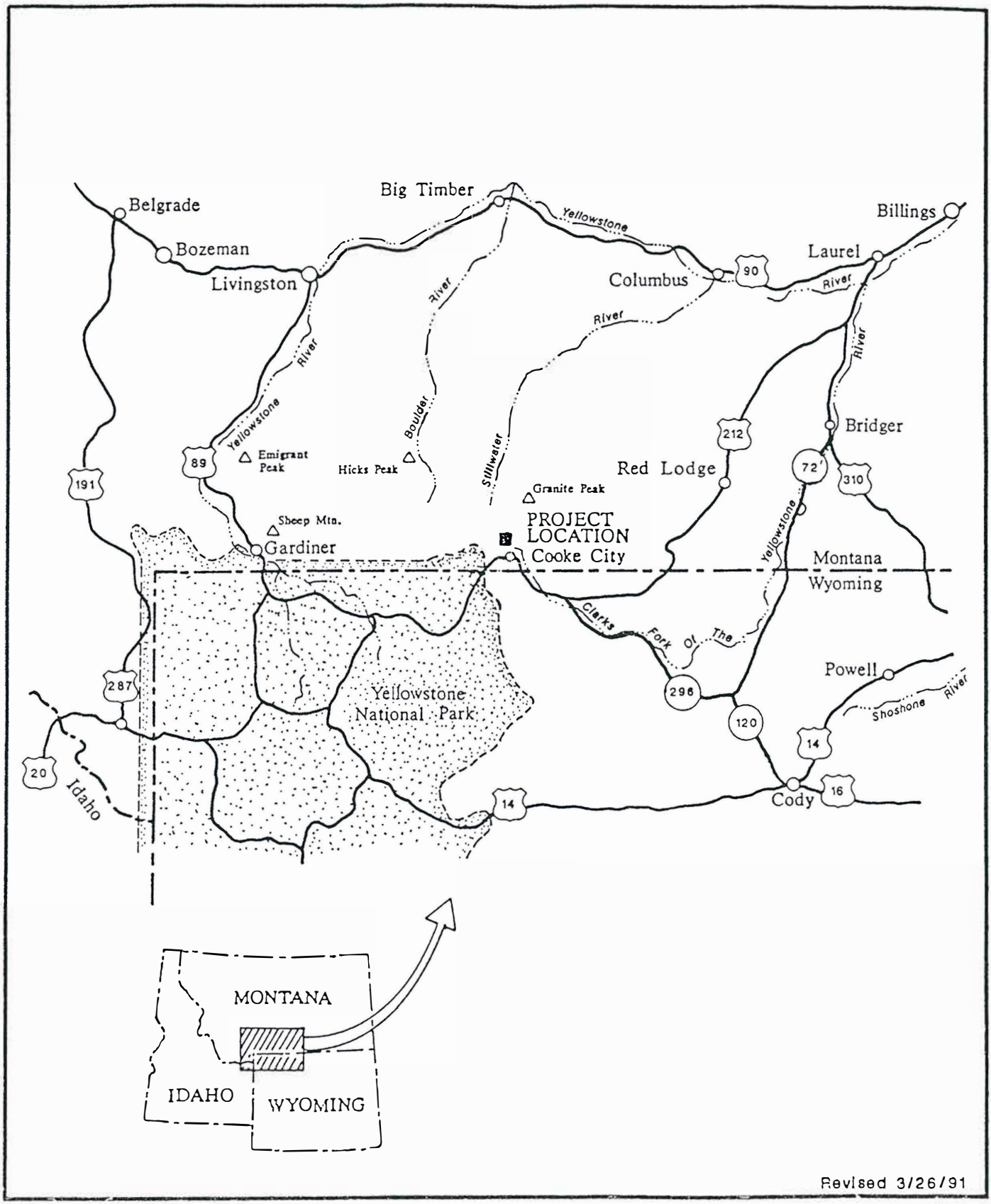
Crouch, D.B., and Poulter, D.A. 1986. *Solid Waste Disposal Site Selection for the McLaughlin Gold Project in Northern California.* SME/AIME. Transaction 278:1,839-1,846.

Robertson, A. MacG. and Moss, A.S. 1981. *Site selection and optimization studies for mill sites and tailings impoundments.* Asian Mining '81. The Institution of Mining and Metallurgy Conf., Singapore, Nov. 1981, pp. 301-311.

Robertson, A. MacG., Shepherd, T.A. and van Zyl, D.J.A. 1980. *Uranium tailings impoundment site selection.* Proc. Third Symp. on Uranium Mill Tailings Management, Colorado State Univ., Fort Collins, Colo., 1980, pp. 107-140.

APPENDIX A
JULY 9-10, 1991 MEETING ATTENDEES

Name	Affiliation	Position
Clint Erb	DSL	EIS Coordinator
Bob Winegar	DSL	Program Supervisor
Patrick Plantenberg	DSL	Reclamation Specialist
Craig Pagel	DSL	Mining/Geotechnical Engineer
Alicia Stickney	DSL	NEPA Coordinator
Sherm Sollid	USFS	Geologist
Mary Lennon	USFS	Geologist
Doug McClelland	USFS	Geotechnical Engineer
Roger White	USFS	Dams and Hydraulic Engineer
Gene Gibson	USFS	Engineer
Terry Webster	DHES	Environmental Specialist
Dave Williams	BLM	Geologist
Dan McLaughlin	Noranda Minerals Corp.	Project Manager
Nancy Winslow	Noranda Minerals Corp.	Permitting Coordinator
Roy Cellan	Noranda Minerals Corp.	Metallurgical Engineer
Peter Lintern	Noranda Minerals Corp.	Director-Projects
Dave Rovig	Crown Butte Mines, Inc.	President
Frank Tomerson	Bechtel	Study Manager
Ignacio Arango	Bechtel	Geotechnical Engineer
Thomas Hughes	Bechtel	Civil Engineer
Roy Egawa	Bechtel	Civil Engineer
Richard Trenholme	IMS	EIS Project Manager
Don Poulter	IMS/D.P. Engineering, Inc.	EIS Geotechnical Engineer



Scale: 1" = 20 miles (approx.)

New World Project - Park County, Montana

NORTH

Figure 1

Project Location Map

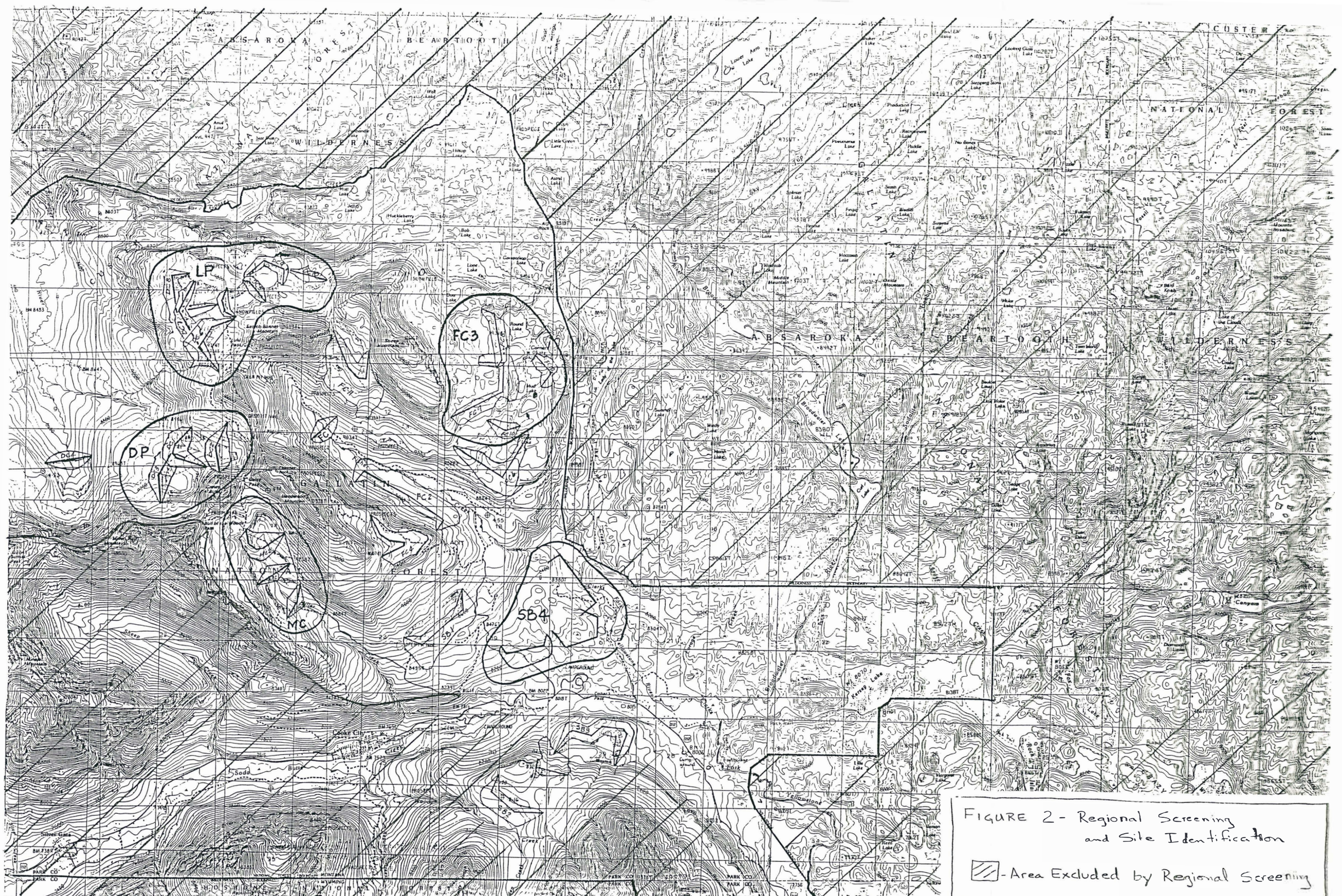


FIGURE 2 - Regional Screening and Site Identification

▨ - Area Excluded by Regional Screening